Board of Curators Meeting - Public Session University of Missouri System Millennium Student Center - UMSL Nov 18, 2021 8:00 AM - 1:45 PM CST

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XII. BOARD OF CURATORS GOVERNANCE, COMPENSATION AND HUMAN RESOURCES COMMITTEE MEETNG - EXECUTIVE SESSION



Vision

To advance the opportunities for success and well-being for Missouri, our nation and the world through transformative teaching, research, innovation, engagement and inclusion.

Mission

To achieve excellence in the discovery, dissemination, preservation and application of knowledge. With an unwavering commitment to academic freedom and freedom of expression, the university educates students to become leaders, promotes lifelong learning by Missouri's citizens, fosters meaningful research and creative works, and serves as a catalyst for innovation, thereby advancing the educational, health, cultural, social and economic interests to benefit the people of Missouri, the nation, and the world.

Missouri Compacts for Achieving Excellence

The Missouri Compacts for Achieving Excellence provide unifying principles that inform and guide the four universities and their strategic plans. Learn more about the compacts, below, at http://umurl.us/prespri.



Core Values

Our institution collectively embraces a series of core values that serve as the foundation upon which we build new knowledge and provide outstanding programs for students and citizens of our state and beyond.

 Academic Access Accountab Civility 	reedom · Collaboration · Creativity lity · Discovery · Engagement	ExcellenceFreedom of expressionInclusionInnovation	• • •	Integrity Respect Responsibility Transparency
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Guiding Principles

- 1. Support courageous and proactive leadership that is articulate, unified and committed to excellence in carrying out our existing core missions of teaching, research, engagement and economic development and in meeting the changing needs of the world and the state.
- 2. Establish a collaborative environment in which UM System universities work together to achieve collective results that cannot be achieved individually and are committed to each other and our mutual success.
- 3. Exercise central authority that recognizes and respects institutional distinctiveness, appropriate deference and accountability.
- 4. Enact informed decisions based on collaboratively developed strategic directions and planning.
- 5. Identify and promote systemwide core values, including respect for all people, transparency, accountability, stewardship and purposeful self-assessment of performance.

UNIVERSITY OF MISSOURI BOARD CHAIR REPORT

There are no materials for this information item.

OPEN – GB II A – INFO 1-1

November 18, 2021

UNIVERSISTY OF MISSOURI PRESIDENT'S REPORT

There are no materials for this information item.

OPEN – GB II A – INFO 2-1

STUDENT REPRESENTATIVE TO THE BOARD OF CURATORS REPORT

There are no materials for this information item.

OPEN – GB II A – INFO 3-1

November 18, 2021

No. 1

Recommended Action - Resolution for Julia G. Brncic

It was endorsed by President Choi, recommended by Chair Chatman, moved by

Curator ______ and seconded by Curator _____, that the

following resolution recognizing the dedicated service of Julia G. Brncic to the

University be approved:

RESOLUTION

WHEREAS, Julia G. Brncic served the people of Missouri with distinction as a member of the University of Missouri Board of Curators from July 31, 2017 until December 31, 2020; and

WHEREAS, during her term, she was a member of several Standing Committees and the Executive Committee, and also served as Chair of the Finance and Executive Committees; and

WHEREAS, Julia was named Vice Chair of the Board on January 1 and served until December 31, 2019; and

WHEREAS, Julia Brncic was named Chair of the Board of Curators, serving from January 1, 2020 through December 31, 2020; and

WHEREAS, Curator Brncic provided leadership throughout the COVID-19 pandemic during unprecedented times in higher education, the state and the country; and

WHEREAS, Julia advocated for the use of data analytics in making university-wide decisions, and stressed the importance of operational efficiencies; and as Chair, led discussions that looked at governance structure and ultimately led to the combining of the roles of UM System President and MU Chancellor; and

WHEREAS, in 2019, she was invited to be a member of the newly formed UM System Honorary Degree Committee, working with faculty, staff, students, curators, and the community to recommend outstanding candidates to President Choi for approval and conferral; and

WHEREAS, she encouraged the development of a system-wide compliance program, which is now being implemented; and

OPEN – GB II B – 1-1 November 18, 2021

WHEREAS, Curator Brncic advocated for all Missouri students, faculty and staff and cared deeply about what was best for the University of Missouri, as an entity in and of itself, and in its role in the State of Missouri; and

WHEREAS, Curator Brncic is a true professional. Her contributions will have a lasting influence on the future of the University of Missouri System and the State:

NOW, THEREFORE, BE IT RESOLVED, that the Board of Curators, on behalf of the students, faculty, staff and alumni of the University of Missouri System, and on behalf of the citizens of the State of Missouri, does hereby adopt this resolution in sincere appreciation of the dedicated and devoted leadership of Julia G. Brncic;

AND ALSO, that her future relations with the University of Missouri System be formally recognized by bestowing the title of "Curator Emeritus" upon Julia G. Brncic; and

BE IT FURTHER RESOLVED, that the Secretary of the Board of Curators cause this resolution to be spread upon the minutes of this meeting and that a duly inscribed copy thereof be furnished to Julia G. Brncic.

Roll call vote:	YES	NO
Curator Brncic		
Curator Chatman		
Curator Graham		
Curator Graves		
Curator Layman		
Curator Hoberock		
Curator Holloway		
Curator Wenneker		
Curator Williams		
The motion		

No. 2

Recommended Action - Resolution for Maurice B. "Marcy" Graham

It was endorsed by President Choi, recommended by Chair Chatman, moved by Curator _______ and seconded by Curator _______, that the following resolution recognizing the dedicated service of Maurice B. "Marcy" Graham to the University be approved:

RESOLUTION

WHEREAS, Maurice B. "Marcy" Graham served the people of Missouri with distinction as a member of the University of Missouri Board of Curators from January 2, 2015 until December 31, 2020; and

WHEREAS, during his term, Curator Graham was a member of many Standing Committees and the Executive Committee, and he also served as Chair of the Audit; External Affairs, Marketing & Advancement; Health Affairs; and Executive Committees; and

WHEREAS, he was named Vice Chair of the Board, serving from January 1 until December 31, 2016, and was also named to a second term, serving from January 1 until December 31, 2020; and

WHEREAS, Marcy Graham was elected as Chair of the Board of Curators for 2017, leading the Board from January 1 through December 31, 2017; and

WHEREAS, Curator Graham was a member of the search committee for the 24th President of the University of Missouri System; and

WHEREAS, as Chair, he diligently worked to originate a development session for Strategic Planning with Curators, the new President and administrators from both the UM System and the four campuses; and

WHEREAS, Curator Graham initiated a Board Assessment in 2017 as good governance practice, and was passionate about effective communications and public relations; and

WHEREAS, he was described by other Curators as a "bridge builder and connector;"; and

WHEREAS, Marcy Graham and his wife Edna Mae Graham were honored by Missouri S&T to serve as Grand Marshalls for the Celebration of Nations Parade in Rolla on September 30, 2017; and

OPEN – GB II B – 2-1 November 18, 2021

WHEREAS, in 2020, the St. Pat's Board of Missouri S&T selected Curator Graham to be knighted in the 112th Court of St. Patrick, which celebrates St. Patrick as the Patron Saint of Engineers, honoring Marcy for his outstanding service to the state, the nation, S&T, and to the St. Pat's tradition; and

WHEREAS, Curator Graham advocated for all Missouri students, faculty and staff and cared deeply about what was best for the University of Missouri, as an entity in and of itself, and in its role in the State of Missouri; and

WHEREAS, Curator Graham is a true professional. He is considerate, kind and is famous for the handwritten letters of thanks sent to leaders and staff who assisted him during his term on the Board. His contributions will have a lasting influence on the future of the University of Missouri System and the State:

NOW, THEREFORE, BE IT RESOLVED, that the Board of Curators, on behalf of the students, faculty, staff and alumni of the University of Missouri System, and on behalf of the citizens of the State of Missouri, does hereby adopt this resolution in sincere appreciation of the dedicated and devoted leadership of Maurice B. "Marcy" Graham;

AND ALSO, that his future relations with the University of Missouri System be formally recognized by bestowing the title of "Curator Emeritus" upon Maurice B. "Marcy" Graham; and

BE IT FURTHER RESOLVED, that the Secretary of the Board of Curators cause this resolution to be spread upon the minutes of this meeting and that a duly inscribed copy thereof be furnished to Maurice B. "Marcy" Graham.

OPEN - GB II B - 2-2

Roll call vote:	YES	NO
Curator Brncic		
Curator Chatman		
Curator Graham		
Curator Graves		
Curator Layman		
Curator Hoberock		
Curator Holloway		
Curator Wenneker		
Curator Williams		
The motion		

No. 3

Recommended Action - Resolution for David L. Steelman

It was endorsed by President Choi, recommended by Chair Chatman, moved by Curator _______, that the following resolution recognizing the dedicated service of David L. Steelman to the University be approved:

RESOLUTION

WHEREAS, David L. Steelman served the people of Missouri with distinction as a member of the University of Missouri Board of Curators from September 26, 2014 until June 1, 2021; and

WHEREAS, during his term, he was a member of the Academic, Student & External Affairs; Audit; Compensation and Human Resources; Finance; Governance, Resources and Planning; Health Affairs; and Executive Committees; and

WHEREAS, Curator Steelman also served as Chair of the Finance; Governance, Resources & Planning; and Executive Committees; and

WHEREAS, David was elected Chair of the Board of Curators, leading the Board from January 1, 2018 through December 31, 2018; and

WHEREAS, before beginning his service to the State of Missouri as curator, David Steelman served the citizens as State Representative from 1979 to 1985 and was the Republican Floor Leader of the Missouri House of Representative from 1982 to 1985; and

WHEREAS, while serving as Chair of the Finance Committee, David advocated for strong financial and capital planning processes, which are still in place today; and

WHEREAS, Curator Steelman encouraged outside the box thinking to strengthen the University. As an example, he advocated for all Missouri students as a steady and strong proponent of the expansion and promotion of E-Learning as a means of bringing convenient and affordable education to all; and

WHEREAS, he supported the 2019 NextGen Precision Health Initiative and the Alliance for Precision Health with Siemens Healthineers as top priorities to advance research and benefit all Missourians; and

WHEREAS, Curator Steelman and his wife Sarah Hearne Steelman were appointed Honorary Parade Marshals in the 2015 Missouri S&T Celebration of Nations event; and

OPEN – GB II B – 3-1 November 18, 2021

in April 2018, at the MU Law Day Awards Ceremony, he was awarded The Citation of Merit by his alma mater, from which he had graduated first in his class in 1978; and

WHEREAS, Curator Steelman was a member of the search committee for the 24th President of the University of Missouri System; and

WHEREAS, he was a continuous champion of the need for transparency of University of Missouri business, both internally and externally; and

WHEREAS, Curator Steelman is a true professional. He is quoted as saying to the Senate Gubernatorial Appointments Committee when questioned after his appointment by Governor Jay Nixon, "I think it's impossible to overestimate the value of the University of Missouri." His contributions will have a lasting influence on the future of the University of Missouri System and the State:

NOW, THEREFORE, BE IT RESOLVED, that the Board of Curators, on behalf of the students, faculty, staff and alumni of the University of Missouri System, and on behalf of the citizens of the State of Missouri, does hereby adopt this resolution in sincere appreciation of the dedicated and devoted leadership of David L. Steelman;

AND ALSO, that his future relations with the University of Missouri System be formally recognized by bestowing the title of "Curator Emeritus" upon David L. Steelman; and

BE IT FURTHER RESOLVED, that the Secretary of the Board of Curators cause this resolution to be spread upon the minutes of this meeting and that a duly inscribed copy thereof be furnished to David L. Steelman.

Roll call vote:	YES	NO
Curator Brncic		
Curator Chatman		
Curator Graham		
Curator Graves		
Curator Layman		
Curator Hoberock		
Curator Holloway		
Curator Wenneker		
Curator Williams		
The motion		

No. 4

Recommended Action - Resolution for Jon T. Sundvold

It was endorsed by President Choi, recommended by Chair Chatman, moved by Curator _______, that the following resolution recognizing the dedicated service of Jon T. Sundvold to the University be approved:

RESOLUTION

WHEREAS, Jon T. Sundvold served the people of Missouri with distinction as a member of the University of Missouri Board of Curators from June 8, 2016 until January 31, 2017 and again from July 31, 2017 until February 27, 2020; and

WHEREAS, during his terms, he served on several Standing Committees, and also was named Chair of both the Health Affairs Committee and the Executive Committee; and

WHEREAS, in 2019, Curator Sundvold was elected and served as Chair of the Board of Curators from January 1 to December 31, 2019; and

WHEREAS, as Board Chair, he revamped the Board meeting format, creating a one-day session with committee meetings held the week prior to the full Board meeting. It was important to him to provide time during the meetings and receptions to develop relationships with other Curators and University leaders; and

WHEREAS, during his time on the Board, Curator Sundvold promoted the University of Missouri by advocating for increased minority enrollment following the 2015 racial protests on the Mizzou campus and by utilizing "strength" as his Board Chair's theme, working to help everyone realize that, in his words, "it's THE University of Missouri, not "a" university in Missouri," with campuses in Columbia, Kansas City, Rolla, and St. Louis. It is the collective strength of the Board, President, faculty and staff all working to improve the lives of students and the citizens of the State; and

WHEREAS, Curator Sundvold was an advocate for research excellence and a quality education and university experience for all students; and

WHEREAS, Jon Sundvold was a member of the search committee for the 24th President of the University of Missouri System; and

WHEREAS, Jon was a well-known basketball player at Mizzou from 1979-1983, a fouryear guard ranking third in school history in assists and points, and is one of only two Missouri players to play on four consecutive Big 8 Conference championship teams. He played for the US National Team in the 1982 FIBA World Championship and was an All-American in 1983. Jon Thomas "Sunny" Sundvold went on to play nine years in the National Basketball Association for the Seattle Supersonics, the San Antonio Spurs, and ending his career with the Miami Heat. Curator Sundvold was inducted into the University of Missouri Athletics Hall of Fame in 1990; was voted the MVP of Missouri's All-Decade Team in the 1980s; is a member of the University of Missouri Basketball All-Century Team; and is a member of the National Federation of State High School Associations Hall of Fame; and

WHEREAS, he was honored by the MU Alumni Association as an outstanding Alumnus at the 32nd Annual Faculty-Alumni Awards Banquet and served as the grand marshal in the 2009 Missouri Homecoming festivities. In December 2015, he was chosen by the Missouri Sports Hall of Fame as a Sports Legend and enshrined with a bust located in Springfield, MO; and

WHEREAS, Curator Sundvold is a true professional. His contributions will have a lasting influence on the future of the University of Missouri System and the State:

NOW, THEREFORE, BE IT RESOLVED, that the Board of Curators, on behalf of the students, faculty, staff and alumni of the University of Missouri System, and on behalf of the citizens of the State of Missouri, does hereby adopt this resolution in sincere appreciation of the dedicated and devoted leadership of Jon T. Sundvold;

AND ALSO, that his future relations with the University of Missouri System be formally recognized by bestowing the title of "Curator Emeritus" upon Jon T. Sundvold; and

BE IT FURTHER RESOLVED, that the Secretary of the Board of Curators cause this resolution to be spread upon the minutes of this meeting and that a duly inscribed copy thereof be furnished to Jon T. Sundvold.

Roll call vote:	YES	NO
Curator Brncic		
Curator Chatman		
Curator Graham		
Curator Graves		
Curator Layman		
Curator Hoberock		
Curator Holloway		
Curator Wenneker		
Curator Williams		
The motion		

REVIEW CONSENT AGENDA

There are no materials for this information item.

November 18, 2021

CONSENT

Recommended Action - Consent Agenda

It was endorsed by President Choi, moved by Curator ______ and seconded

by Curator ______, that the following items be approved by consent agenda:

CONSENT AGENDA

Action

- A. Minutes, September 2, 2021 Board of Curators Meeting
- B. Minutes, September 2, 2021 Board of Curators Committee Meetings
- C. Minutes, September 13, 2021 Special Board of Curators Meeting
- D. Minutes, September 30, 2021 Special Board of Curators Meeting
- E. Amendments to Collected Rules and Regulations 70.050 Authorization of Real Estate Sales, Leases, Licenses, Easements, Right-of-Way, and Mineral Rights

Roll call vote of the Board: YES

Curator Brncic Curator Chatman Curator Graham Curator Graves Curator Hoberock Curator Holloway Curator Layman Curator Wenneker Curator Williams

The motion _____.

NO

Consent A

Recommended Action - Minutes, September 2, 2021 Board of Curators Meeting Minutes

It was moved by Curator ______ and seconded by Curator ______, that the minutes of the September 2, 2021 Board of Curators meeting

be approved as presented.

Roll call vote:

YES NO

Curator Brncic

Curator Chatman

Curator Graham

Curator Graves

Curator Hoberock

Curator Holloway

Curator Layman

Curator Wenneker

Curator Williams

The motion _____.

November 18, 2021

OPEN - CONSENT - A-1

Consent B

Recommended Action -	Minutes, September Committee Meetings	2, 2021 I	Board of Curators
It was moved by	Curator	and	seconded by Curator
, that the m	ninutes of the Septembe	er 2, 2021 Boai	d of Curators committee
meetings, be approved as pre	sented.		
Roll call vote:		YES	NO
Curator Brncic			
Curator Chatman			
Curator Graham			
Curator Graves			
Curator Hoberock			
Curator Holloway			
Curator Layman			
Curator Wenneker			
Curator Williams			

The motion ______.

November 18, 2021

OPEN – CONSENT – B-1

Consent C

Recommended Action - Minutes, September 13, 2021 Board of Curators Special Meeting

It was moved by Curator ______ and seconded by Curator ______, that the minutes of the September 13, 2021 Board of Curators special meeting be approved as presented.

Roll call vote:	YES	NO
Curator Brncic		
Curator Chatman		
Curator Graham		
Curator Graves		
Curator Hoberock		
Curator Holloway		
Curator Layman		
Curator Wenneker		
Curator Williams		
The motion .		

November 18, 2021

OPEN – CONSENT – C-1

Consent D

Recommended Action - Minutes, September 30, 2021 Board of Curators Special Meeting

It was moved by Curator ______ and seconded by Curator ______, that the minutes of the September 30, 2021 Board of Curators special meeting be approved as presented.

Roll call vote:	YES	NO
Curator Brncic		
Curator Chatman		
Curator Graham		
Curator Graves		
Curator Hoberock		
Curator Holloway		
Curator Layman		
Curator Wenneker		
Curator Williams		
The motion		

November 18, 2021

OPEN – CONSENT – D-1

Amendment to Collected Rules and Regulations Section 70.050 Authorization of Real Estate Sales, Leases, Licenses, Easements, Rightof-Way, and Mineral Rights UM

The Executive Vice President of Finance and Operations and Chief Financial Officer is recommending for Board approval, modifications to Collected Rules and Regulations 70.050 Authorization of Real Estate Sales, Leases, Licenses, Easements, Right-of-Way, and Mineral Rights. The changes listed here were developed with the Office of General Counsel.

The suggested amendment is intended to update the conditions which warrant Board of Curators approval for property sales and property leases. The detailed revisions are described as follows:

• 70.050.C.2 and 70.05.0D – The blanket Board of Curators and state legislative approval requirement for the "sale or conveyance of title to any land contained within a campus" will be removed from section 70.050.D. On July 13, 2021, Governor Mike Parson signed HB 297 which included a change to 172.020 RSMo that removed the requirement for legislative approval on the sale of university land contained within a campus.

The related revision to section 70.050.C.2 adds back a requirement that clarifies all sales of property located within 1 mile of the student union at each university campus shall require Board of Curators approval.

• 70.050.C.4 – The deletion of this section will remove the Board of Curators approval requirement for all property leases that meet the following condition: property leases with persons/entities (including all affiliates of such persons/entities), which exceed \$2,000,000 per year, in the aggregate.

Elimination of 70.050.C.4 will delegate authority for university staff to pursue leases that do not rise to the level of substance (\$1,000,000/year or longer than 10 years) warranting curator approval and thereby eliminate unnecessary delays in the leasing process and mitigate the potential loss of preferred locations to competing interests. Limitation of leasing exposure to a single entity is not a procurement requirement of the University and to date, has resulted in numerous low dollar, short duration leases being brought before the Board of Curators for consideration.

Recommended Action - Amendment to Collected Rules and Regulations Section 70.050 Authorization of Real Estate Sales, Leases, Licenses, Easements, Right-of-Way, and Mineral Rights, UM

It was recommended by Executive Vice President of Finance and Operations and Chief Financial Officer Rapp, endorsed by President Choi, recommended by the Finance Committee, moved by Curator ______ and seconded by Curator _____, that the following action be approved:

that the Collected Rules and Regulations Section 70.050 Authorization of Real Estate Sales, Leases, Licenses, Easements, Right-of-Way, and Mineral Rights be amended to update the conditions which warrant Board of Curators approval for property sales and property leases.

Roll call vote Finance Committee	YES	NO
Curator Hoberock		
Curator Graves		
Curator Layman		
The motion		
Roll call vote Full Board:	YES	NO
Curator Brncic		
Curator Chatman		
Curator Graham		
Curator Graves		
Curator Hoberock		
Curator Holloway		
Curator Layman		
Curator Wenneker		
Curator Williams		
The motion		

Collected Rules and Regulations Business Management Chapter 70: Execution of Instruments

70.050 Authorization of Real Estate Sales, Leases, Licenses, Easements, Right-of-Way, and Mineral Rights

172.020 R.S. Mo.; Bd. Min. 3-6-52, p. 5,906; Bd. Min. 4-19-69, p. 34,497, Bd. Min. 6-29-79, Amended Bd. Min. 5-3-91, Amended Bd. Min. 12-15-95, Amended Bd. Min. 5-5-06; Amended Bd. Min. 12-7-17.

- A. The President or his or her designee, or other persons designated by the Board, shall have the authority to acquire and sell real property, authorize sale agreements, rental agreements, lease agreements, license agreements, and easement and right-of-way agreements covering real property, accept or disclaim gifts of real property, and acquire and sell or lease mineral rights, in conformance with these Collected Rules and Regulations. Deeds and instruments conveying title to real estate shall be executed in the manner and signed by such persons as referenced in Section 70.010B of these Collected Rules and Regulations. Contracts, instruments and agreements, other than deeds and instruments conveying title to real estate, shall be executed in the manner and signed by such persons as described in Section 70.010C of these Collected Rules and Regulations.
- B. The President shall have the authority to acquire property from the UMKC Trustees without obtaining appraisals.
- C. Board of Curators approval shall be required for:
 - 1. Property purchases with a negotiated price of more than \$1,000,000.
 - 2. Property sales with a negotiated sale price of more than \$1,000,000 or located within 1 mile of the student union at each university campus.
 - 3. Property leases for more than \$1,000,000 per year or for more than ten years.
 - 4. Property leases with persons/entities (including all affiliates of such persons/entities), which exceed \$2,000,000 per year, in the aggregate.

- 5.4. Easements and right-of-way agreements that: i) convey rights to entities other than utility companies or governmental entities for a term longer than twenty-four (24) months, or ii) significantly impair the use of the property or significantly decrease the value of the property.
- D. Board of Curators approval, and if required by applicable statutes, legislative approval by concurrent resolution signed by the governor, shall be required for the subdivision, sale or conveyance of title to any land contained within a campus or to any parcel of land containing in excess of 2,500 contiguous acres.

Collected Rules and Regulations Business Management Chapter 70: Execution of Instruments

70.050 Authorization of Real Estate Sales, Leases, Licenses, Easements, Right-of-Way, and Mineral Rights

172.020 R.S. Mo.; Bd. Min. 3-6-52, p. 5,906; Bd. Min. 4-19-69, p. 34,497, Bd. Min. 6-29-79, Amended Bd. Min. 5-3-91, Amended Bd. Min. 12-15-95, Amended Bd. Min. 5-5-06; Amended Bd. Min. 12-7-17.

- A. The President or his or her designee, or other persons designated by the Board, shall have the authority to acquire and sell real property, authorize sale agreements, rental agreements, lease agreements, license agreements, and easement and right-of-way agreements covering real property, accept or disclaim gifts of real property, and acquire and sell or lease mineral rights, in conformance with these Collected Rules and Regulations. Deeds and instruments conveying title to real estate shall be executed in the manner and signed by such persons as referenced in Section 70.010B of these Collected Rules and Regulations. Contracts, instruments and agreements, other than deeds and instruments conveying title to real estate, shall be executed in the manner and signed by such persons as described in Section 70.010C of these Collected Rules and Regulations.
- B. The President shall have the authority to acquire property from the UMKC Trustees without obtaining appraisals.
- C. Board of Curators approval shall be required for:
 - 1. Property purchases with a negotiated price of more than \$1,000,000.
 - 2. Property sales with a negotiated sale price of more than \$1,000,000 or located within 1 mile of the student union at each university campus.
 - 3. Property leases for more than \$1,000,000 per year or for more than ten years.
 - 4. Easements and right-of-way agreements that: i) convey rights to entities other than utility companies or governmental entities for a term longer than twenty-four (24) months, or ii) significantly impair the use of the property or significantly decrease the value of the property.

D. Board of Curators approval, and if required by applicable statutes, legislative approval by concurrent resolution signed by the governor, shall be required for the subdivision, sale or conveyance of title to any parcel of land containing in excess of 2,500 contiguous acres.

FINANCE COMMITTEE

Greg E. Hoberock (Chair) Todd P. Graves Jeff L. Layman

The Finance Committee ("Committee") oversees the fiscal stability and long-term economic health of the University. The Committee will review and recommend policies to enhance quality and effectiveness of the finance functions of the University.

I. Scope

In carrying out its responsibilities, the Committee monitors the University's financial operations, fundraising performance, debt level, capital priorities and investment performance; requires the maintenance of accurate and complete financial records; and maintains open lines of communication with the Board about the University's financial condition.

II. Executive Liaison

The Vice President for Finance of the University or some other person(s) designated by the President of the University, with the concurrence of the Board Chair and the Committee Chair, shall be the executive liaison to the Committee and responsible for transmitting committee recommendations.

III. Responsibilities

In addition to the overall responsibilities of the Committee described above and in carrying out its responsibilities, the charge of the Committee shall include

- A. Reviewing and making recommendations to the Board on the following matters:
 - 1. University operating budget and financial plan;
 - 2. University capital budget and master facility plans;
 - 3. capital projects;
 - 4. tuition, fees and housing rates;
 - 5. state appropriation requests;
 - 6. pursuant to applicable Collected Rules and Regulations, contracts and reports;
 - 7. insurance brokers and self-insurance programs;
 - 8. pursuant to applicable Collected Rules and Regulations, real estate sales, purchases, leases, easements and right-of-way agreements;
 - 9. the issuance of debt;
 - 10. asset allocation guidelines and other policies related to the University's investment management function; and
 - 11. additional matters customarily addressed by the finance committee of a governing board for an institution of higher education.
- B. Providing governance oversight to:
 - 1. long-range financial planning strategies;
 - 2. fundraising and development strategies;
 - 3. total indebtedness and debt capacity of the University;
 - 4. the investment portfolio performance; and
 - 5. the financial condition of the pension fund.
- C. Reviewing periodic reports including:
 - 1. quarterly and year-end financial reports that measure the University's fiscal condition;
 - 2. annual purchasing reports on bids and equipment leases;
 - 3. quarterly debt-management reports;

- 4. quarterly and year-end investment performance reports;
- 5. semi-annual reports on development and fundraising activities; and
- 6. other financial reports as requested by the Committee.

Approved by the Board of Curators: Feb 4, 2021

FY2021 Financial Status Report UM

At the November 18th Board of Curators Meeting, Executive Vice President Ryan Rapp will present the annual financial status report, reflecting on the University's performance for FY2021. The report will include an update on the University's overall financial position along with a breakdown of performance across business units.

EXECUTIVE SUMMARY

FY2021 saw a significant recovery in public higher education after the onset of the pandemic, with fiscal stimulus serving to off-set revenue losses and increased cost. The University of Missouri's financial performance recovered well during FY2021 with the infusion of non-recurring stimulus funding, strong investment returns and the enactment of temporary cost containment measures through the pandemic. Increased operating cash flows coupled with outsize positive investment performance replenished the University's working capital strengthening the balance sheet.

With the recovery in FY2021, the University remains at or slightly above its defined financial performance targets on a consolidated basis. The University's revenue streams sit roughly in line with expectations from the previous financial plan completed in FY2019.

From an operating perspective, non-recurring revenue increases and temporary cost reductions drove the operating performance above target. When these temporary measures are removed, the consolidated operation remains close to financial performance targets.

The balance sheet remains critical to the University's financial health, and continues to underpin the University's credit. Any future investments should be considered in the context of their impact to the long-term health of the balance sheet. Longer-term challenges in demographics and the demand for higher education remain, and each institution's ability to grow revenue will be the future limiting factor on their ability to invest and generate resources.

Even with the balance sheet recovery that occurred in FY2021, the University does not have unlimited financial capacity to invest. Throughout this fall, each University will complete a long-range financial plan to quantify investments necessary for their strategic plan and identify related plans of finance. This will be presented to the Board at the February meeting together with the financial performance targets for each University.

RATING AGENCIES: PUBLIC UNIVERSITY PERFORMANCE HOLDS STEADY DURING PANDEMIC

Public university operating performance remained stable in FY2020 as cost-containment strategies and federal funding mitigated the impacts from the onset of the pandemic, with the largest declines accruing to auxiliary revenues for universities. Key trends highlighted by Moody's include:

- 1) Large universities continue to outperform smaller sized institutions
- 2) Expense growth continues to outpace revenue growth within the industry, with four consecutive years of increased expenses
- 3) Net tuition growth continues to weaken due to state policy decisions and competition
- 4) Wealth levels remain stable as universities manage liquidity during pandemic
- 5) Median total debt levels continue to decline, but capital investment continues
- 6) Pension liabilities continue to add significantly to leverage and operating risks for universities.

In March 2021, Moody's revised the industry outlook for higher education from "negative" to "stable". Factors cited as the reasoning for the industry movement include the funding boost from federal stimulus, the return to campus for in-person instruction, a steadier outlook for state funding, and strong investment returns. However, not all universities will benefit equally, and the sector continues to face longer-term demographic changes and shifts in consumer preferences that will constrain revenue growth.

Overall, the University's performance mirrors that seen across the industry, with federal stimulus filling in the gaps created when revenues dropped precipitously before expenditures could be reduced and positive investment performance providing a replenishment of long-term assets on the backside of the pandemic.

While the University's rating remains Aa1 for Moody's and AA+ for S&P, S&P revised their outlook for the University to negative during the University's spring 2020 debt issuance. In S&P's revision to a negative outlook, the primary factor cited is that the public health crisis and social risks from the pandemic would dampen the economy and result in declines in revenue for higher education. S&P cites weakened operating results during their outlook period as the primary driver for the negative watch. While the University had positive performance for FY2021, maintaining performance close to targets in future years will be the key to maintaining the current ratings.

STRONG PERFORMANCE IN FY2021 SERVES TO RECOVER FROM UNDERPERFORMANCE IN FY2020

After earning a 2.8% operating margin in FY2020, the University's performance recovered to an 11.5% operating margin in FY2021 on a target of 5.0%. The University's outsize performance in FY2021 is largely the result of one-time items with the receipt of non-recurring federal stabilization funding and temporary reduction measures enacted through the pandemic. Over the same time, the University prevented cost growth and took some permanent measures to restructure operations for a successful future.

	Operating Margin (%)	Operating Margin (\$)
Actual	11.5%	\$434 million
One-time Cost Containment Measures	-2.7%	-\$98 million
Federal Stimulus Funding	-2.8%	-\$117 million
Adjusted	6.0%	\$219 million
Target	5.0%	

Table 1: FY2021 Operating Margin Adjusted for Temporary Measures

Table 1 above demonstrates the impact of the temporary increases in revenue from nonrecurring federal fiscal stimulus and the enactment of temporary cost management initiatives. Temporary cost measures included the following:

- \$60 million reduction in travel and meeting expenses
- \$24 million reduction in utilities, facility maintenance, and department expenditures
- \$14 million in salary saving from temporary pay reductions

The addition of unexpected non-recurring federal stimulus funding had a significant impact on financial performance across years. Table 2 presents the operating revenue impact of the federal stimulus funding across fiscal years 2020 - 2022.

	FY2020	FY2021	FY2022
Federal Direct Funding			
Student Aid	\$17 million	\$17 million	\$51 million
Institutional Support	\$15 million	\$41 million	\$51 million
State/County Stimulus Funding			
Governor's Emergency		\$10 million	
Education Relief Fund			
Coronavirus Relief Fund		\$61 million	
Coronavirus Relief Fund		\$3 million	
for Remote Learning			
Healthcare Support		\$2 million	
Less Student Aid Awarded	(\$17) million	(\$17) million	(\$51) million
Net Amount Reported as	\$15 million	\$117 million	\$51 million
Operating Revenues			

Table 2: Federal Stimulus Funding and Request for Reimbursement

Note: MU Healthcare presents federal stimulus funding as non-operating in accordance with GASB standards. The University received \$26 million in provider relief funds that are not included in the table above.

Part of the underperformance in FY2020 and related overperformance in FY2021 relates to the timing of recognition of non-recurring federal stimulus funding. The University received \$132 million in non-recurring federal stimulus funding for institutional use spanning across fiscal years 2020 and 2021 and will receive an additional \$51 million in FY2022. These revenues represent non-recurring funding sources that will not continue past the pandemic, and much of the revenue received in FY2021 relates to losses incurred in FY2020. The stimulus allowed the University to recover unbudgeted expenses related to reopening the universities, supported infrastructure for remote learning, and recover lost revenues stemming from the pandemic

Revenue growth rebounds in FY2021, growth in healthcare and grants continues

The relative diversity of operations and revenue streams provides a key strength for the University, as strength in one portion of the enterprise offsets weakness in another. Operating revenues recovered in FY2021, experiencing 8.7% growth from FY2020 excluding the impact of non-recurring federal fiscal stimulus. Much of the revenue growth in FY2021 can be attributed to revenues recovering to FY2019 levels, especially in auxiliary operations and state funding. The University expects more growth in auxiliary operations moving into FY2022 as each university resumes more normal in-person operations.



Figure 2: Revenues by Source

Figure 2 demonstrates revenues by source over the past five years. The past five years have presented a challenging picture for the academic enterprise, with flat revenues for most academic related revenue streams. The main area of revenue growth has been grants and contracts, as the University has improved research growth along with some growth in philanthropy, growing by a combined \$100 million since FY2017. The major growth driver for the institution has been the healthcare enterprise, which grew revenue by \$300 million since FY2017.

The pandemic amplified revenue disruptions, with losses in auxiliaries and state appropriations amounting to \$80 million in FY2020. Stimulus funding received to offset the effects of the pandemic had the opposite effect in FY2021, where over \$100 million in revenue was attributed to non-recurring federal stimulus funding. When looking across revenue streams grants and contracts, philanthropy, and patient medical services have exceeded pre-pandemic levels. Unrestricted funding sources of net tuition and fees and state appropriations are back close to pre-pandemic levels in FY2019.



Figure 3: Operating Revenue Growth from FY2016

The onset of the pandemic drove the projected revenue growth down by almost 3%. Figure 3 presents the University's revenue growth from FY2016, the pandemic created volatile swings in the University's revenue growth over the past two fiscal years, however the University's budget growth by FY2022 is within 2% of the long-term revenue growth projected prior to the onset of the pandemic. Going forward, the key drivers of revenue growth for the academic units will continue to be enrollment as the number of students primarily drives tuition and auxiliary services (housing, dining, parking, etc.) on campus along with new tuition pricing models. Research productivity and philanthropy also represent other key areas for future growth, with research already seeing gains with the growth in grant revenues.

The University managed costs within available revenue streams

The analysis that follows will segment the Universities revenue and expense management amongst the academic units and the healthcare unit, as the business operations and related financial performance differed over the past year. Academic units and the healthcare operation experienced disruptions from the pandemic differently, and have different trends in related financial performance.

With the fiscal stimulus replacing losses from the prior year, both the academic units and healthcare continued to manage costs to available revenue sources. Even with the recovery in state support and federal stimulus, the University still faced revenue pressures in auxiliary operations dependent on an in-person presence.



Figure 4: Five-year trend in revenue and expenses for Academic Units

Figure 4 demonstrates that relative cost growth remained within available revenues for academic units (four Universities and System Administration) over the past five years. Academic revenues have remained relatively flat from FY2017 to FY2020 years, with growth in research and philanthropy offsetting tuition declines. Growth spiked in FY2021 with the federal stimulus funding, but there was also growth in research revenues coupled with stabilizing tuition and state support. Without the fiscal stimulus, revenue growth would have remained flat. Academic unit spending remained relatively flat over the five years, with declines in both FY2020 and FY2021 due to the actions undertaken as a result of the pandemic.

	Change from FY2019 - 2021
Reductions	
Salaries and Wages	(\$6) million
Benefits	(\$1) million
Supplies Services and Other	(\$85) million
Growth	
Depreciation	\$4 million
Interest	\$5 million
Net Change	(\$83) million

Table 3: Cost Cuts Concentrated in Supplies, Services & Other

Table 3 demonstrates the total change in costs by major classification from FY2019 to FY2021. The supplies and other expenses dropped by \$59 million in FY2020 from FY2019, and then fell by an additional \$26 million from FY2020 to FY2021. The biggest drivers of this decrease included:

- \$60 million decline in travel and meeting expenses (78% reduction)
- \$12 million decline in equipment purchases (20% reduction)
- \$13 million decline in cost of goods sold (18% reduction)
In FY 2022, many of these declines will reverse as the University repopulates campus and transitions back to normal operations. The temporary measures were successful in reducing cost during the one-time revenue decline. Unlike the change in supplies and other, the University's labor force is experiencing more lasting changes. Much of these changes are the result of the labor dynamics continuing to shift towards more skilled and technical labor.



Figure 5: Three-year trend in salaries and benefits

Figure 5 demonstrates the change in compensation over the last three fiscal years. At the onset of the pandemic in March 2020, the University had already experienced a planned increase in salaries. Personnel costs were initially managed with some temporary pay decreases as the University undertook reshaping staffing in the already underway FY2021 budget process. Over the course of the last quarter of FY2020, the University's leaders identified the key position eliminations or pay decreases within each institution's budget guidelines. These reductions became effective in FY2020, however with the University's Transition Assistance Pay (TAP) policy much of the run-out cost occurring during FY2022. The TAP policy increased the cost of layoffs in many circumstances. The proposed edits to this policy will be presented to the Board at the November meeting, which will decrease the benefit and bring it more in line with that of other Universities.

Small change in salary spend masks larger transformation underway. The Universities continue to trend back towards more tenured faculty, especially at MU, to help the

institution towards the goal of achieving academic excellence. Adjunct faculty adjusted downward to match volumes and offset tenured hires.



Figure 6: Changes in Employee Headcount from Fall 2019 to Fall 2020 Census

On the staff side, overall headcount declined by 6.9% or 849 jobs. Amongst full-time staff outside of the healthcare setting, the largest reduction in jobs was amongst Office and Administrative Support positions, with 238 less jobs in FY2021 from FY2020. The one area of growth in jobs was amongst the Computer Science and Engineering category, where the University added 183 positions reflecting the shift to online learning and the increased role of technology in the University's Operations.



Figure 7: Revenue growth pauses at healthcare while expenses continue to grow due to the pandemic

The Health System resumed historical growth rates in revenue in FY2021 over renewed volumes after the delay of elective procedures in FY2020. The Hospital continues to experience cost pressure on margins as the pandemic exacerbates staffing shortages and upward pressure on wages as the demand for healthcare workers increases across the country, with mobile workers commanding a higher salary. Inflationary pressures on drug prices and medical supplies continue to put pressure on margins even as volumes increase at the hospital. In FY2022 and beyond, the health system will need to realize greater price increases or adjust cost structures if inflationary pressures prove permanent rather than transitory.

BALANCE SHEET EXPERENCES LIFT FROM MARKET GAINS

While the income statement demonstrates performance over a period of time, the balance sheet provides a snapshot of the institution's financial condition at any moment in time. In higher education, the balance sheet is a key indicator of the financial condition and strong balance sheet positioning is a key component of credit quality. As a university's business cycle is multiple years long, significant assets are necessary to provide an appropriate operational buffer for higher education institutions.

Assets grow on strong operating and investment performance

The key asset for any university is its liquid assets in the form of cash and investments, specifically those held outside of restricted endowments, referred to as spendable cash and investments. The University's spendable cash and investments increased by 14% or \$485 million from FY2020. This increase was attributed to the positive operating performance and outsize investment performance.

						FY2021	10 year
	FY2017	FY2018	FY2019	FY2020	FY2021	Benchmark	Annualized
General Pool	4.5%	2.2%	3.3%	0.2%	7.9%	4.7%	2.7%
Endowment Pool	13.7%	9.4%	5.7%	1.2%	29.7%	25.4%	8.6%

Table 4: Annual Investment Returns for the General and Endowment Pool

To provide perspective on the volatility of the investment returns and the outsize impact of FY2021 returns on the University's balances, Table 4 presents the annual returns for the University's investment pools. The General Pool represents the institution's spendable cash and investments, and the Endowment Pool represents funds which are permanently restricted. The investment performance from FY2021 was the best performance in the last decade.



Figure 8 demonstrates the trend in both cash and investments and spendable cash and investments. Permanently endowed gifts represent the difference between total cash and investments and spendable cash and investments. Spendable cash and investments represent usable working capital, as endowment balances are permanently restricted and cannot be used for operating needs. The significant increase in FY2021 is largely a result of the investment returns.

The cash and investment balances increase noted in figure 8 accrue throughout the University. Investment gains in the endowment pool accrue to the individual endowments and increase the amount of spending distribution for each endowment's given restrictions. The gains in the general pool first go to the University's liquidity needs, with any excess return invested back in the Universities and approved by the Board in the strategic dividend. The excess returns from the General Pool will be distributed to the universities in FY2022 based upon the plans approved by the Board at the September Board meeting. Both the endowment spending distributions and the general pool dividend have smoothing mechanisms to layer gains (and losses) in over several years to provide for a more stable budget.

The other key asset on the balance sheet is capital assets and the related debt that funds those assets. Capital assets represent the long-term infrastructure of the institution and are recorded at historical cost and depreciated over their expected useful lives.

Figure 8: Trend in Cash and Investments



Figure 9: Capital Assets and Debt 10-year History

Figure 9 demonstrates capital assets have begun to grow again after a pause from FY2016 to FY2019. In FY2020, both debt and capital assets grew slightly with the addition of the Precision Health Institute. With additional funding from the State and philanthropy, the University continued to invest in capital during FY2021. The University anticipates capital spend will continue to increase as the four universities uses for the strategic dividend distribution centered around key capital priorities for their strategy. Future capital investment will be constrained by each university's operating performance and ability to generate revenue growth on investment.

Liability growth moderates, largely due to decreases in net benefit liabilities

The largest liabilities for the University are externally issued debt and benefit liabilities. After a debt issue in FY2020 to permanently finance the Precision Health Institute and meet the University's working capital needs, the University did not have any debt issuances in FY2021. Figure 9 demonstrates the University's debt growth over the past decade, with a period of growth from FY2011 to FY2015, followed by a flat period from FY2015 to FY2019. Going forward, the University will likely have an additional debt issue in the next two years as several elements of the debt portfolio converge for a potential bond issue. Additional debt funded capital needs will be identified through the financial planning process currently underway at each institution.

Prior to FY2021, Benefit-related liabilities were the largest liabilities on the University's balance sheet. The two benefit liabilities are the University's Pension Plan and the University's Post-Employment Benefits Plan (OPEB). Liabilities on the University's balance sheet are presented net of related assets in the plan, with the Pension maintaining a significant asset base to make future plan payments. Table 5 below presents the total benefit liability along with the fiduciary assets.

	Total Liability	Fiduciary Net	Net Liability (on balance sheet)
D	Total Liability	1 OSITION	balance sheet)
Pension			
FY2020	\$4,764	\$3,654	\$1,110
FY2021	\$4,872	\$4,557	\$315
OPEB			
FY2020	\$407	\$39	\$368
FY2021	\$253	\$39	\$214

Table 5: Benefit-related Liabilities and Assets, \$'s in millions

The decrease in the net pension liability attributes to the significant investment returns experienced in FY2021, this increased the pension's net position by \$1 billion thus reducing the University's net pension liability by 75%, or \$795 million. The University is currently working on an update to the actuarial assumptions and asset allocation of the pension plan that will be brought to the Board for approval in the spring. The net pension liability of growth in the total liability coupled with the relative volatility of market returns on the pension assets. The relative size of the total pension liability poses a significant risk for the University on a forward basis, as the ability to cross pledge other assets towards this commitment is limited by its sheer size.

The decrease in the net OPEB liability is a more permanent reduction due to changes implemented in retiree benefits. In FY2021, the University put the retiree medical plan out to bid and combined the medical and pharmacy management into a single vendor. The bids reduced the medical premiums from \$120 per month to \$42 per month. The decrease in liability was also the result of better aligning plan experience to the premium structure, shifting costs of optional increased coverage on to the retirees who desire that coverage without subsidy. These changes reduce the plan assumptions immediately, resulting in a reduction in the liability. Additionally, the University better aligned plan design and experience requiring the retirees who desire a richer benefit to fully pay for their increased benefit on a monthly basis.

Net position (equity) grows

Governmental accounting standards require the University to show net position by restriction type. This provides additional information to financial statement users on the ability of the institution to direct the net resources available after debts are paid.



Figure 10: Net Position by Type

Figure 10 outlines the University's net position (equity) by restriction type. The categories demonstrate that a significant portion of the University's net position is inaccessible for operating purposes, such as \$1.6 billion in the endowment and \$1.9 billion invested in capital assets such as building, land and equipment. The following factors attributed to the increase in the University's Net Position.

- Unrestricted Increased by \$584 million.
 - An increase of \$115 million directly relates to the variance between actual versus expected investment returns on the pension plan.
 - Investment returns from the general pool and unrestricted endowments increased unrestricted net position by \$280 million.
 - The remaining \$189 million increase is attributed to the university's positive operating performance.
- Restricted Increased by \$180 million.
 - The University received \$36 million from the State to fund M&R projects. As of June 30, 2021, approximately \$4 million of these funds have been expended. The remaining expense will be recognized in subsequent years as the projects are completed.

- The University recognized an increase of \$68 million in capital gifts. This funding is restricted for specific capital projects which will be expensed in subsequent years.
- The remaining increase is attributed to the timing of expenditures versus when the gifts were received. Increases in investment income provided restricted sources with more funding to be spent in future years but spending from these accounts must match the donor or external sponsor's intent.
- Invested in Capital Assets Increased by \$91 million.
 - This number represents the value of the University's capital assets net of depreciation and the related outstanding debt. The biggest driver of the increase was spending on the NextGen Precision Health Institute without any related debt issuances.
- Endowment Increased by \$389 million.
 - This increase was primarily attributed to the market returns of 29.7% from the endowment pool

FINANCIAL PERFORMANCE BY UNIT

The financial performance metrics in this section represent the key metrics the System utilizes to monitor financial performance amongst the different universities. These metrics are used by Moody's to determine the University's credit rating and are presented to the Board as a part of the long-range financial plan and operating budget.

The University and Rating Agencies evaluate financial performance with an eye towards the longer-term. The University's financial performance targets do not represent the floor but rather where an institution should be over a longer time horizon. Due to University's long business cycle, financial performance and operating margin should be evaluated over several years looking at trends rather than just looking at a single year.

Operating Margins rebound in FY2021 and performance remains close to target

Operating Margin demonstrates management's ability to adjust expenditures within revenues received in an annual period. Operating margin generally shows management's ability to control financial performance within the annual planning cycle. A positive operating margin provides the University with resources to support operations and invest in future mission-based activities and capital.

					MU	
	MU	UMKC	S&T	UMSL	Health	Consolidated
Actual	8.4%	16.2%	11.9%	10.0%	6.8%	11.5%
One-time Cost Containment Measures	-2.7%	-8.5%	-3.0%	-6.6%		-2.7%
Federal Stimulus Funding	-3.5%	-5.1%	-6.8%	-8.3%		-2.8%
Adjusted	2.2%	2.6%	2.1%	-4.9%	6.8%	6.0%
Target	3.5%	0.0%	3.0%	3.0%	7.0%	5.0%

Table 6: FY2021 Operating Margin by Unit

Similar to FY2020, the pandemic and related stimulus continues to distort longer-term trends in financial performance and the trajectory of each unit. Table 6 presents the actual operating margin for FY2021 and the adjusted operating margin excluding the non-recurring federal stimulus funding. The operating margins have also been adjusted for the impact of temporary measures, providing an estimate of the longer-term run rate for each institution based on expected recurring revenues and expenses in FY2021.



Figure 11: Five-year Average Operating Margin by Business Unit

Figure 11 shows each unit's operating margin five-year average performance as compared to their target. A five-year average is used to demonstrate performance over roughly one business cycle for the University, as students take multiple years to complete their degrees. The chart does not demonstrate the relative impact of each institution on the University's consolidated operating margin. Taken together, MU and MU Healthcare represent 73% of the total revenues for the University of Missouri. As such, their financial performance on operating margin drives the consolidated total.

Highlights on operating margin from each business unit includes:

- MU operating margin for FY2021, when excluding the one-time federal stimulus funding, is 4.9% which is above MU's target of 3.5%. This margin was attained by the growth in MU's auxiliary enterprise and state support coupled with temporary non-personnel cost containment. Temporary cost measures included \$39 million reduction in travel and meeting expenses. The underperformance in prior years is largely in relation to enrollment declines and revenue losses relating back to protest in November 2015.
- **MU Healthcare** continues to maintain a positive operating margin with an increase from prior fiscal year but below historical performance from FY2017-FY2019. MU Healthcare continues to face increased costs of labor and supplies in responding to the pandemic, without significant operating revenue increases to offset these cost increases.
- UMKC operating margin for FY2021, when excluding the one-time federal stimulus funding, is 11.1%. This margin was attained by the growth in UMKC's private gifts and grants and contract revenue coupled with temporary non-personnel cost containment. Temporary cost containment measures were put into place as uncertainty around revenue streams related to on-campus presence fluctuated with COVID

restrictions. Temporary cost measures included \$8 million reduction in travel and meeting expenses, \$6 million temporary compensation reduction, and \$20 million reduction in maintenance, utilities, and department expenditures.

- Missouri S&T operating margin increased over the prior year when excluding the onetime federal stimulus funding, is 5.1% which is above S&T's target of 3.0%. In Fall 2020 and 2021 S&T has continued to see a decline in total enrollment as the cohort decline progresses through the college student lifespan. In Fall 2021 S&T experienced a 7% increase in first-time freshman cohort, but the incoming cohort is still smaller than the exiting cohort leading to revenue declines. S&T had temporary non-personnel cost measures related to travel and meeting expenses totaling \$6 million.
- UMSL experienced an increase in operating margin driven by one-time federal stimulus funding coupled with temporary compensation reductions. When excluding the one-time federal stimulus funding UMSL operating margin drops to 1.7%. Temporary cost containment measures were put into place as uncertainty around revenue streams related to on-campus presence fluctuated with COVID restrictions. Temporary cost measures included \$5 million reduction in travel and meeting expenses, \$7 million temporary compensation reduction, and \$1 million reduction in maintenance, utilities, and department expenditures. Over the past five years, UMSL experienced consistent declines in enrollment, necessitating further expenditure reductions. Without an ability to turn around the consistent pattern of falling enrollments, UMSL will need to continue with deeper cost reductions

Figure 12: FY2021 Revenue by Business Unit, excluding Federal Stimulus Funding, \$'s in millions



NOTE: Operating revenue growth has been adjusted for smoothing of investment income for the consolidated level, similar to the operating margin, excludes institutional federal stimulus funding.

MU and MU Healthcare account for nearly three quarters of the enterprise's operating revenue, as shown in Figure 12 above. MU and MU Healthcare both generate over \$1

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billion in revenues while the other three operating units combined generate less than \$800 million. This scale demonstrates MU and MU Healthcare are the primary drivers of the University's consolidated financial performance, with small movements in their relative performance impacting the institution on a greater scale.

Spendable Cash and Investments to Debt recovers on positive performance

Spendable Cash and Investments to Debt shows the relative size of liquid assets compared to the outstanding debt of the organization. This metric moves over a longer time horizon, eroding when debt is issued and rebuilding as debt is re-paid and cash grows with positive operating performance. Spendable cash and investments to debt represents one measure of debt capacity.



Figure 13: Spendable Cash & Investments to Debt Trend

Spendable cash to debt increased over prior year due to the strong investment returns and positive operating margins following the pandemic. Spendable cash to debt of 2.2 is above the target and remains above the average of 1.5 from 2011-2016 when the University issued significant amounts of debt to fund the building of significant capital assets. The current target reflects the floor range of Aa1-rated institutions, with spendable cash and investments to debt likely being a limiting factor in the University's current rating band. A key piece of the financial planning process currently underway is to quantify the cost of the current strategy and related investments underway at each campus and compare to each unit and the University's financial capacity to invest. The availability of debt and cash at current rating levels will likely be a limiting factor on some University's plans.



Figure 14: Spendable Cash to Debt by Business Unit – Beige bar represents FY2020

Figure 14 demonstrates spendable cash to debt varies by business unit. During FY2021 every business unit increased this ratio due to the strong investment returns and positive operating margins. UMKC experienced significant growth in spendable cash and investments which was attributed to market returns, philanthropy, and temporary operating performance improvements. Targets for UMKC were set below peer institutions as UMKC had invested significantly in the early part of the decade to achieve growth. With the positive performance from the last year, there is the opportunity to deleverage and reduce risk for the campus. Through the financial planning process targets for the institutions will be set to align with peer institutions. These targets will be presented to the Board at the February meeting.

Spendable Cash to Operations improves on growth in cash balances

Spendable Cash to Operations shows the relative size of cash balances to the operating expenses of the organization. This metric shows the organization's capacity to adapt to unexpected changes in revenue streams or unexpected increases in cost. The cash to operations measure grew in FY2021 as the University increased cash balances with federal stimulus funding and unprecedented market returns.



Figure 15: Spendable Cash to Operations Trend

Spendable cash provides the University with time to implement actions that reduce expenditures. Table 7 demonstrates the relative performance of the business units on the spendable cash to operations metric. Whereas MU Healthcare is comparable to MU on cash to debt, MU Healthcare falls lower when the cash balance is compared to the size of the operation. MU Healthcare's target is lower to reflect the nature of healthcare industry compared to higher education.

	MU	UMKC	UMSL	S&T	MUHC
FY2019	0.75	0.39	0.51	0.87	0.55
FY2020	0.75	0.41	0.50	0.75	0.51
FY2021	0.85	0.78	0.69	1.05	0.49
Target	0.80	0.45	0.50	0.80	0.55

Table 7: Three-year Spendable Cash to Operations by Business Unit

This metric increased across all units except for MU Healthcare, which experienced an expected decline in cash with the implementation of a new revenue cycle software and increased capital spending. The working capital balance for each university has rebounded from the pandemic creating capacity for investment. However, for the investments to continue to sustain the University's growth, they need to earn a return and replenish the cash balance spent over time. The Spendable Cash to Operations numbers at the campuses are lower than the consolidated numbers due to reserves held centrally to offset liabilities incurred at the enterprise level. The University holds significant cash balances to self-insure both benefits and other business liabilities, and these amounts are included in the consolidated totals.

LOOKING FORWARD: LONG-TERM CHALLENGES REMAIN

The pandemic presented the University with an unexpected shock that significantly and abruptly shifted operations. As the University continues to move past the emergent issues driven by the pandemic, longer-term trends driving public higher education economics will come back into focus. Nationally, public higher education faces a lack of available recurring funding for investment. In the mid-west, institutions face challenging demographic patterns for traditional college students. As a result of both of these trends, the industry will face a struggle to growth revenues. The institutions in the University of Missouri have faced this challenge for the past five years.

50.0% 40.0% 30.0% 20.0% 10.0% 0.0% -10.0% FY 2016 FY 2017 FY 2018 FY 2019 FY2020 FY2021 -UMKC UMSL MUHC MU S&T

Figure 16: Revenues Growth by Business Unit, excluding Institutional Federal Stimulus Funding

NOTE: Operating revenue growth has been adjusted for smoothing of investment income for the consolidated level, similar to the operating margin, excludes institutional federal stimulus funding s.

Figure 16 above demonstrates total operating revenue growth over the preceding five years by operating unit. MU Healthcare is the only unit which has experienced significant revenue growth. Prior to the pandemic, MU Healthcare's revenue growth was on pace to slow over prior year's growth. Revenue growth is the key long-term indicator for financial health, without revenue growth, institutions remain in a cycle of cost cutting. Without revenue growth, investment and capital renewal remain difficult for institutions, as they cannot generate the income to pay for the areas they need. In a flat growth environment, cost management becomes the key to maintaining financial performance.



Since FY2016, enrollments have declined across the University, with declines across all universities. Since FY2019, MU which has started to see an upward trend as it moves past the enrollment declines from November 2015. In total, the University's enrollment across all four institutions is 9% lower than where it was in FY2011. Declining enrollments impact multiple revenue streams across the University, as payments from students do not just include tuition but impact residence halls, dining, bookstores, and other student service auxiliaries. As student populations across campuses have declined, so have the related revenues paid by students. Turning around enrollments and student related revenues remains a large challenge for the University. Without additional students at the same or increased revenue per student, continued cost reductions will be necessary to maintain financial performance.

Looking forward, tuition strategies will be key to maintaining revenues for the academic units. The revenue outlook for the state remains highly uncertain and the state's ability to provide support to higher education will be challenged by other spending programs as well. Each university will need to focus on building their brand and pricing their brand to the market. Tuition and fees continue to grow, but scholarships have been growing at a faster rate reducing the total amount of net tuition revenue received from students. Each university will need to examine scholarship strategies together with tuition to build a class profile that is distinct from others in the state that also provides the necessary program revenues. Programs and areas of support from state appropriations will need to be aligned with the state's priorities and limited resources. The University will utilize the financial planning process to ensure this happens.

OPEN – FIN – INFO 1-24

NEXT STEP: LONG-RANGE FINANCIAL PLANS

While the stimulus and investment returns strengthened the University's relative financial position, work still needs to be done to ensure each University's financial model remains sound for the future.

The University is in the process of incorporating the strategic and capital initiatives into the long-range financial plans for each university and the health system. This process includes peer benchmarking to ensure that University leaders understand the relationship between university finances and their eminence. Financial plans will reflect that increased investment requires a period of improved financial performance to fund the investments. The university's leadership team will utilize the financial planning process to quantify necessary investments to both improve academic excellence and revenue growth and balance those investments against available resources. This long-term financial plan will serve as the basis for the FY2023 budget process.

As a part of the planning process, the University is in evaluating the performance targets set three years ago during the implementation of the financial management framework with the Board. Enterprise level targets will be approved by the Board with appropriate competitive market context as the University works to reset long-range financial plans, as codified in Collected Rule 140.025. The financial plan presented to the Board in February will align with the capital plan and will incorporate the universities' key strategies with related funding.

Projected Performance - Key Financial Metrics

	Target	Consolidated	MU	S&T	UMKC	UMSL	MU Healthcare
Operating Margin - Total Operating Revenues less Total Operating Expenses divided by Total Operating Revenues Demonstrates management's ability to manage expenditures within revenues.	5.0%	↑ 11.5% ●	♠ 8.4%	♠ 11.9% ●	1 6.2%	个 10.0%	♠ 6.8%
Operating Revenue Growth -Change in Total Operating Revenues from prior year divided by Total Operating Revenues from prior year Demonstrates growth of operation. Core of long-term financial health.	3.2%	1 0.4%	♠10.1% ●	♠ 9.0% ●	↑ 12.2% ●	♠ 9.9%	1 0.4%
Cash to Debt - Total Spendable Cash divided by Total Debt Outstanding Shows the relative size of debt burden against available liquid sources to fund debt.	2.00	↑ 2.19	↑ 1.53	1 .66	↑ 1.52	↑ 1.20	1 .76
<u>Cash to Operations</u> - Total Spendable Cash divided by Operating Expenses Shows the amount of cash available to weather unexpected disruptions in revenue or expense.	1.00	1 .17	♠ 0.85 ●	1 .05	♠ 0.78 ●	♠ 0.69 ●	♥ 0.49

Arrows indicate trend over prior year performance, higher is better on all ratios. Dots indicate if projected metric is over /at target (green) or under target (red). All ratios from Moody's Higher Education Scorecard.

Summary of Current Ratings								
Industr								
Rating Agency	Rating	UM Outlook	Outlook					
Moody's	AA1	Stable	Stable					
Standard & Poor's	AA+	Negative	Negative					

University of Missouri System - for Discussion Only

Statement of Net Position

For the Year Ended June 30, 2021 and June 30, 2020 (in thousands)

Line						
No.		FY 2020	FY 2021	5	6 Change	% Change
	Assets					
	Current Assets					
1	Cash and Cash Equivalents \$	536,260	\$ 764,176	\$	227,916	42.5%
2	Short-Term Investments	53,334	32,509	\$	(20,825)	-39.0%
3	Investment of Cash Collateral	1,261	9,230		7,969	632.0%
4	Accounts Receivable, Net	356,737	374,523		17,786	5.0%
5	Pledges Receivable, Net	23,482	34,796		11,314	48.2%
6	Investment Settlements Receivable	400,674	218,197		(182,477)	-45.5%
7	Notes Receivable, Net	7,854	7,598		(256)	-3.3%
8	Due (To) From Component Unit	(9,415)	(8,915)		500	-5.3%
9	Inventories	37,721	43,946		6,225	16.5%
10	Prepaid Expenses and Other Current Assets	23,918	28,104		4,186	17.5%
11	Total Current Assets	1,431,826	1,504,164		72,338	5.1%
	Noncurrent Assets					
12	Pledges Receivable, Net	40,125	51,075		10,950	27.3%
13	Notes Receivable, Net	51,948	38,580		(13,368)	-25.7%
15	Other Assets	1,880	1,880		-	0.0%
14	Long-Term Investments	4,108,016	4,775,208		667,192	16.2%
16	Capital Assets, Net	3,540,387	3,593,675		53,288	1.5%
17	Total Noncurrent Assets	7,742,356	8,460,418		718,062	9.3%
18	Deferred Outflow of Resources	486,517	219,013		(267,504)	-55.0%
	Total Assets and Deferred					
19	Outflow of Resources \$	9,660,699	\$ 10,183,595	\$	522,896	5.4%
	Liabilities					
	Current Liabilities					
20	Accounts Payable	134,305	186,064	\$	51,759	38.5%
21	Accrued Liabilities	173,516	177,053		3,537	2.0%
22	Deferred Revenue Current	92,516	104,399		11,883	12.8%
23	Investment Settlements Payable	758,856	378,200		(380,656)	-50.2%
24	Collateral Held for Securities Lending	1,261	9,230		7,969	632.0%
25	Commercial Paper and Current Portion of Long-Term	13,583	12,421		(1,162)	-8.6%
26	Long-Term Debt Subject to Remarketing Agreements	78,755	74,820		(3,935)	-5.0%
27	Total Current Liabilities	1,252,792	942,187		(310,605)	-24.8%

University of Missouri System - for Discussion Only

Statement of Net Position

For the Year Ended June 30, 2021 and June 30, 2020 (in thousands)

Line						
No.		FY 2020	FY 2021	5	6 Change	% Change
	Liabilities, Continued					
	Noncurrent Liabilities					
28	Long-Term Debt	1,735,189	1,701,847		(33,342)	-1.9%
29	Deferred Revenue	14,445	13,967		(478)	-3.3%
30	Asset Retirement Obligation	62,433	62,433		-	0.0%
31	Derivative Instrument Liability	45,958	34,851		(11,107)	-24.2%
32	Other Postemployment Benefits Liability	367,614	213,817		(153,797)	-41.8%
33	Net Pension Liability	1,109,623	314,943		(794,680)	-71.6%
34	Other Noncurrent Liabilities	86,376	90,500		4,124	4.8%
35	Total Noncurrent Liabilities	3,421,638	2,432,358		(989,280)	-28.9%
36	Deferred Inflow of Resources	133,851	712,288		578,437	432.1%
	Total Liabilities and Deferred					<u> </u>
37	Inflow of Resources	\$ 4,808,281	\$ 4,086,833	\$	(721,448)	-15.0%
	Net Position					
38	Net Investment in Capital Assets	1,833,145	1,924,128		90,983	5.0%
	Restricted					
	Nonexpendable -					
39	Endowment	1,270,680	1,659,825		389,145	30.6%
	Expendable -					
40	Scholarship, Research, Instruction and Other	438,067	552,920		114,853	26.2%
41	Loans	79,000	76,084		(2,916)	-3.7%
42	Capital Projects	41,205	109,461		68,256	165.6%
43	Unrestricted	1,190,321	1,774,344		584,023	49.1%
44	Total Net Position	4,852,418	6,096,762		1,244,344	25.6%
	Total Liabilities, Deferred Inflow of					
45	Resources and Net Position	\$ 9,660,699	\$ 10,183,595	\$	522,896	5.4%

University of Missouri System - for Discussion Only

Simplified View Statement of Revenues, Expenses, and Changes in Net Position - non-GAAP For the Year Ending June 30, 2021 Compared to Year Ended June 30, 2020 (in thousands)

Line		Acutals		Original Budget	Acutals	
No.			FY 2020	<u>F</u> Y 2021		FY 2021
	Operating Revenues					
1	Tuition and Fees	\$	873,335	\$ 856,898	\$	883,315
2	Less Scholarship Allowances		353,141	356,142		374,649
3	Net Tuition and Fees		520,194	500,756		508,666
4	Federal Pell Grants		54,480	54,900		55,539
5	Government Scholarship Funding		29,038	27,792		28,321
6	CARES Act Funding		14,520	-		116,872
7	Grants and Contracts		323,688	325,184		343,587
8	Auxiliary Enterprises		374,961	394,891		411,510
9	Patient Medical Services Net		1,355,094	1,383,090		1,482,415
10	Other Operating Revenues		65,576	56,910		61,237
11	State Appropriations		364,412	419,574		419,690
12	Federal Appropriations		27,108	28,011		27,964
13	Private Gifts		71,003	53,223		83,933
14	Spendable Investment Income (Moody's)		210,100	214,986		223,586
15	Revenue Contingency		-	(81,580)		-
16	Total Operating Revenues		3,410,174	3,377,737		3,763,320
	Operating Expenses					
17	Salaries and Wages		1,588,345	1,518,239		1,565,023
18	Benefits		481,679	505,775		471,475
19	Supplies, Services and Other Operating Expenses		975,374	957,966		1,009,810
20	Depreciation		207,216	203,277		214,252
21	Interest Expense		63,282	73,953		68,972
22	Expense Contingency		-	(53,246)		-
23	Total Operating Expenses		3,315,896	3,205,964		3,329,532
24	Net Operating Income		94,278	171,773		433,788
25	Net Operating Margin		2.8%	5.1%		11.5%
	Nonoperating Revenues (Expenses)					
26	Investment Income (Losses), Net of Fees		31,857	166,882		764,308
27	Spendable Investment Income (Moody's)		(210,100)	(214,986)	1	(223,586)
28	Other Nonoperating Revenues (Expenses)		31,409	(520)	1	25,974
29	State Capital Appropriations		-	-		-
30	Capital Gifts and Grants		40,648	59,703		67,825
31	Private Gifts for Endowment Purposes		45,916	5,689		61,029
32	Pension and OPEB Impact on Income Statement		(104,906)	(80,000)	1	115,006
33	Mandatory Transfers		-	-		-
34	Non-Mandatory Transfers		-	(155)	1	-
35	Net Nonoperating Revenues (Expenses)		(165,176)	(63,387)	1	810,556
36	Increase in Net Position		(70,898)	108,386		1,244,344
37	Net Position, Beginning of Year		4,890,236	4,852,418		4,852,418
38	Cumulative Effect of Change in Accounting Principle		33,080	-		-
39	Net Position, Beginning of Year, Adjusted		4,923,316	4,852,418		4,852,418
40	Net Position, End of Period	\$	4,852,418	\$ 4,960,804	\$	6,096,762

For the Year Ending June 30, 2021 Compared to Year Ended June 30, 2020 (in thousands) Line Acutals **Original Budget** Acutals No. FY 2020 FY 2021 FY 2021 **Operating Revenues** \$ 432.603 \$ 427,521 \$ 449,414 1 Tuition and Fees 184,088 2 Less Scholarship Allowances 187,838 200,455 3 Net Tuition and Fees 248,515 239,683 248,959 4 Federal Pell Grants 22.520 22.000 23.794 5 15,963 Government Scholarship Funding 14,894 14,122 6 CARES Act Funding 7.711 57.044 7 219,499 Grants and Contracts 215,100 230,748 8 Auxiliary Enterprises 258,060 269,708 296,614 9 Patient Medical Services Net 256,272 269,641 262,166 10 Other Operating Revenues 39,309 32,758 32,254 11 State Appropriations 188,295 217,849 219,719 12 Federal Appropriations 17,237 18,075 18,256 13 Private Gifts 37.864 22.696 37.238 14 Spendable Investment Income (Moody's) 94,453 93,305 96,637 15 Revenue Contingency (50, 238)16 **Total Operating Revenues** 1,404,629 1,357,405 1,546,685 **Operating Expenses** 17 Salaries and Wages 814,562 770,497 801,930 18 Benefits 226,984 242,425 232,867 19 Supplies, Services and Other Operating Expenses 261,487 230,766 252,351 20 Depreciation 88,849 86,414 93,077 21 Interest Expense 29,582 32,841 36,687 22 Expense Contingency (45, 626)23 1,421,464 1,317,317 1,416,912 **Total Operating Expenses** 24 129,773 **Net Operating Income** (16, 835)40,088 25 **Net Operating Margin** -1.2% 3.0% 8.4% **Nonoperating Revenues (Expenses)** 90.043 26 Investment Income (Losses), Net of Fees 20.366 313.566 27 Spendable Investment Income (Moody's) (94, 453)(93, 305)(96,637) 28 Other Nonoperating Revenues (Expenses) 12,529 6 2,273 29 State Capital Appropriations 30 14,304 14,907 28.941 Capital Gifts and Grants 31 Private Gifts for Endowment Purposes 39,237 133 43,072 32 86 Mandatory Transfers (4, 677)33 Non-Mandatory Transfers 56,938 28,533 16,402 307,702 34 **Net Nonoperating Revenues (Expenses)** 44,244 40,317 35 **Increase in Net Position** 27,409 80.405 437,476 2,932,281 2,970,602 2,970,602 36 Net Position, Beginning of Year

University of Missouri System - Columbia - for Discussion Only Simplified View Statement of Revenues, Expenses, and Changes in Net Position - non-GAAP For the Year Ending June 30, 2021 Compared to Year Ended June 30, 2020 (in thousands)

\$

10,912

\$

2,943,193

2,970,602

2,970,602

3,051,007

S

37

38

39

Cumulative Effect of Change in Accounting Principle

Net Position, Beginning of Year, Adjusted

Net Position, End of Period

0

2,970,602

3,408,078

ne).			Acutals FY 2020	Original Budget FY 2021		Acutals FY 2021	
	Operating Revenues						
	Tuition and Fees	\$	-	\$ -	\$	-	
	Less Scholarship Allowances		-	-		-	
	Net Tuition and Fees		-	-		-	
	Federal Pell Grants		-	-		-	
	Government Scholarship Funding		-	-		-	
	Grants and Contracts		137	89		124	
	Auxiliary Enterprises		23,255	23,906		22,750	
	Patient Medical Services Net		1,060,215	1,080,865		1,174,494	
	Other Operating Revenues		2	30		(21)	
	State Appropriations		-	-		-	
	Federal Appropriations		-	-		-	
	Private Gifts		1,564	1,318		1,152	
	Spendable Investment Income (Moody's)		-	-		-	
	Total Operating Revenues		1,085,173	1,106,208		1,198,499	
	Operating Expenses						
	Salaries and Wages		333,810	331,490		347,591	
	Benefits		110,721	117,856		116,641	
	Supplies, Services and Other Operating Expenses		525,676	533,466		588,862	
	Depreciation		48,164	52,049		53,668	
	Interest Expense		11,190	11,074		10,782	
	Total Operating Expenses		1,029,560	1,045,935		1,117,544	
	Net Operating Income		55,613	60,273		80,956	
	Net Operating Margin		5.1%	5.4%		6.8%	
	Nonoperating Revenues (Expenses)						
	Investment Income (Losses), Net of Fees		(6,412)	1,715		37,399	
	Spendable Investment Income (Moody's)		-	-		-	
	Other Nonoperating Revenues (Expenses)		19,153	(228)		22,068	
	State Capital Appropriations		-	-		-	
	Capital Gifts and Grants		3,845	-		4,519	
	Private Gifts for Endowment Purposes		42	-		11	
	Mandatory Transfers		-	-		(0)	
	Non-Mandatory Transfers		(28,229)	(18,328)		(24,199)	
	Net Nonoperating Revenues (Expenses)		(11,600)	(16,841)		39,798	
	Increase in Net Position		44,012	43,432		120,754	
	Net Position, Beginning of Year		850,808	894,820		894,820	
	Cumulative Effect of Change in Accounting Principle		-	-		-	
	Net Position, Beginning of Year, Adjusted		850,808	894,820		894,820	
	Net Position, End of Period	\$	894,820	\$ 938,252	\$	1.015.574	

University of Missouri System - Hospital - for Discussion Only Simplified View Statement of Revenues, Expenses, and Changes in Net Position - non-GAAP For the Year Ending June 30, 2021 Compared to Year Ended June 30, 2020 (in thousands)

Note: Income Statement presentation is based on the current Moody's Higher Education metholodology which includes interest expense as part of operating expenses. Numbers presented to Health Affairs show interest expense as non-operating.

Line No.		Acutals FY 2020	0	riginal Budget FY 2021	Acutals FY 2021
	Operating Revenues				
1	Tuition and Fees	\$ 196,383	\$	191,832 \$	195,267
2	Less Scholarship Allowances	61,230		62,539	61,676
3	Net Tuition and Fees	135,153		129,293	133,591
4	Federal Pell Grants	12,949		13,600	12,996
5	Government Scholarship Funding	4,061		4,000	3,917
6	CARES Act Funding	2,948		-	24,299
7	Grants and Contracts	41,597		44,143	48,278
8	Auxiliary Enterprises	36,342		40,643	33,664
9	Patient Medical Services Net	38,567		40,008	38,261
10	Other Operating Revenues	13,472		13,949	16,567
11	State Appropriations	64,058		73,852	74,060
12	Federal Appropriations	-		-	-
13	Private Gifts	17,318		11,180	27,074
14	Spendable Investment Income (Moody's)	13,537		13,190	13,720
15	Revenue Contingency	-		(15,500)	-
16	Total Operating Revenues	380,002		368,358	426,428
	Operating Expenses				
17	Salaries and Wages	194,985		181,837	187,093
18	Benefits	57,123		58,936	57,400
19	Supplies, Services and Other Operating Expenses	97,420		97,436	81,344
20	Depreciation	24,597		24,560	23,887
21	Interest Expense	8,611		9,000	7,616
22	Expense Contingency			(3,470)	
23	Total Operating Expenses	382,736		368,299	357,339
24	Net Operating Income	(2,734)		59	69,088
25	Net Operating Margin	-0.7%		0.0%	16.2%
	Nonoperating Revenues (Expenses)				
26	Investment Income (Losses), Net of Fees	7,228		12,304	53,705
27	Spendable Investment Income (Moody's)	(13,537)		(13,190)	(13,720)
28	Other Nonoperating Revenues (Expenses)	22,552		-	2,179
29	State Capital Appropriations	-		-	-
30	Capital Gifts and Grants	12,784		24,606	18,191
31	Private Gifts for Endowment Purposes	471		800	441
32	Mandatory Transfers	39		-	25
33	Non-Mandatory Transfers	6,863		5	1,542
34	Net Nonoperating Revenues (Expenses)	36,400		24,525	62,364
35	Increase in Net Position	33,666		24,584	131,452
36	Net Position, Beginning of Year	447,115		501,858	501,858
37	Cumulative Effect of Change in Accounting Principle	21,077		-	-
38	Net Position, Beginning of Year, Adjusted	468,192		501,858	501,858
39	Net Position, End of Period	\$ 501,858	\$	526,442 \$	633,310

University of Missouri System - Kansas City - for Discussion Only Simplified View Statement of Revenues, Expenses, and Changes in Net Position - non-GAAP For the Year Ending June 30, 2021 Compared to Year Ended June 30, 2020 (in thousands)

University of Missouri System - Missouri S&T - for Discussion Only Simplified View Statement of Revenues, Expenses, and Changes in Net Position - non-GAAP For the Year Ending June 30, 2021 Compared to Year Ended June 30, 2020 (in thousands)

Line		Acutals	Original Budget	Acutals
No.		FY 2020	FY 2021	FY 2021
	Operating Revenues			
1	Tuition and Fees	\$ 128,227	\$ 121,550	\$ 119,678
2	Less Scholarship Allowances	62,086	61,563	61,046
3	Net Tuition and Fees	66,141	59,987	58,632
4	Federal Pell Grants	6,412	6,800	6,032
5	Government Scholarship Funding	6,127	6,000	4,865
6	CARES Act Funding	1,960	-	15,809
7	Grants and Contracts	34,824	36,102	37,656
8	Auxiliary Enterprises	19,982	19,727	21,094
9	Patient Medical Services Net	-	-	-
10	Other Operating Revenues	4,216	4,389	3,611
11	State Appropriations	43,543	50,234	50,375
12	Federal Appropriations	-	-	-
13	Private Gifts	3,398	6,610	6,815
14	Spendable Investment Income (Moody's)	15,559	15,635	15,503
15	Revenue Contingency	-	(7,612)	-
16	Total Operating Revenues	202,162	197,872	220,391
	Operating Expenses			
17	Salaries and Wages	102,582	100,770	95,663
18	Benefits	30,385	32,360	29,368
19	Supplies, Services and Other Operating Expenses	44,245	37,936	44,193
20	Depreciation	18,970	17,660	19,789
21	Interest Expense	5,067	5,150	5,072
22	Total Operating Expenses	201,249	193,876	194,085
23	Net Operating Income	913	3,996	26,306
24	Net Operating Margin	0.5%	2.0%	11.9%
	Nonoperating Revenues (Expenses)			
25	Investment Income (Losses), Net of Fees	3,637	7,274	52,741
26	Spendable Investment Income (Moody's)	(15,559)	(15,635)	(15,503)
27	Other Nonoperating Revenues (Expenses)	1,664	-	9,069
28	State Capital Appropriations	-	-	-
29	Capital Gifts and Grants	6,009	20,190	10,805
30	Private Gifts for Endowment Purposes	4,118	3,255	13,255
31	Mandatory Transfers	10	-	27,616
32	Non-Mandatory Transfers	4,491	116	(1,816)
33	Net Nonoperating Revenues (Expenses)	4,369	15,200	96,166
34	Increase in Net Position	5,283	19,196	122,472
35	Net Position, Beginning of Year	520,946	526,586	526,586
36	Cumulative Effect of Change in Accounting Principle	357	-	-
37	Net Position, Beginning of Year, Adjusted	 521,303	526,586	526,586
38	Net Position, End of Period	\$ 526,586	\$ 545,782	\$ 649,058

University of Missouri System - St. Louis - for Discussion Only Simplified View Statement of Revenues, Expenses, and Changes in Net Position non-GAAP For the Year Ending June 30, 2021 Compared to Year Ended June 30, 2020 (in thousands)

Line		Acutals	Original Budget	Acutals
No.		FY 2020	FY 2021	FY 2021
	Operating Revenues			
1	Tuition and Fees	\$ 116,122	\$ 115,995 \$	\$ 118,956
2	Less Scholarship Allowances	45,552	44,098	51,269
3	Net Tuition and Fees	70,570	71,897	67,687
1	Endered Dell Create	12 509	12 500	12 716
4	Covernment Scholershin Funding	12,398	12,500	12,710
5	CARES Act Euroding	5,950	5,070	5,575 19 925
0	CARES Act Funding	1,901	- 20.750	10,033
/ 0	Auxiliant Entermises	27,119	29,730	20,070
0	Auximary Enterprises	15,175	10,107	13,400
9	Other Orenting Beverves	40	2 804	2 124
10	State Appropriations	2,100	2,804	2,124
11	State Appropriations	48,430	55,914	55,940
12	Private Cife	-	-	-
13	Private Gills	10,749	11,304	11,428
14	B eventue Contingenery	9,577	9,078	9,813
15	Tatal On anating Payanuag	-	(7,221)	-
10	Operating Expanses	202,287	200,554	222,213
17	Seleries and Wages	107 966	102 205	07.852
10	Salaries and wages	22 811	102,203	97,032
10	Benefits	33,011	34,170	32,238
19	Supplies, Services and Other Operating Expenses	47,879	40,712	40,384
20	Interest Expanse	5 776	1/,41/	5 557
21	European Contingener	5,770	(2,525)	5,557
22	Total Operating Expanses	212 221	(5,525)	100 0/8
23 24	Not Operating Income	(11.044)	3 998	22 265
24		(11,044)	5,776	22,205
25	Net Operating Margin	-5.5%	1.9%	10.0%
	Nonoperating Revenues (Expenses)			
26	Investment Income (Losses), Net of Fees	3,512	6,482	27,080
27	Spendable Investment Income (Moody's)	(9,577)	(9,678)	(9,813)
28	Other Nonoperating Revenues (Expenses)	72	(200)	(70)
29	State Capital Appropriations	-	-	-
30	Capital Gifts and Grants	1,501	-	348
31	Private Gifts for Endowment Purposes	2,048	1,500	4,248
32	Mandatory Transfers	(94)	-	(1,888)
33	Non-Mandatory Transfers	1,563	237	1,286
34	Net Nonoperating Revenues (Expenses)	(975)	(1,659)	21,191
35	Increase in Net Position	(12,019)	2,339	43,455
36	Net Position, Beginning of Year	368,364	356,526	356,526
37	Cumulative Effect of Change in Accounting Principle	181	-	-
38	Net Position, Beginning of Year, Adjusted	 368,545	356,526	356,526
39	Net Position, End of Period	\$ 356,526	\$ 358,865 \$	\$ 399,982

University of Missouri System - System Administration - for Discussion Only Simplified View Statement of Revenues, Expenses, and Changes in Net Position - non-GAAP For the Year Ending June 30, 2021 Compared to Year Ended June 30, 2020 (in thousands)

ie).		Acutals FY 2020	Original Budget FY 2021		Acutals FY 2021	
	Operating Revenues					
	Tuition and Fees	\$ -	\$ -	\$	-	
	Less Scholarship Allowances	156	71		168	
	Net Tuition and Fees	(156)	(71)	(168)	
	Federal Pell Grants	-	-		-	
	Government Scholarship Funding	-	-		-	
	CARES Act Funding	-	-		885	
	Grants and Contracts	512	-		106	
	Auxiliary Enterprises	22,148	22,720		23,989	
	Patient Medical Services Net	-	-		-	
	Other Operating Revenues	5,887	3,431		4,244	
	State Appropriations	10,612	12,258		10,130	
	Federal Appropriations	-	-		-	
	Private Gifts	109	113		223	
	Spendable Investment Income (Moody's)	21,800	21,905		22,931	
	Revenue Contingency	-	(1,009)	-	
	Total Operating Revenues	60,912	59,347		62,339	
	Operating Expenses					
	Salaries and Wages	34,617	31,440		33,173	
	Benefits	11,336	10,852		11,270	
	Supplies, Services and Other Operating Expenses	12,808	14,305		8,788	
	Depreciation	3,871	2,765		3,503	
	Interest Expense	-	-		-	
	Expense Contingency	-	(625)	-	
	Total Operating Expenses	62,631	58,737		56,735	
	Net Operating Income	(1,720)	610		5,604	
	Net Operating Margin	-2.8%	1.0%		9.0%	
	Nonoperating Revenues (Expenses)					
	Investment Income (Losses), Net of Fees	14,738	25,604		45,053	
	Spendable Investment Income (Moody's)	(21,800)	(21,905)	(22,931)	
	Other Nonoperating Revenues (Expenses)	(31)	2		(1)	
	State Capital Appropriations	-	-		-	
	Capital Gifts and Grants	-	-		-	
	Private Gifts for Endowment Purposes	-	-		-	
	Mandatory Transfers	-	-		-	
	Non-Mandatory Transfers	(38,348)	(718)	(1,586)	
	Net Nonoperating Revenues (Expenses)	(45,441)	2,983		20,534	
	Increase in Net Position	(47,161)	3,593		26,138	
	Net Position, Beginning of Year	253,143	206,615		206,615	
	Cumulative Effect of Change in Accounting Principle	633	-		-	
	Net Position, Beginning of Year, Adjusted	253,776	206,615		206,615	
	Net Position, End of Period	\$ 206,615	\$ 210,208	\$	232,754	

University of Missouri University-wide - for Discussion Only Simplified View Statement of Revenues, Expenses, and Changes in Net Position - non-GAAP For the Year Ending June 30, 2021 Compared to Year Ended June 30, 2020 (in thousands)

Line No.		Acutals Original Budget FY 2020 FY 2021		Acutals FY 2021	
	Operating Revenues				
1	Tuition and Fees	\$ - \$	- \$	-	
2	Less Scholarship Allowances	29	33	36	
3	Net Tuition and Fees	(29)	(33)	(36)	
4	Fodoral Poll Granta				
4	Covernment Scholershin Funding	-	-	-	
5	Greate and Contracts	-	-	-	
07	Auviliant Enterprises	-	-	-	
/ 0	Auxiliary Enterprises	-	-	(0)	
0	Other Operating Poverves	-	- (451)	- 2 450	
9	State Appropriations	0.467	(451)	2,439	
10	Federal Appropriations	9,407	9,407	9,407	
11	Privata Cifta	9,071	9,755	9,009	
12	Private Grits	2 55 172	41 272	5	
13	Total Operating Bevenues	55,175 75,007	90.013	04,965 96 765	
14	Operating Expanses	/5,00/	80,015	80,705	
15	Selections and Wages	(77)		1 720	
15	Salaries and wages	(77)	-	(8,200)	
10		(14,990)	9,176	(8,309)	
1/	Supplies, Services and Other Operating Expenses	(14,880)	(4,655)	(11,410)	
18	Depreciation	4,766	2,412	2,412	
19	Interest Expense	3,056	10,331	3,258	
20	Total Operating Expenses	4,186	17,264	(12,329)	
21	Net Operating Income	70,822	62,749	99,094	
22	Net Operating Margin	94.4%	78.4%	114.2%	
	Nonoperating Revenues (Expenses)				
23	Investment Income (Losses), Net of Fees	(11,213)	23,460	234,764	
24	Spendable Investment Income (Moody's)	(55,173)	(61,273)	(64,983)	
25	Other Nonoperating Revenues (Expenses)	(24,529)	(100)	(9,543)	
26	State Capital Appropriations	-	-	-	
27	Capital Gifts and Grants	2,205	-	5,020	
28	Private Gifts for Endowment Purposes	1	1	3	
29	Pension and OPEB Impact on Income Statement	(104,906)	(80,000)	115,006	
30	Mandatory Transfers	4,722	-	(25,838)	
31	Non-Mandatory Transfers	(8,669)	(10,000)	9,073	
32	Net Nonoperating Revenues (Expenses)	(197,562)	(127,912)	263,502	
33	Increase in Net Position	(126,741)	(65,163)	362,596	
34	Net Position, Beginning of Year	(482,418)	(609,238)	(609,238)	
35	Cumulative Effect of Change in Accounting Principle	(79)	-	-	
36	Net Position, Beginning of Year, Adjusted	(482,497)	(609,238)	(609,238)	
37	Net Position, End of Period	\$ (609,238) \$	(674,401) \$	(246,643)	

Master Plan 2021 Campus Master Plan Update UMSL

The University of Missouri-St. Louis requests approval of the 2021 Campus Master Plan Update.

In accordance with the University of Missouri Collected Rules and Regulations 70.060, each campus is required to bring updated Campus Master Plans for approval to the Board of Curators every three years or when significant changes are proposed. The 2021 Campus Master Plan Update builds upon planning from the 2018, 2013, 2009, 2006 and 2002 Master Plans and integrates the 2018-2023 Strategic Plan goals into a unified framework to guide the future growth and development of the campus within the context of UMSL's Vision and Mission.

Vision:

The University of Missouri–St. Louis will be a beacon of hope, a force for good, and a leader in the pursuit of excellence in education, impactful research and community service. We boldly assert that education is for everyone who is willing and able to seek it out. We honor the duties inherent in our land-grant beginnings by positioning ourselves as partners in the search for knowledge, progress and positive change for ourselves, our communities, our world.

Mission:

We transform lives.

The Campus Master Plan document identifies the principles that have guided the master planning process and support the above vision and mission.

2021 Major Changes to the Previous Master Plan Update:

- Consolidate 230,000 gross square feet of space on north and south campus to right-size campus footprint.
- Consolidation will organize north and south campus into regions: Academics, Athletics, Arts, Health Science, while opening up land for a Public-Private-Partnership that will be a community-centered, Transit Oriented Development (TOD) located near the south MetroLink station.
- Gateway entrances will be added at all entrances to identify UMSL campus with wayfinding signage.
- Eliminate new construction on north and south campus (including College of Business Phase 2).

November 18, 2021

No. 1

Recommended Action - 2021 Campus Master Plan, UMSL

It was recommended by Chancellor Sobolik, endorsed by President Choi, recommended by the Finance Committee, moved by Curator ______ and seconded by Curator ______, that the following action be approved:

that the 2021 University of Missouri - St. Louis Campus Master Plan be approved.

Roll call vote Finance Committee	YES	NO
Curator Graves		
Curator Hoberock		
Curator Layman		
The motion		
Roll call vote Full Board:	YES	NO
Curator Brncic		
Curator Chatman		
Curator Graham		
Curator Graves		
Curator Hoberock		
Curator Holloway		
Curator Layman		
Curator Wenneker		
Curator Williams		
The motion		

Fiscal Year 2023 Student Housing and Dining Rates UM

At the November 18, 2021 Board of Curators meeting, Executive Vice President Ryan Rapp will present the FY2023 Housing and Dining rate recommendations for approval. Recommendations for residence halls and family student housing for FY 2023 are summarized within the pages that follow. The rates would become effective for the Summer Session 2022.

Many housing and dining opportunities are available to University of Missouri System students. On-campus living has been provided on our campuses for many years and continues to provide these valuable benefits:

- Improves student academic success
- Increases the likelihood of continuance and graduation
- Builds a sense of connection to other students from living in a community
- Provides better security and safety from campus police and security measures.

Room and board charges vary across the four universities. The table below shows current and recommended rates for the predominant room and board plan on each university. The rates are driven by various factors that impact housing and dining and university operations such as debt service, future investments, food, labor, utility costs, and contractual arrangements with third-party vendors. The rates were set to achieve a balance between maintaining financial sustainability of the housing and dining auxiliary and affordability for students.

			Increase/	Percent
	FY 2022	FY 2023	Decrease	Change
				< 00 /
MU	\$ 9,915	\$10,509	\$594	6.0%
UMKC	11,004	11,248	244	2.2%
Missouri S&T	10,570	10,920	350	3.3%
UMSL	10,606	10,919	313	3.0%

Summary of Predominant Room and Board Plans for an Academic Year

Recommended Action - Fiscal Year 2023 Student Housing and Dining Rates, UM

It was recommended by the respective Chancellors, endorsed by President Choi, recommended by the Finance Committee, moved by Curator ______ and seconded by Curator ______, that the attached schedule of rates for the Residence Halls and Family Student Housing at MU, UMKC, Missouri S&T, and UMSL be approved effective beginning with the 2022 Summer Session.

Roll call vote Finance Committee	YES	NO
Curator Graves		
Curator Hoberock		
Curator Layman		
The motion		
Roll call vote Full Board:	YES	NO
Curator Brncic		
Curator Chatman		
Curator Graham		
Curator Graves		
Curator Hoberock		
Curator Holloway		
Curator Layman		
Curator Wenneker		
Curator Williams		
The motion		

Fiscal Year 2023 Student Housing and Dining Rates UM

Attached are rate recommendations for residence halls (housing and dining) and family student housing for FY 2023. The rates would become effective Summer Session 2022. These recommendations are being presented for approval.

Fee recommendations were prepared by each university. Planning for fee changes is conducted using operating assumptions unique to each university and activity, and the financial performance of Residential Life must be supported by the financial position of the individual university. Rates seek to balance affordability of housing and dining for students with the financial and capital commitments necessary to maintain the housing and dining facilities in a competitive market environment.

Figure 1 below presents the predominant room and board rates since FY 2018 for each university. MU dropped rates in FY 2019 then proceeded to hold rates flat until FY 2022. This was part of an intentional strategy to recover enrollment with lower housing costs. As enrollment and occupancy has now recovered to a more sustainable level, MU is looking to reset pricing to match the financial needs of the housing auxiliary. MU's proposed rate for FY 2023 is 4% higher than FY 2018, but still well below the inflationary increase from September 2017 to September 2021 of 11%. The other three universities are proposing increases at or below inflation.



Figure 1: Predominant Room and Board Rates by University

November 18, 2021

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Housing and Dining Financial Statements

Each university provides an income statement with the rate submission to show the impact of the rates on the financial performance of housing and dining; those income statements are included in pages 12 to 15. Each University reviews the financial statements together with the rate schedules as a part of the rate setting process. The housing and dining auxiliaries remain an integral part of each campus, and their financial results contribute to each university's overall financial performance.

			Missouri		
Projected FY 2023	MU	UMKC	S&T	UMSL	Total
Total Operating Revenues	\$83	\$11	\$19	\$6	\$25
Total Operating Revenues	million	million	million	million	million
Total Dalt Octation line	\$263	\$69	\$64	\$14	\$410
Total Debt Outstanding	million	million	million	million	million
% of Total University	260/	2004	500/	1/10/	240/
Debt	50%	39%	3870	1470	2470
Debt Service Coverage	1.34	0.83	1.17	1.03	

Table 1: FY 2023 Projected Financial Indicators

Note: UMKC's Debt Service Coverage includes debt service payments for Oak Place Apartments funded by general revenue sources.

Rates set for room and board are intended to support day to day operations, fund annual debt service, and contribute to building a reserve to fund maintenance needs as the residential facilities age. The housing auxiliaries should maintain sufficient margins to fund debt service (minimum of 1.0 on the above table). Earnings above debt service are generally maintained by the housing auxiliary to fund future investment and capital maintenance needs. Capital investment or reserves are imperative to adequately maintain the residential buildings through their expected lives. MU and Missouri S&T have planned for these investments and have historically made these investments. UMKC and UMSL have historically had thinner debt service coverage, many times below the floor of 1.0, and have not been able to build a capital reserve. Maintaining and building adequate reserve balances will be integrated in with the financial plans presented to the Board in February.

It is important note the total outstanding debt referenced above does not include any debt associated with operating leases or public private partnerships. If any of the universities entered into lease agreements spanning over a fiscal year or public private partnerships the total debt outstanding would increase over the projected amount referenced in Table 1. Operating leases are included as an operating expense on the income statements included on the subsequent pages.

<u>University of Missouri (MU)</u>

The recommended predominant room and board plan will cost \$10,509 per academic year for FY 2023 and consists of the traditional double room and the Tiger Plan Plus dining plan which offers dining anywhere on campus with an average of 12 meals per week.

November 18, 2021

$$OPEN - FIN - 2-4$$

Housing rates for FY 2023 in university owned housing range from a high of \$10,920 per academic year for a single suite open over breaks to a low of \$6,500 for a traditional double room in Hatch Hall. In setting rates, MU segmented housing inventory into three different groups by demand profile: low-cost, mid-range, and premium housing options and structured pricing accordingly.

per academic year	FY 2022 Rate	FY 2023 Rate	Increase \$	Increase %
Mid-range traditional double room	\$6,710	\$7,145	\$435	6.5%
Premium traditional double room	\$7,445	\$7,920	\$475	6.4%
Single room, suites and high-demand halls	Low: \$9,240 High: \$10,275	Low: \$9,825 High: \$10,920	\$585- \$645	6.3%
Predominant Room – weighted average cost	\$6,876	\$7,319	\$443	6%

Housing rates for off-campus housing units range from \$11,030 to \$11,240 per academic year for a single suite in a premium apartment. In case there is a need to lease additional space late in the spring due to higher-than-expected enrollment, MU will set a rate for the leased space within the recommended range above. MU will price rooms based on the terms of the lease and available amenities.

MU is proposing a 6% housing rate increase. This increase reflects a combination of inflationary increases in costs and the need to move rates back towards the historical trend and market prices. MU has benchmarked against off-campus housing options and believes these rates are comparable to off-campus housing options – particularly those in close proximity to campus. With enrollment increases, MU has seen a return to occupancy levels exceeding 90% and expects this to continue even with the rate increases.

While developing the pricing strategy for FY 2023 MU focused on three overarching goals:

- Providing safe, attractive, and well-maintained housing facilities
- Maintaining low-cost options for students who desire those options
- Providing long term financial stability through adequate funding of maintenance.

The benefits of living on campus are proven across the nation and MU's data, which shows that students who live in MU's residence halls are more likely to stay enrolled and graduate in four years than their peers who do not.

As housing and dining operations account for 36% of MU's outstanding debt portfolio, it is imperative for the institution to continue to maintain the underlying assets leveraged by this debt. Levels of spending over the last four years were not adequate to maintain the

buildings in the current state and maximize their useful life. The rate declines to gain enrollment were never meant to be permanent, and this increase is a step towards restoring the cash flow necessary to maintain the buildings.

Due to the increase in enrollment, MU has a three-year master lease (FY 2021-FY 2023) with an off-campus property. At this time, it is not anticipated that the lease will be extended beyond this term. MU anticipates being able to meet housing demand utilizing MU owned properties beyond the lease term. Any short term need for additional beds would be managed through reducing the number of returning students living on campus or through short term leases with off-campus housing providers.

Dining plans will continue to offer flexibility and include low-cost options. Student can choose from three plans ranging from \$3,670 to a low of \$1,780 for a flexible dining plan option that works at all locations (including the Student Center). Students have options on the dining plan that include traditional all you care to eat locations and many a la carte residential and retail choices with hours ranging from 7:00 a.m. - 11:00 p.m. The dining plan anticipated to be selected most by students next year will be \$3,190, a flexible dining option, which is \$151, or 5% more expensive than the current year.

MU recognizes the cost to students and their families when student have to move out for breaks, Residential Life will continue to remain open for fall, winter and spring breaks. In addition, the popular "365 housing" option will continue for students who need housing year-round. Currently, many students are without housing the second half of May and first half of August, when apartment complexes are turning rooms over. Returning students who select 365 housing will be able to either stay in their room or move into a new room in May without any break in housing.

University of Missouri Kansas City (UMKC)

The predominant room and board plan at UMKC for FY 2023 will cost \$11,248 per year, an increase of \$244 or 2.2%. The major components of the predominant room and board include a double room at Johnson Hall or Oak Street Hall, and a 180-meal plan block. UMKC students have four University-owned housing options available to them: Oak Street Hall, Johnson Hall, Hospital Hill Apartments and Rockhill Apartments.

The Residence Halls and UMKC Homes housing rates have a proposed increase of 1% from FY 2022 rates. Based on the proposed FY 2023 rates, UMKC housing operation will breakeven and support required maintenance in existing space. Emerging from the pandemic has tested UMKC's housing system, with lower-than-expected occupancy rates. The original FY 2022 housing budget included an overall occupancy rate of 84%, but the current occupancy rate is 79%. The FY 2023 plan is based on an 87% occupancy. This occupancy assumption requires growth in enrollment at UMKC. Residential Life management is working to improve financial performance by increasing occupancy, while also balancing affordability with the financial viability of the housing function.
The Hospital Hill Apartments have a proposed increase of 2%. Upper-classmen, transfers, and graduate/professional students are the typical residents of Hospital Hill Apartments. The rate increase proposed for Hospital Hill apartments reflects the need to cover operational costs of the facility, the amenities offered, and the current demand for the housing stock which is 244 beds at 67% occupancy.

Dining rates are proposed to increase by 4.7% to cover increases in the cost of plans provided by the contracted dining services provider. The current third-party vendor also considers the consumer price index for "food away from home" which is approximately 4.7% percent higher than the prior year. The rate increases match the cost of delivery for the dining plan offered by the vendor.

UMKC is challenged by the negative perception of its residential life related to the issues stemming from the failure of Oak Place Apartments. The facility was demolished in the summer of 2020, in FY 2020 the campus utilized insurance proceeds to pay off a portion of the outstanding debt. The remaining debt of \$21 million was restructured for UMKC in FY 2020 as an interest only loan with a balloon payment due in FY 2025. Oak Place's bad debt remains a burden for the university and UMKC is assuming this responsibility without attempting to recover any of the underlying debt with current housing rates. Residential life is projecting a 1.04 debt service coverage ratio in FY 2023 when excluding the Oak Place debt service payments being covered by general revenue sources. The campus support for this uncollateralized debt is included as an information item on the income statement on page 13.

University of Missouri Science & Technology (Missouri S&T)

The predominant room and board plan at Missouri S&T for FY 2023 will cost \$10,920 per academic year and consists of a renovated double room and 225 meals plus \$150 declining balance per semester. The increase in the predominant room and board plan at Missouri S&T is 3.3% or \$350 for the academic year.

The recommended rates are a balance between meeting the financial needs of the housing auxiliary and affordability for students. The rates were set with the objective of making minimal increases to rooms with the least demand and greater increases for rooms in more desirable halls. Room rates range from a high of \$9,790 per academic year (a 2% increase from prior year) for a single bedroom/apartment style room in University Commons, which is the newest facility, to \$5,500 per academic year (flat from prior year) for a double basement room in Farrar Hall, which is the oldest residence hall.

Missouri S&T has five different meal plans available ranging from a high of \$4,030 for all access in Thomas Jefferson plus \$100 declining balance per year to a low of a \$2,080 declining balance per year. Missouri S&T is requesting an average 4.8% increase across the five options ranging from 4.5% to 5.0%, this decision was based on contracted obligations from the third-party provider and demand for the meals plans offered.

Missouri S&T is projecting a continued growth in freshman enrollment which will continue slowly increasing this occupancy rate. For FY 2023 Missouri S&T anticipates an 85.1% occupancy rate. The majority of the resident students are either first year or second year students, so these increases primarily reflect the anticipated growth in freshman classes for FY 2023 and FY 2024.

The student housing facilities operated by the university have either been constructed or renovated since 2005 and while contributions have been regularly made to the residence halls capital reserves, no major facility work is anticipated to be needed for these structures for at least the next 5 years. With the projected increases in enrollment, there is sufficient capacity to accommodate the projected demand for student housing through FY 2026.

Missouri S&T has sustained spending levels that have adequately maintained the residential buildings through their expected lives. With uncertainty surrounding the pandemic most major non-essential facilities projects were delayed and capital contributions were reduced in FY 2020 and 2021 to preserve cash.

Going forward, the financial outlook for residential facilities is improving. The freshman classes sizes are beginning to increase with continued growth being projected. Also, the financial challenges resulting from the pandemic will have subsided, allowing spending on facility maintenance to resume.

University of Missouri St. Louis (UMSL)

The predominant room and board plan at UMSL for FY 2023 will cost \$10,919 per academic year. The predominant plan consists of a single room in Oak Hall and a 100-block meal plan plus \$350 declining balance dollars per semester. The increase in the predominant room and board plan at UMSL is 3.0% or \$313 for the academic year.

UMSL strives to maintain affordability for students, 42.5% of the current residential population are Pell eligible students which depend on their education, campus experiences and housing to be financially accessible. To maintain affordable housing rates for students, UMSL has proposed to increase housing rates by 2%.

UMSL's meal plans are contracted with a third-party food service provider which will necessitate an annual increase to account for food at home cost changes each year. Four meal plans are offered and range from a low of \$3,924 per academic year for a 100-meal block with a \$350 declining balance per semester to a high of \$4,531 for a 200-meal block with a \$150 declining balance per semester. The increases in FY 2022 of 3.5% and FY 2023 of 4.7% are a result of the pandemic and related inflationary factors driving vendor costs upward. The University is entering a comprehensive campus dining RFP process in Fall 2021/Spring 2022 which will allow UMSL to ensure board plans remain market competitive in subsequent fiscal years.

Occupancy in Mansion Hill apartments is at its highest rate ever, 97% which is a result of additional student athletes in residence and increased student interest in apartment living. November 18, 2021

OPEN-FIN-2-8

Apartment unit interest is projected to remain high moving into upcoming fiscal years and UMSL has kept its occupancy projects constant moving forward. Mansion Hill apartments are 40% of UMSL's total residential capacity.

Projected occupancy in Oak Hall for FY 2022 was 70% or 295 beds. Current occupancy to date is 214 beds or 49% occupancy. The current occupancy rates are artificially suppressed due to the course delivery options for Fall 2021. With in-person instruction accounting for only 30% of courses this semester, most students in the 1000 and 2000-level courses, opted out of living in the residential hall. For students who have the bulk of their courses online, on-campus housing was not a priority for the current semester. Provided the University offers more in-person instruction options in the upcoming semester, occupancy rates are projected to return to pre-pandemic levels.

The University is currently engaged in a ground lease agreement with Campus Living Villages which provides apartment-style living for UMSL students. Campus Living Villages has not reached 100% occupancy throughout the duration of the ground lease. Campus Living Villages is able to provide housing assistance should University-owned housing exceed capacity due to enrollment increases. Currently, Campus Living Villages is at approximately 60% occupancy which provides room for growth moving forward. Additional expansion of housing is not expected at this time.

The table on the next page summarizes the room and board predominant plan for each campus as well as the range of plan options. Campus specific tables detailing contract rates for housing and dining options follow.

Summary	of Housing	Contracts . Effective	Beginning	with the	2022 Summe	r Session
			· a a			

				MU	
Room and Board Plans				Increase/	Percent
Academic Year - 2 Semesters		FY2022	FY2023	Decrease	Change
Room and Board - Predominant I	Plan	\$9,915	\$10,509	\$594	6.0%
Traditional double room (ave	rage)	6.876	7,319	443	6.4%
Tiger Plan Plus	8-)	3.039	3,190	152	5.0%
		5,055	5,190	102	5.676
Range of Plan Options					
Housing Options High		\$10,275	\$10,920	Single/Dout	ole suite open over breaks
Housing Options Low		6,105	6,500	Double (low	r cost)
Meal Plan Options	High	3,502	3,670	Tiger Plan P	latinum
Meal Plan Options	Low	1,700	1,780	Tiger Plan	
				UMKC	
Room and Board Plans				Increase/	Percent
Academic Year - 2 Semesters		FY2022	FY2023	Decrease	Change
Room and Board - Predominant I	Dlan	\$11.004	\$11 248	\$244	2 20%
Traditional Double A/C	lall	7 278	7 452	52 44 74	1.0%
180 Maal Dia ak w/\$175 Elay m	angamagtan	7,378	2 706	/4 170	1.070
180 Meal Block w/\$175 Flexp	ersemester	5,020	5,790	170	4./70
Range of Plan Options (1)					
Housing Options	High	\$12,210	\$12,454	Single room	apartment
Housing Options	Low	7,378	7,452	Double A/C	
Meal Plan Options	High	3,906	4,090	140 block w	ith \$300 flex/sem
Meal Plan Options	Low	3,489	3,653	12 Meal Plan	n - \$175 flex/sem
				S&T	
Room and Board Rates				Increase/	Percent
Academic Year - 2 Semesters		FY2022	FY2023	Decrease	Change
Room and Board - Predominant I	Plan	\$10 570	\$10,920	\$350	3 3%
Renovated Double	lan	7 100	7 280	180	2.5%
225 Meals plus \$150 DBD/set	mester	3 470	3 640	170	2.570 4 Q%
		5,170	5,010	170	1.970
Range of Plan Options	TT: 1	¢0. (00	¢0.700		ite C
Housing Options	High	\$9,600	\$9,790	Single Univ	ersity Commons
Housing Options	Low	5,500	5,500	Double Bas	ement
Meal Plan Options	High	3,840	4,030	All Access	plus \$100 DBD/sem
Meal Plan Options	Low	1,990	2,080	Declining Ba	alance Dollars
				UMSL	
Room and Board Plans				Increase/	Percent
Academic Year - 2 Semesters		FY2022	FY2023	Decrease	Change
Room and Board - Predominant I	Plan	\$10,606	\$10,919	\$313	3.0%
Single Room		6,858	6,995	137	2.0%
100 Block Meals - DBD \$350/	semester	3,748	3,924	176	4.7%
Range of Plan Options (1)					
Housing Options	High	6,858	6,995	Oak Hall Sin	igle
Housing Options	Low	4,800	4,896	Villa Honors	& Optometry only
Meal Plan Options	High	4,328	4,531	200 Block M	Ieals DBD \$150/sem
Meal Plan Options	Low	3,748	3,924	100 Block M	Ieals DBD \$350/sem

(1) Meal plan costs are still under negotiation with third-party vendor but will not increase more than stated rate on following tables

Room and Board Plans					Inc	crease/	Percent	
Academic Year - 2 Semesters	F	Y2022	F	Y2023	De	ecrease	Change	
Predominant Plan								
Room and Board	\$	9,915	\$	10,509	\$	594	6.0%	
Traditional double room (average)		6,876		7,319		443	6.4%	
Tiger Plan Plus		3,039		3,190		152	5.0%	
Meal Plans Options								
Regular Academic Year (Two Semesters)								
Tiger Plan Platinum	\$	3,502	\$	3,670	\$	168	4.8%	
Tiger Plan Plus		3,039		3,190		152	5.0%	
Tiger Plan		1,700		1,780		80	4.7%	
Summer Session								
Tiger Plan		\$850		\$890		\$40	4.7%	
Housing Options								
Regular Academic Year (Two Semesters)								
Single Suite	\$	10,275	\$	10,920	\$	645	6.3%	
Single		9,240		9,825		585	6.3%	
Single - Hatch and Schurz Hall		7,865		8,365		500	6.4%	
Semi-Suite Double		8,765		9,320		555	6.3%	
Double Suite		10,275		10,920		645	6.3%	
Double (premium)		7,445		7,920		475	6.4%	
Double (mid-range)		6,710		7,145		435	6.5%	
Double (low cost)		6,105		6,500		395	6.5%	
		FY2	2022			FY	2023	
		low	р	remium		low	premium	
Mizzou apartments (range)	\$	10,405	\$	10,605	\$	11,030	\$ 11,240	
					In	orease/	Percent	
Summer Session	F	Y2022	F	Y2023	De	ecrease	Change	
Sincle	¢	1 925	¢	1 045	¢	110	6 00/	
Double	Ф	1,855	Э	1,945	Ф	80	6.0% 6.1%	
		1,515		1,575		00	0.170	
Family Student Housing (Per Month)		FY	2022			FY	2023	
		1000	- <u></u>	remium		low	premium	
Tara Apartments (Range)	\$	605	р \$	870	\$	605	\$ 895	

University of Missouri - Columbia, Proposed Changes in Housing & Dining Contract Rates for FY2	2023
Effective Beginning with the 2022 Summer Session	

Room and Board Plans				Inc	rease/	Percent
Academic Year - 2 Semesters		FY2022	FY2023	De	crease	Change
Predominant Plan						
Room and Board	\$	11,004	\$ 11,248	\$	244	2.2%
Double		7,378	7,452		74	1.0%
Meal Plan Block 180 Meal w/\$175 Flex per sem		3,626	3,796		170	4.7%
Meal Plans Defined (1)						
Meal Plan 1 - 15 meal - w/\$125 Flex/sem	\$	3,645	\$ 3,817	\$	171	4.7%
Meal Plan 2 - 12 meal - w/\$175 Flex/sem		3,489	3,653		164	4.7%
Meal Plan 3 - 180 Block Meal w/ \$175 Flex/sem		3,626	3,796		170	4.7%
Meal Plan 4 - 160 Block Meal w/\$200 Flex/sem		3,626	3,796		170	4.7%
Meal Plan 5 - 140 Block Meal w/\$300 Flex/sem		3,906	4,090		184	4.7%
Housing Options - Regular Academic Year (Two Semeste	ers)					
Johnson Hall						
Double	\$	7,378	\$ 7,452	\$	74	1.0%
Single Private Bath A/C		9,326	9,420		94	1.0%
Single Shared Bath A/C		9,122	9,214		92	1.0%
Oak Street						
Double	\$	7,378	\$ 7,452	\$	74	1.0%
Single Private Bath A/C		9,326	9,420		94	1.0%
Single Shared Bath A/C		9,122	9,214		92	1.0%
Triple & Single W/Common (2)		9,542	9,638		96	1.0%
Hospital Hill Apts						
Quad Apts	\$	9,702	\$ 9,896	\$	194	2.0%
Double Apt		11,056	11,278		222	2.0%
Single Apt		12,210	12,454		244	2.0%
UMKC Homes Rockhill (3rd Party)						
Double Apt	\$	10,698	\$ 10,804	\$	106	1.0%

University of Missouri - Kansas City, Proposed Changes in Housing & Dining Contract Rates for FY2023 Effective Beginning with the 2022 Summer Session

(1) Meal plan costs are still under negotiation with third-party vendor but will not increase more than 4.7%

(2) Oak Street 6 Person Suites were converted to new room type/rate in FY20.

UMKC Changes in Housing & Dining Contract Rates (co	Inci	rease/	Percent			
Summer Session (1)		FY2022	FY2023	Dec	crease	Change
Johnson Hall - Room Only						
Double	\$	2,670	\$ 2,698	\$	27	1.0%
Single Private Bath		3,376	3,410		34	1.0%
Single Shared Bath		3,302	3,335		33	1.0%
Oak Street East - Room Only						
Double	\$	2,670	\$ 2,698	\$	27	1.0%
Single Private Bath A/C		3,376	3,410		34	1.0%
Single Shared Bath A/C		3,302	3,335		33	1.0%
Triple & Single W/Common (2)		3,453	3,488		35	1.0%
Hospital Hill Apts						
Quad Apt	\$	3,511	\$ 3,582	\$	71	2.0%
Double Apt		4,001	4,082		81	2.0%
Single Apt		4,419	4,508		88	2.0%
UMKC Homes Rockhill (3rd Party)						
Double Apt	\$	3,872	\$ 3,910	\$	38	1.0%

(1) Starting FY22 Summer Rate is for Full Summer (134 days) and based on the daily rate for Spring/Fall

Room and Board Rates Academic Year - 2 Semesters	F	Y2022	F	Y2023	Inc: Dec	rease/ crease	Percent Change
Predominant Plan							
Room and Board	\$	10,570	\$	10,920	\$	350	3.3%
Thomas Jefferson North Renovated Double		7,100		7,280		180	2.5%
Meal Plan 3 225 Meals plus \$150 DBD		3,470		3,640		170	4.9%
Meal Plans Defined							
Meal Plan 1 Declining Balance Dollars	\$	2,820	\$	2,950	\$	130	4.6%
Meal Plan 2 All Access plus \$100 DBD		3,840		4,030		190	4.9%
Meal Plan 3 225 Meals plus \$150 DBD		3,470		3,640		170	4.9%
Meal Plan 4 150 Meals plus \$280 DBD		2,980		3,130		150	5.0%
Meal Plan 5 Declining Balance Dollars		1,990		2,080		90	4.5%
Housing Options - Regular Academic Year (Two	Sem	esters)					
Farrar Hall Co-op							
Double	\$	6,730	\$	6,730	\$	-	0.0%
Single		8,100		8,100		-	0.0%
Double Basement		5,500		5,500		-	0.0%
Residential College Suites							
Double Suite	\$	8,150	\$	8,330	\$	180	2.2%
Double Deluxe Suite		8,320		8,500		180	2.2%
Single Deluxe Suite		9,570		9,670		100	1.0%
Triple		6,100		6,230		130	2.1%
Single Bed in Triple Room		8,930		9,130		200	2.2%
Double as a Single		9,570		9,570		-	0.0%
Thomas Jefferson North							
Double Room	\$	7,100	\$	7,280	\$	180	2.5%
Thomas Jefferson South							
Double Room	\$	7,270	\$	7,450	\$	180	2.5%
Large Double Room		7,520		7,710		190	2.5%
Single Room		8,210		8,390		180	2.2%
Triple Room		5,760		5,890		130	2.3%
Miner Village Apartments							
4 Bedroom Apartments	\$	8,400	\$	8,580	\$	180	2.1%
2 Bedroom Apartments		8,900		9,100		200	2.2%
University Commons							
Double	\$	8,210	\$	8,420	\$	210	2.6%
Single		9,600		9,790		190	2.0%
Rolla Suites							
Single Efficiency	\$	8,370	\$	8,550	\$	180	2.2%
Single Studio		8,880		9,070		190	2.1%

Missouri S&T, Proposed Changes in Housing & Dining Contract Rates for FY2023 Effective Beginning with the 2022 Summer Session

Summer Session			Increase/	Percent
Combined Room and Board Rates	FY2022	FY2023	Decrease	Change
University Commonsrate includes 100 Mine	r Bucks			
Single	\$ 1,040	\$ 1,075	\$ 35	3.4%
Double	775	800	25	3.2%

S&T Changes in Housing & Dining Contract Rates (continued)

Room and Board Plans Academic Year - 2 Semesters		Y2022	F	Y2023	Inc De	rease/ crease	Percent Change
Predominant Plan							
Room and Board	\$	10,606	\$	10,919	\$	313	3.0%
Oak Single Room		6,858		6,995		137	2.0%
100 Block Meals - \$350 declining balance/sem		3,748		3,924		176	4.7%
Meal Plans Defined (1)							
100 Block Meals - DBD \$350/sem	\$	3,748	\$	3,924	\$	176	4.7%
150 Block Meals - DBD \$250/sem		4,212		4,410		198	4.7%
200 Block Meals - DBD \$150/sem		4,328		4,531		203	4.7%
All Declining Balance Dollars (DBD)		3,768		3,945		177	4.7%
Housing Options - Regular Academic Year (Two Semesters)							
Oak Hall							
Double Room	\$	5,505	\$	5,615	\$	110	2.0%
Double Room Dept and Student Leader		4,950		5,049		99	2.0%
Single Room		6,858		6,995		137	2.0%
Single Room Dept and Student Leader		6,172		6,295		123	2.0%
Villa Honors & Optometry only	\$	4,800	\$	4,896	\$	96	2.0%
Summer Session - Room Only	F	Y2022	F	Y2023	In De	crease/ ecrease	Percent Change
Oak Hall Double Room - LL	\$	1.230	\$	1.255	\$	25	2.0%
Oak Hall Single Room	Ψ	1.540	Ψ	1.571	Ŷ	31.00	2.0%
Villa Honors & Optometry only		1,080		1,102		22.00	2.0%
					In	crease/	Percent
Family Student Housing (Per Month)	F	Y2022	F	Y2023	D	ecrease	Change
Mansion Hill 1 Bedroom Furnished	\$	885	\$	903	\$	18	2.0%
Mansion Hill 1 Bedroom Unfurnished		722		736		14	1.9%
Mansion Hill 2 Bedroom Indivdual Furnished		1,098		1,120		22	2.0%
Mansion Hill 2 bedroom Individual Unfurnished		933		952		19	2.0%
Mansion Hill 2 Bedroom Furnished		548		559		11	2.0%
Mansion Hill 2 Bedroom Unfurnished		468		477		9	1.9%
Mansion Hill Student Leader 1 Bedroom Furnished		814		830		16	2.0%
Mansion Hill Student Leader 1 Bedroom Unfurnished		651		664		13	2.0%
Mansion Hill Student Leader 2 Bedroom Indiv. Furnished		1,016		1,036		20	2.0%
Mansion Hill Student Leader 2 Bedroom Indiv. Unfurnished		834		851		17	2.0%
Mansion Hill Student Leader 2 Bedroom Furnished		508		518		10	2.0%
Mansion Hill Student Leader 2 Bedrooom Unfurnished		426		435		9	2.1%
Mansion Hill Efficiency Unit		576		588		12	2.1%
Mansion Hill Loft Unit		667		680		13	1.9%

UMSL, Proposed Changes in Housing & Dining Contract Rates for FY2023 Effective Beginning with the 2021 Summer Session

(1) Meal plan costs are still under negotiation with third-party vendor, plan to increase by 4/7% for FY23 and 2% for FY24 and beyond. Food Service Provider will go out on RFP June 2022

University of Missouri-Columbia

Housing and Dining System Income Statements

		Actual		Projection	For			recast			
	FY2019	FY2020	FY2021	FY2022		FY2023		FY2024			
Revenues											
Meal Contracts	\$ 18,537,194	\$ 14,525,229	\$ 18,114,738	\$ 20,000,000	\$	23,788,110	\$	24,263,872			
Room Contracts	38,262,407	45,688,866	47,151,772	49,475,949		56,525,050		53,831,197			
Apartment Rental	2,218,044	2,018,998	1,823,729	1,880,293		1,380,000		1,400,700			
Other	6,949,963	3,462,478	5,876,595	5,565,121		5,643,663		5,723,448			
Total Revenues	65,967,608	65,695,571	72,966,834	76,921,363		87,336,823		85,219,217			
Scholarships/Waivers	(4,308,812)	(3,138,113)	(3,205,667)	(3,140,000)		(3,540,000)		(3,491,000)			
One-Time CARES reimbursement		7,780,872	4,953,624	-		-		-			
Net Revenue	\$ 61.658.796	\$ 70,338,330	\$ 74,714,791	\$ 73,781,363	\$	83,796,823	\$	81,728,217			
Expenditures & Transfers	, ,	, ,	, ,	, ,		, ,		, ,			
Salaries & Wages	10 000 591	11 264 557	11 222 345	12 026 040		12 507 082		12 757 223			
Staff Benefits	5.553.451	6.822.707	7.386.557	7.217.785		7.504.249		7.654.334			
Total Compensation	15,554,042	18,087,264	18,608,902	19,243,825		20,011,331		20,411,557			
COGS	6.961.367	6.142.343	7.840.159	7.636.748		9.083.190		9.264.854			
Utilities	5,879,829	5,681,153	5,545,176	5,888,365		6,142,616		6,268,608			
Maintenance	3,159,540	3,080,292	3,169,441	5,351,196		6,207,506		6,394,381			
Rent/Lease Equipment & Space	553,541	4,261,511	4,709,357	3,972,436		4,085,319		350,000			
Other	5,941,111	6,543,977	8,079,156	6,876,236		7,333,785		7,738,893			
Total Expenditures	38,049,430	43,796,540	47,952,191	48,968,806		52,863,747		50,428,293			
Net Operating Income	\$ 23,609,366	\$ 26,541,790	\$ 26,762,600	\$ 24,812,557	\$	30,933,076	\$	31,299,924			
Debt Service	(22,658,900)	(22,841,179)	(22,956,187)	(23,162,255)		(23,103,376)		(23,261,298)			
Change in Net Position before Transfers	\$ 950,466	\$ 3,700,611	\$ 3,806,413	\$ 1,650,302	\$	7,829,700	\$	8,038,626			
Debt Service Coverage	1.04	1.16	1.17	1.07		1.34		1.35			
Transfers for Capital Investment	(1,533,538)	(1,946,095)	(4,271,329)	(1,579,823)		(7,320,360)		(7,542,036)			
Other Transfers	619,965	(1,774,510)	685,949	(42,129)		(509,340)		(496,590)			
Change in Net Position	\$ 36,893	\$ (19,994)	\$ 221,033	\$ 28,350	\$	-	\$	-			
Occupancy Statistics											
Residence Hall Occupancy	5,454	6,686	6,898	6,340		6,633		6,292			
Residence Hall Capacity	5,896	6,965	7,182	6,798		6,984		6,555			
Percent of Capacity	92.5%	96.0%	96.0%	93.3%		95.0%		96.0%			
Apartment Occupancy	288	282	283	283		210		210			
Apartment Capacity	296	296	296	296		218		218			
Percent of Capacity	97.3%	95.3%	95.3%	95.3%		96.3%		96.3%			

University of Missouri Kansas City

Housing and Dining System Income Statements

		 Actual		 Projection	Fore			cast		
	FY2019	FY2020	FY2021	FY2022		FY2023		FY2024		
Revenues										
Meal Contracts	\$ 3,471,378	\$ 2,910,471	\$ 2,235,476	\$ 3,093,479	\$	3,155,348	\$	3,218,456		
Room Contracts	5,397,455	3,918,791	3,972,963	5,328,393		5,640,645		6,106,146		
Apartment Rental	3,725,652	3,556,187	2,178,270	2,095,500		2,555,526		2,957,894		
Other	577,774	793,327	243,418	208,091		465,532		518,210		
Total Revenues	13,172,259	11,178,776	8,630,127	10,725,463		11,817,051		12,800,706		
Scholarships/Waivers	(483,932)	(516,630)	(448,156)	(422,637)		(446,181)		(454,927)		
One-Time CARES reimbursement		2,256,182								
Net Revenue	\$ 12,688,327	\$ 12,918,328	\$ 8,181,971	\$ 10,302,826	\$	11,370,870	\$	12,345,779		
Expenditures & Transfers										
Salaries & Wages	844,094	714,757	690,028	837,628		895,980		913.093		
Staff Benefits	214,276	220,791	221,591	231,406		241,868		252,584		
Total Compensation	1,058,370	935,548	911,619	1,069,034		1,137,848		1,165,677		
COGS	3,098,699	2,662,884	2,114,138	2,984,482		3,044,172		3,105,055		
Utilities	1,000,776	812,747	527,753	623,730		641,301		654,127		
Maintenance	528,977	932,000	421,434	986,223		1,191,638		1,188,730		
Rent/Lease Equipment & Space	2,163,534	2,248,722	207,383	235,440		240,149		244,952		
Other	426,308	338,648	519,564	918,848		1,108,454		1,561,805		
Total Expenditures	8,276,664	7,930,549	4,701,891	6,817,757		7,363,562		7,920,346		
Net Operating Income	\$ 4,411,663	\$ 4,987,779	\$ 3,480,080	\$ 3,485,069	\$	4,007,308	\$	4,425,433		
Debt Service	(6,434,843)	(6,435,100)	(4,638,951)	(4,699,662)		(4,800,455)		(4,801,711)		
Change in Net Assets before Transfers	\$ (2,023,180)	\$ (1,447,321)	\$ (1,158,871)	\$ (1,214,593)	\$	(793,147)	\$	(376,278)		
Debt Service Coverage	0.69	0.78	0.75	0.74		0.83		0.92		
Transfers for Capital Investment	(285,462)	-	(133,138)	-		-		-		
Other Transfers	(302,923)	499,703	(84,442)	-		-		-		
Change in Net Position	\$ (2,611,565)	\$ (947,618)	\$ (1,376,451)	\$ (1,214,593)	\$	(793,147)	\$	(376,278)		
Oak Place Debt Service Funded by University Operations	2,911,618	2,462,396	2,156,775	965,315		965,315		965,315		
Debt Service w/o Oak Place	1.25	1.26	1.40	0.93		1.04		1.15		
Occupancy Statistics										
Residence Hall Occupancy	729	778	566	709		771		791		
Residence Hall Capacity	956	958	862	861		862		862		
Percent of Capacity	76.3%	81.2%	65.7%	82.3%		89.4%		91.8%		
Apartment Occupancy	357	338	203	185		215		239		
Apartment Capacity	383	376	268	268		266		266		
Percent of Capacity	94.9%	89.9%	75.7%	69.0%		80.8%		89.8%		

(1) Capacity decrease in Residence Hall and Apartments due to discontinuation of 3rd Party Contracted Properties in FY20

Missouri S&T

Housing and Dining System Income Statements

	Actual							Projection	Fore	cas	st	
		FY2019		FY2020		FY2021		FY2022	FY2023		FY2024	
Revenues												
Meal Contracts	\$	5,399,651	\$	4,847,998	\$	4,337,378	\$	4,432,800	\$ 4,747,529	\$	4,961,168	
Room Contracts		14,504,326		11,108,588		13,709,329		14,010,934	14,462,367		14,823,926	
Apartment Rental		-		-		-		-	-		-	
Other		1,062,264		993,649		484,752		495,000	500,000		505,000	
Total Revenues		20,966,241		16,950,235		18,531,459		18,938,734	19,709,896		20,290,094	
Scholarships/Waivers		(716,780)		(919,953)		(934,500)		(953,600)	(982,208)		(1,011,674)	
One-Time Pandemic Impact						(598,551)		(160,000)				
Net Revenue	\$	20,249,461	\$	16,030,282	\$	16,998,408	\$	17,825,134	\$ 18,727,688	\$	19,278,420	
Expenditures & Transfers												
Salaries & Wages		2,756,075		1,924,073		1,272,691		1,428,145	1,456,708		1,485,843	
Staff Benefits		839,629		801,595		580,595		623,013	647,934		673,851	
Total Compensation		3,595,704		2,725,669		1,853,286		2,051,158	2,104,642		2,159,694	
COGS		4,919,077		4,098,421		4,281,146		4,562,015	4,740,875		4,930,510	
Utilities		1,499,030		1,257,527		1,312,600		1,486,793	1,516,529		1,562,025	
Maintenance		810,415		1,032,794		832,254		848,263	873,711		895,554	
Rent/Lease Equipment & Space		270,035		9,491		-		-	-			
Other		1,533,490		1,452,165		1,782,635		1,798,000	1,851,940		1,898,238	
Total Expenditures		12,627,751		10,576,067		10,061,921		10,746,229	11,087,697		11,446,021	
Net Operating Income	\$	7,621,710	\$	5,454,216	\$	6,936,487	\$	7,078,905	\$ 7,639,991	\$	7,832,399	
Debt Service		(6,434,843)		(6,435,100)		(6,433,657)		(6,436,293)	(6,510,480)		(6,514,071)	
Change in Net Assets before Transfers	\$	1,186,867	\$	(980,884)	\$	502,830	\$	642,612	\$ 1,129,511	\$	1,318,328	
Debt Service Coverage		1.18		0.85		1.08		1.10	1.17		1.20	
Transfers for Capital Investment		(683,346)		(500,000)		(100,000)		(500,000)	(1,000,000)		(1,200,000)	
Other Transfers		(20,400)		(236,255)		(46,221)		-	-			
Change in Net Position	\$	483,121	\$	(1,717,138)	\$	356,609	\$	142,612	\$ 129,511	\$	118,328	
Occupancy Statistics												
Residence Hall Occupancy		2,069		1,850		1,801		1,845	1,880		1,940	
Residence Hall Capacity		2,385		2,300		2,270		2,215	2,210		2,210	
Percent of Capacity		86.8%		80.4%		79.3%		83.3%	85.1%		87.8%	

University of Missouri St. Louis

Housing and Dining System Income Statements

	Actual			Projection		Forecas		t	
	FY2019		FY2020	FY2021	FY2022		FY2023		FY2024
Revenues									
Meal Contracts	\$ 1,347,642	\$	1,012,636	\$ 802,812	\$ 753,863	\$	1,255,038	\$	1,429,957
Room Contracts	2,339,119		1,805,737	1,337,890	1,461,560		2,229,011		2,430,244
Apartment Rental	1,121,691		1,126,069	1,395,936	1,855,004		1,943,010		1,981,563
Other	397,552		385,385	403,776	70,000		76,000		78,000
Total Revenues	5,206,004		4,329,827	3,940,414	4,140,427		5,503,059		5,919,764
Scholarships/Waivers	(676,532)		(650,006)	(397,638)	(260,063)		(380,432)		(401,135)
One-Time Pandemic Impact			827,437						
Net Revenue	\$ 4,529,472	\$	4,507,258	\$ 3,542,776	\$ 3,880,364	\$	5,122,627	\$	5,518,629
Expenditures & Transfers									
Salaries & Wages	364,356		303,630	254,948	265,223		274,425		283,713
Staff Benefits	84,526		95,949	89,561	88,951		89,890		90,848
Total Compensation	448,882		399,579	344,509	354,174		364,315		374,561
COGS	1,352,061		1,086,447	765,031	753,863		1,255,038		1,429,957
Utilities	248,836		242,272	201,085	212,000		216,240		220,565
Maintenance	1,245,843		1,245,843	1,338,817	1,801,000		1,801,000		1,805,460
Rent/Lease Equipment & Space	-		-	-	-		-		-
Other	749,254		333,148	4,068	93,783		48,783		44,323
Total Expenditures	4,044,876		3,307,289	2,653,510	3,214,820		3,685,376		3,874,866
Net Operating Income	\$ 484,596	\$	1,199,969	\$ 889,266	\$ 665,544	\$	1,437,251	\$	1,643,763
Debt Service	(1,397,406)		(1,399,531)	(1,400,006)	(1,398,802)		(1,396,723)		(1,398,723)
Change in Net Assets before Transfers	\$ (912,810)	\$	(199,562)	\$ (510,740)	\$ (733,258)	\$	40,528	\$	245,040
Debt Service Coverage	0.35		0.86	0.64	0.48		1.03		1.18
Transfers for Capital Investment	(373,000)		(373,000)	(373,000)	-		-		-
Other Transfers	827,030		251,215	(7,884)	-		-		-
Change in Net Position	\$ (458,780)	\$	(321,347)	\$ (891,624)	\$ (733,258)	\$	40,528	\$	245,040
Occupancy Statistics									
Residence Hall Occupancy	370		356	223	214		327		376
Residence Hall Capacity	455		447	421	421		447		447
Percent of Capacity	81.3%		79.6%	53.0%	50.8%		73.2%		84.1%
Apartment Occupancy	190		216	257	297		305		305
Apartment Capacity	222		257	283	305		305		305
Percent of Capacity	85.6%		84.0%	90.8%	97.4%		100.0%		100.0%

Project Approval Arrival Court Missouri S&T

The Missouri University of Science and Technology requests Project Approval for the Arrival Court project. The total project budget of \$9,600,000 is funded by gifts.

The University Drive Relocation and US Highway 63 roundabout projects, currently under construction, define a new arrival district that will pronounce the new Missouri S&T campus main entrance "a gateway into the S&T Experience". The new entrance and Arrival Court will provide an iconic and powerful first impression at the east end of the realigned University Drive. The Arrival Court will be developed around a west to east axis formed between the new roundabout and the historically significant Rolla Building, and is encircled by the existing Havener Center and proposed Student Experience Center to the north, the proposed Welcome Center to the northeast, and a future building to the south; as indicated on the current 2020 Campus Master Plan. The Arrival Court will also include vehicular circulation, accessible parking, drop-off areas, sidewalks, multiple outdoor plaza areas and features, wayfinding signage, and landscape improvements.

Missouri S&T envisions an Entry Plaza, with sodded seating areas to the north and south, adjacent to and slightly elevated from the main vehicular entrance and drop-off. Visitors would be greeted by a water feature in the area, which could house a series of sculptural pieces, historic artifacts, and iconic signage to promote the Missouri S&T Brand.

The Main Lawn, which unites the entry plaza and Rolla Building in an axial relationship, will gently slope from east to west, creating opportunities for informal student gatherings and recreational activities, as well as more formal events, such as outdoor lectures and graduation ceremonies. The vision is to incorporate soft and hardscape with a pedestrian walkway to accommodate emergency vehicles.

In addition to the entry plaza, an events plaza is envisioned to be sited between the Student Experience Center and the future Welcome Center. The events plaza will serve as a primary gathering point for students, providing a lively and vibrant atmosphere for casual socialization, and a venue for Missouri S&T's innovative community to engage with one another. This plaza will be a combination of hard surfaces and landscaped areas. Hard surfaces will consist of a variety of colored concrete pavers and other durable materials as determined during the design phase, and landscaped areas will include native plants as well as flowering trees. The plaza will also have a variety of seating options for students to collaborate.

SWT Design, LLC, St. Louis, Missouri is the recommended landscape architect for this project. SWT Design, LLC presented a very strong design team with experience on the Missouri S&T campus and working on similar projects to the Arrival Court. The design team includes David Mason and Associates, Inc., St. Louis, Missouri (MBE) for civil engineering; Antella Consulting Engineers, Inc., Kansas City, Missouri (MBE/WBE) for November 18, 2021

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lighting design; Archer Elgin Surveying and Engineering, LLC, Rolla, Missouri for utility engineering and APS, Ellisville, Missouri for cost estimating.

The selection committee also interviewed RDG Planning & Design, Inc., St. Louis; and Lamar Johnson Collaborative, LLC, St. Louis, Missouri.

The fee for basic architectural and engineering services has been determined by referencing the University of Missouri's "Architectural and Engineering Basic Services Fee Estimating Guidelines." The project is considered a Type I - New Construction (less than average complexity), and the calculated basic services fee is \$373,026 based upon 5.1% of the estimated \$7,314,228 construction cost. Additional services to the basic design fee include: signature landscape designer, water feature designer, multiple construction packages, site furnishings and coordination of Owner's special consultants are anticipated at \$314,430 for a total design fee of \$687,456.

Construction completion is scheduled for Fall 2023. The project will be delivered as a traditional Design-Bid-Build project.

No. 3

Recommended Action - Project Approval, Arrival Court, Missouri S&T

It was recommended by Chancellor Dehghani, endorsed by President Choi, recommended by the Finance Committee, moved by Curator ______ and seconded by Curator ______, that the following action be approved:

the project approval for the Arrival Court, Missouri S&T

Funding of the project budget is from	:		*• • • • • • •
Gifts			<u>\$9,600,000</u>
Total Funding			\$9,600,000
Roll call vote Finance Committee	YES	NO	
Curator Hoberock			
Curator Graves			
Curator Layman			
The motion			
Roll call vote Full Board:	YES	NO	
Curator Brncic			
Curator Chatman			
Curator Graham			
Curator Graves			
Curator Hoberock			
Curator Holloway			
Curator Layman			
Curator Wenneker			
Curator Williams			
The motion			

Project Approval Missouri Protoplex - Phase One Missouri S&T

The Missouri University of Science and Technology requests Project Approval for the Missouri Protoplex - Phase One project. The total project budget of \$13,068,182 will be funded by gifts.

As identified in Missouri S&T's 2018 Strategic Plan, the University's mission includes discovering, disseminating, preserving and applying knowledge, and fostering innovation to support economic development. In September, the Board of Curators approved Missouri S&T's 2020 Master Plan, which identified the area north of Interstate 44 at Exit 185 for a Manufacturing Technology and Innovation Campus. The purpose of the Manufacturing Technology and Innovation Campus is to broaden Missouri S&T's ability to engage with technology partners and grow economic development opportunities for Missouri. The Missouri Protoplex will be the first building in this new campus, providing space for manufacturing outreach, research, and technology development collaborations with Missouri companies. The site for this new facility is located at Exit 185 to the north of Interstate 44, east of White Columns Drive and south of Collegiate Boulevard; roughly where the existing General Services Building is located. This location provides good access and visibility from Interstate 44.

The Missouri Protoplex - Phase One project will construct a new General Services Building near Exit 185 to the north of Interstate 44 and Nagogami Road (Route E) and just to the north west of Fraternity Circle. The new 39,621 gross square feet (GSF), single story building includes offices, conference rooms, a training room, shop space, and storage to accommodate Facilities Operations; Design, Construction and Space Management; and Environmental Health and Safety. The building exterior façade is anticipated to be an insulated metal panel system. Once the new facility is constructed, the existing General Services building will be demolished to clear the site for the Missouri Protoplex facility construction.

The project is scheduled to be completed in June 2023. The project will be delivered as a Design/Build project. The Design/Build team will be selected through a competitive process with the project design being submitted to the Board of Curators in May 2022.

Recommended Action - Project Approval, Missouri Protoplex – Phase One, Missouri S&T

It was recommended by Chancellor Dehghani, endorsed by President Choi, recommended by the Finance Committee, moved by Curator ______ and seconded by Curator ______, that the following action be approved:

the project approval for the Misson	ıri Protoplex – Ph	ase One, M	issouri S&T
Funding of the project budget is fr Gifts Total Funding	om:		<u>\$13,068,182</u> \$13,068,182
Roll call vote Finance Committee	YES	NO	
Curator Graves Curator Hoberock Curator Layman			
The motion			
Roll call vote Full Board:	YES	NO	
Curator Brncic Curator Chatman Curator Graham Curator Graves Curator Hoberock Curator Holloway Curator Layman Curator Wenneker			
Curator Williams			
The motion			

November 18, 2021

Project Re-Approval Student Experience Center Missouri S&T

Missouri University of Science and Technology requests approval to add a geothermal plant to the Student Experience Center project. The project budget will increase from \$30,000,000 to \$37,720,750. The additional \$7,720,750 will be funded by gifts.

In February 2021, the Board of Curators approved the Student Experience Center project with a total project cost of \$30,000,000 funded by gifts. At the September 2021, the Board of Curators approved the use of a \$6,507,206 strategic dividend for this project, reducing the gift portion of the funding accordingly.

The original scope for the Student Experience Center included space for a future geothermal plant. This request will allow the project to add the actual geothermal plant to the project. An additional geothermal plant is necessary to support the heating and cooling needs of the new Student Experience Center, the new Welcome Center, and the new Engineering Research Laboratory Addition. Design and construction of this plant and well field was originally planned as a separate infrastructure project. However, to meet the project schedule, the geothermal plant scope will be bid and constructed as part of the Student Experience Center project. The geothermal system will also provide additional capacity to provide heating and cooling to existing facilities such as Parker Hall, Norwood Hall and Harris Hall, which are not currently served by the geothermal system.

The plant will be located in the lower level of the Student Experience Center. Three heat recovery chillers with a total capacity of approximately 350 tons of cooling and 6800 MBH of heating will connect to 260 geothermal wells. The wells will be located under parking lots, streets, sidewalks and green space in the area west of State Street, east of US Highway 63, south of 14th Street, and north of 11th Street. The plant will also include three, 4,000 MBH condensing boilers for heating redundancy and peak capacity; and a 500-ton electric water-cooled chiller and tower to facilitate replacement of aging chillers on campus. The cooling tower will be located on the roof of the Student Experience Center.

The McClure Corporation, St. Louis, Missouri is the recommended engineer for this project. McClure has in-depth knowledge of geothermal systems and is the engineer of record for the existing geothermal system at Missouri S&T. The design team includes The McClure Corporation, St. Louis for the mechanical, electrical and plumbing engineering; and Archer-Elgin Surveying and Engineering, LLC, Rolla, Missouri for civil engineering.

The fee for basic architectural and engineering services for the Geothermal scope of work has been determined by referencing the University of Missouri's "Architectural and Engineering Basic Services Fee Estimating Guidelines." The project is considered a Type VI (engineering project), and the basic services fee is \$432,000 based upon 7.2% of the estimated \$6,000,000 construction cost.

The project is expected to be completed by December 2023 per the original schedule. The project is anticipated to be delivered by Construction Manager at Risk.

No. 5

Recommended Action - Project Re-Approval, Student Experience Center, Missouri S&T

It was recommended by Chancellor Dehghani, endorsed by President Choi, recommended by the Finance Committee, moved by Curator _____ and seconded by Curator _____, that the following action be approved:

the project re-approval for the Student Experience Center, Missouri S&T

Funding of the project budget is from	1:		
Campus funds		S	\$6,507,206
Gifts		<u>\$3</u>	31,213,544
Total Funding		\$3	37,720,750
Roll call vote Finance Committee	YES	NO	
Curator Graves			
Curator Hoberock			
Curator Layman			
The motion			
1 ne motion			
Roll call vote Full Board:	YES	NO	
Curator Brncic			
Curator Chatman			
Curator Graham			
Curator Graves			
Curator Hoberock			
Curator Holloway			
Curator Layman			
Curator Wenneker			
Curator Williams			
The motion			

SUMMARY AMENDMENT TO CRR 110.010, REGULATIONS

On February 2, 2021, the Missouri Court of Appeals ruled that the University's rule regarding the possession of and discharge of firearms, weapons, and explosives on University property (the "Rule") is constitutional and does not violate the Missouri Constitution's right to bear arms; but the Rule is not consistent with a Missouri statute which permits University employees to have a firearm in the employee's vehicle. On September 1, 2021, the Missouri Supreme Court declined to review the Court of Appeals' decision and the case was remanded to the Boone County Circuit Court.

The state statute at issue provides:

"[T]he state shall not prohibit any state employee from having a firearm in the employee's vehicle on the state's property provided that the vehicle is locked and the firearm is not visible. This subsection shall only apply to the state as an employer when the state employee's vehicle is on property owned or leased by the state and the state employee is conducting activities within the scope of his or her employment." Section 571.030.6 RSMo.

It is proposed that the University's Rule be amended in order to comport with the state statute and the Court of Appeals' ruling. The language of the proposed amendment is almost verbatim the language of the statute. The amendment will allow a state employee, including a University employee, to have a firearm in the employee's vehicle provided that the vehicle is locked and the firearm is not visible. Like the statute, the amendment will apply when the employee's vehicle is on property owned or leased by the University and the employee is conducting activities within the scope of his or her employment. A red-lined version of the amended Rule is part of these materials.

November 18, 2021

No. 6

Recommended Action -	Amendment to Collected Rules and Regulations 110.010,
	Regulations

It was recommended by Executive Vice President of Finance and Operations and Chief Financial Officer Rapp, endorsed by President Choi, recommended by the Finance Committee, moved by Curator ______ and seconded by Curator ______, that the following action be approved:

that the Collected Rules and Regulations Section 110.010, Regulations be amended as attached.

Roll call vote Finance Committee	YES	NO
Curator Hoberock		
Curator Graves		
Curator Layman		
The motion		
Roll call vote Full Board:	YES	NO
Curator Brncic		
Curator Chatman		
Curator Graham		
Curator Graves		
Curator Hoberock		
Curator Holloway		
Curator Layman		
Curator Wenneker		
Curator Williams		
The motion		

110.010 Regulations

Bd. Regs. Book dated 12-10-49, pp. 70-76; Bd. Min. 7-22-65, p. 30,624; Bd. Min. 9-26-69, p. 34,751; Bd. Min. 5-18-73, p. 36,693; Amended Bd. Min. 11-19-82; Revised Bd. Min. 9-16-88.

A. **Facilities and Equipment** -- Unless otherwise specifically ordered by the Board, the President of the University may assign or reassign sites of the University for use by the University or any campus thereof. The use of sites assigned to the University shall be under the direction and control of the President. Sites assigned to a campus of the University shall be subject to the following regulations on use of facilities. Sites assigned to the University shall be subject to such regulations except that assignments or waivers provided for in such regulations shall be made by the President.

B. General Regulations

- 1. Written Permission of the Chancellor -- University buildings and grounds are intended for use by students, faculty and staff in support of the University's mission of research, instruction and extension. University buildings and grounds may not be used by individuals, groups or organizations not connected with the University except by written permission of the Chancellor and then, only in accordance with University rules and regulations. Where regulations require direction of the Chancellor, said regulations may be administered by Chancellors' designee(s).
- 2. **Permits** -- Written permits for the temporary use of University grounds, buildings or rooms therein for any purpose other than regularly scheduled classroom work must be secured in advance from the Chancellor.
- 3. **Religious Services or Groups** -- No advantage shall be given to any religion or religious group.
- 4. **Requirements** -- All classes, meetings or assemblages and use by individuals of any sort held in University buildings or on University grounds are subject to applicable U.S. and Missouri laws and University requirements, rules and regulations. In addition, it is expected that proper care will be taken of the facility and that simple rules of courtesy, decency and good manners will be observed at all times. Any failure to abide by these requirements may cause the permission for the use of the facility to be withdrawn at any time, or for future permission for use of any University facilities to be denied.
 - a. The possession of and discharge of firearms, weapons and explosives on University property including University farms is prohibited except in regularly approved programs or by University agents or employees in the line of duty.
 - a.i. Notwithstanding any other provision of these regulations, a state employee, including a University employee, may have a firearm in the employee's vehicle provided the vehicle is locked and the firearm is not visible. This subsection shall only apply to the University as an employer when the employee's vehicle is on property owned or leased by the University and the employee is conducting activities within the scope of his or her employment.

- b. No University building, or part thereof, or grounds may be occupied as living rooms or bedroom except those duly set aside for such purposes.
- c. The University reserves the right to set reasonable time, place and manner restrictions on all meetings, gatherings or get-togethers to assure that the most beneficial use of the buildings and grounds of the University is made and that there is no interference with the right of students to obtain an education.
- d. The use of University facilities should not imply an endorsement of any individual, group or organization and the name of the University shall not be identified in any way with the aims, policies, programs, products, or opinions of any individual, groups or organizations which may meet in University buildings or on University grounds in accordance with these regulations.

C. Use for Classrooms, Laboratories and Office Space

- 1. Assignment of space in University buildings for continuing use by division, departments or other units for use as research laboratories, offices or other specific purposes will be made by the Chancellor.
- 2. Assignment of classrooms and laboratories for scheduled classes and examinations will be made on a semester-by-semester basis by the Chancellor.
- 3. Members of the University faculty, staff or students who are assigned office space in a building on the campus, and who have been authorized to have a building exterior key, shall be authorized to use such assigned office space whenever their work may require such use.

D. Use by Recognized Student Groups

- 1. In addition to the general rules and procedures, the following rules apply to use of University facilities by student groups and individuals.
- 2. University buildings and grounds may be utilized and open to the public for appropriate activities and programs sponsored by an officially recognized student organization, provided that such programs are in accordance with the rules and regulations established by the Board of Curators for such events, and further, that the organization file a written request for approval of the activity or program at least ten days prior to the event. The Chancellor is authorized to make an exception to the ten day rule in special circumstances.
- 3. University buildings or grounds may not be used by student organizations or enterprises which declare a dividend among its members or from which members derive financial profit; but such student organizations or enterprises may use facilities under the same conditions as nonstudent groups.
- 4. It is recognized that from time to time ad hoc groups or students may wish to use University facilities for purposes of meetings for social events. Such groups may do so only by written permission of the Chancellor.

E. Use by Non-Student Individuals and Groups

1. In addition to the general rules and procedures specified above, the following rules apply to use of University facilities by non-student individuals and non-student groups; but this section of the regulations does not apply to official University public functions.

- 2. Persons who are not students or employees of the University, while on University property, are required to abide by University policies and regulations.
- 3. Persons who are not current students or employees of the University and who are on University property without specific permission or authorization or without an appropriate purpose may be deemed guilty of trespass. A person shall be deemed to be on University property "without specific permission or authorization" from and after such time as they are requested to leave the property. A person shall be deemed to be on University property "without an appropriate purpose" whenever their presence is not reasonably related to the University's educational function, or an approved University related extracurricular activity.
- 4. Use of available University facilities may be granted to nonstudent groups for meetings, programs and activities:
 - a. When the meeting, program and activity is sponsored by or the group is invited by an instructional or administrative division or department as a part of its educational program with the approval of the dean or the appropriate administrative officer of that division or department.
 - b. When sponsored by a learned, educational, professional, or scientific society for organizational or educational purposes when recommended by a dean or other appropriate administrative officer.
 - c. Other nonaffiliated and nonsponsored groups may make use of the facilities of the University upon written approval of the Chancellor.
- 5. Affiliated groups, as specified above in Section 110.010 E.4.a and E.4.b may be charged an approved fee.
- 6. Nonaffiliated, nonsponsored groups, as specified above in Section 110.010 E.4.c will be charged a fee approved by the Chancellor.
- 7. The Chancellor is authorized to establish specific procedures for scheduling and use of University facilities for all meetings of non-student groups to implement these regulations.

F. Sales, Solicitation, Collections and Advertising in University Buildings or on University Grounds

- 1. The sale of anything, the soliciting of subscriptions or the collection of dues is prohibited in the University buildings and upon University grounds without prior authorization of the Chancellor.
- 2. Recognized student organizations may not solicit subscriptions or collect dues from prospective students or guests of the University when such guests are in University buildings or on University grounds.

G. Cleaning and Decorations

- 1. **Cleaning** -- All debris must be removed from buildings and premises immediately following an event by the organization concerned. In case extraordinary cleaning is necessary by the University, the cost of such work shall be paid by the organization creating such a necessity. Any damage to a building or a loss of University owned material or equipment resulting from the use of a building by any organization shall likewise be charged to the responsible organization.
- 2. **Approval** -- No decorations shall be permitted in or on University buildings or grounds except as approved by the Business Officer.

- 3. **Fees** -- With the approval of the Chancellor, the Business Officer may establish an appropriate fee for use of University buildings by groups.
- 4. Any rules and regulations not in conformity herewith are hereby repealed.

H. University Equipment

- 1. Use of Equipment -- The use of University equipment by individuals or organizations for activities not directly connected with the University of Missouri shall be prohibited and no loan of University equipment shall be made to any individual or organization except where reciprocal use of property is involved such as the exchange of chairs between the University of Missouri and Stephens College.
- 2. Equipment to Remain on Property -- No University equipment may be taken from University property except where such equipment is to be used in the line of official duty.

110.010 Regulations

Bd. Regs. Book dated 12-10-49, pp. 70-76; Bd. Min. 7-22-65, p. 30,624; Bd. Min. 9-26-69, p. 34,751; Bd. Min. 5-18-73, p. 36,693; Amended Bd. Min. 11-19-82; Revised Bd. Min. 9-16-88.

A. **Facilities and Equipment** -- Unless otherwise specifically ordered by the Board, the President of the University may assign or reassign sites of the University for use by the University or any campus thereof. The use of sites assigned to the University shall be under the direction and control of the President. Sites assigned to a campus of the University shall be subject to the following regulations on use of facilities. Sites assigned to the University shall be subject to such regulations except that assignments or waivers provided for in such regulations shall be made by the President.

B. General Regulations

- 1. Written Permission of the Chancellor -- University buildings and grounds are intended for use by students, faculty and staff in support of the University's mission of research, instruction and extension. University buildings and grounds may not be used by individuals, groups or organizations not connected with the University except by written permission of the Chancellor and then, only in accordance with University rules and regulations. Where regulations require direction of the Chancellor, said regulations may be administered by Chancellors' designee(s).
- 2. **Permits** -- Written permits for the temporary use of University grounds, buildings or rooms therein for any purpose other than regularly scheduled classroom work must be secured in advance from the Chancellor.
- 3. **Religious Services or Groups** -- No advantage shall be given to any religion or religious group.
- 4. **Requirements** -- All classes, meetings or assemblages and use by individuals of any sort held in University buildings or on University grounds are subject to applicable U.S. and Missouri laws and University requirements, rules and regulations. In addition, it is expected that proper care will be taken of the facility and that simple rules of courtesy, decency and good manners will be observed at all times. Any failure to abide by these requirements may cause the permission for the use of the facility to be withdrawn at any time, or for future permission for use of any University facilities to be denied.
 - a. The possession of and discharge of firearms, weapons and explosives on University property including University farms is prohibited except in regularly approved programs or by University agents or employees in the line of duty.
 - i. Notwithstanding any other provision of these regulations, a state employee, including a University employee, may have a firearm in the employee's vehicle provided the vehicle is locked and the firearm is not visible. This subsection shall only apply to the University as an employer when the employee's vehicle is on property owned or leased by the University and the employee is conducting activities within the scope of his or her employment.

- b. No University building, or part thereof, or grounds may be occupied as living rooms or bedroom except those duly set aside for such purposes.
- c. The University reserves the right to set reasonable time, place and manner restrictions on all meetings, gatherings or get-togethers to assure that the most beneficial use of the buildings and grounds of the University is made and that there is no interference with the right of students to obtain an education.
- d. The use of University facilities should not imply an endorsement of any individual, group or organization and the name of the University shall not be identified in any way with the aims, policies, programs, products, or opinions of any individual, groups or organizations which may meet in University buildings or on University grounds in accordance with these regulations.

C. Use for Classrooms, Laboratories and Office Space

- 1. Assignment of space in University buildings for continuing use by division, departments or other units for use as research laboratories, offices or other specific purposes will be made by the Chancellor.
- 2. Assignment of classrooms and laboratories for scheduled classes and examinations will be made on a semester-by-semester basis by the Chancellor.
- 3. Members of the University faculty, staff or students who are assigned office space in a building on the campus, and who have been authorized to have a building exterior key, shall be authorized to use such assigned office space whenever their work may require such use.

D. Use by Recognized Student Groups

- 1. In addition to the general rules and procedures, the following rules apply to use of University facilities by student groups and individuals.
- 2. University buildings and grounds may be utilized and open to the public for appropriate activities and programs sponsored by an officially recognized student organization, provided that such programs are in accordance with the rules and regulations established by the Board of Curators for such events, and further, that the organization file a written request for approval of the activity or program at least ten days prior to the event. The Chancellor is authorized to make an exception to the ten day rule in special circumstances.
- 3. University buildings or grounds may not be used by student organizations or enterprises which declare a dividend among its members or from which members derive financial profit; but such student organizations or enterprises may use facilities under the same conditions as nonstudent groups.
- 4. It is recognized that from time to time ad hoc groups or students may wish to use University facilities for purposes of meetings for social events. Such groups may do so only by written permission of the Chancellor.

E. Use by Non-Student Individuals and Groups

1. In addition to the general rules and procedures specified above, the following rules apply to use of University facilities by non-student individuals and non-student groups; but this section of the regulations does not apply to official University public functions.

- 2. Persons who are not students or employees of the University, while on University property, are required to abide by University policies and regulations.
- 3. Persons who are not current students or employees of the University and who are on University property without specific permission or authorization or without an appropriate purpose may be deemed guilty of trespass. A person shall be deemed to be on University property "without specific permission or authorization" from and after such time as they are requested to leave the property. A person shall be deemed to be on University property "without an appropriate purpose" whenever their presence is not reasonably related to the University's educational function, or an approved University related extracurricular activity.
- 4. Use of available University facilities may be granted to nonstudent groups for meetings, programs and activities:
 - a. When the meeting, program and activity is sponsored by or the group is invited by an instructional or administrative division or department as a part of its educational program with the approval of the dean or the appropriate administrative officer of that division or department.
 - b. When sponsored by a learned, educational, professional, or scientific society for organizational or educational purposes when recommended by a dean or other appropriate administrative officer.
 - c. Other nonaffiliated and nonsponsored groups may make use of the facilities of the University upon written approval of the Chancellor.
- 5. Affiliated groups, as specified above in Section 110.010 E.4.a and E.4.b may be charged an approved fee.
- 6. Nonaffiliated, nonsponsored groups, as specified above in Section 110.010 E.4.c will be charged a fee approved by the Chancellor.
- 7. The Chancellor is authorized to establish specific procedures for scheduling and use of University facilities for all meetings of non-student groups to implement these regulations.

F. Sales, Solicitation, Collections and Advertising in University Buildings or on University Grounds

- 1. The sale of anything, the soliciting of subscriptions or the collection of dues is prohibited in the University buildings and upon University grounds without prior authorization of the Chancellor.
- 2. Recognized student organizations may not solicit subscriptions or collect dues from prospective students or guests of the University when such guests are in University buildings or on University grounds.

G. Cleaning and Decorations

- 1. **Cleaning** -- All debris must be removed from buildings and premises immediately following an event by the organization concerned. In case extraordinary cleaning is necessary by the University, the cost of such work shall be paid by the organization creating such a necessity. Any damage to a building or a loss of University owned material or equipment resulting from the use of a building by any organization shall likewise be charged to the responsible organization.
- 2. **Approval** -- No decorations shall be permitted in or on University buildings or grounds except as approved by the Business Officer.

- 3. **Fees** -- With the approval of the Chancellor, the Business Officer may establish an appropriate fee for use of University buildings by groups.
- 4. Any rules and regulations not in conformity herewith are hereby repealed.

H. University Equipment

- 1. Use of Equipment -- The use of University equipment by individuals or organizations for activities not directly connected with the University of Missouri shall be prohibited and no loan of University equipment shall be made to any individual or organization except where reciprocal use of property is involved such as the exchange of chairs between the University of Missouri and Stephens College.
- 2. Equipment to Remain on Property -- No University equipment may be taken from University property except where such equipment is to be used in the line of official duty.

Project Approval Subsurface Parking Garage Missouri University of Science & Technology

The Missouri University of Science and Technology requests Project Approval for the Subsurface Parking Garage project. The total project budget of \$10,227,630.00 is funded by gifts.

The proposed subsurface parking garage will provide convenient and accessible parking at the new arrival court for visitors to campus while reserving prime campus real estate for future development of academic and research facilities. This parking structure will support visitor parking for Havener Center, Student Experience Center, and the future Welcome Center. Other options for parking are located on the west side of Bishop Avenue (US Highway 63). The proposed parking structure is an integral component of the arrival court that is formed at the new campus entrance created by the realignment of University Drive and the construction of the new roundabout on Bishop Avenue.

The subsurface parking garage will be located in the new arrival court immediately south of Havener Center, east of US Highway 63, west of State Street, and north of Bertelsmeyer Hall in the heart of campus. The site takes advantage of the depressed grade area between the Rolla building and the new entrance being created to campus. The parking garage will accommodate parking for a minimum 130 vehicles; the design/build process will be used to optimized the maximum number of parking spaces. Two pedestrian area ways will exit the structure with an elevator at one location exiting into the center of the events plaza between the new Student Experience Center and the future Welcome Center. The top of the garage will accommodate the appropriate drainage for landscaping, and shall be structurally capable of accommodating emergency vehicles on the hardscape pedestrian walkway. Mechanical ventilation, fire suppression system, security cameras and lighting will be provided as well as a climate-controlled area for the elevator.

The project is scheduled to be completed in May 2023. The project will be delivered as a Design/Build project. The Design/Build team will be selected through a competitive process with the project design being submitted to the Board of Curators in May 2022.

No. 7

Recommended Action - Project Approval, Subsurface Parking Garage, Missouri S&T

It was recommended by Chancellor Dehghani, endorsed by President Choi, recommended by the Finance Committee, moved by Curator ______ and seconded by Curator ______, that the following action be approved:

the project approval for the Subsurface Parking Garage, Missouri S&T Funding of the project budget is from: Gifts \$10,227,630 **Total Funding** \$10,227,630 Roll call vote Finance Committee YES NO **Curator Graves** Curator Hoberock Curator Layman The motion . Roll call vote Full Board: YES NO **Curator Brncic** Curator Chatman **Curator Graham Curator Graves** Curator Hoberock Curator Holloway Curator Layman Curator Wenneker **Curator Williams** The motion .

ACADEMIC, STUDENT AFFAIRS, RESEARCH AND ECONOMIC DEVELOPMENT COMMITTEE

Todd P. Graves (Chair) Greg E. Hoberock Jeff L. Layman Robin R. Wenneker

The Academic, Student Affairs, Research and Economic Development Committee ("Committee") will review and recommend polices to enhance quality and effectiveness of academic, student affairs, research and economic development and align the available resources with the University's academic mission.

I. Scope

In carrying out its responsibilities, the Committee reviews and makes recommendations to the Board of Curators on strategies and policies relating to student and faculty welfare, academic standards, educational and instructional quality, intercollegiate athletics, degree programs, economic development, research initiatives, and associated programs.

II. Executive Liaison

The Senior Associate Vice President for Academic Affairs of the University, or some other person(s) designated by the President of the University, with the concurrence of the Board Chair and the Committee Chair, shall be the executive liaison to the committee and responsible for transmitting committee recommendations.

III. Ex Officio Member

The Student Representative to the Board of Curators shall be an ex officio member of the Committee.

IV. Responsibilities

In addition to the overall responsibilities of the Committee described above and in carrying out its responsibilities, the charge of the Committee shall include reviewing and making recommendations to the Board on the following matters:

- A. Selection of Curators' Distinguished Professors;
- B. Approval and review of new degree programs;
- C. Intercollegiate athletics, as specifically outlined in Section 270.060 of the Collected Rules and Regulations with a commitment to the academic success, and physical and social development of student-athletes;
- D. Changes to university-level admissions requirements, academic standards, student services, and graduation requirements;
- E. Quarterly and annual reports providing information on academic programs that have been added, deactivated, or deleted;
- F. Provide oversight over the University of Missouri System's diversity, equity and inclusion programs;
- G. Highlight successful research and economic development efforts and partnerships; linking research and commercialization from the University with business and industry across the state and around the world.
- H. Additional matters customarily addressed by the academic, student affairs, research & economic development committee of a governing board for an institution of higher education.

Approved by the Board of Curators: Feb 4, 2021

Executive Summary Intercollegiate Athletics Annual Reports

Pursuant to Collected Rule and Regulation (CR&R) 270.060 (E) relating to Campus Athletic Directors and Compliance Officers, the attached reports for the 2020-2021 academic year from each of the four UM universities is submitted for your information. Each report includes information relating to student-athlete admissions exceptions, academic progress of student-athletes, graduation rates by sport, financial performance, and other comments. More detailed information relating to each report can be found in the appendix of this section.

The Campus Athletic Directors will be available during the Board of Curators meeting to answer any questions you have regarding the contents of these reports.



Office of the Chancellor

October 28, 2021

Mun Y. Choi, Ph.D. President University of Missouri System 105 Jesse Hall Columbia, MO 65211

Dear Dr. Choi:

This letter serves as the 2020-21 annual Athletics report required by CRR 270.060 (E). More specifically, this letter summarizes data provided per subparts of CRR 270.060 (E) (1) through (5).

- Rates of admissions exceptions for Athletics as compared to campus admissions 1. exceptions.
 - Admissions for student-athletes are handled in the same manner as the general student body. Athletics does not request admission exceptions. There were four admission exceptions for student-athletes as compared to 31 for the general student body. Studentathletes represented 12.90% of the total student body with admissions exceptions.
- 2. Academic progress rates by sport, as defined by the NCAA if applicable.
 - NCAA Division II does not have Academic Progress Rates.
 - NCAA Division II does have a different measure, Academic Success Rates, which are . included on the attached report showing an 80% academic success rate for studentathletes.

Graduation rates by sport, as defined by the NCAA if applicable. 3.

- Graduation rates for student-athletes continue to be significantly higher than the general • student body. For the 2014 cohort, student-athletes were at 76% graduation rate while the general study body was at 65%.
- See attached report for disaggregated graduation rates data by sport.
- Financial performance of all operations of the Department of Intercollegiate Athletics. 4. There were a number of decreased income and expenses in the annual budget that occurred due to the COVID-19 pandemic. Athletic teams played reduced schedules resulting in a decrease in expenses for the 2020/21 year. Hiring freezes prevented several positions from being filled also reducing overall expenses due to budget cuts. Expenses that exceeded the annual budget were covered by Athletics through fiscal closing and gift/sponsorship accounts. Balance of fiscal closing was retained by athletics to offset additional expenses that would be incurred during the 2021/22 year when teams resumed full playing schedules.

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206 Parker Hall | 300 West 13th Street | Rolla, MO 65409-0910 | 573-341-4114 | chancellor@mst.edu | mst.edu

OPEN – ASARED – INFO – 1-2

November 18, 2021
Mun Y. Choi, Ph.D. Page 2 October 26, 2020

The following financial support was also secured in athletics in 2020/21.

- \$14,298 was fundraised by the Academy of Miner Athletics for COVID related expenses.
- \$34,500 was donated by John & Kristie Gibson, Steve Malcolm, and Keith Bailey for lost ticket revenue due to no spectators at home competitions.
- \$214,483 was fundraised by each sport program and through general athletics.

5. Those items as the President may from time to time direct be added to the annual reports.

- Missouri S&T has a national ranking of seventh all-time in NCAA Division II in the number of Academic All-America honors.
- 1 Great Lakes Valley Conference (GLVC) Team Championship in Men's Outdoor Track & Field
- 1 NCAA Elite 90 Winner for Division II men's Swimming
- 232 GEICO Academic All-GLVC Honorees
- 41 GLVC Distinguished Scholar-Athletes
- 30 All-GLVC Selections
- 10 GLVC Academic Excellence Awards
- 10 GEICO Team Academic Awards
- .13 CSCAA Scholar All-America Honorees
- 5 Swimming All-America Honorees
- 5 USTFCCCA All-Region Honorees (men's track & field)
- 1 GCAA All-Region Honoree (men's golf)
- 12 GLVC Player of the Week Selections
- 9 CoSIDA Academic All-District Selections
- 6 CoSIDA Academic All-America Selections
- 2 GLVC Scholar-Athletes of the Year
- 3 GCAA All-America Scholars (men's golf)
- 5 NFCA/Easton All-America Scholar Honorees (softball)

Sincerely,

Mo. Dehghabi, Ph.D. Chancellor

MMD:chg Attachments

cc: UM System Academic Affairs

UMSL Chancellor

401 Woods Hall One University Boulevard St. Louis, MO 63121, USA 1-314-516-5252 chancellor@umsl.edu

October 27, 2021

Mun Y. Choi, Ph.D. President University of Missouri System 105 Jesse Hall Columbia, MO 65211

Dear Dr. Choi,

This letter serves as the 2020-21 annual athletics report required by CRR 270.060 (E). More specifically, this letter summarizes data provided per subparts of CRR 270.060 (E) (1) through (5).

1. Rates of admissions exceptions for Athletics as compared to campus admissions exceptions.

At the University of Missouri-St. Louis the admission exceptions are consistently 80% or higher for the general population as compared to Intercollegiate Athletics. Rationale includes:

- Requirements of the NCAA for a prospective student-athlete and the core courses they must successfully complete while in high school establishes a strong baseline for admissions.
- Coaches are recruiting earlier in each cycle; therefore, prospective students have time to meet university standards and not qualify for an exception (i.e. Standardized Test Scores retake, summer school courses in a junior college).

2. Academic success rate by sport: Cohort is from 2014-2015

Academic success rates include your first-time freshman and all transfer students.

- Overall academic success rate for the entire department is 83%
- Tendencies are the female sports success rates are higher. 91% versus 77%
- Comprehensive plan from the Academic Coordinator for Athletics to each student and coach allows a true plan to earn a diploma. Students do not get lost within a very complex system of degrees and NCAA restrictive rules.
- Individual sports (tennis, and golf) are consistently higher than team sports.
- Flagging system within the university communicates earlier in each semester students who are struggling and need additional academic support or intervention.
- Monthly meeting between the FAR, Associate Director and Assistant Director for Academics to discuss and strategize plans for students identified as concerns.

3. Graduation rate by sport, as defined by the NCAA:

- Graduation rates are based only on first time, full time freshman.
- Cohorts for each UMSL sport of true freshman are very small
- Overall 72% graduation rates for athletics compared to 52% of all students.

4. Financial performance of all operations of the Department of Intercollegiate Athletics.

- Abbreviated seasons for all sports which led to an overall reduction of budgets. • Lost 2 student-athletes due to COVID op-outs for 2020-2021.
- Reduced sport sponsorship engagements and facility rentals has impacted the overall revenue streams to the department. Loss of ticket and concession revenues due to no fans.
- COVID testing supplies and operation led to an unanticipated \$50,000 in expense.

5. Substantive Issues and Plans for resolving / addressing such issues

- Overall winning percentage of the program is .605
- Overall grade point average of the 17 sports is 3.45 (Highest ever)
- 150 students achieved Academic All-GLVC Accolades with a cumulative grade point of 3.3 or above.
- Addition of an appointed staff person from Advancement to work on alumni and fundraising activities for athletics.
- Men's and women's cross country and track and field in the first season of training and competition.
- Secured funding for the renovation of current study hall area in the Mark Twain • Building.
- 6. Plans
- **COVID 19 Requirements** •
 - Working with local, state and University guidelines or protocols
 - Working with conference and NCAA requirements or recommendations
 - Resocialization of sports to provide safe environments for student-athletes and coaches.
- Enhancements •
 - Incorporating first year students from the Sport Management Degree Program 0 to provide game day support and oversight. Working with student interns to create marketing/promotions events.
 - Web streaming and digital productions (Working with interns from the 0 business schools, communications department to offset requirements.
 - Increase of 10% the student-athlete population for 2021-2022 0
 - Renovated the tennis courts, and newly designed basketball/volleyball court 0 Summer 2021
 - o Life Skill programming for all student athletes continued through virtual training.

Sincerely,

visti Sobolie

Kristin Sobolik Chancellor



October 29, 2021

Mun Y. Choi, Ph.D. President University of Missouri System 321 University Hall Columbia, MO 65211

Dear Dr. Choi,

This letter serves as a brief summary of the 2020-21 data provided in the annual athletics report required by CCR 270.060 (E). More specifically, this letter summarizes data provided per subparts (a) through (E) of CCR 270.060 (E).

a. Rates of admissions exceptions for Athletics as compared to campus admissions exceptions.

There were 801 student admissions exceptions made, 21 of which were made for student-athletes.

b. Academic Progress Rates (APR) by sport, as defined by the NCAA, if applicable.

The NCAA's APR is a measurement of eligibility and retention. As determined by the NCAA all varsity teams are evaluated and need to meet the minimum multi-year threshold score of 930. The maximum score a team can achieve is 1000. The APR score is a four year average.

All of Kansas City Athletics teams scored above 960. Men's basketball scored 966, while women's basketball scored 986 and volleyball scored 995. Women's soccer scored 993 and men's soccer scored 982. Women's tennis scored 991. Complete APR details can be found in the attached annual athletics report (spreadsheet).

c. Graduation Success Rate (GSR) by sport, as defined by the NCAA if applicable.

There are two main metrics used to track student-athlete graduation rates, the Federal Graduation Rate (FGR) and the Graduation Success Rate (GSR). Both methods analyze the percentage of students who complete a BA/BS within a six year time frame. The FGR counts all transfers as academic failures, however the GSR calculation allows for transfers in and out. In the GSR calculation, student-athletes who depart a school while in good academic standing (meetings the NCAA's Progress Towards Degree standards) are passed from one school's cohort to another school's cohort.

For 2020-21 Kansas City's GSR was 96%, above the NCAA average. The federal rate was 69% for student-athletes and 51% for UMKC students. The GSR for men's basketball was 100%, while women's basketball scored 100%. Three of Kansas City's teams scored 100%, and 8/8 teams were at 80% and higher. Complete GSR details can be found in the attached annual athletics report (spreadsheet).

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d. Financial performances of all operations of the Department of Intercollegiate Athletics.

The department had a total expense sum of \$10,385,035 for Fiscal Year 2021. Overall, the department's change in net assets was \$1,981,743, which exceeded both the FY21 budget as well as prior year actuals. In the area of sponsorships, the department fell short of its goal, however sponsorships significantly increased from the previous years. In FY21 sponsorships reached \$323,836. Gift revenue reached \$1,017,439, exceeding the previous year by more than double. More detailed information regarding the budget and financial picture can be found in the attached annual athletics report.

e. Those items as the President may from time to time direct be added to the annual reports.

Academic Highlights:

Kansas City Athletics continues to produce strong results in the classroom. The cumulative GPA for student-athletes rose to 3.41 after the spring semester, with 10 of 10 teams achieving a GPA above 3.0. Leading the way in GPA was women's soccer at 3.63, followed closely by women's tennis at 3.60, and men's golf at 3.46. The Graduation Success Rate also continued to climb, reaching 96%. The department's cumulative APR of 980.

Inclusion Highlights:

Kansas City Athletics continues to engage the urban core; however, service hours have been limited this past year as a result of COVID-19. Our Department and Teams continue to engage virtually and in outdoor settings with the Boys and Girls Club, Turn the Page KC, Children's Mercy Hospital, and several local elementary schools. The department also participated Title IX training from Dr. Sybil Wyatt, former Director of Affirmative Action. We also provided mental health training to all 10 of our sports teams, and engaged all new student-athletes in Step UP! bystander intervention training. In line with new NCAA regulations, we designated a new position within our staff of a Diversity, Equity and Inclusion Officer, this individual will guide programming for both staff and student-athletes.

Leadership Highlights:

Dr. Brandon Martin continued his impressive elevation of Kansas City Athletics throughout 2020-21. He continued to prioritize the external unit, and focus on securing revenue while enhancing the Athletic Department's relevance within the region. The Roo Athletic Fund continued to grow its membership, while the department secured new major strategic partnerships with Truman Medical Center and Evergy. In the season of a global pandemic, fundraising efforts surpassed the million-dollar mark under Martin's leadership, with seven multi-year pledges signed. Kansas City Athletics continued to solidify its brand by unveiling facility improvements to the interior and exterior of the Swinney Center, and also updated the Durwood Soccer Field with a new field.

As a result of COVID several strategic decisions were made to ensure the future proofing of the Department, including the suspension of Men's and Women's Cross Country, and Indoor and Outdoor Track and Field. The decision along with the reduction in staffing providing the department the ability to end the fiscal year with a positive change in net assets.

Athletic Highlights:

Competitively Kansas City Athletics competed well during COVID-19. Men's Soccer Head Coach, Ryan Pore, was named Summit League Coach of the Year. Men's Basketball improved to .500 in Conference play, with significant wins over Oral Roberts, the Summit League team that advanced to the Sweet 16 of the NCAA Tournament.

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Volleyball, led by Christi Posey, won 11 games in-a-row, the longest winning streak since 2014. Softball, led by Kerry Shaw, defeated ranked no. 6 Oklahoma State and finished their season with a winning record. Several individual student-athletes earned awards including Men's Basketball player Brandon McKissic, earning conference Defensive Player of the Year, and Volleyball player Melanie Brecka earning conference Offensive Player of the Year.

We are hopeful that this information is helpful to you and to the Board of Curators. Please feel free to contact me for any additional questions you may have.

Sincerely,

C. Mauli Agrawal, Ph.D. Chancellor

Enclosures: Annual Athletic Department Report 2020-21 – Kansas City

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October 19, 2021

Darryl Chatman Board of Curators Board of Curators Office 316 University Hall Columbia, MO 65211

Dear Mr. Chatman,

This letter serves as the 2020-2021 annual athletics report required by CRR 270.060 (E). More specifically, this letter summarizes data provided per subparts of CRR 270.060 (E) (1) through (5).

1. Rates of admissions exceptions for Athletics as compared to campus admissions exceptions.

There were 388 student admissions exceptions made, 30 of which (7.7%) were made for studentathletes. Complete details can be found in the attached annual athletics report (spreadsheet).

2. Academic progress rates ("APR") by sport, as defined by the NCAA, if applicable.

NCAA rules require each sport to have an APR rate above 930 in order to avoid penalties. All women's team APR rates were above 991 while all men's team APR rates were above 962. The Football team APR was 977, while the Men's Basketball team APR was 974. Complete APR details can be found in the attached annual athletics report (spreadsheet).

3. Graduation rates by sport, as defined by the NCAA if applicable.

There are two main metrics used to track student-athlete graduation rates, the Federal Graduation Rate ("FGR") and Graduation Success Rate ("GSR"). Both methods analyze the graduation rates from freshmen cohorts over a four-year period, beginning ten years prior. For example, the most recent 2020-2021 FGR and GSR rates are generated by looking at the freshmen cohorts from 2011-2012, 2012-2013, 2013-2014 and 2014-2015. The primary difference between the two metrics is that the FGR does not take into account transfers into or from any cohort, while the GSR does. For 2020-2021, the FGR was 61 percent and the GSR (four-year cohort) was 85 percent. The GSR for the Football team was 77 percent, while the Men's Basketball team was at 67 percent. Complete graduation rate details can be found in the attached annual athletics report (spreadsheet).

4. Financial performance of all operations of the Department of Intercollegiate Athletics.

The department had a \$3.5M operational budget deficit in 2020-2021. More detailed information regarding the budget and financial picture can be found in the attached annual athletics report (spreadsheet).

5. Those items as the President may from time to time direct be added to the annual reports.

Academic Highlights:

- 110 student-athletes graduated.
- Mizzou student-athletes achieved a fall-record tying GPA of 3.18 and a spring semester mark of 3.21.
- 14 teams achieved record-setting GPA marks in either the fall or winter semester.
- 410 student-athletes were recognized on their respective Dean's List.
- 324 student-athletes achieved a 3.0 or higher GPA in fall 2020 with 334 earning the mark in spring 2021.
- 344 student-athletes earned SEC Honor Roll recognition.
- Sixteen of Mizzou's 18 programs registered a team grade-point average of 3.00 or above for the Spring 2021 semester and eight established a program record for the term, as 66 percent of Mizzou's student-athletes had a spring GPA of 3.00 or better.
- Mizzou had 307 student-athletes named to the 2020-2021 SEC Academic Honor Rolls and came within one student (206) of breaking the department record for Dean's List honorees set just last year.
- The Men's and Women's Cross Country teams received the 2020 NCAA Division-I All-Academic Team honors and Sarah Chapman and Kieran Wood each received the All-Academic Individual distinction.
- The Men's and Women's Track and Field teams received the 2021 USTFCCCA All-Academic team honor and three individual Track and Field athletes earned All-Academic Individual Recognition: Jacob Brunsman, Thomas George, and Erin Zimmerman.
- Mizzou Volleyball was recognized for its collective success in the classroom for the eighth year in a row with the 2020-2021 AVCA Team Academic Award.
- Three members of the Wrestling team earned Academic All-MAC honors: Jarrett Jacques, Peyton Mocco, and Noah Surtin.
- Nine members of the Mizzou Gymnastics squad earned Scholastic All-America recognition. Chelsey Christensen was recognized for the fourth time in her career while Alisa Sheremeta earned the honor for the third time. Kambrie Brandt, Lauren Clevenger, Adalayna Hufendiek, Anna McGee and Sienna Schreiber all picked up their second Scholastic All-America honors. Rounding out the nine Tigers to garner accolades were Kyra Burns and Hollyn Patrick.
- Over 20,000 tutoring appointments were scheduled for our student-athletes to aid in understanding their course material, over 7,500 mentoring appointments were scheduled to enhance student-athletes' study skills and assist with time management

Student-Athlete Development Highlights:

- More than 500 hours were spent aiding student-athletes in the career center with assessments, resumes, mock interviews, personal branding, and career coaching sessions.
- Mizzou student-athletes spent over 1,700 hours volunteering with over 70 different organizations virtually, in Columbia, and the surrounding communities.
- Carter Grimes (Men's Swim and Dive) and Amanda Smith (Women's Swim and Dive) were both finalists for the SEC Boyd McWhorter Postgraduate Scholarship earning \$10,000 postgraduate scholarships.

- Canten Marriott (Wrestling) and Morcquess Oliphant (Soccer) were both finalists for the SEC Brad Davis Community Service Award earning \$5,000 postgraduate scholarships.
- Oliphant was also selected for the 2021 Arthur Ashe Jr. Sports Scholars fourth team and honored with the AD Leadership Award.
- Grimes and Momola Adesanmi (Soccer) were named to the MU Letter Winners Club.
- Gabby Goldin (Tennis) was awarded the NCAA Ethnic Minority & Women's Enhancement Scholarship.

Inclusion Highlights:

- Athletics and other university staff, and student-athletes traveled to five St. Louis Public Schools on September 28 to host the Mizzou Youth Experience and provide academic learn shops for sixth grade underserved and underrepresented youth who were not able to travel to Mizzou's campus due to pandemic-related restrictions in fall 2021. A similar trip is planned to Kansas City on October 19.
- A Mizzou4Change Speaker Series was initiated, inviting iconic sports figures (1968 Olympian, John Carlos and five-time Olympic Medalist, Jackie Joyner-Kersee) to engage in a social justice discussion about their sports/lived experience hosted and moderated by Mizzou student-athletes.
- Through MACIE (Mizzou Athletics Committee on Inclusive Excellence), served as Inclusive Excellence liaisons and participated in a series of Campus Community Discussions centered on the ACE Reports hosted by Mizzou Division of Inclusion, Diversity and Equity (IDE).
- MACIE hosted an onboarding celebration for over 40 new hires providing each new employee an onboarding commemorative gift box. Various speakers and presentations were provided to make all employees feel welcomed and valued.
- An SEC Diversity Database was developed for use as a networking resource to assist with increasing candidate pools for open positions.
- An initial team diversity and inclusion education and training workshop was created and initiated for Gymnastics (model for other teams and staff IDE education).
- On-going education and awareness of inclusive topics relative to multiple identities of studentathletes continues to be provided through Student Athletes Fostering Equality (S.A.F.E.).
- Athletics highlighted Black Women In Sports through social media posts, graphics and videos highlighting and recognizing athletics, soccer and track and field contributions during the national Juneteenth celebration.

Outreach and Engagement Highlights:

- Mizzou Athletics continues to partner City of Columbia Parks & Recreation Department to host meets at the nationally renowned Gans Creek Cross Country Course, including Mizzou regular season competitions, the 2021 SEC Championship and meets involving local youth, high school and college teams. There is a five-year, ongoing agreement to host the Missouri state high school championships and the 2025 NCAA national championship was awarded to the community along with the 2022 NCAA regional competition.
- Athletics continues to have a representative on the Columbia Sports Commission, working to bring events to Columbia benefitting the entire community.

- A Policing Initiative pilot study was developed; designed to create community and dialogue with Mizzou student-athletes, and the MU and Columbia police departments.
- Mizzou Athletics again partnered with Mizzou Greek Life to have an Athletics Ambassador within each sorority and fraternity and teamed with Residential Life to simplify the sign-up process for a student all-sports pass, resulting in an increase of nearly 500 sold in 2021 over 2019.
- The partnership with MU Extension Services has seen our Ambassador volunteer program grow to nearly 100 individuals covering 96 of the state's 115 counties, and we again partnered with them on a state-wide healthy eating campaign featuring Mizzou student-athletes.

Athletic Highlights:

- Mizzou finished 48th in the final 2020-21 Learfield Directors' Cup standings, marking the 16th time in the awards' 28-year history the Tigers finished inside the top 50.
- Despite the immense challenges of playing during the COVID-19 pandemic, Mizzou saw a schoolrecord 18 teams represented in the 2020-2021 postseason and six finish among the nation's Top 25 at season's end in Wrestling (T-7th at 2021 NCAA Championships), Softball (No. 8, NCAA Super Regional), Women's Gymnastics (No. 14), Men's Swimming and Diving (No. 16 at 2021 NCAA Championships), Women's Swimming and Diving (18th at 2021 NCAA Championships) and Volleyball (No. 25).
- Ten Mizzou teams earned Top-25 status during the year, including Football's appearance at No. 25 in the Dec. 7 College Football Playoff (CFP) Top 25 and Men's Basketball's 11-straight weeks in the AP listing, reaching a high of No. 10.
- The department welcomed two new head coaches including women's soccer Stefanie Golan who was hired on May 20, 2021, after leading Minnesota and Army to five NCAA tournament appearances and conference championships, and tennis' Chris Wootton had the interim tag removed on May 11, 2021, after joining the Tigers as an associate head coach in August 2019. Wootton guided Bronte Murgett to the first NCAA Championship win in program history last season.
- Mizzou was represented at the 2020 Tokyo Olympics by four alumni who represented four different countries – Karissa Schweizer (United States - Track/Cross Country), Fabian Schwingenschlögl (Germany - Swim/Dive), Mikel Schreuders (Aruba – Swim/Dive), Ian Kinsler (Israel - Baseball).
- Wrestling won its 10th-straight conference title.
- Mizzou had 36 All-SEC performers and 19 All-Americans in 2020-2021 across 11 sports, including two conference freshman of the year honorees in Jenna Laird (Softball) and Keegan O'Toole (Wrestling).
- Desiree Reed-Francois was named Mizzou's Director of Athletics on Aug. 8, 2021. She is the first female athletic director in MU history and the first female athletic director in a public institution in the SEC.

We are hopeful that this information is helpful to you and to the Board of Curators. Please feel free to contact me for any additional questions you may have.

Sincerely,

The y choi

Dr. Mun Choi President and Chancellor University of Missouri

Enclosures:

Annual Athletic Department Report 2020-21 - Missouri - Columbia

Appendices Intercollegiate Athletics – Additional Information

Appendix A: Missouri University of Science and Technology (p. 15-23)
Appendix B: University of Missouri – St. Louis Intercollegiate Athletics (p. 24-30)
Appendix C: University of Missouri – Kansas City Intercollegiate Athletics (p. 31-37)
Appendix D: University of Missouri – Columbia Intercollegiate Athletics (p. 38-44)

2020/2021 ANNUAL REPORT Department of Intercollegiate Athletics Missouri S&T

List of Sponsored Sports

Instructions: Check all that apply. Add sports as needed.

Men's Sports

- _X__Baseball
- _X__Basketball
- _X__Cross Country
- _X__Football
- _X__Golf
- _X__Indoor Track & Field
- _X__Outdoor Track & Field
- ___Rifle
- _X__Soccer
- _X__Swimming & Diving SWIMMING ONLY
- ____Wrestling

Women's Sports

- _X__Basketball
- _X_Cross Country
- _X__Golf
- ___Gymnastics
- _X__Indoor Track & Field
- _X_Outdoor Track & Field
- ____Rifle
- _X__Soccer
- _X__Softball
- ____Swimming & Diving
- ____Tennis
- X__Volleyball

BASEBALL

Athletic Accomplishments

- Qualified for the GLVC Tournament for the sixth consecutive time.
- Michael Ward named to All-GLVC second team; also broke the program's single season home run record.
- Team has tied or set seven school records during the season.

Academic Accomplishments

- 27 student-athletes recognized as GEICO Academic All-GLVC Honorees
- 4 GLVC Brother James Gaffney Distinguished Scholar Award (4.0 GPA for academic year)
- 3 GLVC Council of Presidents Academic Excellence Award (3.5 Cum GPA with no eligibility remaining)
- GLVC Team Academic Award (3.3 GPA entire Year)
- 2 CoSIDA Academic All-District
- 1 CoSIDA Academic All-American

MEN'S BASKETBALL

Athletic Accomplishments

- Defeated Drury in Springfield and swept the season series from the Panthers for the first time since the 1976-77 season.
- Julien Smith named to GLVC All-Freshman team.

Academic Accomplishments

- 5 student-athletes recognized as GEICO Academic All-GLVC Honorees
- 1 GLVC Brother James Gaffney Distinguished Scholar Award (4.0 GPA for academic year)

MEN'S CROSS COUNTRY

Athletic Accomplishments

- Qualified for A-race (top eight teams) at GLVC Championships.
- Andrew Lofgren, GLVC Scholar-Athlete of the Year

Academic Accomplishments

- 8 student-athletes recognized as GEICO Academic All-GLVC Honorees
- 2 GLVC Brother James Gaffney Distinguished Scholar Award (4.0 GPA for academic year)
- 1 CoSIDA Academic All-District

FOOTBALL

- Athletic Accomplishments
- Finished 2-1 in shortened spring season.
- Had four players named as GLVC players of week.

Academic Accomplishments

- 36 student-athletes recognized as GEICO Academic All-GLVC Honorees
- 6 GLVC Brother James Gaffney Distinguished Scholar Award (4.0 GPA for academic year)
- 2 CoSIDA Academic All-District
- 2 CoSIDA Academic All-American

MEN'S GOLF

Athletic Accomplishments

- Team qualified for GLVC match play competition with a top-four finish at the GLVC Championships.
- Carl Miltun was GLVC medalist, named as GLVC Freshman of Year and All-GLVC and qualified for NCAA Centra/Midwest Regional tournament.

-1 GCAA All Region Honoree

Academic Accomplishments

- 8 student-athletes recognized as GEICO Academic All-GLVC Honorees
- 1 GLVC Brother James Gaffney Distinguished Scholar Award (4.0 GPA for academic year)
- GLVC Team Academic Award (3.3 GPA entire Year)
- 3 GCAA All-America Scholars

MEN'S SOCCER

Athletic Accomplishments

- Jason Jorgensen named to All-GLVC third team.
- Defeated Rockhurst in Kansas City for just the second time in program history.

Academic Accomplishments

- 24 student-athletes recognized as GEICO Academic All-GLVC Honorees
- 6 GLVC Brother James Gaffney Distinguished Scholar Award (4.0 GPA for academic year)
- 1 GLVC Council of Presidents Academic Excellence Award (3.5 Cum GPA with no eligibility remaining)
- GLVC Team Academic Award (3.3 GPA entire Year)
- 1 CoSIDA Academic All-District
- 1 CoSIDA Academic All-American

SWIMMING

Athletic Accomplishments

- Team finished fourth at GLVC Championships and $\mathbf{13}^{\mathrm{th}}$ at NCAA Division II Championships.
- Andy Huffman won GLVC title in 200-yard breaststroke and Josh Umrysh won GLVC 100-yard breaststroke title.
- Team had five NCAA Division II qualifiers and set five school records during the season.
- -5 Swimming All-America Honorees

Academic Accomplishments

- Andy Huffman was selected as NCAA Elite 90 winner for Division II men's swimming.
- 14 student-athletes recognized as GEICO Academic All-GLVC Honorees
- 4 GLVC Brother James Gaffney Distinguished Scholar Award (4.0 GPA for academic year)
- -13 CSCAA Scholar All-America Honorees
- 1 CoSIDA Academic All-District
- 1 CoSIDA Academic All-American
- 1 CoSIDA Academic All-American

MEN'S TRACK AND FIELD

Athletic Accomplishments

- Won GLVC Outdoor Track & Field Championships and won six individual titles in the meet.

- Nathan Swadley was named as the GLVC Field Athlete of the Year.
- Shaun Meinecke was named as the GLVC Coach of the Year.
- Team has set six school records during the outdoor season and has seven individuals who have reached an NCAA Division II provisional qualifying mark.
- Team earned four GLVC Athlete of Week awards during the season.
- -5 USTFCCCA All-Region Honorees

Academic Accomplishments

- Nathan Swadley, GLVC Scholar-Athlete of the Year
- 22 student-athletes recognized as GEICO Academic All-GLVC Honorees
- 3 GLVC Brother James Gaffney Distinguished Scholar Award (4.0 GPA for academic year)
- 2 CoSIDA Academic All-District
- 1 CoSIDA Academic All-American

WOMEN'S BASKETBALL

Athletic Accomplishments

- Alex Kerr and Laura Rodriguez were named to the All-GLVC third team.
- Team defeated Maryville, who qualified for the GLVC Tournament.

Academic Accomplishments

- 5 student-athletes recognized as GEICO Academic All-GLVC Honorees

WOMEN'S CROSS COUNTRY

Athletic Accomplishments

- Krista Hilmas won B-race at GLVC Championships.

Academic Accomplishments

- 11 student-athletes recognized as GEICO Academic All-GLVC Honorees
- 2 GLVC Brother James Gaffney Distinguished Scholar Award (4.0 GPA for academic year)
- GLVC Team Academic Award (3.3 GPA entire Year)

WOMEN'S GOLF

Athletic Accomplishments

- Team finished seventh at GLVC Championships and won William Woods Invitational.
- Lauren Allen was named as GLVC Golfer of Week during the season.

Academic Accomplishments

- GLVC Team Academic Award (3.3 GPA entire Year)

- 5 student-athletes recognized as GEICO Academic All-GLVC Honorees
- 2 GLVC Brother James Gaffney Distinguished Scholar Award (4.0 GPA for academic year)
- 2 GLVC Council of Presidents Academic Excellence Award (3.5 Cum GPA with no eligibility remaining)

WOMEN'S SOCCER

Athletic Accomplishments

- Team played to a draw with GLVC Tournament qualifier Quincy and defeated Missouri-St. Louis on the road for the first time since 2013.

Academic Accomplishments

- 21 student-athletes recognized as GEICO Academic All-GLVC Honorees
- 5 GLVC Brother James Gaffney Distinguished Scholar Award (4.0 GPA for academic year)
- 1 GLVC Council of Presidents Academic Excellence Award (3.5 Cum GPA with no eligibility remaining)
- GLVC Team Academic Award (3.3 GPA entire Year)

SOFTBALL

Athletic Accomplishments

- Swept a doubleheader at Truman State for the first time since 1991.
- Taylor Caton named as GLVC Player of Week during the season.

Academic Accomplishments

- 11 student-athletes recognized as GEICO Academic All-GLVC Honorees
- 1 GLVC Brother James Gaffney Distinguished Scholar Award (4.0 GPA for academic year)
- 2 GLVC Council of Presidents Academic Excellence Award (3.5 Cum GPA with no eligibility remaining)
- GLVC Team Academic Award (3.3 GPA entire Year)
- 5 NFCA/Easton All-American Scholar Honorees

WOMEN'S TRACK AND FIELD

Athletic Accomplishments

- Set one school record during the season.
- Academic Accomplishments
- 22 student-athletes recognized as GEICO Academic All-GLVC Honorees
- 6 GLVC Brother James Gaffney Distinguished Scholar Award (4.0 GPA for academic year)
- GLVC Team Academic Award (3.3 GPA entire Year)

VOLLEYBALL

Athletic Accomplishments

- Won GLVC West Division championship and reached championship game of GLVC Tournament (first championship game appearance in program history).
- Team recorded four wins over nationally-ranked teams and reached the top 25 for the first time in program history.
- Jordan Burton selected as the GLVC Freshman of the Year.
- Three members of the team named to All-GLVC team (Payton Gannaway, Jordan Burton, Hannah Merjil).
- Nine school records were tied or broken during the season.

Academic Accomplishments

- 13 student-athletes recognized as GEICO Academic All-GLVC Honorees
- 1 GLVC Brother James Gaffney Distinguished Scholar Award (4.0 GPA for academic year)
- GLVC Team Academic Award (3.3 GPA entire Year)
- 1 CoSIDA Academic All-District

2020/2021 ANNUAL REPORT

Department of Intercollegiate Athletics

		Missouri S	ið l					
		Budget						
		Men's	Women's	Other	Non-Program	Operating	Capital	
Revenues:	Football	Basketball	Basketball	Sports	Specific	Total	Projects	Total
Broadcast, Television, Radio, and Internet Rights						-		-
Contributions	22,239	31,259	12,504	82,182	85,746	233,930		233,930
Direct Institutional Support	1,370,333	366,988	237,533	2,700,560	766,651	5,442,065		5,442,065
Endowment and Investment Income	98,533	21,931	15,375	65,373	35,488	236,700		236,700
Guarantees	0	4,000	0	0	0	4,000		4,000
Indirect Facilities and Administrative Support						-		-
NCAA/Conference Distributions incl. All Tournament Revenues				9,033	7,688	16,721		16,721
Other Revenues	12,254	135	505	13,286	8,865	35,045		35,045
Program Sales, Concessions, Novelty Sales, and Parking				0	0	-		-
Royalties, Advertisements, and Sponsorships					33,000	33,000		33,000
Sports Camp Revenues	50	0	2,150	14,345	0	16,545		16,545
Student Activity Fee	83,000	129,993	131,993	284,799	358,397	988,182		988,182
Ticket Sales	0	0	0	0	0	-		-
Total Revenues	1,586,409	554,306	400,060	3,169,578	1,295,835	7,006,188	-	7,006,188

		Men's	Women's	Other	Non-Program	Operating	Capital	
Expenses:	Football	Basketball	Basketball	Sports	Specific	Total	Projects	Total
Athletic Facilities Debt Service, Leases and Rental Fee				(7,520)		(7,520)		(7,520)
Athletics Student Aid	(1,104,087)	(338,082)	(241,089)	(2,252,225)		(3,935,483)		(3,935,483)
Coaching Salaries, Benefits, & Bonuses Paid by the University	(335,061)	(136,399)	(87,952)	(573,760)		(1,133,172)		(1,133,172)
Direct Overhead and Administrative Expenses	(2,908)	(1,454)	(1,595)	(7,501)	(44,254)	(57,712)		(57,712)
Equipment, Uniforms, and Supplies	(67,737)	(11,102)	(8,929)	(71,099)	(70,208)	(229,075)		(229,075)
Fundraising, Marketing, and Promotion	(3,707)			(722)	(3,828)	(8,257)		(8,257)
Game Expenses	(7,338)	(8,928)	(9,178)	(39,050)	(2,614)	(67,108)		(67,108)
Guarantees						-		-
Indirect Facilities and Administrative Support								-
Medical Expense and Medical Insurance	(9,952)			(30)	(139,291)	(149,273)		(149,273)
Membership and Dues	(1,560)	(500)	(570)	(6,245)	(12,514)	(21,389)		(21,389)
Other Operating Expenses	(3,109)	(3,298)	(3,509)	(18,656)	(47,140)	(75,712)		(75,712)
Recruiting	(6,974)	(8,502)	(3,479)	(5,729)		(24,684)		(24,684)
Spirit Groups								-
Sports Camp Expense	(1,514)		(424)	(7,932)		(9,870)		(9,870)
Student-Athlete Meals (non-travel)	(8,698)	(6,762)	(4,995)	(9,821)		(30,276)		(30,276)
Support Salaries Paid by the University	(50)		(272)	(3,932)	(575,787)	(580,041)		(580,041)
Team Travel	(6,653)	(22,749)	(17,610)	(209,628)		(256,640)		(256,640)
Total Expenses	(1,559,348)	(537,776)	(379,602)	(3,213,850)	(895,636)	(6,586,212)		(6,586,212)
Excess (Deficiency of Revenues over Expenses)	27,061	16,530	20,458	(44,272)	400,199	419,976	-	419,976

	_		
Net Assets	_	30-Jun-20	30-Jun-21
Unrestricted	-	135,057	422,943
Restricted Expendable		407,112	539,846
Restricted Non-expendable		5,677,084	7,165,384
	TOTAL	6,219,253	8,128,173

Athletic Participation by Student Athletes

Men's Sports (indicate if not applicablen/a)	Scholarship	Walk-On	Total
Baseball	34	9	43
Basketball	11	3	14
Football	85	26	111
Golf	9	3	12
Rifle	NA	NA	0
Soccer	18	23	41
Swimming & Diving	19	1	20
Track & Field/Cross Country	20	31	51
Wrestling	NA	NA	0
Subtotal	196	96	292

Women's Sports (indicate if not applicablen/a)	Scholarship	Walk-On	Total
Basketball	10	2	12
Gymnastics	NA	NA	0
Golf	7	0	7
Rifle	NA	NA	0
Soccer	27	7	34
Softball	15	4	19
Swimming & Diving	NA	NA	0
Tennis	NA	NA	0
Track & Field/Cross Country	9	22	31
Volleyball	19	0	19
Subtotal	87	35	122

NOTE: Scholarship student-athletes include all students receiving athletic aid awards, including post-eligible and medical awards.

2020/2021 ANNUAL REPORT

	Department of Intercollegiate At	hietics	
	Missouri S&T		
	Academic Success Rate		
S&T a	ind UMSL ONLY - I	Division II	
20/21 for the 2014 of	cohort	80%	76%
Men's Sports (ind	icate if not applicablen/a)	ASR score	Fed Rate
	Baseball	83	77
	Basketball	60	38
	Cross Country/Track	83	86
	Football	68	63
	Golf	NA	NA
	Indoor Track & Field	NA	NA
	Outdoor Track & Field	NA	NA
	Rifle	NA	NA
	Soccer	88	79
	Swimming & Diving	75	65
	Wrestling	NA	NA
Women's Sports	indicate if not applicablen/a)	ASR Score	Fed Rate
	Basketball	64	75
	Cross Country/Track	96	91
	Golf	NA	NA
	Gymnastics	NA	NA
	Indoor Track & Field	NA	NA
	Outdoor Track & Field	NA	NA
	Rifle	NA	NA
	Soccer	97	96
	Softball	96	96
	Swimming & Diving	NA	NA
	Tennis	NA	NA
	Volleyball	95	75

Missouri S&T

Grade Point Averages by Semester

(indicate if not applicable n/a)										
	2016-	2017	2017-	2017-2018		-2019	2019-	2020	2020-	2021
Men's Sports	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
Baseball	3.086	3.14	3.221	3.269	3.361	3.29	3.332	3.612	3.431	3.467
Basketball	2.541	2.805	2.646	2.509	3.083	3.038	2.845	3.047	2.772	2.987
Football	2.542	2.725	2.685	2.741	2.599	2.825	2.754	3.407	2.97	2.96
Golf			3.043	3.201	3.452	3.378	3.489	3.745	3.531	3.603
Soccer	3.327	3.364	3.509	3.558	3.381	3.333	3.342	3.785	3.179	3.412
Swimming & Diving	3.299	3.231	3.342	3.188	3.276	3.186	3.315	3.642	3.264	3.561
Track & Field/Cross Country										
Cross Country	2.977	2.996	3.226	3.196	3.073	3.326	3.267	3.713	3.325	3.249
Indoor Track	3.127	3.079	3.207	3.208	3.264	3.311	3.243	3.709	3.359	3.241
Outdoor Track	3.113	2.952	3.176	3.202	3.264	3.311	3.243	3.709	3.359	3.241
Subtotal	3.002	3.037	3.117	3.119	3.195	3.222	3.203	3.597	3.243	3.302

	2016-	2017	2017-2018		2018-2019		2019-	2020	2020-2021	
Women's Sports	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
Basketball	2.858	2.866	3.31	3.116	3.165	3.242	3.278	3.546	3.242	3.28
Golf			3.528	3.593	3.446	3.311	3.51	3.892	3.84	3.548
Soccer	3.611	3.367	3.332	3.321	3.279	3.389	3.085	3.587	3.416	3.372
Softball	3.456	3.349	3.361	3.333	3.174	3.397	3.232	3.793	3.354	3.398
Track & Field/Cross Country										
Cross Country	3.278	3.256	3.174	3.385	3.23	3.228	3.41	3.826	3.477	3.592
Indoor Track	3.263	3.255	3.267	3.398	3.224	3.324	3.356	3.711	3.516	3.673
Outdoor Track	3.392	3.405	3.285	3.415	3.224	3.324	3.356	3.711	3.516	3.673
Volleyball	3.546	3.521	3.472	3.607	3.25	3.314	3.358	3.786	3.56	3.415
Subtotal	3.343	3.288	3.341	3.396	3.249	3.316	3.323	3.732	3.490	3.494

Grand Total	3.172	3.162	3.229	3.258	3.222	3.269	3.263	3.664	3.367	3.398

Missouri S&T

STUDENT-ATHLETE GRADUATION RATES (Freshman cohort)

Four-year average (Federal IPEDS Rate)	All Students	Student Athletes
2021 (14-15, 13-14, 12-13, 11-12 freshman cohort)	<u>65%</u>	<u>76%</u>
2020 (13-14, 12-13, 11-12, 10-11 freshman cohort)	<u>67%</u>	<u>77%</u>
2019 (12-13, 11-12, 10-11, 09-10 freshman cohort)	<u>65%</u>	<u>75%</u>
2018 (11-12, 10-11, 09-10, 08-09 freshman cohort)	<u>66%</u>	<u>74%</u>
2017 (10-11, 09-10, 08-09, 07-08 freshman cohort)	<u>67%</u>	<u>72%</u>
2016 (09-10, 08-09, 07-08, 06-07 freshman cohort)	<u>66%</u>	<u>71%</u>

Missouri S&T

Admission Exceptions

	Summer 2020	Fall 2020	Winter 2021	Total
Student-Athlete Admission Exceptions (# of individual exceptions)	0	4	0	4
All Student Admission Exceptions (# of individual exceptions)	0	30	1	31
Percent of Admissions Exceptions who are Student-Athletes	0.00%	13.33%	0.00%	12.90%

UMSL

List of Sponsored Sports

Men's Sports

- X Baseball
- X Basketball
- x Cross Country
- Football
- X Golf
- Indoor Track & Field
- x Outdoor Track & Field
- Rifle
- X Soccer
- X Tennis
- x Swimming & Diving Wrestling

Women's Sports

- X Basketball
- x Cross Country
- X Golf
 - Gymnastics
 - Indoor Track & Field
- x Outdoor Track & Field Rifle
- X Soccer
- x Softball
- x Swimming & Diving
- X Tennis
- X Volleyball

UMSL EADA / NCAA REPORT 2020-2021

REVENUE																	
	Men's	Men's		Men's	Men's		Mens Track	Women's	Women's	Women's	Women's	Women's	Women's	Womens	Women's		
Sport	Baseball	Basketball	Men's Golf	Soccer	Swimming	Men's Tennis	and Field	Basketball	Golf	Soccer	Softball	Swimming	Tennis	and Field	Volleyball	Other	Grand Total
01 Ticket Sales	\$0	\$1,327	\$0	\$0	\$0	\$0	\$0	\$1,327	\$0	\$0	\$0	\$0	\$0	\$0	\$1,387	\$0	\$4,042
04 Direct Institutional Support	\$297,377	\$480,348	\$150,147	\$258,918	\$145,668	\$98,631	\$71,868	\$451,490	\$150,729	\$276,190	\$366,429	\$113,769	\$114,726	\$81,354	\$236,048	\$1,852,982	\$5,146,676
08 Contributions	\$0	\$5,000	\$0	\$0	\$0	\$891	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$37,618	\$43,509
15 Royalties, Licensing, Advertisem	\$190	\$0	\$18,851	\$0	\$3,160	\$0	\$0	\$0	\$2,216	\$0	\$300	\$305	\$0	\$0	\$0	\$83,172	\$108,194
17 Athletics Restricted Endowment	\$9,592	\$0	\$834	\$1,795	\$841	\$0	\$0	\$1,164	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$4,775	\$19,001
Grand Total	\$307,160	\$486,676	\$169,832	\$260,713	\$149,669	\$99,523	\$71,868	\$453,981	\$152,945	\$276,190	\$366,729	\$114,074	\$114,726	\$81,354	\$237,435	\$1,978,548	\$5,321,422
EXPENSES																	
20 Athletic Student Aid	\$143,318	\$256,522	\$149,177	\$189,886	\$157,594	\$154,395	\$17,500	\$273,808	\$145,422	\$172,294	\$175,027	\$195,480	\$210,458	\$44,399	\$189,776	\$0	\$2,475,055
22 Coaching Salaries, Benefits and B	\$114,101	\$215,170	\$34,467	\$87,231	\$41,389	\$35,361	\$39,966	\$177,145	\$31,855	\$83,758	\$158,859	\$41,389	\$35,361	\$39,966	\$65,127	\$0	\$1,201,147
24 Support Staff/Administrative Co	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$798,718	\$798,718
27 Recruiting	\$0	\$2,358	\$1,750	\$0	\$201	\$0	\$0	\$2,062	\$0	\$81	\$1,059	\$154	\$0	\$0	\$848	\$0	\$8,513
28 Team Travel	\$16,082	\$19,498	\$32,155	\$18,808	\$19,935	\$5,698	\$3,456	\$15,496	\$29,160	\$14,110	\$29,178	\$9,453	\$5.873	\$3,456	\$16,289	\$953	\$239,600
29 Sports Equipment, Uniforms & S	\$15,120	\$11,360	\$6,796	\$7,280	\$7,165	\$2,743	\$5,551	\$13,775	\$10,593	\$12,526	\$13,473	\$6,204	\$1,504	\$5,551	\$7,730	\$1,625	\$128,998
30 Game Expenses	\$13,561	\$9,900	\$455	\$3,465	\$400	\$145	\$0	\$11,380	\$1,335	\$3,465	\$4,830	\$200	\$145	\$0	\$5,110	\$7,911	\$62,302
34 Athletic Facilities Deb Service,	\$0	\$0	\$5,011	\$90	\$0	\$994	\$0	\$0	\$3,863	\$60	\$0	\$0	\$994	\$0	\$0	\$1,844	\$12,856
35 Direct Overhead and Administra	\$15,808	\$5,530	\$24,340	\$10,520	\$13,695	\$265	\$97	\$3,420	\$6,306	\$9,772	\$15,639	(\$11,901)	\$488	\$97	\$2,095	\$117,440	\$213,610
37 Medical Expenses and Insurance	\$16,000	\$5,800	\$4,215	\$11,045	\$4,600	\$3,065	\$5,260	\$6,160	\$2,700	\$10,885	\$6,130	\$4,600	\$3,070	\$5,260	\$6,895	\$40,664	\$136,349
38 Memberships and Dues	\$0	\$330	\$275	\$1,665	\$300	\$150	\$0	\$343	\$225	\$1,480	\$454	\$300	\$150	\$0	\$190	\$12,788	\$18,650
39 Student Athlete Meals (Non Trav	\$0	\$3,494	\$0	\$0	\$0	\$0	\$0	\$3,561	\$0	\$0	\$171	\$0	\$0	\$0	\$0	\$19	\$7,245
40 Other Operating Expenses	\$206	\$3,481	\$1,383	\$2,253	\$643	\$255	\$37	\$2,214	\$1,055	\$1,524	\$135	\$871	\$582	\$24	\$3,651	\$20,229	\$38,541
Grand Total	\$334,195	\$533,444	\$260,025	\$332,243	\$245,922	\$203,071	\$71,868	\$509,364	\$232,513	\$309,956	\$404,955	\$246,749	\$258,623	\$98,753	\$297,711	\$1,002,191	\$5,341,585
FYCESS	(\$27.035.76)	(\$46 767 78)	1 (\$00 103 16)	(\$71 530 18)	(\$96.253.05)	(\$103 548 66)		(\$55 383 72)	(\$79 568 00)	(\$33 765 65)	(\$38,226,80)	(\$132 674 60)	(\$1/13 896 80)	(\$17 300 20)	(\$60.275.80)		(\$20,162,71)

Athletic Participation by Student Athletes

Men's Sports	Scholarship	Walk-On	Total
Baseball	21	14	35
Basketball	14	1	15
Cross Country	6	4	10
Golf	10	1	11
Soccer	23	4	27
Swimming	15	4	19
Tennis	6	2	8
Track and Field	0	8	8
Subtotal	95	38	133

Women's Sports	Scholarship	Walk-On	Total
Basketball	13	0	13
Cross Country	4	3	7
Golf	7	1	8
Soccer	19	5	24
Softball	17	1	18
Swimming	15	5	20
Tennis	8	0	8
Track and Field	0	5	5
Volleyball	17	0	17
Subtotal	100	20	120
Grand Total	195	58	253

NOTE: Scholarship student-athletes include all students receiving athletic aid awards, including post-eligible and medical awards.

2020 - 2021 ANNUAL REPORT

Department of Intercollegiate A	thletics	
University of Missouri - St. L	ouis	
Academic Success Rate		
UMSL ONLY - Divis	sion II	
2014-2015 Graduation Years	83%	72%
Men's Sports (indicate if not applicablen/a)	ASR score	Fed Rate
Baseball	84	73
Basketball	64	60
Golf	92	57
Soccer	72	75
Swimming & Diving	63	n/a
Tennis	88	50
Women's Sports (indicate if not applicablen/a)	ASR Score	Fed Rate
Basketball	71	36
Golf	100	86
Soccer	89	57
Softball	90	84
Swimming & Diving	100	100
Tennis	91	75
Volleyball	94	69

2020 - 2021 Annual Report Department of Intercollegiate Athletics

UMSL

Grade Point Averages by Semester

		2	2017-2018	2	018-2019		2019-2020	2	020-2021	4-Year
Men's Sports		Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Average
Baseball		3.223	3.107	3.085	3.006	2.944	3.386	3.391	3.264	3.176
Basketball		2.678	2.834	2.718	2.875	2.900	2.876	2.900	2.818	2.825
Golf		3.577	3.589	3.338	3.316	3.463	3.562	3.586	3.440	3.484
Soccer		3.060	3.190	3.060	3.138	2.960	2.836	3.000	3.130	3.047
Swimming		3.013	3.303	2.918	3.153	3.708	3.730	3.080	3.227	3.267
Tennis		3.427	3.448	3.463	3.626	2.993	3.081	3.588	3.705	3.416
Track and Field		n/a	n/a	n/a	n/a	n/a	n/a	3.444	3.304	3.374
	Avera	3.163	3.245	3.097	3.186	3.161	3.245	3.284	3.270	3.202

		2017 - 2018	2	018-2019	2019 - 202	0	2	020-2021	4-Year
Women's Sports	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Average
Basketball	3.275	3.345	3.404	3.406	3.573	3.838	3.471	3.466	3.472
Golf	3.627	3.611	3.133	3.244	2.650	3.496	3.874	3.938	3.447
Soccer	3.327	3.282	3.483	3.420	3.533	3.427	3.430	3.341	3.405
Softball	3.473	3.381	3.597	3.332	3.657	3.819	3.657	3.552	3.559
Tennis	3.737	3.582	3.733	3.731	3.862	3.905	3.862	3.905	3.790
Track and Field	n/a	n/a	n/a	n/a	n/a	n/a	3.575	3.160	3.368
Swimming	3.371	3.450	3.669	3.621	3.630	3.692	3.503	3.458	3.549
Volleyball	3.649	3.570	3.649	3.776	3.600	3.598	3.800	3.699	3.668
Ave	raj 3.494	3.460	3.544	3.521	3.489	3.656	3.672	3.579	3.532

Overall Average	3.341	3.361	3.327	3.357	3.344	3.480	3.477	3.427	3.390

2020 -2021ANN Department of Inter	UAL REPORT	ics
UM	SL	
STUDENT-ATHLETE GRADUAT	ION RATES (Fre	shman cohort)
Four-year average (federal IPEDS rate)	All Students	Student Athletes
2019 (13-12, 12-11, 10-09, 09-08, freshman cohort)	52%	72%
2018 (12-11,11-10, 09-10, 08-09, freshman cohort)	57%	64%
2017 (11-10, 09-10, 08-09, 07-08, freshman cohort)	55%	62%
2016 (09-10,08-09,07-08, 06-07, freshman cohort)	60%	56%
2015 (08-09,07-08, 06-07, 05-06, freshman cohort)	54%	62%

UMSL

Admission Exceptions

	Summer 2020	Fall 2020	Winter 2021	Total
Student-Athlete Admission Exceptions (# of individual exceptions)	0	15	0	15
All Student Admission Exceptions (# of individual exceptions)	0	100	5	105
Percent of Admissions Exceptions who are Student-Athletes	#DIV/0!	15.00%	0.00%	14.29%

UMKC

Men's Sports

Baseball

- X Basketball Cross Country Football
- X Golf Indoor Track & Field Outdoor Track & Field Rifle
- X Soccer
 Tennis
 Swimming & Diving
 Wrestling

Women's Sports

- X Basketball Cross Country Golf Gymnastics Indoor Track & Field Outdoor Track & Field Rifle
- x Soccer
- x Softball Swimming & Diving
- x Tennis
- x Volleyball

		Actuals					
Revenues:	Men's Basketball	Women's Basketball	Other Sports	Non- Program Specific	Operating Total	Capital Projects	Total
Student fees (Athletic Fee)				\$ 1,301,258	\$1,301,258		\$1,301,258
Ticket Sales	\$1,051	\$0	\$2,500		\$3,551		\$3,551
Guarantees	\$170,000	\$20,000	\$0		\$190,000		\$190,000
Contributions				\$1,017,439	\$1,017,439		\$1,017,439
Direct Institutional Support	\$1,458,535	\$1,024,814	\$2,308,021	\$1,428,957	\$6,220,327		\$6,220,327
Indirect Facilities and Administrative Support				\$334,048	\$334,048		\$334,048
NCAA/Conference Distributions incl. All Tournament Revenues				\$649,650	\$649,650		\$649,650
Broadcast, Television, Radio, and Internet Rights					\$0		\$0
Program Sales, Concessions, Novelty Sales, and Parking				\$19,251	\$19,251		\$19,251
Royalties, Advertisements, and Sponsorships				\$350,836	\$350,836		\$350,836
Endowment and Investment Income				\$74,188	\$74,188		\$74,188
Other Revenues	\$215,609	\$201,737	\$1,646,485	\$142,399	\$2,206,230		\$2,206,230
Total Revenues	\$1,845,194	\$1,246,551	\$3,957,006	\$5,318,026	\$12,366,778	\$0	\$12,366,778

Fypenses:	Men's Basketball	Women's Basketball	Other Sports	Non- Program	Operating Total	Capital Projects	Total
Athletics Student Aid	\$536 754	\$500 613	\$2 138 097	\$341 530	\$3 516 995		\$3 516 995
Guarantees	\$18,000	\$3,000	\$2,000	φ0+1,000	\$23,000		\$23,000
Coaching Salaries Benefits & Bonuses Paid by the University	\$795.309	\$474,922	\$1.027.188		\$2,297,420		\$2,297,420
Support Salaries Paid by the University	\$6 685	\$0	\$0	\$1 480 011	\$1 486 695		\$1 486 695
Severance	\$0,000	ψũ	\$32,117	ф.,.со,от.	\$32,117		\$32,117
Recruiting	\$6,908	\$6,673	\$8,106	\$0	\$21,687		\$21,687
Team Travel	\$172,821	\$109,184	\$253,434	\$1,381	\$536,820		\$536,820
Equipment, Uniforms, and Supplies	\$49,472	\$35,830	\$169,136	\$150,168	\$404,606		\$404,606
Game Expenses	\$97,045	\$52,745	\$45,599	\$42,667	\$238,056		\$238,056
Fundraising, Marketing, and Promotion	\$200	\$3,666	\$11,448	\$118,375	\$133,689		\$133,689
Direct Facilities, Maintenance, and Rental	\$5,095	\$1,055	\$120,766	\$55,752	\$182,667		\$182,667
Spirit Groups				\$8,670	\$8,670		\$8,670
Indirect Facilities and Administrative Support				\$334,048	\$334,048		\$334,048
Medical Expense and Medical Insurance	\$3,019	\$2,000	\$7,950	\$474,616	\$487,585		\$487,585
Membership and Dues	\$0	\$180	\$1,206	\$39,966	\$41,351		\$41,351
Camp Expenses	\$0	\$2,023	\$5,726		\$7,749		\$7,749
Student Athlete Meals - Non Travel	\$109,002	\$14,498	\$37,639		\$161,138		\$161,138
Other Operating Expenses	\$31,064	\$29,216	\$63,109	\$347,351	\$470,741		\$470,741
Total Expenses	\$1,831,373	\$1,235,605	\$3,923,521	\$3,394,536	\$10,385,035	\$0	\$10,385,035
Excess (Deficiency of Revenues over Expenses)	\$13,822	\$10,946	\$33,485	\$1,923,490	\$1,981,743	\$0	\$1,981,743

Totals will calculate automatically.

	·····		
Men's Sports	Scholarship	Walk-On	Total
Basketball	15	4	19
Golf	7	1	8
Soccer	22	6	28
Track & Field/Cross Country	31	9	40
Tennis	1	0	1
Subtotal	76	20	96

Athletic Participation by Student Athlet
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Women's Sports	Scholarship	Walk-On	Total
Basketball	13	0	13
Golf	1	0	1
Soccer	27	2	29
Softball	23	2	25
Tennis	8	0	8
Track & Field/Cross Country	34	0	34
Volleyball	12	5	17
Subtotal	118	9	127
Grand Total	194	29	223

NOTE: Scholarship student-athletes include all students receiving athletic aid awards, including post-eligible and medical awards.

UMKC

Academic Progress Rate by Sport and Respective Sport Ranking within the Western Athletic Conference

Men's Sports (indicate if not applicablen/a)	APR Score	Ranking
Basketball	966	9/9
Cross Country	986	5/7
Golf	968	6/9
Indoor Track & Field		
Outdoor Track & Field	971	5/7
Soccer	982	3/6
Tennis		

Women's Sports (indicate if not applicablen/a)	APR Score	Ranking
Basketball	986	6/9
Cross Country	993	3/8
Golf		
Indoor Track & Field		
Outdoor Track & Field	974	6/8
Soccer	993	7/9
Softball	966	6/7
Tennis	991	1/7
Volleyball	995	3/9

#REF!

Department of Intercollegiate Athletics

UMKC

Grade Point Averages by Semester

The "#DIV/0" will disappear when you enter all data. It simply means the formula is trying to average a series in which the denominator is zero.

		201	6-17	201	7-18	201	8-19	202	0-21	4-Year	4-Year
Men's Sports		Fall	Spring	Fall	Spring	Fall	Spring			Average	Change
Basketball		3.060	3.190	2.980	2.570	2.780	2.260	3.20	3.12	2.895	0.035
Golf		3.120	3.080	3.210	2.930	3.360	2.860	3.59	3.65	3.225	0.520
Soccer		3.180	3.500	3.230	3.330	3.440	3.440	3.36	3.34	3.353	0.010
Tennis		3.420	3.060	2.830	2.950	3.280	3.320	N/A	N/A		
Cross Country		3.090	3.370	3.410	3.400	3.440	3.350	3.53	3.48	3.384	0.275
Indoor Track		3.160	3.200	3.200	3.100	3.010	3.210	3.19	3.06	3.141	-0.055
Outdoor Track		3.160	3.200	3.200	3.100	3.010	3.210	3.19	3.06	3.141	-0.055
	Average	3.170	3.229	3.151	3.054	3.189	3.093	3.343	3.285	3.190	0.122

		2016	6-17	2017	7-18	2018	8-19	2020)-21	4-Year	4-Year
Women's Sports		Fall	Spring	Fall	Spring	Fall	Spring			Average	Change
Basketball		3.660	3.680	3.030	3.100	3.270	3.360	3.21	3.29	3.325	-0.420
Golf		3.600	3.380	3.700	3.490	3.670	3.700			3.590	
Soccer		3.470	3.400	3.250	3.460	3.630	3.620	3.64	3.65	3.515	0.210
Softball		3.330	3.230	3.250	3.460	3.510	3.380	3.37	3.30	3.354	0.055
Tennis		3.030	3.060	3.400	3.310	3.530	3.590	3.59	3.68	3.399	0.590
Cross Country		3.450	3.390	3.490	3.520	3.580	3.610	3.88	3.47	3.549	0.255
Indoor Track		3.350	3.280	3.300	3.100	3.210	3.210	3.42	3.17	3.255	-0.020
Outdoor Track		3.350	3.280	3.300	3.100	3.210	3.210	3.24	3.17	3.233	-0.110
Volleyball		3.520	3.410	3.270	3.210	3.460	3.540	3.41	3.47	3.411	-0.025
	Average	3.418	3.346	3.332	3.306	3.452	3.469	3.470	3.400	3.403	0.067
Overall Average		3.309	3.294	3.253	3.196	3.337	3.304	3.416	3.351	3.318	0.090

NOTE: Scholarship student-athletes include all students receiving athletic aid awards, including post-eligible and medical awards.

STUDENT-ATHLETE GRADUATION RATES (Freshman cohort)

Six-year average (federal IPEDS rate)	All Students	Student Athletes
2020-21 (2014-15 Rate)	51%	69%
2019-20 (2013-14 Rate)	47%	66%
2018-19 (2012-13 Rate)	48%	62%
2017-18 (2011-12 Rate)	49%	76%
2016-17 (2010-11 Rate)	49%	60%
2015-16 (2009-10 Rate)	50%	71%

Six-year average (graduation success rate)	All Students	Student Athletes	
2020-21			96%
2019-20			95%
2018-19 (2012-13 Rate)			92%
2017-18 (2011-12 Rate)			91%
2016-17 (2010-11 Rate)			88%
2015-16 (2009-10 Rate)			87%

UMKC

Admission Exceptions

	Summer 2021	Fall 2020	Winter 2021	Total
Student-Athlete Admission Exceptions (# of individual exceptions)	0	3	18	21
All Student Admission Exceptions (# of individual exceptions)	38	11	752	801
Percent of Admissions Exceptions who are Student-Athletes	0.00%	27.27%	2.39%	2.62%

University of Missouri - Columbia

List of Sponsored Sports

Instructions: Check all that apply. Add sports as needed.

Men's Sports

- _X__Baseball
- _X__Basketball
- _X_Cross Country
- _X__Football
- _X__Golf
- _X__Indoor Track & Field
- _X__Outdoor Track & Field
- ____ Rifle
- ___ Soccer
- _X__Swimming & Diving
- _X__Wrestling

Women's Sports

- _X__Basketball
- _X__Cross Country
- _X__Golf
- X______Gymnastics
- _X__Indoor Track & Field
- _X__Outdoor Track & Field
- ___ Rifle
- _X__Soccer
- _X__Softball
- _X__Swimming & Diving
- _X__Tennis
- _X__Volleyball
2020-2021 ANNUAL REPORT Department of Intercollegiate Athletics University of Missouri - Columbia

Actuals												
		Men's	Women's		Non-Program	Operating	Capital					
Revenues:	Football	Basketball	Basketball	Other Sports	Specific	Total	Projects	Total				
Ticket Sales	2,307,201	945,639	67,583	119,601	134,333	3,574,357		3,574,357				
Guarantees	-	-	-	-		-		-				
Contributions	4,465,024	851,749	95,552	566,138	10,572,430	16,550,893	8,038,149	24,589,042				
Direct Institutional Support					1,015,000	1,015,000		1,015,000				
Indirect Facilities and Administrative Support						-		-				
NCAA/Conference Distributions incl. All Tournament Revenues	18,718,862	6,606,030	-	25,200	46,130,434	71,480,526		71,480,526				
Broadcast, Television, Radio, and Internet Rights	-				4,095,393	4,095,393		4,095,393				
Program Sales, Concessions, Novelty Sales, and Parking	1,226,788	305,612	30,569	3,953	16,067	1,582,989		1,582,989				
Royalties, Advertisements, and Sponsorships					793,870	793,870		793,870				
Endowment and Investment Income					1,308,662	1,308,662	-	1,308,662				
Other Revenues	58,240	50,041	36,913	437,242	1,435,869	2,018,305	-	2,018,305				
Total Revenues	26,776,115	8,759,071	230,617	1,152,134	65,502,058	102,419,995	8,038,149	110,458,144				

		Men's	Women's		Non-Program	Operating	Capital	
Expenses:	Football	Basketball	Basketball	Other Sports	Specific	Total	Projects	Total
Athletics Student Aid	3,724,804	630,846	572,049	7,102,097	254,745	12,284,541		12,284,541
Guarantees	221,601	200,000	74,625	13,546	-	509,772		509,772
Coaching Salaries, Benefits, & Bonuses Paid by the University	11,342,511	3,865,735	1,256,122	5,035,870	-	21,500,238		21,500,238
Support Salaries Paid by the University	2,283,722	512,761	427,021	333,074	15,196,369	18,752,947		18,752,947
Recruiting	175,008	35,527	36,929	66,798	-	314,262		314,262
Team Travel	1,265,186	816,921	766,161	2,333,740	756	5,182,764		5,182,764
Equipment, Uniforms, and Supplies	1,647,972	225,158	21,092	377,678	117,657	2,389,557	-	2,389,557
Game Expenses	1,173,345	295,598	166,526	429,039	225,372	2,289,880		2,289,880
Fundraising, Marketing, and Promotion	2,750	-	15	14	690,518	693,297		693,297
Direct Facilities, Maintenance, and Rental	98,012	97,147	4,785	284,470	32,453,319	32,937,733	7,844,138	40,781,871
Spirit Groups					177,040	177,040		177,040
Indirect Facilities and Administrative Support	-	-	-	-	-	-		-
Medical Expense and Medical Insurance	-	-	-	-	1,503,809	1,503,809		1,503,809
Membership and Dues	5,681	1,678	476	17,820	73,989	99,644		99,644
Other Operating Expenses	2,139,851	639,866	103,606	547,135	3,811,054	7,241,512	194,011	7,435,523
Total Expenses	24,080,443	7,321,237	3,429,407	16,541,281	54,504,628	105,876,996	8,038,149	113,915,145
Excess (Deficiency of Revenues over Expenses)	2,695,672	1,437,834	(3,198,790)	(15,389,147)	10,997,430	(3,457,001)	-	(3,457,001)

Net Assets		30-Jun-20	30-Jun-21
Unrestricted		(5,357,469)	(10,571,935)
Restricted Expendable		9,615,683	14,922,164
Restricted Non-expendable		34,143,714	43,062,745
	TOTAL	38,401,928	47,412,975

* Includes additional debt paid down

2020-21 ANNUAL REPORT **Department of Intercollegiate Athletics** University of Missouri - Columbia

Athletic Participation by Student Athletes

Men's Sports (indicate if not applicablen/a)	Scholarship) W	/alk-On	Total	
Baseball		31	26		57
Basketball		13	2		15
Football	1	01	38		139
Golf		10	0		10
Rifle	N/A	N/A	N/A		
Soccer	N/A	N/A	N/A		
Swimming & Diving		29	1		30
Track & Field/Cross Country		23	29		52
Wrestling		30	10		40
Subtotal	237		106	343	
Women's Sports (indicate if not applicable, n/a)	Scholarshir	. 14	lalk On	Total	

Women's Sports (indicate if not applicablen/a)	Scholarship	Walk-On	Total
Basketball	1;	3 () 13
Gymnastics	14	4 5	5 19
Golf		7 2	2 9
Rifle	N/A	N/A	N/A
Soccer	34	4 () 34
Softball	29	9 4	4 33
Swimming & Diving	3	1 () 31
Tennis	10) (3 13
Track & Field/Cross Country	30	6 22	2 58
Volleyball	1;	3 2	2 15
Subtotal	187	38	225
Grand Total	42	1 144	1 568

NOTE: Scholarship student-athletes include all students receiving athletic aid awards, including post-eligible and medical awards.

2020-21 ANNUAL REPORT Department of Intercollegiate Athletics

University of Missouri - Columbia

Academic Progress Rate by Sport and

Respective Sport Ranking within the Southeastern Conference

Men's Sports (indicate if not applicablen/a)	APR Score	Ranking*
Baseball	962	
Basketball	974	
Cross Country	975	
Football	977	
Golf	1000	
Outdoor Track & Field	966	
Swimming & Diving	990	
Wrestling	981	

Women's Sports (indicate if not applicablen/a)	APR Score	Ranking*
Basketball	1000	
Cross Country	1000	
Golf	992	
Gymnastics	995	
Outdoor Track & Field	1000	
Soccer	991	
Softball	992	
Swimming & Diving	998	
Tennis	1000	
Volleyball	995	

APR Score based upon multi-year rate including the 2016-17, 2017-18, 2018-19 and 2019-20 academic years.

*APR Data for 2019-20 and 2020-21 is not publicly released in response to the COVID-19 pandemic and its impact on intercollegiate athletics as well as means to allow for a review of the APR metric.

2020-21 ANNUAL REPORT

Department of Intercollegiate Athletics

University of Missouri - Columbia

Grade Point Averages by Semester

(indicate if not applicable - - n/a)

	2010)-2011	2011	-2012	2012	2-2013	201	3-2014	2014	-2015	2015	-2016	2016	-2017	2017	-2018	2018	-2019	2019	-2020	2020	-2021
Men's Sports	Fall	Spring																				
Baseball	2.99	2.87	3.08	3.06	3.05	2.94	2.96	2.76	2.47	2.62	2.86	2.56	2.90	2.52	2.98	2.94	3.13	2.95	3.03	3.36	3.14	3.03
Basketball	2.55	2.42	2.74	2.47	3.06	2.45	2.46	2.30	2.31	2.37	2.29	2.20	2.61	2.70	2.50	2.46	2.69	2.73	2.62	2.89	2.63	2.49
Football	2.48	2.64	2.65	2.64	2.62	2.59	2.41	2.57	2.58	2.55	2.69	2.52	2.48	2.34	2.48	2.62	2.90	2.87	2.97	3.12	2.79	2.91
Golf	3.41	3.53	3.48	3.42	3.32	3.23	3.46	3.43	3.08	3.31	3.38	3.07	3.47	3.40	3.41	3.26	3.38	3.38	3.45	3.64	2.89	3.01
Swimming & Diving	2.91	2.94	2.74	2.93	2.93	2.89	2.84	2.97	2.95	3.14	3.24	3.09	3.18	3.18	3.21	3.05	3.19	3.20	3.22	3.64	3.40	3.32
Track & Field/Cross Country	1																					
Cross Country	3.29	3.27	3.33	3.38	2.93	3.05	3.01	2.93	3.07	3.07	3.09	3.27	3.43	3.34	2.92	3.27	3.02	3.05	2.83	3.60	3.22	3.38
Track	3.06	3.12	3.27	3.27	2.97	3.04	2.84	2.88	2.81	2.89	2.99	3.18	3.11	3.16	2.81	2.80	2.90	2.91	2.84	3.33	3.08	3.05
Wrestling	2.81	2.95	2.91	2.60	3.02	2.91	2.79	2.64	2.68	2.63	2.80	2.78	2.67	2.62	2.89	2.87	2.89	2.79	2.80	3.16	3.14	3.17
Subto	2.94	2.97	3.03	2.97	2.99	2.89	2.85	2.81	2.74	2.82	2.92	2.83	2.98	2.91	2.90	2.91	3.01	2.99	2.97	3.34	2.99	3.01

	2010)-2011	2011	-2012	2012	2-2013	2013	3-2014	2014	-2015	2015	-2016	2016	2017	2017-	-2018	2018-	2019	2019	-2020	2020	-2021
Women's Sports	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring												
Basketball	3.00	2.91	3.03	3.01	3.13	3.04	2.99	3.12	2.89	2.86	3.17	3.31	3.29	3.28	3.34	3.40	3.14	3.11	3.05	3.39	2.90	3.10
Golf	3.29	3.30	3.27	3.46	3.21	3.40	3.08	3.26	3.48	3.55	3.44	3.22	3.36	3.20	3.53	3.33	3.35	3.38	3.34	3.61	3.45	3.53
Gymnastics	3.41	3.63	3.41	3.19	3.32	3.38	3.35	3.39	3.34	3.43	3.34	3.42	2.94	3.18	3.30	3.40	3.20	3.24	3.28	3.76	3.45	3.45
Soccer	3.08	2.79	2.89	3.12	3.20	3.30	3.27	3.24	3.11	3.29	3.40	3.21	2.93	3.29	3.14	3.26	3.13	3.29	3.44	3.61	3.39	3.46
Softball	3.35	3.22	3.31	3.18	3.10	3.05	2.89	2.98	3.22	3.03	3.14	3.17	3.22	3.08	3.02	3.19	3.14	3.14	3.19	3.52	3.21	3.38
Swimming and Diving	3.12	3.23	3.12	3.14	3.38	3.22	3.29	3.37	3.26	3.35	3.57	3.52	3.43	3.49	3.40	3.38	3.53	3.47	3.50	3.73	3.63	3.52
Tennis	3.27	3.44	3.29	3.47	3.16	3.32	3.08	3.18	3.32	3.33	3.46	3.27	3.31	3.32	3.54	3.42	3.39	3.52	3.77	3.92	3.66	3.73
Track & Field/Cross Country																						
Cross Country	3.17	3.33	3.57	3.59	3.26	3.55	3.68	3.52	3.32	3.35	3.44	3.33	3.35	3.37	3.50	3.33	3.39	3.47	3.60	3.82	3.44	3.57
Track	3.41	3.40	3.47	3.43	3.40	3.53	3.50	3.39	3.28	3.32	3.18	3.34	3.32	3.34	3.37	3.35	3.42	3.41	3.49	3.73	3.50	3.60
Volleyball	2.86	3.03	3.12	3.22	3.26	3.26	3.40	3.38	3.44	3.55	3.55	3.57	3.55	3.50	3.53	3.56	3.30	3.57	3.38	3.74	3.53	3.39
Subto	3.20	3.23	3.25	3.28	3.24	3.31	3.43	3.43	3.27	3.31	3.37	3.34	3.27	3.31	3.37	3.36	3.30	3.36	3.40	3.68	3.43	3.48

Grand Total 3.07 3.10 3.14 3.12 3.00 3.06 3.14 3.08 3.11 3.13 3.14 3.16 3.17 3.19 3.51 3.18 3.21
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2020-21 ANNUAL REPORT Department of Intercollegiate Athletics

University of Missouri - Columbia

STUDENT-ATHLETE GRADUATION RATES (Freshman cohort)

Four-year average (Federal IPEDS Rate)	All Students	Student-Athletes
2021 (14-15, 13-14, 12-13, 11-12 freshman cohort)	73%	61%
2020 (13-14, 12-13, 11-12, 10-11 freshman cohort)	69%	64%
2019 (12-13, 11-12, 10-11, 09-10 freshman cohort)	69%	66%
2018 (11-12, 10-11, 09-10, 08-09 freshman cohort)	69%	71%
Four-year average (Graduation Success Rate)		Student-Athletes
Four-year average (Graduation Success Rate) 2021 (14-15, 13-14, 12-13, 11-12 freshman cohort)	N/A	Student-Athletes 85%
Four-year average (Graduation Success Rate) 2021 (14-15, 13-14, 12-13, 11-12 freshman cohort) 2020 (13-14, 12-13, 11-12, 10-11 freshman cohort)	N/A N/A	Student-Athletes 85% 89%
Four-year average (Graduation Success Rate) 2021 (14-15, 13-14, 12-13, 11-12 freshman cohort) 2020 (13-14, 12-13, 11-12, 10-11 freshman cohort) 2019 (12-13, 11-12, 10-11, 09-10 freshman cohort)	N/A N/A N/A	Student-Athletes 85% 89% 89%
Four-year average (Graduation Success Rate) 2021 (14-15, 13-14, 12-13, 11-12 freshman cohort) 2020 (13-14, 12-13, 11-12, 10-11 freshman cohort) 2019 (12-13, 11-12, 10-11, 09-10 freshman cohort) 2018 (11-12, 10-11, 09-10, 08-09 freshman cohort)	N/A N/A N/A N/A	Student-Athletes 85% 89% 89% 91%

Men's Sports (2011-2014 Cohorts)	GSR Score	
Baseball	71	
Basketball	67	
Cross Country	71	
Football	77	
Golf	92	
Outdoor Track & Field	71	
Swimming & Diving	83	
Wrestling	80	
Women's Sports (2011-2014 Cohorts)	GSR Score	
Basketball	93	
Cross Country	96	
Golf	100	
Gymnastics	91	
Outdoor Track & Field	96	
Soccer	96	
Softball	94	
Swimming & Diving	100	
Tennis	100	
Volleyball	86	

2020-21 ANNUAL REPORT Department of Intercollegiate Athletics

University of Missouri - Columbia

Admission Exceptions

	Summer 2020	Fall 2020	Spring 2021	Total
Student-Athlete Admission Exceptions (# of individual exceptions)	0	20	10	30
All Student Admission Exceptions (# of individual exceptions)	0	344	44	388
Percent of Admissions Exceptions who are Student-Athletes	0.00%	5.81%	22.73%	7.73%

Executive Summary

Joint Degree Program in Psychological Sciences – MU UMSL

<u>Overview</u>

The University of Missouri System proposes a Joint B.A. Degree Program in Psychological Sciences to be offered collaboratively by the University of Missouri – Columbia and the University of Missouri – St. Louis. Recognizing the strength of combining two existing, strong programs in Psychology, faculty and academic leaders from MU and UMSL came together to design a collaborative, fully online, 33-hour joint degree program that draws entirely on existing resources. This innovative approach will provide more options for students and be to the mutual benefit of the existing programs. Upon completion, students will earn a joint degree that carries the name of both UM universities.

<u>Key Details</u>

- **Guiding Principles:** The guiding principles of this joint offering will be to deliver a student-focused program that emphasizes flexibility and greater choice, that enhances the collaboration relationship between MU and UMSL, that maintains and builds on the existing high-quality curriculum, and that serves as a model for the future.
- **New Efficiencies:** Through enhanced, targeted marketing, this program will drive more students to this degree and enable both departments to share in the increased enrollment. This joint venture will attract a new population of students and enable both institutions to make better use of existing resources.
- **Revenue Sharing Model:** This program will align with the Course Sharing Revenue model, which beginning in Fall 2022 will be a 50/50 split. This new revenue sharing model, which will be piloted for AY 2022-2023, is designed to provide greater incentive for UM universities to work together and share expertise and resources.
- **Curriculum:** This program combines the best of the curricula currently offered at the UMSL and MU campuses. Students will complete 33 credit hours for this degree and a 15-hour core. Students will have the opportunity to choose coursework in areas of Clinical, Social and Developmental Psychology as well as Cognitive/Neurological Psychology.
- **Existing Programs**: Currently, MU and UMSL both offer bachelor's degrees in Psychology with on-ground and online options. This joint degree program will effectively merge the two online options, while leaving the on-ground versions of the program intact. These programs will continue to be available to students in their traditional form, while creating additional opportunities for those interested in online coursework.

This program has involved significant work across MU and UMSL, with substantial hands-on engagement from the relevant department chairs, program directors, and associated faculty members. In addition, Interim Dean Cooper Drury (MU) and Dean Andy Kersten (UMSL) have met regularly to work out the logistics for how this program will be run and governed. MU and UMSL hope to begin offering this innovative program in Fall 2022.

Appendix A: Proposed Curriculum

Full Degree Program (120-credit hours)

33 hours	Joint Psychology Program
39 hours	College of Arts & Sciences college-level requirements
42 hours	General education coursework
6 hours	Electives

Joint Program (33-credit hours)

15 hours	Core courses
12 hours	Distribution courses:
6 hours	Cognitive/Neuroscience
6 hours	Clinical/Social/Developmental
6 hours	Electives

Core Courses (15 CR)	Credits	MU COURSE	UMSL COURSE
General Psychology	3	Psych1000	Psych1003
Choosing a Career in	1	Psych100X	Psych1001
Statistics	3	Stat1200	Psych2201
Research Methods I	3	Psych3010	Psych 2219
Research Methods II	3	Psych3020	Does not offer
Capstone Integrated Psych	2	Does not offer	Psych4999

Distribution-Cognitive/Neuroscience (6 CR)	
MU COURSE	UMSL COURSE
2210: Mind, Brain, & Behavior	2211: Intro to Bio Psych
2220: Drugs & Behavior	2200: Drugs & Behavior
4210: Physiological Psych	
3870: Sleep & Sleep Disorders	

Distribution-Clinical/Social (6 CR)	
MU COURSE	UMSL COURSE
2310: Intro to Social Psych (8 wk)	2520: Social Psychological Science
2520 Intro to Addiction Science	
3003: Positive Motivation (8 wk)	
3003: Psychology of Gender	
4830: Psychology of Women	
	2268 Lifespan Development
2410 Developmental Psych	2270 Dev Psych: Infancy
2510 Abnormal Psych	2245 Abnormal Psych
	3232 Psych of Trauma
	3280 Psych of Death & Dying
3510 Intro to Clinical Psych	3346 Intro to Clinical Psych
	4365 Psych Testing & Assessment
	4376 Mental Health & Aging
	4250 Drugs & Addiction
2511 Military & Veteran Psych	
3370 Science of Mindfulness	
3815 Cross-Cultural Psychology	
3830 Health Psychology	

Appendix B

October 29, 2021



University of Missouri System

Members of the Board of Curators,

As the Deans of the College of Arts and Sciences at our respective institutions, it is our pleasure to support the University of Missouri System's first-ever joint bachelor's degree program in Psychological Sciences. This program will build on the already considerable strength of our existing degree programs in Psychology while creating new opportunities. We appreciate the opportunity to share information about this program with you as we work toward implementation.

This program combines the best of the existing online curricula offered at the UMSL and MU campuses. Students will complete 33 credit hours for this degree and a 15-hour core, with the choice to specialize in the areas of Clinical, Social and Developmental Psychology or Cognitive/Neurological Psychology. By combining the curriculum, students will have more options when it comes to building their course schedule, making the degree an attractive offering to online students that are increasingly looking for a personalized curriculum that is flexible to their needs and circumstances. Through enhanced marketing efforts with support from the Office of eLearning, we anticipate this program will generate new enrollments and enable our academic units to share in that success.

This program will be among the first to utilize the University's new Course Sharing Revenue Model, which was recently modified to foster greater intercampus collaborations. Revenue from the 33-hours taken as part of the program will be split 50/50 across our two universities. To manage and assess the program over time,

We are looking forward to beginning this new venture and establishing a model for joint degree programs at the University of Missouri System.

Best regards,

Pans

Cooper Drury, Ph.D. Interim Dean, College of Arts & Science

John E. Kut

Andrew Kersten, Ph.D. Dean, College of Arts and Sciences

Executive Summary New Degree Program, PhD in Translational Biosciences, MU

The School of Medicine (SOM) at the University of Missouri-Columbia (UMC) campus proposes to develop a new predoctoral training program, the Translational Biosciences PhD program. The Translational Biosciences PhD program represents a new paradigm for graduate training in biomedical research at the university. It will span the entire breadth of the biomedical research spectrum, from basic science discoveries to improved clinical outcomes. Existing departmental-based graduate programs in the basic science departments will be incorporated into it. By coordinating graduate training throughout the SOM, the Translational Biosciences PhD program will: (i) provide graduate students with research skills that will enhance the productivity of faculty research programs; (ii) increase the number of national research fellowships awarded to graduate students; (iii) increase the submission of highly competitive institutional training grants; (iv) increase the number of research-active faculty in the SOM who are involved in training and mentoring graduate students; (v) support the recruitment of additional research-active faculty with active research programs; (vi) enhance collaborative research between basic and clinical scientists.

Through close collaborations with the outstanding scientists and clinicians of the Precision Health Institute, a UM System-wide effort to translate ground-breaking biomedical research into life-changing reality for patients in Missouri and around the world, the Translational Biosciences PhD program will provide state-of-the-art research training to young biomedical scientists at the beginning of their scientific careers. By combining graduate education and training with cutting-edge research, the Translational Biosciences PhD program will enhance biomedical research at MU and help MU maintain its AAU status as leading research university.

Students who earn their PhD from the Translational Biosciences PhD program will be highly trained biomedical scientists. The societal need for biomedical scientists is illustrated by the rapid development and deployment of highly effective vaccines against the virus that causes COVID19. The Translational Biosciences PhD program will meet a growing demand for biomedical scientists in the State of Missouri, where the demand for biomedical scientists is projected to grow faster than overall job growth in the state.

The development of biomedical scientists through graduate education and research requires a multi-year investment that pays off through new scientific discoveries and research innovation. The Translational Biosciences PhD program will invest in recruitment and provide stipend/tuition support of first-year graduate students. Our goal is to increase the number of incoming graduate students to 20 per year, up from the current level of 8 per year in the existing PhD programs in the SOM. No additional faculty will be needed for instructional purposes. One new staff member will be hired to support the recruitment activities of the Program. During the latter years of graduate training (years 2 -5), stipend/tuition support will be provided by research grants, with the graduate students serving as graduate research assistants on externally funded faculty-led research projects. The research activities of graduate students will support the ability of faculty to sustain externally funded long-term research programs. Although the Translational Biosciences PhD program will not generate net revenue as a stand-alone educational program, the program will have an overall net financial benefit to the University, through increased research productivity of faculty-led teams capable of garnering competitive external grant support. No. 1

Recommended Action - PhD in Translational Biosciences - University of Missouri-Columbia

It was recommended by the University of Missouri System Office of Academic Affairs, endorsed by President of the University of Missouri Mun Choi, recommended by the Academic, Student Affairs and Research & Economic Development Committee, moved by Curator_____, seconded by Curator_____that the following action be approved:

that the University of Missouri – Columbia be authorized to submit the attached proposal for a PhD in Translational Biosciences to the Coordinating Board for Higher Education for approval.

Roll call vote of the Committee:	YES	NO
Curator Graves		
Curator Hoberock		
Curator Layman		
Curator Wenneker		
The motion		
Roll call vote of Board:	YES	NO
Curator Brncic		
Curator Chatman		
Curator Graham		
Curator Graves		
Curator Hoberock		
Curator Holloway		
Curator Layman		
Curator Wenneker		
Curator Williams		
The motion		

New Degree Program Proposal:

Doctor of Philosophy in Translational Biosciences

University of Missouri – Columbia November 2021 Board of Curators Meeting

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Executive Summary

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1. Introduction

Academic components of the Translational Biosciences PhD program: The academic home of the Translational Biosciences PhD program will be the School of Medicine at the University of Missouri-Columbia. The School of Medicine contains 21 departments, including 5 basic science departments and 16 clinical science departments. All Faculty in the School of Medicine who have appropriate Graduate Faculty Status, as determined by the MU Graduate School, will have an opportunity to participate in the Translational Biosciences PhD program, as classroom instructors, as research mentors and as members of doctoral program committees.

Basic Science Departments (5) in MU School of Medicine

- Biochemistry (jointly administered with College of Food, Agriculture and Natural Resources [CAFNR])
- Medical Pharmacology and Physiology (MPP)
- Molecular Microbiology and Immunology (MMI)
- Nutrition and Exercise Physiology (jointly administered with CAFNR)
- Pathology and Anatomical Sciences

Clinical Science Departments (16) in MU School of Medicine

- Anesthesiology and Perioperative Medicine
- Child Health
- Dermatology
- Emergency Medicine
- Family and Community Medicine
- Health Management and Informatics
- o Medicine
- Neurology
- Obstetrics, Gynecology and Women's Health
- Ophthalmology
- Orthopedic Surgery
- Otolaryngology
- Physical Medicine and Rehabilitation
- Psychiatry
- Radiology
- o Surgery

There are two PhD programs that are solely administered by the School of Medicine: the PhD program in the Department of Molecular Microbiology and Immunology (MMI) and the PhD program in the Department of Medical Pharmacology and Physiology (MPP). These PhD programs will be eliminated, once currently enrolled students have completed their training. The disciplinary areas represented by these two department-based programs will be incorporated into the Translational Biosciences PhD program as two of the six Emphasis Areas within the PhD program.

The six Emphasis Areas of the Translational Biosciences PhD program are:

- Biochemistry and Biophysics
- Cancer Biology
- Infection and Immunity
- Integrative Physiology
- Nutrition and Exercise Physiology
- Population and Precision Health

An important feature of the Translational Biosciences PhD program will be that faculty and students will not be confined within departmental silos. Instead, research-active faculty will be encouraged to participate in multiple Emphasis Areas and graduate students will be allowed to join the lab of any research-active faculty member that participates in any of the Emphasis Areas. We believe that this mechanism will enhance interdisciplinary collaborations in both research and training, as faculty from different research backgrounds and expertise will be brought together into each Emphasis Area. The use of Emphasis Areas instead of departmental PhD programs to organize research training of graduate students provides the Translational Biosciences program with the flexibility to add new Emphasis Areas or remove Emphasis Areas that fail to attract a critical mass of research active faculty and graduate students.

The Translational Biosciences PhD program will provide our PhD graduates with both a deep knowledge base of their chosen discipline and the ability to communicate and collaborate across disciplines. The six Emphasis Areas represent well-defined disciplines across the entire biomedical research spectrum and prospective employers will be able to readily identify the disciplinary expertise of our PhD graduates. We anticipate that the PhD graduates from the Translational Biosciences program will be sought after by a wide range of employers, including: research universities looking for postdoctoral scholars and tenuretrack faculty; large and small pharmaceutical companies that translate basic research findings into clinically-proven treatments; government laboratories that conduct research and assess the safety and efficacy of pharmaceuticals; and a wide variety of nongovernmental organizations that need biomedical expertise.

Preliminary steps toward the development of the Translational Biosciences PhD program: In 2017, Dr. Patrice Delafontaine, then Dean of the School of Medicine, initiated the development of an umbrella-type PhD program in biomedical sciences in the School of Medicine. Dr. Delafontaine had two goals for developing an umbrella program in the School of Medicine: (1) to encourage interdisciplinary training of PhD graduate students, and (2) to provide research faculty who are in clinical departments that do not have departmental PhD graduate programs with the opportunity to participate in graduate training. Dr. Delafontaine appointed a faculty committee to develop an umbrella PhD program in the School of Medicine. This faculty committee met individually with every department chair in the School of Medicine and held extensive discussions with faculty members from both basic science and clinical departments. From these discussions, a framework for a new PhD program, now called the Translational Biosciences PhD program, was developed.

The School of Medicine has begun the process of consolidating existing departmental PhD programs and developing the core curriculum for the Translational Biosciences PhD program. For example, one component of the curriculum (see Section 5) is Molecular and Cellular Biosciences, a Fall Semester 3-credit hour class. This course sequence is based on an

existing 5-credit hour class that was initiated in Fall 2018 as a collaborative course between the Biochemistry Department and the Molecular Pharmacology and Physiology (MPP) Department. After this trial run, the structure and content of the course was revised for the Fall 2019, with enrollment increasing from 9 students in Fall 2018 to 15 students in Fall 2019. In Fall 2020, 18 first-year graduate students in Biochemistry, MPP, Molecular Microbiology and Immunology (MMI) and Nutrition and Exercise Physiology (NEP) took this class.

Leadership of the Translational Biosciences Program: The Translational Biosciences program will be co-directed by Dr. Mark Hannink and Dr. Gillian Bartlett. Dr. Hannink is a tenured faculty member in the Biochemistry Department and has been a leader in graduate education on the University of Missouri-Columbia campus. Dr. Hannink has been a faculty member at MU since 1990, has served as the Director of the Life Sciences Fellowship program since 2004 and is currently the Program Director/Principal Investigator of two NIH-funded predoctoral training grants (T32 GM008396-30 and T32 GM135744-02) and one NIH-funded undergraduate training grant (T34 GM136493-02). During FY22, these three training grants will bring in \$1.3M to support undergraduate (\$491,044) and graduate (\$824,500) training in biomedical research at MU.

Dr. Gillian Bartlett is a tenured faculty member in Family and Community Medicine and serves as the Associate Dean for Population Health and Outcomes Research in the School of Medicine. Dr. Bartlett came to MU in 2020 from McGill University, where she completed a 10-year mandate as Research and Graduate Program Director and led the development and successful accreditation of three training programs that have enrolled over a hundred trainees – a MSc program in Family Medicine, a PhD program in Family Medicine and Primary Care and the Clinician Scholars Program which is an Enhanced Skills program that provides training for third-year family medicine residents to develop their research skills.

Dr. Hannink and Dr. Bartlett will be joined by a six-member Executive Committee, comprised of one representative from each of the six Emphasis Areas. As graduate training and research are closely aligned, Dr. William Fay, Senior Associate Dean for Research in the School of Medicine, will be an ex-officio member of the Executive Committee.

The current members of the Executive Committee (home department) and Emphasis Area are listed below. Copies of their NIH Biosketches are provided in Appendix A.

Dr. Charlotte Phillips (Biochemistry), Biochemistry and Biophysics Dr. James Amos-Landgraf (Veterinary Pathobiology), Cancer Biology Dr. Mark Daniels (MMI), Infection and Immunity Dr. Alan Parrish (MPP), Integrative Physiology Dr. Chris Hardin (NEP), Nutrition and Exercise Physiology Dr. Gillian Bartlett (Fam. Comm. Med.), Population and Precision Health **External Reviews of the proposed Translational Biosciences Program:** This proposal was reviewed by three external reviewers. All three reviewers are prominent biomedical scientists with extensive involvement in graduate and postdoctoral training. The reviewers were:

Reviewer #1: Dr. Gad Shaulsky. Dr. Shaulsky is Professor, Vice Chair and Program Director in Genetics & Genomics at Baylor College of Medicine (Houston, TX)

Reviewer #2: Dr. William C. Parks. Dr. Parks is Professor of Medicine and Biomedical Sciences, Director of the Doctoral Program in Biomedical and Translational Biosciences and Associate Dean, Graduate Research Education at Cedars-Sinai Medical Center (Los Angeles, CA).

Reviewer #3: Dr. Huntington F. Willard. Dr. Willard is Chief Scientific Officer, Genome Medical Inc.

Each reviewer provided a detailed list of strengths and weaknesses of the proposed program. These reviews, and detailed information on how the proposal was modified in response to these reviews, is provided in Appendix F. A summary of the major strengths and weaknesses and modifications to the proposal is provided below.

Strengths: The reviewers were unanimous in viewing the proposed Translational Biosciences program as a marked improvement over the current departmental-based format for PhD training at the University of Missouri-Columbia.

Dr. Shaulsky stated that "Overall, the proposal is very strong and I recommend that the University should consider it very favorably."

Dr. Parks stated: "Among the many potential strengths will be expanding opportunities for graduate students and increasing collaborations among labs and groups, which will ideally lead to increased extramural funding."

Dr. Willard compared the proposed program to umbrella-type programs that have been developed at other institutions, including UCSF, Washington University and Case Western Reserve. Dr. Willard noted that umbrella-type programs have "demonstrated benefits to the students, faculty, and institutions, as they allow for programmatic flexibility, exposure of students to a broad range of research approaches, and financial efficiencies that are not as evident in institutions with numerous small departmental programs, often of variable quality." Dr. Willard added: "The program proposed here certainly has the potential to be successful in this same way."

Weaknesses: All three reviewers shared the viewpoint expressed by Dr. Shaulsky: "Any negative comments made below should be considered as opportunities for improvement rather than reasons for rejection."

One major concern was the pace of increased student enrollment. Both Dr. Shaulsky and Dr. Parks felt that it was unrealistic to increase the enrollment of students into the SOM PhD training program from 8 to 20 in one year. To address this concern, we have changed our enrollment projections, anticipating that there will be a gradual increase from 8 entering students to 20 entering students over the first five years of the program. Thus, in Year 1 (FY23), we anticipate that there will not be a net increase in enrollment, with 8 matriculating

students. Over the next four years, we anticipate a net increase in enrollment of 3 students per year, reaching 20 newly enrolled students in Year 5 (FY27). We have changed the budget projections to reflect a slower pace of increased enrollment.

A major challenge noted by all three reviewers was that the Translational Biosciences program must develop features that make the program stand out from other PhD training programs at the University of Missouri as well at other institutions across the nation. Dr. Willard noted: "A challenge will be how to emphasize the "translational" aspects of the program and thus define the field that the program intends to impact. What will distinguish this doctoral program from the current departmental programs?" To address this concern, we have modified the proposed training program to emphasize the training in translational sciences that the PhD students will experience. Following the detailed suggestions of Dr. Parks and Dr. Willard, the training program will: (1) integrate Big Data and genomic sciences into the first-year coursework; (2) involve faculty with expertise in clinical research in PhD training at multiple points, including in coursework, in the Translational Biosciences Journal Club, in clinical rotations and as members of a PhD student's Doctoral Program Committee.

We thank the reviewers for their insightful comments and believe that the responsive changes we have made to the Translational Biosciences program will strengthen the program and allow our objectives to be met.

2. Fit With University Mission & Other Academic Programs

2.A. Alignment With Mission and Goals

Alignment with the University mission: The mission of the University is to achieve excellence in the discovery, dissemination, preservation and application of knowledge (https://www.umsystem.edu/about-us/weareum). The goal of the Translational Biosciences PhD program is train graduate students to become scientific leaders in biomedical research. This goal is closely aligned with the mission of the University. The Precision Health Institute is a priority of the University, and the new model for graduate training in biomedical research that will be developed by the Translational Biosciences PhD program will facilitate cross-disciplinary collaborations between basic and clinical scientists and help the Precision Health Institute achieve its goal of improving health outcomes through accelerated innovation.

Alignment with the campus goals and priorities: The strategic plan of the University of Missouri-Columbia (MU) is organized around five critical areas: Excellence in Student Success; Excellence in Research and Creative Works; Excellence in Engagement and Outreach; Inclusive Excellence; and Excellence in Planning, Operations and Stewardship. The Translational Biosciences PhD program will make substantive contributions to MU's Strategic Plan in at least three of these areas, including: Excellence in Student Success; Excellence in Research and Creative Works; and Inclusive Excellence

In the area of Excellence in Student Success, key priorities for graduate and professional education include the recruitment of high research/creative graduate students who can support the research activities of faculty and increased funding for PhD training in strategic priority fields. The Translational Biosciences PhD program will invest significant effort and funding in the recruitment of highly qualified undergraduates to matriculate into the

program. Furthermore, the structure of the Translational Biosciences PhD program, which will provide graduate students with increased research opportunities and will facilitate collaborative interactions between basic and clinical scientists, will be highly attractive to talented undergraduates who are interested in pursuing state-of-the-art research. By providing a platform for the submission of highly competitive individual fellowships and institutional training grants, the Translational Biosciences PhD program will increase external funding for PhD training in the priority areas of biomedical and translational research.

In the area of Excellence in Research and Creative Works, one of the key priorities is to identify and capitalize on areas where collaboration can drive excellence. Team Science built on interdisciplinary collaborations will be the hallmark feature of the Precision Health Institute, a high priority of both MU and the UM System. The Translational Biosciences PhD program will facilitate collaborations between basic and clinical scientists in graduate research and mentorship and increase interdisciplinary research collaborations between faculty.

In the area of Inclusive Excellence, one of the key priorities is to increase the enrollment of graduate and professional students from underrepresented backgrounds to 15% by 2023. The Translational Biosciences PhD program is poised for leadership towards achieving the goal of increasing the number of graduate and professional students from underrepresented backgrounds. For example, the diversity of predoctoral students in the MMI graduate program more than doubled from 2011 to 2021, as the percentage of Underrepresented Minorities (URM) increased from 9.4% in Fall 2021 to 20.6% in Spring 2021. In contrast, the percentage of URM PhD students across all life science PhD programs at MU increased from 7.2% to 10.9% over that same period. Based in part on the success of the MMI PhD program in recruitment and training of PhD students from diverse backgrounds, the School of Medicine was awarded a new NIH-funded T32 training program in February 2020 that is specifically focused on increasing the number of PhD scientists from underrepresented backgrounds. Dr. Hannink is the Program Director of this new T32 training program (T32 GM135744), which will be an important component of the Translational Biosciences PhD program.

Alignment with the goals and priorities of the School of Medicine: A top priority for the School of Medicine is to increase the amount of federally funded research. To accomplish this goal requires faculty members to write competitive research proposals. A highly trained workforce is needed to generate preliminary data in support of research proposals and to carry out the research once a grant proposal is funded.

Research carried out by PhD students during their graduate training is a critical component of federally funded research, particularly in the biomedical sciences. As described in a 2011 report on National Needs for Biomedical, Behavioral and Clinical Research Personnel, "graduate students and postdoctoral fellows provide the dynamism, the creativity, and the sheer numbers that drive the biomedical research endeavor"

(https://grants.nih.gov/training/research_training_biomedical.pdf). As an example of how graduate students contribute to the biomedical research enterprise at MU, the 44 PhD graduates who entered graduate school between 2004 and 2014 and participated in the training program co-sponsored by the Life Sciences Fellowship Program and T32 GM008396 contributed to a total of 216 published research articles, an average of 4.9 research articles per student.

Given the important contributions of graduate research to the ability of research universities to compete for federal research grants, reliance on a department-based graduate training model puts the MU School of Medicine at a structural disadvantage relative to other academic medical schools. For example, in FY21, of the 145 faculty in the MU School of Medicine with NIH research expenditures, 64% (93/145) were in clinical departments that do not have a department-based graduate training program. These research-active faculty in clinical departments in the MU SOM were responsible for 64% (87/135) of all NIH-funded grants that were active in the MU SOM during FY21. Yet these research-active faculty in clinical departments in the MU SOM do not have ready access to graduate students and are at a competitive disadvantage relative to faculty who have ready access to graduate students.

In contrast to the lack of access to graduate students faced by research-active faculty in MU SOM clinical departments, research-active faculty in clinical departments in the School of Medicine at Washington University in St. Louis are integrated into a campus-wide graduate training program, the Division of Biology and Biomedical Sciences (DBBS). At Washington University, there are no departmental-based graduate programs. Instead, the DBBS coordinates PhD training across the entire Washington University campus. In the Washington University DBBS program, 60% (309/515) of all faculty participants in the DBBS program are from clinical departments in the Washington University School of Medicine. These research-active faculty in clinical departments at the Washington University School of Medicine have ready access to highly qualified graduate students, which enhances the productivity of their research programs. The Translational Biosciences PhD program, by connecting research-active faculty in the MU SOM with a SOM-wide graduate training program, will enhance the ability of all faculty in the SOM to develop highly productive research teams and compete for NIH research funding.

One goal of the SOM is to double research funding over the next five years. This will be accomplished, in part, through the hiring of at least 40 new faculty with very active research programs. A robust graduate training program will be an attractive feature to new faculty recruits, who recognize the value that graduate research assistants provide to their research program.

2.B. Duplication/Collaboration Within Campus and Across System

Duplication with existing programs within the UM System or the state of Missouri: The proposed Translational Biosciences PhD program does not duplicate any other existing PhD programs within MU or the UM System. The Translational Biosciences PhD program, when approved, will be the only PhD program administered by the SOM. Existing departmental-based PhD programs in the SOM, including the Molecular Microbiology and Immunology PhD program and the Molecular Pharmacology and Physiology PhD program will no longer accept new students and these degree programs will be eliminated once the currently enrolled PhD students complete their degree.

Within the UM System, the Translational Biosciences PhD program will be uniquely positioned as the only PhD graduate program in the only state-supported four-year medical school and associated University Hospital and Clinics. The Translational Biosciences program will be the only PhD program within the UM System that spans the entire breadth of biomedical research from basic science to clinical outcomes.

In the state of Missouri, there are two broad-based, umbrella-type doctoral training programs for biomedical scientists: (1) the Graduate School of the Stowers Institute, and (2) the Division of Biology and Biomedical Sciences doctoral training program at Washington University in St. Louis.

The Graduate School of the Stowers Institute, which has 19 faculty investigators who provide research training to 70 predoctoral graduate students, is focused on foundational biomedical research and awards a PhD degree in Biology to its graduates. In contrast, the proposed Translational Biosciences PhD program will integrate training across the basic sciences/clinical sciences continuum. Furthermore, while the Stowers Institute is a standalone research institution, predoctoral training in the Translational Biosciences PhD program occurs in the context of a medical school that is affiliated with the teaching hospital of MU Health Care.

The Division of Biology and Biomedical Sciences at Washington University is a highly successful umbrella graduate program that brings together 515 faculty from 38 academic departments into 13 graduate training programs that, collectively, train 645 predoctoral students. The success of the Division of Biology and Biomedical Sciences at Washington University is something that we hope to emulate in the Translational Biosciences PhD program. However, the history of MU as a land-grant state-supported medical school and our goal to closely integrate the basic and clinical sciences into a single PhD training program are unique aspects of the proposed Translational Biosciences PhD program.

Collaboration with existing complementary programs on campus, across the System and the state of Missouri: The Translational Biosciences PhD program will collaborate with several graduate programs at MU, across the UM System and across the state, as described below.

Collaboration across the MU campus: One of the Emphasis Areas in the Translational Biosciences PhD program will be "Biochemistry and Biophysics". This interdisciplinary Emphasis Area will include faculty with expertise in biophysics, structural biology, and cell/molecular biology. Many of the faculty that will provide research training in this Emphasis Area have primary appointments in the Biochemistry Department. The Biochemistry Department is jointly administered by both the SOM and College of Agriculture, Food and Natural Resources (CAFNR), with 50% of Biochemistry faculty appointed through the SOM and 50% of Biochemistry faculty appointed through CAFNR. As a strength of the CAFNR-appointed faculty in the Biochemistry Department is in plant sciences research, there is a need to maintain an independent Biochemistry PhD degree program. To avoid duplication of effort, the Translational Biosciences PhD program will coordinate coursework and training activities with the Biochemistry graduate program. A letter from Dr. Michael Chapman, Chair of Biochemistry, is included in Appendix B.

The Translational Biosciences PhD program will coordinate graduate recruitment, education and training activities with the MU Institute for Data Science and Informatics (IDSI), particularly in training graduate students in quantitative skills. There are strong collaborations between the MU Informatics Institute PhD program and existing department-based PhD training programs in the SOM. For example, faculty from both MU IDSI and MMI participate as faculty mentors in an NIH-funded training program for biomedical PhD graduate students (T32 GM008396). Because of the importance of quantitative skills in biomedical research, we anticipate that these existing interactions will

be strengthened in the Translational Biosciences PhD training program. A letter from Dr. Chi-Ren Shyu, Director of the MU Institute for Data Science and Informatics, is included in Appendix B.

The Translational Biosciences PhD program will coordinate coursework and training with the Department of Veterinary Pathobiology in the College of Veterinary Medicine (CVM). The Department of Veterinary Pathobiology and the MMI Department in the School of Medicine have a joint graduate program, the Molecular Pathogenesis and Therapeutics (MPT) program. Many of the faculty who are currently part of the MPT program will be included in the Infection and Immunity Emphasis Area. Others, including Dr. James Amos-Landgraf, will be included in the Cancer Biology Emphasis Area. A letter from Dr. Brenda Beernsten, Interim Chair of Veterinary Pathobiology is included in Appendix B.

The Translational Biosciences PhD program will coordinate coursework and training with the PhD program in the Department of Nutrition and Exercise Physiology, which is jointly administered by CAFNR and SOM. There are foundational aspects of nutrition and of exercise physiology that are shared by other disciplines, including biochemistry, physiology, immunology and microbiology. The Translational Biosciences PhD program and the Department of Nutrition and Exercise Physiology will coordinate coursework and training to minimize redundancy in faculty effort. In addition, some of the faculty in the Department of Nutrition and Exercise Physiology will participate as faculty mentors in the Translational Biosciences PhD program. A letter from Dr. Jill Kanaley, chair of Nutrition and Exercise Physiology, is included in Appendix B.

The Translational Biosciences PhD program will coordinate coursework and training with the PhD program of the Division of Biological Sciences, in the College of Arts & Sciences. The Division of Biological Sciences hosts one of the largest graduate PhD programs in the life sciences on the MU campus. Several faculty members with academic appointments in Biological Sciences are faculty mentors in the MPT program and the Biological Sciences PhD program is a key partner in two SOM-led NIH predoctoral training grants (T32 GM008396 and T32 TM135744). A letter of support from Dr. Dave Schulz, Chair of Biological Sciences, is included in Appendix B.

Collaboration across the UM system: The Precision Health Institute, comprised of experts and scientists from the four UM universities, will translate ground-breaking biomedical research into life-changing reality for patients in Missouri and around the world. Through close collaborations with the outstanding scientists and clinicians of the Precision Health Institute, the Translational Biosciences PhD program will provide state-of-the-art training to young biomedical scientists at the beginning of their scientific careers.

Collaboration across the state of Missouri: There are no immediate plans for formal collaborations with other biomedical PhD programs across the state of Missouri. However, future collaborations with other broad-based biomedical PhD programs in the state of Missouri can be envisioned. As mentioned above, both the Stowers Institute in Kansas City and Washington University in St. Louis have broad-based training programs in biological and biomedical research. Potential collaborations between the Translational Biosciences PhD program could include research symposia that provide PhD students in these three programs to present their research or professional development/career development workshops that provide students with networking opportunities with potential employers.

3. Business-Related Criteria and Justification

3.A. Market Analysis

3.A.1. Need for Program

Students who earn their PhD from the Translational Biosciences PhD program will be highly trained biomedical scientists. Biomedical scientists are employed by a wide range of employers, including academia, non-profit organizations, government and business/industry. The importance of biomedical scientists to the U.S. economy is highlighted by the fact that research and development (R&D) expenditures for health or biomedical applications constituted 26% of total R&D expenditures across all industries in 2018, according to the National Center for Science and Engineering Statistics (https://ncses.nsf.gov/pubs/nsf21316). Collectively, the companies engaged in health and biomedical-related applications spent more than 3X on R&D than companies engaged in defense-related applications, the next largest R&D application area.

Consistent with the high levels of investment in biomedical research by both private companies and the federal government, the employment prospects for highly trained biomedical scientists are excellent. The U.S. Bureau of Labor Statistics (<u>https://www.bls.gov</u>) classifies Medical Scientists as PhD-level scientists who work in offices and laboratories, typically on research projects aimed at improving overall human health. According to the Occupational Outlook Handbook published by the U.S. Bureau of Labor Statistics (<u>https://www.bls.gov/ooh/life-physical-and-social-science/medical-scientists.htm#tab-7</u>), the number of Medical Scientists with a PhD degree is projected to grow 6% over the next 10 years, from a base of 138,300 Medical Scientists in 2019 to 146,700 in 2029. In contrast, the average rate of job growth for all jobs in the US economy during the 2019-2029 time frame is projected to be 4%.

In Missouri, the rate of growth of Medical Scientists is projected to be higher than the national average, according to Projections Central (<u>http://www.projectionscentral.com</u>), which predicts a growth rate of 8.7% in the number of PhD-level Medical Scientists, from 1,840 in 2018 to 2,000 in 2028.

We expect that the majority of the students who earn their PhD from the Translational Biosciences PhD program will develop a career in a research-intensive or research-related field. For example, 33 of the 39 (85%) graduate students who participated in the training

program funded by T32 GM008396 and who have earned their PhD degree over the past 15 years are continuing their career in research-intensive occupations in academia (N = 22), industry (N = 10) or government labs (N = 1). Of the remainder, 5 (13%) are working in research-related positions in industry or private foundations, typically in positions that involve program management or sales. Only 1 of the 39 graduate students is not working in a research-intensive or research-related position. In terms of where these PhD graduates found suitable employment, the largest number (16, or 41%) stayed in Missouri while the remainder were scattered throughout the US. As we anticipate that approximately 20% of the PhD students in this program will be from the State of Missouri, this program will result in a net influx of highly trained biomedical scientists that will help grow Missouri's economy.

3.A.2. Student Demand for Program

Student Demand: Supported by comments made by the external reviewers, we anticipate that there will be robust demand by students for the Translational Bioscience PhD program. The Translational Bioscience PhD program will merge the two existing PhD programs that are currently offered by the School of Medicine, which are housed in Molecular Microbiology and Immunology (MMI) Department and the Medical Pharmacology and Physiology (MPP) Department, respectively. Over the past 5 years, these two PhD programs have received an average of 46 applications per year, yielding an average of 8 matriculating students per year. As the breadth of the Translational Biosciences PhD program includes additional disciplines, including Cancer Biology, Population Health and Precision Medicine, we anticipate receiving approximately 120 applications, yielding 20 matriculating students, by Year 5.

Student Enrollment Projection: To project the student enrollment in this program, we have made a number of assumptions: (1) We assume that the applicant pool will increase from 46 per year to 120 per year over the course of five years; (2) From the applicant pool, we assume that the number of matriculating students will increase at the rate of 3 per year, such that the number of entering students increases from 8 in Year 1 to 20 in Year 5; (3) We assume a PhD completion rate of 87% and a time-to-degree of 5.5 years, based on our historical data with the existing biomedical PhD programs at MU (see Table 1C, page 14; and Table 4, page 21). These assumptions are modeled in Table 1A. As students are discrete entities, only whole numbers are included in the table. In year 5, this model predicts that, from the Year 1 cohort of 8 students, 7 of those students will still be enrolled in the program during the Fall Semester of Year 5 and complete their degree during Year 6. In Years 6 through Year 10, we assume that 20 students per year will matriculate into the program.

Table 1a.	Student Enrollmer	nt Projections ((anticipated	total 1	number	of students
enrolled in pro	ogram during the f	all semester of	given year).			

Year	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
Full-Time	8	11	14	17	20
Part-Time	0	0	0	0	0
Total	8	19	32	48	67

Projections for new-to-campus student enrollment: We assume that student matriculation into this program will increase from 8 students in Year 1 to 20 students in Year 5. Given that the average enrollment in the existing SOM PhD programs (MMI and MPP) is approximately 8 per year, a cohort of 20 entering students per year would include 12

students per year that would not otherwise have matriculated into an existing PhD program at MU. Thus, we project that the new-to-campus enrollment will be 12 per year by Year 5.

enrolled during t	enrolled during the fall semester of given year who were new to campus).									
Year Yr 1 Yr 2 Yr 3 Yr 4										
Full-Time	0	3	6	9	12					
Part-Time	0	0	0	0	0					
Total	0	3	6	9	12					

Table 1b. Student Enrollment Projections (anticipated number of students enrolled during the fall semester of given year *who were new to campus*).

Projections for PhD degrees awarded. Using the assumptions described for Table 1A, which include an overall PhD completion rate of 87%, we anticipate that 62 degrees will be awarded over the first ten years of this PhD. All the PhD degrees will be awarded in years 6-10. The number of PhD degrees awarded per year will increase from 7 in Year 6 to 18 in Year 10. After Year 10, we anticipate that there will be a steady-state enrollment of 20 new students per year and 17-18 PhD degrees awarded per year.

Table It.	Table It. I Tojetteu Number of Degrees Awarueu										
Year		Yr 1	Yr 2	Yr 3	Yr4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10
# Degrees Awarded	of	0	0	0	0	0	7	10	12	15	18

Table 1c. Projected Number of Degrees Awarded

3.B. Financial Projections

3.B.1. Additional Resources Needed

- No new faculty or facilities are needed. The School of Medicine Umbrella PhD program will utilize existing facilities and faculty resources to facilitate the instruction and infrastructure of the program. The facilities and faculty resources available to the Translational Biosciences PhD program include the Roy Blunt NextGen Precision Health Building and the faculty-led research programs housed therein. The Roy Blunt NextGen Precision Health Building will open on the MU campus in Fall of 2021.
- One new staff person will be hired, with primary responsibility for graduate student recruitment. As two existing PhD programs (in MMI and MPP) are being consolidated into the Translational Biosciences PhD program, the responsibilities of one existing staff person will be re-assigned to the Translational Biosciences PhD program to administer the educational and training activities of the program.
- Once the Translational Biosciences PhD program is established, no new graduate students will matriculate into the existing SOM PhD programs. After the current graduate students in the existing SOM PhD programs complete their degree, the existing SOM PhD programs will be consolidated into the Translational Biosciences PhD program.
- We anticipate that the Translational Biosciences PhD program will increase the number of PhD graduate students in the SOM. Currently, the SOM brings in an average of 8 new graduate students per year. We anticipate that, starting in Year 2 of the program, the number of new graduate students will increase by 3 per year.

- The projected increase in the number of PhD graduate students will require an increased financial commitment to graduate student support. MU competes with highly ranked public and private universities located throughout the Midwest (University of Wisconsin, Northwestern University, Washington University, etc) and on both coasts (University of California campuses, Johns Hopkins University, etc) for well-prepared and highly motivated undergraduates who are committed to pursuing a career in biomedical research. It is standard practice to offer competitive stipends as well as to waive all tuition and fees for graduate students in biomedical PhD programs. For example, the FY22 stipend level for Biochemistry graduate students at the University of Wisconsin is \$31,000, with all tuition and fees waived. To be competitive in student recruitment, MU must offer a competitive stipend as well as waive all tuition and fees not supported by research grants, training grants or fellowships. Tuition and fees that are waived are identified as Program Costs in Table 2.
- Federal research and training grants allow tuition and fees to be paid from the grant. Currently, in the SOM, about 40% of all tuition and fees are provided by grant funds, except for first-year students, who are typically not supported by research grants. We anticipate that the percentage of tuition and fees paid by research grants will increase to 60% by Year 5 of the Translational Biosciences program. Tuition and fees paid from grant sources is listed as Program Revenue in Table 2. The dollar amount of tuition and fees that are not recovered from grants is listed as Program Costs in Table 2.
- All first-year graduate students will be hired as 0.5 FTE Graduate Research Assistants (GRA). This 0.5 FTE GRA appointment will continue for the duration of their PhD training. In Year 0 (FY22), the current GRA stipend for SOM graduate students is \$30,000 per year. We anticipate a 3% annual inflation increase in graduate student stipends per year, such that the amount of a graduate student stipend in Year 2 (FY24) will be \$31,827. During their first year, graduate students will be funded by the Translational Biosciences program. The cost of stipends for new students, is included in the budget, starting in Year 2 (FY24) and continuing through Year 5 (FY27). During their subsequent training years, graduate student stipends are provided from research grants to the faculty mentors, training grants or fellowships.

3.B.2. Revenue

• Revenue is driven by students enrolling in a total of 72 credit hours during their 5year graduate education, including 23 credit hours per year during their first two years; 16 hours during their third year and 5 hours during years 4 and 5. Tuition is based on FY22 Board approved rates and then inflation adjusted each year after. Student fees are based on \$120 per credit hour starting in FY22 and inflation adjusted going forward. We anticipate that the amount of tuition and fees that are recovered from research and training grants will increase from the current level of 40% to a projected level of 60% by Year 5.

3.B.3. Net Revenue

• Graduate Education and Training is and will continue to be a non-revenue generating mission. Because a high-quality biomedical PhD graduate training program is synergistic with strong faculty-driven biomedical research programs,

recruitment of students into biomedical PhD programs is highly competitive across the nation. To be competitive in student recruitment, MU must offer a competitive stipend as well as waive all tuition and fees not supported by research grants, training grants or fellowships. Graduate education aligns with the School of Medicine's missions of research and education. As described below, graduate students make substantive contributions to the research productivity of faculty-led research teams. In the absence of a high-quality PhD training program, the ability of faculty to conduct research and compete for research grants would markedly diminish.

Table 2. Financial Projections for Proposed Program for Years 1 Through 5.

The Financial Projections outlined in Table 2 were developed by Jess Berkey, Director of Finance for the School of Medicine, with input provided by Victor Arnold, Associate Dean for Finance and Practice Plan Management. This is a pro forma budget, in which only new expenses and income is stated. This budget reflects the net cost of expanding the number of incoming PhD graduate trainees in the SOM from 8 per year in Year 1 to 20 per year in Year 5, with an anticipated increase of 3 PhD trainees per year, starting in Year 2 (FY24).

In Year 0 (FY22), the year before any students matriculate into the Translational Biosciences PhD program, we anticipate that operating expenses will be \$253,000 per year to cover the cost of a new staff member and costs associated with the recruitment of new students. Funds for recruitment are included in each of the subsequent years. In Year 1 (FY23), which is the year we anticipate that 8 students will matriculate into the Translational Biosciences PhD program, we are not including additional expenses or income for these 8 students, because the current graduate programs in the SOM bring in an average of 8 students per year. In Year 1, no students will enter the existing departmental-based programs of MPT and MPP. Instead, all 8 will enter the Translational Biosciences program, with no net gain of PhD students in SOM graduate programs. Starting in Year 2 (FY24), we anticipate an increase of 3 new PhD students per year is achieved by Year 5 (FY27).

Table 2				-			
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	
	FY22	FY23	FY24	FY25	FY26	FY27	
	1. Expenses per year						
	A. One-time						
New/Renovate d Space	0	0	0	0	0	0	
Equipment	0	0	0	0	0	0	
Library	0	0	0	0	0	0	
Consultants	0	0	0	0	0	0	
Others	0	0	0	0	0	0	
Total one- time	0	0	0	0	0	0	
	B. Recurring						
Faculty	\$ 0	\$ 0	\$ 0	\$ 0	\$ 0	\$ 0	
Staff	\$ 60,000	\$ 61,200	\$ 62,424	\$ 63,672	\$ 64,946	\$ 66,245	
Benefits	\$ 18,000	\$ 18,360	\$ 18,727	\$ 19,102	\$ 19,484	\$ 19,873	
Equipment							
Library							
Computing and Supplies	\$25,000	\$12,000	\$11,000	\$12,450	\$14,153	\$16,156	
Travel and Training	\$150,000	\$165,000	\$181,500	\$199,650	\$219,615	\$241,577	
Stipends	\$0	\$0	\$93,000	\$192,000	\$297,000	\$408,000	
Total recurring	\$253,000	\$256,650	\$366,651	\$486,874	\$615,198	\$751,851	
Total expenses (A+B)	\$253,000	\$256,650	\$366,651	\$486,874	\$615,198	\$751,851	
	2. Revenue p	er year					
Tuition/Fees	\$0	\$0	\$14,208	\$47,893	\$123,323	\$211,705	
Institutional Resources							
State Aid – CBHE							
State Aid – Other							
Total revenue	\$0	\$0	\$14,208	\$47,893	\$123,323	\$211,705	
3. Net revenue (loss) per year	(\$253,000)	(\$256,650)	(\$352,444)	(\$438,982)	(\$491,784)	(\$540,146)	
4. Cumulative revenue (loss)*	(\$253,000)	(\$509,560)	(\$862,004)	(\$1,300,955)	(\$1,792,859)	(\$2,333,005)	

Please provide responses to the statements below.

1. What are the specific sources of funds to support the new proposed program?

Response: With the consolidation of current PhD program, the School of Medicine will continue to use graduate research assistant (GRA) funds or campus allocated funds to cover staff salaries. Graduate stipends will come from operating fund dollars as well as CARTS R dollars allocated to the SOM from MUHC for strategic research initiatives.

2. If the new program is being funded through the 'core institutional budget,' what amount of funds will be reallocated and from which areas? (i.e., if existing resources are being used, please provide details.)

Response: With the consolidation of current PhD programs, the School of Medicine will continue to use GRA funds or campus allocated funds to cover staff salaries associated with the new program.

3. Are there any programs that will be deleted as a result of implementing this new program?

Response: The intent of this program is to consolidate current PhD programs that are administered by the SOM into the Translational Biosciences program while phasing out the old programs and students. The two current PhD programs that will be consolidated are housed in the Department of Molecular Microbiology and Immunology and the Department of Molecular Pharmacology and Physiology.

4. If the program will be supported by external funds, have the funding agency, the amount of funds, and whether they are one-time or ongoing funds been identified?

Response: The School of Medicine is the academic home of two current NIH T grants. Collectively, these two grants (T32 GM008396 and T32 GM135744) provide stipends and partial (60%) tuition recovery for 16 graduate students per year. We anticipate that Translational Biosciences PhD program will provide a training infrastructure that will allow the SOM to obtain additional T grants that will provide partial support of the program.

3.B.4. Graduate Training increases the Research Productivity of Faculty

- The ability of faculty to successfully compete for external grant funding is inextricably linked to their prior publication record. Research publications provide the foundational premise for the research described in a grant proposal. Graduate students, through their dissertation research, make substantive contributions to research publications. For example, the 44 PhD graduates who entered graduate school between 2004 and 2014 and participated in the training program cosponsored by the Life Sciences Fellowship Program and T32 GM008396 contributed to 216 published research articles, an average of 4.9 research articles per student.
- The ratio of graduate students to grant-funded faculty in the School of Medicine is low compared to peer institutions in the State of Missouri. The Graduate School of the Stowers Institute has a student/faculty ratio of 3.7 (70 students/19 faculty investigators). The Division of Biology and Biomedical Sciences at Washington

University has a student/faculty ratio of 1.25 (645 students/515 faculty). In contrast, the student/faculty ratio in the MU SOM is 0.37 (53 students/145 faculty with NIH-funded research expenditures in FY21).

- A significant number (64%, 93/145) of SOM faculty who have NIH-funded research expenditures do not have access to a departmental graduate PhD program. By aligning research-active faculty with graduate student training, the Translational Biosciences PhD program will enhance the research productivity of SOM faculty.
- One goal of the SOM is to double research funding over the next five years. This will be accomplished, in part, through the hiring of at least 40 new faculty with very active research programs. A robust graduate training program will be an attractive feature to new faculty recruits, who recognize the value that graduate research assistants provide to their research program.

3.B.5. Financial and Academic Viability

The Translational Biosciences PhD program will not achieve stand-alone financial independence. However, a high-quality PhD training program is closely aligned with both the research and educational missions of the SOM. The current size of PhD graduate programs in the SOM provides a minimum level for the number of PhD graduate students needed for academic viability of the Translational Biosciences PhD program. Over the past five years, the average number of entering PhD graduate programs) has totaled 8 per year. Projected over the next five years and assuming a retention rate of 97.5% per year and a PhD completion rate of 87%, there would be 38 PhD graduate trainees in SOM graduate programs at the end of five years. If enrollment in the Translational Biosciences program does not exceed this projection based on the current size of the existing SOM graduate programs, we will, in consultation with the Dean, Provost and UM Office of Academic Affairs, decide if any changes and/or investments designed to enhance the program are needed or if the program should be placed on an inactive status. If additional changes or investments are made, the program will then be reviewed on an annual basis to assess progress.

Table 3a: Enrollment at the End of Year 5 for the Program to Be Financially and Academically Viable.

Viability	Minimum Enrollment
Financial	Not applicable
Academic	38

Table 3b. Enrollment at the End of Year 5 for the Program to Be Financially and Academically Viable.

Enrollment Status	Full-Time	Part-Time	Total
Number of Students	38	0	38

3.C. Business and Marketing Plan: Recruiting and Retaining Students

Sustained, substantive and coordinated recruitment activities are critical for the success of the proposed program. Several recruitment activities are outlined below. Many of these activities are currently being used by participating departments and by the Life Sciences Fellowship Program. The goal of these recruitment activities will be to attract qualified students who are interested in biomedical research in any department or program at MU. These recruitment activities will be directed by a staff person (to be hired), who will report directly to the co-Directors of the Translational Biosciences program (Dr. Mark Hannink and Dr. Gillian Bartlett). Our recruitment activities will involve multiple faculty members, graduate students and staff. The Translational Biosciences program will collaborate with the Life Sciences Fellowship Program, with non-SOM departmental PhD programs in Biochemistry (CAFNR), Biological Sciences (Arts & Sciences), Biomedical Sciences (College of Veterinary Medicine), and with interdisciplinary graduate programs administered by MU's Graduate School (Genetics, Interdisciplinary Neuroscience Program, and Informatics) to identify and attract highly qualified students to pursue a PhD in biomedical research at MU.

A notable feature of the Translational Biosciences PhD program, that differentiates this program from most biomedical PhD graduate programs, is the emphasis on training in the translational sciences. Two of the external program reviewers (Dr. Parks and Dr. Willard) noted that this emphasis on "translational sciences" would be very attractive to undergraduate students who are interested in biomedical research. Both reviewers emphasized the need to clearly communicate the long-term career benefits that derived from being trained in a broad translational sciences program to prospective students. The success of our program requires a dedicated effort to reach out and communicate with prospective students. We will devote substantial resources to recruitment, as described below.

Recruitment personnel and expenses: Starting in FY22, which is Year 0 of the program (the year before any students will matriculate into the PhD program) and in all subsequent years, we will devote approximately \$250,000 for recruitment activities, including the salary of a staff person dedicated to recruitment, travel expenses associated with various recruitment activities described below and stipends to support undergraduate research experiences with faculty. The size of the recruitment budget is justified by the multi-disciplinary nature of the Translational Biosciences PhD program, the need to recruit highly qualified students into this program and the highly competitive nature of biomedical PhD programs across the nation.

Faculty visits to regional colleges and universities: We will maintain strong relationships that have been developed between MU and undergraduate institutions such as Truman State University, Lincoln University, Central Methodist University, Grinnell College, Calvin College and Hope College. We will develop similar relationships with other small colleges that have strong science departments, particularly those institutions who have faculty members who earned their PhD from MU. The development of relationships between MU faculty and the faculty at these small, undergraduate-focused institutions has been critical to our past successes in recruitment of outstanding graduate students.

Recruitment of underrepresented minority students:

a. We will continue with a successful strategy of recruiting at undergraduate recruitment

conferences, including Annual Biomedical Research Conference for Minority Students (ABRCMS) and the annual meeting of the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS). The Life Sciences Fellowship Program has developed a robust recruitment effort at these conferences over the past 15 years, in which faculty, graduate students and staff members from multiple departments and colleges/schools attend these undergraduate recruitment conferences. For example, at the 2019 ABRCMS conference, the last in-person conference before the COVID19 pandemic, the team of MU recruiters talked to more than 500 undergraduates interested in pursuing their graduate studies at MU. These initial contacts led to more than a dozen applications, with four of these students matriculating in Fall 2020 as first-year graduate students at MU.

b. Faculty visits to Historically Black Colleges and Universities (HBCU's) and Minority Serving Institutions (MSI). The Life Sciences Fellowship Program has a strong relationship with New Mexico State University and Medgar Evers College. We will develop similar relationships with other institutions that have URM-focused undergraduate training programs such as RISE or MARC. The National Name Exchange and existing contacts through the McNair program will also be utilized.

Campus visitation program: In collaboration with the Graduate School, we will use a campus visitation program (Tigerview) that is designed to promote diversity and inclusion in graduate education. This program will provide an opportunity for historically underrepresented and underserved undergraduate students to visit campus and meet with faculty and students in the Translational Biosciences PhD program. These visits will take place early during the Fall semester, so that the visiting students will have an opportunity to learn about research opportunities in our program before the December 1 application deadline.

Providing research opportunities for undergraduates:

a. Academic Year Research for Undergraduates: We will support MU undergraduates in faculty-mentored research during the academic year through partnerships with existing undergraduate research programs on campus, including the Initiative to Maximize Student Development-EXPRESS program (IMSD EXPRESS), the NIH-funded MARC program, the LS-AMP program and the McNair program.

b. Summer Research for Undergraduates: We will support up to 10 undergraduates from a variety of institutions, including MU, to participate in a 10-week faculty-mentored summer research experience. These students will participate in MU's Summer Research Program that is directed by the Office of Undergraduate Research.

Online application: We will develop a website with an online application using the Slate system through the Graduate School. This application will students to provide their undergraduate course record, including GPA. Prospective students will not be allowed to provide GRE scores. As part of the application, applicants will be asked to identify one or two Emphasis Areas that are most relevant to their research interests. Applications will be reviewed by representatives from the individual Emphasis Areas and final decisions on acceptances will be made by the Executive Committee of the Translational Biosciences program.

We will use a holistic review process to evaluate applications. A holistic review is one that places less importance on traditional quantitative measures, such as GPA, and more emphasis on what the applicant has accomplished with the opportunities provided by the applicant's environment, the potential for a career in research and the quality of the

references. Guided by the published work of Roger Chalkley at Vanderbilt on factors that predict success in graduate school

(https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0166742), our review process will emphasize (1) the breadth of a applicant's academic preparation for graduate school; (2) what the applicant learned from prior research experiences; (3) non-cognitive competencies, including initiative, perseverance, conscientiousness and self-awareness/self-appraisal; and (4) inclusion and equity.

Recruitment weekend. A recruitment weekend will be held in late January, after the initial review of applications. in which highly applicants will be invited to visit campus and meet both faculty and students. Over the past 9 years (except during the COVID19 pandemic), several life science departments at MU have collaborated with the Life Sciences Fellowship Program to host a joint recruitment weekend. This joint recruitment weekend has been very successful in showcasing the diverse strengths of life science research at MU. The Translational Biosciences will continue this collaboration with the Life Sciences Fellowship Program.

Plans to ensure program enrollments are achieved. The Executive Committee of the program will conduct an annual review of recruitment and retention efforts. The yield of student inquiries and applications from the past year's recruitment activities will be determined and a cost-benefits analysis will inform planning for recruitment activities for the next year. New strategies, including social media approaches, for reaching out to prospective students will be tested. The minimum number of incoming students per cohort that is needed for the academic vitality of the Translational Biosciences PhD is 15 students per year. If enrollment does not reach this threshold by the end of Year 5, we will consider inactivation of the program.

Historical retention of PhD students in biomedical training programs at MU: A nationwide analysis of PhD-level research training programs in the biomedical sciences, published in 2011 by the National Research Council (NRC), revealed that six-year completion rates for biomedical PhD students ranged from 42% to 56%, depending on the discipline. This analysis is available at:

<u>https://researchtraining.nih.gov/sites/default/files/pdf/biomedical_sciences.pdf</u>. A similar study that was published in 2015 and focused on students from underrepresented minority (URM) students, revealed that the seven-year PhD completion rate for URM PhD students across all life science disciplines was 52%. This study, from the Council of Graduate Schools, is available at: <u>https://cgsnet.org/ckfinder/userfiles/files/DIMAC_2015_final_report_PR.pdf</u>

Table 4 provides a summary of retention and PhD completion rates for biomedical PhD students associated with one or more of the training programs directed by Dr. Hannink, including two different T32 training programs (T32 GM008396 and T32 GM135744) and the Life Sciences Fellowship program. The data in Table 4 covers the time period of 2004 to 2019. During this period, 134 students matriculated into the various departmental PhD programs across campus, including the current PhD programs in the SOM (in the MMI and MPP departments) as well as PhD programs in other departments (Biochemistry in CAFNR and Biological Sciences in A&S). Of these 134 students, 71 completed their training and earned a PhD degree, 11 dropped out of the program before completing their PhD degree, and 52 were still in training during the 2019-2020 academic year.

The data in Table 4 provide clear evidence that the historical training record of biomedical PhD students is well above the national average for both PhD completion rates and time-to-degree. This historical record also indicates that there is not a substantive difference in outcome between URM and non-URM students. We anticipate that the Translational Biosciences PhD program will continue the strong training record established by the current biomedical PhD training programs at MU.

	PhD Completion (2004-2019)	Retention (2004-2019)	Attrition (2004-2019)	Time to Degree
URM (N = 59)	27/32 (84%)	54/59 (92%)	5/59 (9%)	5.3 years
Non-URM (N = 75)	44/50 (88%)	69/75 (92%)	6/75 (8%)	5.6 years
Total (N =134)	71/82 (87%)	123/134 (92%)	11/134 (8%)	5.5 years

 Table 4. Completion, Retention and time-to-degree of Biomedical PhD students from 2004-2019

Plans to retain students through graduation: A PhD training program represents a significant financial investment by the institution as well as a significant time investment by faculty, staff and students. These investments of time and money are lost when students drop out of a PhD training program. Student attrition from PhD programs is driven by multiple factors, including academic, culture/climate, and personal factors. Interventions to address the factors that cause students to drop out of PhD programs have been studied by Wilson and (https://www.lifescied.org/doi/full/10.1187/cbe.17-09-0210). co-authors The Translational Biosciences PhD program will incorporate best practices for retention that have been described in the literature. These best practices include: (1) personalized on-site interviews during Recruitment Weekend to increase the level of understanding by the applicant regarding the nature and expectations of the program; (2) a cohort-based social support network among the students through student-driven journal clubs that start in their first year and continue for the duration of their PhD training; (3) academic support, including peer tutoring by senior graduate students; (4) a consistent grant proposal-based format for the comprehensive exam, along with courses that emphasize professional skill development, particularly in the area of grant-writing; (5) the use of individual development plans and career planning workshops to help students identify and develop competencies, including but not limited to their research skills, that will help them achieve their long-term career goals; (6) as suggested by Dr. Parks, a student support center that addresses personal issues, including financial issues, relationship/marital issues and stress management.

The Executive Committee will conduct an annual review of student progress and outcomes. The purpose of this review is to identify areas of concern and to develop appropriate interventions to enhance student success.
4. Institutional Capacity

Institutional capacity for training graduate students: The Translational Biosciences PhD program will replace two existing PhD programs that are currently administered by the MMI and MPP departments within the School of Medicine. The disciplinary content of the existing PhD programs will be incorporated into one or more of the Emphasis Areas of the Translational Biosciences PhD Program. The prospective students that would otherwise matriculate into the PhD programs of the MMI and MPP departments will, instead, matriculate into the Translational Biosciences PhD program. In the past, 8 students per year matriculate into the PhD training programs offered through either MMI or MPP. At the end of five years, we anticipate that an average of 20 students per year will matriculate into the Translational Biosciences PhD program. This net increase of 12 students per year is easily accommodated by the number of research-active faculty in the SOM who hold Doctoral status, as determined by MU's Graduate School. Faculty with Doctoral status can be primary research advisors of PhD graduate students by serving as the Chair of the student's Doctoral Program Committee. In the School of Medicine, there are 71 faculty who hold Doctoral status. An additional 121 faculty in the School of Medicine have Graduate Faculty Status A, as determined by MU's Graduate School. Faculty with Graduate Faculty Status A can serve as members of a PhD students Doctoral Program Committee and can serve as co-chairs of a student's Doctoral Program Committee. Collectively, the presence of 198 faculty across the School of Medicine who have been approved by MU's Graduate School to mentor PhD graduate students indicates sufficient capacity to accommodate a steady-state number of approximately 100 PhD students per year.

Impact of the Translational Biosciences PhD program on the research capacity of the School of Medicine: There is a well-established interdependence between research funding of faculty and training of PhD graduate students. Research grants to faculty provide the funds for research supplies and personnel, including graduate student stipends, while data generated by graduate students provide the basis for research publications and subsequent grant funding by their faculty mentors. In addition, robust research funding to faculty and well-organized graduate training programs are prerequisites for training grants, including NIH-funded T32 training grants.

We believe that the Translational Biosciences PhD program will have a strong positive impact on the research capacity of the School of Medicine. For example, in FY2021, total research expenditures in the School of Medicine were greater than \$34M, representing the research activity of 145 faculty with primary appointments in 21 School of Medicine departments. However, 64% (93/145) of these research-active faculty in the School of Medicine do not have direct access to graduate students enrolled in a departmental PhD graduate training program. By replacing department-focused training programs with a broad umbrella program that is open to all research-active faculty in the School of Medicine (and to many faculty members outside the School of Medicine), the proposed Translational Biosciences program will provide an efficient mechanism to match graduate students with researchactive faculty. Furthermore, several of the Emphasis Areas of the Translational Biosciences program, including Cancer Biology, Integrative Physiology and Population and Precision Health, are closely aligned with the research foci of the NextGen Precision Health Institute. By both increasing the number of PhD graduate students in the SOM and by providing a SOMwide mechanism for connecting graduate student training to research-active faculty, the Translational Biosciences PhD program will have a positive impact on faculty research activities. Furthermore, the Translational Biosciences PhD program will provide an infrastructure that will result in increased T32 training grants at MU.

5. Program Characteristics

5.A. Program Outcomes

Learning outcomes: To earn their PhD degree, the graduates from the Translational Biosciences program must write and defend a dissertation that describes previously unknown findings revealed by their laboratory experiments or clinical observations. During their research training, the graduates from the Translational Biosciences program will have acquired in-depth expertise in a biomedical discipline and will have learned how to be effective communicators across disciplines. The graduates from the Translational Biosciences program will be independent scientists who are adept at using interdisciplinary and collaborative approaches to solve complex problems that adversely affect human health.

Special skills of graduates specific to the program: As a result of their coursework and research training, the PhD graduates will have acquired the following skills that will allow them to develop successful careers as biomedical scientists.

- Technical skills in state-of-the art experimental and computational approaches used in modern biomedical research.
- Operational skills of hypothesis generation, independent knowledge acquisition, and rigorous analysis of experimental data.
- Professional skills of ethical leadership, communication and teamwork and research program management that allow for productive interdisciplinary collaborations.
- Proficiency in problem-solving skills relevant for finding solutions to both old and new problems in human health and disease.

5.B. Structure

Overview: The curriculum of the Translational Biosciences program was developed with a singular goal in mind: to facilitate the transition of the PhD students from consumers of existing knowledge into producers of new knowledge. The curricular components include formal coursework, research rotations, journal club seminars, research seminars, professional development workshops and dissertation research.

The curriculum of the Translational Biosciences program has both Program-wide components, which all PhD students will participate in, and Emphasis Area-specific components, which will involve PhD students who have selected a particular Emphasis Area of research. The Program-wide components include the first-year coursework, rotation research, professional development courses and workshops, and a cohort-based journal club which will be continued through all years of the training program. The Emphasis Area-specific components include specialized coursework in appropriate discipline(s) relevant for a given Emphasis Area, research seminars and dissertation research under the mentorship of one (or more) faculty members. The balance between Program-wide components and Emphasis Area-specific components will shift over the proposed five-year course of study, with the Program-wide components predominately occurring during the first two years of graduate study and Emphasis Area-specific components becoming predominate during the latter years of graduate study.

5.C. Program Design and Content

PROGRAM STRUCTURE

1. Total credits required for graduation: 72

2. Residency requirements, if any: No residency requirements.

3. General education: Total credits for general education courses: Not applicable for a PhD degree.

4. Major requirements: Total credits required: 72

Process used to design the curriculum to meet the program outcomes: The process of developing the Translational Biosciences PhD program began in 2017, when Dean Delafontaine asked Dr. Mark Hannink (Biochemistry) and Dr. Alan Parrish (Medical Pharmacology and Physiology) to lead an effort to develop an umbrella PhD program in biomedical sciences in MU's School of Medicine. Dr. Hannink and Dr. Parrish led a faculty committee that spent two years in the planning and development of the proposed Translational Biosciences PhD program. Drs. Hannink and Parrish met individually with every department chair in the School of Medicine, including 5 basic science department chairs and 16 clinical department chairs. Extensive discussions were held with the leaders of existing PhD programs in the School of Medicine and with extended groups of faculty members from both basic science and clinical departments.

There were three guiding principles that came out of these discussions:

1: that all biomedical disciplines share a common language based on the foundational sciences of genetics and biochemistry and that mastery of this common language is important to facilitate communication by scientists across disciplinary boundaries.

2: that all biomedical scientists use a common set of operational and professional skills; and that the development of these skills needs to be a major component of research training. These operational and professional skills include:

- Synthesizing information across multiple disciplines
- Understanding strengths and limitations of experimental approaches
- Using appropriate statistical analyses
- Interpreting data
- Identifying gaps in the knowledge base
- Generating novel hypotheses
- Communicating the impact of their research findings, including translational implications of research

3: that the development of an in-depth knowledge base and technical expertise in any biomedical research discipline builds on the common language of genetics and biochemistry and on the operational and professional skills outlined above.

Sequence of courses: The three principles, outlined above, have guided curriculum development of the Translational Biosciences PhD program. The initial Program-wide

coursework, taken by all students, will emphasize the common languages of genetics and biochemistry, as well as the common skills of experimental design and data analysis, particularly for large datasets that are increasingly generated and used by biomedical scientists. As the students make progress through the program and begin to define the problem(s) that will be the focus of their dissertation research, the coursework becomes more specialized within each Emphasis Area. As a counterbalance to increased specialization, students in the Translational Biosciences program will also be required to take one 3 credit hour elective course in a different Emphasis Area or in a different PhD program. Students will be encouraged to take additional elective courses that fit their broader interests. The Translational Biosciences Journal club, which will be taken by students from each entering year as a cohort, will also counterbalance research specialization through continued exposure to research outside of their area of expertise.

Consistent with the requirements of the MU Graduate school for full-time enrollment of graduate students, all of the students in the PhD Translational Bioscience program will be full-time graduate students and will register for 9-12 credit hours per Fall or Spring semester and 5 credit hours in Summer semester until they pass their comprehensive exam. Students will take their comprehensive exam during their second year. After completing their comprehensive exam, students will take a minimum of 2 credit hours per Fall or Spring semester and 1 credit hour in the Summer Semester. The schedule of courses assumes a five-year plan of study for PhD students. A total of 72 credit hours of graduate coursework (including both didactic coursework and research) is required to earn a PhD.

The 72 credit hours of graduate coursework required for a PhD degree in the Translational Biosciences PhD program is divided into five categories: (1) Didactic coursework required of all students, including at least one elective course; (2) Didactic coursework specific to each Emphasis Area; (3) Seminars and Journal Clubs, including both Program-specific and Emphasis Area-specific; (4) Rotation Research; (5) Dissertation Research. Although the amount of didactic coursework required for each individual Emphasis Area varies, an average coursework across all Emphasis Areas was used to determine the distribution of credit hours between these different categories for an "average" student who takes 5 years to complete the PhD, as shown in the Table below.

Type of course	Average credit hours required over 5 years
Program-specific Didactic Coursework	14
Emphasis Area-specific Didactic Coursework	6 - 15
Seminars and Journal Clubs	18
Rotation Research	2
Dissertation Research	23 - 32
Total credit hours	72

Year 1 Coursework (23 credit hours): All PhD students in their first year will take a common set of courses, including coursework in molecular/cellular biology, data design and analysis, a professional skills course, and a seminar course. In addition, all PhD students will participate in research rotations with at least three different research laboratories during their first year. After completing research rotations with three different faculty mentors, the

students will select their primary faculty mentor and initiate their dissertation research during the Spring Semester of their first year.

Fall Sem. Yr. 1		Spring Sem. Yr 1		Summer Sem. Yr 1	
Course	Hrs	Course	Hrs	Course	Hrs
MPP 8500/BIOCHM 8240 Molecular and Cellular BioSciences	3	Emphasis Area Introductory Course	3	Dissertation Research	5
Data Design and Analysis I	3	Emphasis Area Introductory Course	3		
Professional skills for Translational Bioscientists I	1	Professional skills for Translational Bioscientists II	1		
Rotation Research	1	Rotation Research	1		
Research Seminar	1	Research Seminar	1		
TOTAL CREDIT HOURS (Fall)	9	TOTAL CREDIT HOURS (Spring)	9	TOTAL CREDIT HOURS (Summer)	5

Year 2 Coursework (23-32 credit hours): There will be two program-wide requirements of all PhD students during years 2 – 5, including a grant-writing course during their second year and a yearly journal club with other members of their cohort. By the end of their second year, most of the PhD students will have completed didactic coursework for their Emphasis Area. The PhD students will have completed their comprehensive exam by the end of Year 2.

In the tables below, the Emphasis Area-specific coursework is identified as such, without specifying the Emphasis Area or the title of the specific courses. Additional information on the coursework components of the individual Emphasis Areas is provided in the Appendix. The elective coursework will typically be courses offered by other Emphasis Areas, although courses taught by other departments across campus will also qualify as elective coursework, provided that the course is taught at the appropriate graduate (8000 to 9000) level.

Fall Sem. Yr 2		Spring Sem. Yr 2		Summer Sem. Yr 2	
Course	Hrs	Course	Hrs	Course	Η
Translational Biosciences Journal Club (by cohort)	1	Translational Biosciences Journal Club (by cohort)	1	Dissertation Research	5
		Grant-writing for Biomedical Scientists	3		
Emphasis-Area Coursework	3-6	Emphasis-Area Coursework	3-6		
Elective	0-3	Elective	0-3		
Emphasis-Area Research Seminar	1	Emphasis-Area Research Seminar	1		
Dissertation Research	1	Dissertation Research	1		
TOTAL CREDIT HOURS (Fall)	9-12	TOTAL CREDIT HOURS (Spring)	9-15	TOTAL CREDIT HOURS (Summer)	5

Years 3-5 Coursework (7-25 credit hours per year): During years 3-5, the PhD students will focus on their dissertation research while continuing to take the Translational Biosciences Journal Club and Emphasis Area-specific seminars. During years 3-5, the PhD students may take additional elective coursework that are relevant to their interests. Students in their sixth year (or later) of the PhD program will continue to register for Dissertation Research, Translational Biosciences Journal Club and Emphasis Area Research Seminar until they defend their dissertation.

Fall Semester Yrs 3-5		Spring Semester Yrs 3-5		Summer Semester Yrs 3-5	
Course	Hrs	Course	Hrs	Course	Hrs
Translational Biosciences Journal Club (by cohort)	1	Translational Biosciences Journal Club (by cohort)	1	Dissertation Research	1
Emphasis-Area Coursework	0-4	Emphasis-Area Coursework	0-4		
Elective	0-3	Elective	0-3		
Emphasis-Area Research Seminar	1	Emphasis-Area Research Seminar	1		
Dissertation Research	1-3	Dissertation Research	1-3		
TOTAL CREDIT HOURS (Fall)	3-12	TOTAL CREDIT HOURS (Spring)	3-12	TOTAL CREDIT HOURS (Summer)	1

5. Free elective credits: Total free elective credits: One 3 credit elective is required; up to 9 elective credits will be allowed.

6. Requirement for thesis, an internship or other capstone experiences: A PhD dissertation is required. A PhD dissertation describes new findings, including field observations and experimental data, that address a previously unanswered question in an area of human inquiry. Students in the Translational Biosciences PhD program are required to write a dissertation and to present a public defense of the dissertation. All dissertations that are successfully defended will be published by MU. In addition, the research results described in the dissertation must be published in one or more scientific journals as peerreviewed manuscripts. The Translational Biosciences PhD program will require that all PhD graduates have at least 1 first-author research publication related to the dissertation research.

7. Any unique features such as interdepartmental cooperation: Interdepartmental cooperation is at the heart of the Translational Biosciences PhD program. By joining together into a single PhD program rather than attempting to develop individual PhD programs in each of the 21 departments within the School of Medicine, the departments have recognized the

advantages of working together, across departmental and disciplines, to create a novel research training program that will integrates training across the basic and clinical biomedical sciences.

Integration of research training across the basic and clinical biomedical sciences will occur through a PhD student's career. During the first-year coursework, both the Molecular and Cellular BioSciences course and the Data Design and Analysis course will emphasize mechanisms of disease and Big Data science as well as the use of diverse genomic and biomedical databases including the Cancer Genome Atlas (https://www.cancer.gov/about-nci/organization/ccg/research/structural-genomics/tcga) and the UK Biobank (https://www.ukbiobank.ac.uk). Research rotations with clinical scientists will be encouraged. The Translational Biosciences Journal Clubs, which all PhD students will participate in during Years 2-5, will be led by faculty from both the basic and clinical sciences. We will encourage clinical scientists to become participating members of the Emphasis Areas, including serving as members of Doctoral Program Committees of the PhD students.

5.D. Program Goals and Assessment

Didactic Coursework: A variety of methods, including quizzes, homework assignments, group assignments, exams and participation in class discussions will be used to assess learning outcomes for didactic courses. Instructors of individual courses will determine the relative contribution of each learning outcomes to the grade that a student will receive after completing each of the courses. Didactic courses will use the traditional letter grade scale (A = 4.0, B = 3.0, etc.). At MU, all graduate students are required to maintain a 3.0 grade point average (GPA). Students who do not maintain a 3.0 GPA will be put on academic probation for the following semester. Students on academic probation who fail to bring their cumulative GPA above 3.0 will be dismissed from the program.

Research Rotations and selection of a research advisor(s): One goal of the three required research rotations is for the PhD student to gain exposure to the research interests of different faculty mentors. A second goal is for the PhD student to gain exposure to the different mentoring style(s), expectations and cultural environments of faculty mentors and their research groups. Rotations with clinical scientists will be encouraged. Both the PhD student and the faculty mentor will be required to provide the Program Directors with a short description of the rotation experience. The research rotations will be graded on a Pass/Fail basis.

Following three research rotations, selection of a research advisor for PhD students will be based on mutual consent of the PhD student and the faculty mentor. Dual mentorship of PhD students by, for example, a basic scientist and a clinical scientist, will be encouraged.

Research Seminars and Journal Clubs: All students will be required to attend Research Seminars and Journal Club courses. Attendance and participation will be used to assess learning outcomes for seminars and journal clubs. These courses will be graded on a Pass/Fail basis.

Research Progress: Rotation Research courses and Dissertation Research credits will be graded on a Pass/Fail basis. Each student is required to meet with their Doctoral Program

Committee at least once per year. At each meeting, the student will present their research progress to their DPC. Students are also required to submit an annual assessment report of their research progress to the Graduate Education Committee of each Emphasis Area. Both the primary research advisor as well as another member of the DPC will write independent assessments of the student's research progress. The research progress reports should clearly outline how the student's research is progressing towards one or more publishable manuscripts.

Completion of the Comprehensive Examination and Advancement to Candidacy: The comprehensive exam is a hallmark of every PhD program. Successful completion of the Comprehensive exam indicates that the student has advanced to Candidacy for the PhD degree. Graduate students in the Translational Biosciences PhD program will be expected to pass their comprehensive exam before the start of their third year. The Comprehensive Exam will have a written component and an oral component. The written component will be a research proposal written in the format of an NIH F31 proposal. The oral component will be a presentation and defense of the proposed research to the student's DPC. Following successful completion of the Comprehensive Exam, the student's F31 proposal will be submitted to NIH.

Assessment of the Comprehensive Exam: The Comprehensive Exam process will evaluate (1) the student's knowledge of core concepts in the discipline(s) relevant to the Emphasis Area; (2) the student's knowledge of core concepts in the discipline(s) relevant to the research project(s) of the student; and (3) the ability of the student to develop, write and orally defend a hypothesis-driven research proposal that outlines a series of experimental approaches to test the validity of the hypothesis. The written and oral components of the Comprehensive Exam will be assessed separately, on a Pass/Fail basis. Students must receive a Pass on both components to have passed the Exam. Students who fail the Comprehensive Exam will have one opportunity to retake the Exam, which must be completed by the end of the following semester.

Research Dissertation: To earn their PhD degree, the graduates from the Translational Biosciences program must write and defend a dissertation that describes previously unknown findings revealed by their laboratory experiments or clinical observations. The standard expectation of all students in the Translational Biosciences program is that they must submit 2 publications, 1 of which must be a first-author publication, that describe the outcomes of their dissertation research to peer-reviewed journals prior to defending their dissertation. A public oral defense of their dissertation is required.

Goals for retention and graduation rates: As described above (Table 2, Section 3 and Table 4), biomedical training programs at MU, including those in the School of Medicine, have a historical PhD completion rate of 87% and a time-to-degree of 5.5 years. While we aspire to increase the PhD completion rate to 90% while maintaining a time-to-degree of 5.5 years or less, the historical PhD completion rate has been used in all projections.

Projection of graduates per year: We anticipate that the average time-to-degree will be 5.5 years. Thus, we do not anticipate any PhD graduates until Year 6 of the program. In year 6, we anticipate that 7 of the 8 students who joined the program in Year 1 will complete their PhD. In Year 5, we anticipate that new enrollment will plateau at 20 incoming students per year. Thus, by Year 10, with an entering cohort of 20 students per year and a PhD completion

rate of 87%, we anticipate that there will be, on average, 18 PhD graduates per year starting in Year 10.

Projection of Placement rates: We anticipate that 98% of all graduates will be employed in research-intensive or research-related careers within 6 months of completing their PhD. The remaining 2% of PhD graduates will seek and find employment in careers such as law or journalism that are neither research-related nor research-intensive. This projection is based on 20 years of historical outcomes of students who have earned PhD degrees in biomedical disciplines at MU.

5.E. Student Preparation

Recommended preparation for entering students: Students who enter the Translational Biosciences PhD program must have earned a BS or BA degree in a relevant discipline from an accredited institution of higher education. We recommend that students have taken undergraduate coursework in disciplines that are relevant for biomedical research, including calculus, statistics, physics, chemistry, biology, genetics, biochemistry and physiology. Prior experience in research is highly recommended. We recognize that students with diverse undergraduate educational experiences will matriculate into the program. Thus, one goal of the first-year coursework is to provide all students with basic understanding of the language of biomedical research, particularly in the areas of genetics, biochemistry and data analysis.

5.F. Faculty and Administration

Leadership of the Translational Biosciences PhD program: The Co-Directors of the Translational Biosciences PhD program are Dr. Mark Hannink and Dr. Gillian Bartlett. Dr. Hannink and Dr. Bartlett will each devote 15% of their effort to administration of the program. Both Dr. Hannink and Dr. Bartlett will devote additional time to the instructional and training activities of the program. Dr. Bartlett is a Professor in Family and Community Medicine and serves as the Associate Dean for Population Health and Outcomes Research in the School of Medicine. Dr. Hannink is a Professor in the Biochemistry Department. Dr. Bartlett and Dr. Hannink will report directly to Dr. Steven Zwieg, Dean of the School of Medicine. Dr. Bartlett and Dr. Hannink will serve as co-Directors of Graduate Studies for the Translational Biosciences PhD program.

The training programs within each Emphasis Areas are similar in size and scope to traditional departmental-based PhD programs, but with several important differences. First, faculty membership within any given Emphasis Area will be determined by scientific interests of any given faculty member rather than the academic home of that faculty member. Second, although faculty membership in traditional departmental-based PhD programs is typically weighted towards basic science faculty, faculty membership in the Emphasis Areas will be inclusive to clinical faculty with appropriate clinical research interests relevant to a given Emphasis Area.

Each Emphasis Area will be led by a Graduate Education Committee (GEC), chaired by a faculty member who will serve as Director of Graduate Studies (DGS) for that Emphasis Area. The GEC of each Emphasis Area, led by a DGS, will be responsible for the discipline-based education and research training of graduate students in each Emphasis Area. To account for

the time and effort that is required of a Director of Graduate Studies, we have allotted 10% FTE to the DGS for each Emphasis Area. This is allocated effort and does not represent an increase in compensation to the Directors of Graduate Studies.

The initial selections of faculty to serve as DGS for a given Emphasis Area were based on the current role(s) or interest(s) of the faculty members. Once the Translational Biosciences PhD program is established, the leadership of each Emphasis Area will be determined by faculty members in each Emphasis Area.

Conflict resolution: Conflicts between the Emphasis Areas will be brought to the Executive Committee. Dr. Hannink and Dr. Bartlett will have the final say in determining the resolution of such conflicts. Conflicts between Dr. Hannink and Dr. Bartlett will be brought to Dr. William Fay, Senior Associate Dean for Research in the School of Medicine, who will have the authority to resolve conflicts between the leadership of the Program.

Staff support: personnel and expenses: In our budget (see Section 3B), we have allotted \$250,000 per year for staff support for recruitment and instructional activities. One staff person will be primarily responsible for recruitment while the other staff person will be primarily responsible for interacting with enrolled students and assisting with instructional activities. These two staff people will cross-train so that they can assist each other during peak activity periods. The activities involving enrolled students and instruction include student registration, graduate assistantship appointments in HR, assisting faculty with organization and administration of courses and assisting the leadership team in program oversight and evaluation.

Leadership and Administrative Positions in the Translational Biosciences PhD Program			
Nama	Dele	Academic	Administrative
Name	Kole	Department	FTE
Dr. Gillian Bartlett	Co-Director	Fam. Comm. Med.	15%
Dr. Mark Hannink	Co-Director	Biochemistry	15%
Dr. Gillian Bartlett	DGS, Pop. & Prec. Health	Fam. Comm. Med.	10%
Dr. James Amos- Landgraf	DGS, Cancer Biology	Vet. Pathobiology	10%
Dr. Mark Daniels	DGS, Infection & Imm.	Mol. Micro. & Imm.	10%
Dr. Chris Hardin	DGS, Nutr. Ex. Phys.	Mol. Pharm. & Phys.	10%
Dr. Alan Parrish	DGS, Integrative Phys.	Mol. Pharm. & Phys.	10%
Dr. Charlotte Phillips	DGS, Biochem & Biophys,	Biochemistry	10%
Total Faculty FTE for	Leadership and Admin	istrative Roles	90%
To be named	Program manager	SOM Dean's Office	100%
To be named	Recruitment manager	SOM Dean's Office	100%
Total Faculty and Staff FTE for Leadership and Administrative Roles			290%

Instructional needs of the Translational Biosciences Program: There are four categories of instructional needs of the Translational Biosciences PhD program: (1) Didactic coursework; (2) Research seminars and journal clubs; (3) Rotation research; and (4) Dissertation Research.

The Full-Time Equivalents (FTEs) needed to meet the instructional needs for didactic coursework, for research seminars and for journal clubs, can be estimated based on the assumption that teaching a one-semester, 3-credit course is 10% of a given faculty member's annual effort. Based on this assumption, the didactic coursework, for research seminars and for journal clubs will require a total faculty effort of approximately 4 Full-Time Equivalent faculty positions. See tables below for detailed breakdown of FTEs needed for each of these instructional activities.

The FTEs needed to meet the instructional needs for Rotation Research credits and Dissertation Research credits is not easy to determine, as the research training of graduate students overlaps with the research activities of faculty and it is difficult to make accurate distinctions between the activities of mentoring and research. However, as described below, the School of Medicine has more than sufficient capacity, in terms of research-active faculty members, to provide a rich training environment for the graduate students enrolled in the Translational Biosciences PhD program.

1: Instructional needs for didactic coursework: The instructional needs for didactic coursework include both Program-specific components and Emphasis Area-specific components.

Program-specific: The Program-specific components for didactic coursework require students to take four (out of five offered) courses of three credit hours each, for a total of 12 credit hours. The table below lists the instructors for the program-specific didactic courses, along with their academic home department and the %FTE per faculty member for each course. The %FTE is based on a %FTE of 10% for a three-credit hour course. Total faculty effort for the two-semester sequence of Molecular Bioscience I and I is 20%; the total faculty effort for the two-semester sequence of Data Design and Analysis is 20%; the total faculty effort for the one-semester Professional Skills course is 10% and the total faculty effort for the one-semester Grant-writing for Biomedical Scientists course is 10%.

Program-specific Instructional Needs for Didactic Coursework				
Faculty member	Academic Department	Program-specific Courses Taught	% FTE devoted to Program-specific instruction	
Bartlett, Gillian	Fam. Com. Med.	Data Design I	5%	
		Professional Skills	1.7%	
Calcutt, Mick	Vet. Path	Mol Cell BioSciences I	3%	
Cornish, Peter	Biochemistry	Mol Cell BioSciences I	1%	
Daniels, Mark	Mol. Micro. & Imm.	Mol Cell BioSciences I	1%	
Domeier, Tim	Mol. Pharm. & Phys.	Mol Cell BioSciences I	1%	
		Grant-writing class	5%	
Hannink, Mark	Biochemistry	Grant-writing class	5%	
Krenz, Maike	Mol. Pharm. & Phys.	Mol Cell BioSciences I	1%	
Parrish, Alan	Mol. Pharm. & Phys.	Professional Skills	1.7%	
Petroski, Greg	Fam. Com. Med.	Data Design I	5%	
Van Doren, Steve	Biochemistry	Mol Cell BioSciences	3%	
Total FTE for Progra	33.4%			

Emphasis Area-specific: The instructional needs for the Emphasis Area-specific didactic coursework varies between the different Emphasis areas. The table below describes the number of credit hours of didactic coursework required by each Emphasis Area. Detailed information on the specific didactic coursework for each Emphasis Area is provided in the Appendix.

Emphasis Area-specifi	Emphasis Area-specific Instructional Needs for Didactic Coursework			
Emphasis Area	DGS of the Emphasis Area Graduate Education Committee	Number of courses and credit hours of didactic coursework	Total % FTE devoted to Emphasis Area- specific courses	
Biochemistry & Biophysics	Dr. Charlotte Phillips	2 elective courses; 6 credit hours total	20% total FTE	
Cancer Biology	Dr. James Amos- Landgraf	1 required course and 1 elective course; 6 credit hours total	20% total FTE	
Infection & Immunity	Dr. Mark Daniels	4 required courses and 1 elective course; 15 credit hours total	50% total FTE	
Int. Physiology	Dr. Alan Parrish	2 required and 1 elective courses; 9 credit hours total	30% total FTE	
Nutr. & Ex. Physiology	Dr. Chris Hardin	4 required courses and 4 elective courses; 23-24 credit hours	80% total FTE	

Pop. & Precision Health	Dr. Gillian Bartlett	Three courses are planned for this new Emphasis Area	30% total FTE
Total FTE for Emphasis Area-specific Didactic Instruction			230% total FTE

2: Instructional needs for Research Seminars and Journal Club: Every student will take one Research seminar per semester, for one credit hour. The % FTE for a one credit hour class is 3.3%. During their first year, all students will take the Program-specific Research Seminar each semester (2 per academic year). The first year Research seminar will be directed by one or more members of the Executive Committee (Dr. Gillian Bartlett, Dr. Mark Hannink, Dr. Mark Daniels, Dr. Charlotte Phillips, Dr. James Amos-Landgraf, Dr. Alan Parrish, and Dr. Chris Hardin). During subsequent years (Yrs 2-5), all students will take an Emphasis Area-specific Research Seminar every semester. The course directors of the Emphasis Area Research Seminars will vary from year to year. Across the entire Program, there will be 6 Emphasis Area-specific Research Seminars per semester (12 per academic year). In addition, during Years 2-5, each class cohort will take one Translational Biosciences Journal Club per semester, for one credit hour. At steady state, when there are cohorts of 20 students per year across all five years of the program, there will be 4 Journal Clubs per semester (8 per academic year). The Translational Biosciences Journal Clubs will include one faculty member as a facilitator, and the same faculty member will stay with each cohort through graduation. The faculty who will direct the Journal Clubs will include faculty with expertise in clinical research. At steady state, when there are cohorts of 20 students per year, the total Faculty Effort required for Research Seminars and Journal Clubs will be: 3.3% FTE x (2 + 12 + 8) = 72.6% total FTE.

Seminar or Journal Club	Courses/year	%FTE
Translational Biosciences Research Seminar (1 each semester, first year)	2	6.6%
Emphasis Area Research Seminar (6 EAs x 2)	12	39.6%
Translational Biosciences Journal Club (4 cohorts x 2)	8	26.4%
Total FTE for Seminars and Journal Clubs		72.6%

3: Instructional needs for Rotation Research: Each student, in their first year, will complete three Research Rotations, for 1 credit hour each. The total credit hours of Research Rotations for all students in their first year will be 60 credit hours per cohort of 20 students. A total % FTE of 200% will be required across the entire Program for Rotation Research. This faculty effort will be spread across all faculty members who have either Doctoral Faculty status or Graduate Faculty "A" status, as determined by the MU Graduate School. As of March, 2021, there are 198 faculty members in the School of Medicine who have either Doctoral Faculty status (71) or Graduate Faculty "A" status (127). In the Appendix, a complete list of faculty in the School of Medicine who have Doctoral Faculty status or Graduate Faculty "A" status is provided. A total of 60 credit hours per year will be needed for all 20 students to have 3 research rotation experiences.

4: Instructional needs for Dissertation Research: The formal credit hours of Dissertation Research taken by each student will depend on the Emphasis Area and

the specific program of study of each student, as determined by the student's Doctoral Program Committee. Some students will have fewer course credits for didactic coursework, seminars and journal clubs and consequently, have more credit hours of dissertation research in order to reach the 72 total credit hours required for a PhD degree. Other students will have more course credits for didactic coursework, seminars and journal clubs and consequently fewer credit hours of dissertation research. Assuming that students are equally distributed across the Emphasis Areas, an "average" student will take 26.5 credit hours of Dissertation Research.

A more relevant way to assess the instructional needs for Dissertation Research is based on the number of graduate students, assuming that each graduate student will have one faculty member who serves as the primary mentor for the student and is chair of the student's Doctoral Program Committee. With a steady-state graduate student population of approximately 100, and as only faculty with Doctoral Status are able to serve as a chair of the student's Doctoral Program Committee, a total of 100 faculty with Doctoral Status will be needed to serve as chairs of the student's Doctoral Program Committee.

Of course, faculty typically serve as primary research advisors to more than one student at a time, so the number of faculty with Doctoral Status needed is less than the steady state number of graduate students in the program. As of March 2021, there are 71 faculty in the School of Medicine who have Doctoral Status and 127 faculty in the School of Medicine who have Graduate Faculty "A" status. Doctoral Status is limited to faculty who have academic appointments in departments with PhD graduate programs. However, nearly all of the faculty who have Graduate Faculty "A" status would be eligible for Doctoral Status once the Translational Biosciences PhD program is approved. During the first year of the program, we will work with the MU Graduate Faculty Senate and individual faculty members to increase the number of faculty who will be associated with the Translational Biosciences PhD program will be more than sufficient to meet the need for Dissertation Research Advisors.

Special requirements: Faculty participation in the Translational Biosciences PhD program will occur at several levels, including as a course instructor for either the Program-specific courses or the Emphasis Area-specific courses; as a member of a student's Doctoral Program Committee (DPC); or as a Chair of a student's DPC (i.e., serve as the primary research advisor of PhD graduate student). All faculty members who are course instructors must have a terminal degree (PhD or MD) in an appropriate biomedical or clinical discipline. Faculty members who serve as members of a student's DPC must have Graduate Faculty Status "A", as determined by the MU Graduate Faculty Senate. Faculty members who serve as Chair of a student's DPC must have Doctoral Faculty membership, as determined by the MU Graduate Faculty Senate.

Credit hours that will be assigned to full-time faculty: 100% of all credit hours of instruction will be assigned to full-time faculty.

Faculty requirements for involvement in professional activities or teaching/learning innovations: Faculty mentoring is a critical component of all research training programs. We will work with the MU Graduate School to develop a faculty mentor training program. Faculty

that do not participate in faculty mentor training will not be eligible to serve on a student's DPC, as either a regular member or chair.

Faculty CVs: In the appendix, we have included an NIH biosketch for the faculty members who will serve as Chairs of each Emphasis Area. We have also included a list of likely faculty members for each Emphasis Area.

5.G. Alumni and Employer Survey

Annual Surveys of Alumni: We will maintain an email list of all alumni who have graduated from the program. This list will be kept up to date through email or phone contact with alumni as well as social media sources such as LinkedIn. We will coordinate our tracking efforts with the Graduate School to minimize duplication of effort. Once per year, we will send a short survey to all alumni on the list, asking for updated information on their career path and their level of satisfaction with their PhD training. Based on similar outreach activities that have been carried out in association with current PhD training programs, we anticipate a response rate of 80% and a satisfaction rate of 90% or greater.

Annual Surveys of Employers: We do not plan to obtain feedback from employers of our PhD graduates. Such surveys are not commonly performed by PhD graduate programs.

5.H. Program Accreditation

There are no national or state organizations that specifically provide accreditation for biomedical PhD programs. At the institutional level, the University of Missouri-Columbia is accredited by the Higher Learning Commission (<u>https://www.hlcommission.org</u>). The Higher Learning Commission is one of six regional accreditors in the United States that accredits degree-granting post-secondary institutions. The most recent accreditation of the University of Missouri-Columbia was completed in 2015. The next accreditation will occur in 2024-2025.

To maintain its accreditation by the Higher Learning Commission, the University of Missouri-Columbia requires that all degree-granting programs establish learning objectives for the program and individual courses and track the educational outcomes of the students. The University of Missouri-Columbia has a program review process that ensures all accreditation standards are met.

Appendices

A: Biosketches of faculty who will lead the Translational Biosciences Program

- B: Letters of Support and Collaboration
- C: Translational Biosciences Program Course Information
- D: Emphasis Area Course Information
- E: Emphasis Area Faculty Information
- F: External Reviews and Responses
- G: Pro Forma

Appendix A: Biosketches of faculty who will lead the Translational Biosciences Program

Co-Directors:

Dr. Mark Hannink (Biochemistry)

Dr. Gillian Bartlett (Family and Community Medicine)

Executive Committee:

Dr. Charlotte Phillips (Biochemistry), Biochemistry and Biophysics

Dr. James Amos-Landgraf (Veterinary Pathobiology), Cancer Biology

Dr. Mark Daniels (MMI), Infection and Immunity

Dr. Alan Parrish (MPP), Integrative Physiology

Dr. Chris Hardin (NEP), Nutrition and Exercise Physiology

Dr. Gillian Bartlett (Fam. Comm. Med.), Population and Precision Health

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.

Follow this format for each person. DO NOT EXCEED FIVE PAGES.

NAME: Hannink, Mark			
eRA COMMONS USER NAME (agency login): MARK_H	ANNINK		
POSITION TITLE: Professor of Biochemistry			
EDUCATION/TRAINING (Begin with baccalaureate or ot	her initial professiona	l education, s	such as nursing,
include postdoctoral training and residency training if app	olicable.)		
INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Calvin College, Grand Rapids, Michigan	BS	05/1980	Chemistry
University of Washington, Seattle, Washington	MS	06/1982	Organic Chemistry
University of California, San Diego, La Jolla, California	PHD	02/1987	Chemistry
University of Wisconsin, Madison, Wisconsin	Postdoctoral Fellow	08/1990	Tumor Virology

A. Personal Statement

I have been extensively involved in graduate training at MU, with 15 years of experience as the PD/PI of a long-standing T32 training grant at MU (GM008396) and recently as the PD/PI of a new T32 training program (T32 GM135744) and a new undergraduate T34 (T34 GM136493) training program.

I have a long-standing interest in the molecular mechanisms that regulate intracellular signal transduction, particularly in how these pathways are altered in cancer. As a graduate student at UCSD, I characterized the biochemical and cell biological properties of the v-mos and v-sis oncogenes. As a postdoctoral fellow in Dr. Howard Temin's laboratory, I cloned the c-Rel oncogene and demonstrated that this c-Rel protein is a member of the NF-κB/Rel transcription factor family. As a faculty member in the Biochemistry Department at the University of Missouri, my laboratory demonstrated that the Inhibitor of NF-kB (IkB) proteins regulate nuclear localization of NF-kB/Rel proteins through both inhibition of nuclear import and active CRM1dependent nuclear export. Over the past 15 years, my laboratory has characterized the mechanisms whereby the Nrf2 transcription factor regulates expression of anti-oxidant genes. Dysregulated expression of Nrf2regulated anti-oxidant genes is a common feature of many different tumor types and the analysis of mutations in Nrf2 and Keap1 in specific tumor types has led to the identification of Nrf2 as a bona fide oncogene driver of squamous epithelial tumors. We have demonstrated that Nrf2-dependent transcription is regulated at multiple levels, including Keap1-dependent degradation of Nrf2 and competition for DNA binding sites with the Bach1 transcriptional repressor. We were the first to identify Keap1 as a component of a ubiquitin ligase complex. We demonstrated that Keap1 is a redox sensor for electrophilic molecules. Recent work from my laboratory has demonstrated that Nrf2-mediated transcriptional regulation of Heme Oxygenase plays a critical role in the survival and proliferation of melanoma stem cells, using a melanosphere assay. We have used pull-down assays and mass spectrometry to identify other Keap1-interacting proteins, including the p62/SQSTM1 protein and the phosphoglycerate mutase family member 5 (PGAM5) protein as a novel substrate of Keap1. We are interested in the biochemical mechanisms that regulate PGAM5 activity and have demonstrated that multimerization is a key mechanism by which PGAM5's phosphatase activity is regulated. Keap1 is a model BTB-Kelch protein and our biochemical analyses of Keap1 have illuminated the biochemical functions of this large family of Cul3-dependent substrate adaptor proteins. We have used the Keap1 protein as a model system to understand how missense mutations in the gigaxonin protein alter its biochemical properties. Lossof-function mutations in gigaxonin cause Giant Axonal Neuropathy, and we are developing a PROTAC strategy to determine if retargeting Keap1 to substrates of gigaxonin will allow Keap1 to compensate for loss-of-function mutations in gigaxonin. I have initiated a collaboration with Dr. Ben Major at Washington University, based on recent data obtained in my laboratory, demonstrating a novel and unexpected involvement of Keap1 in regulation of STING protein expression and STING agonist-dependent expression of Inteferon-β. My research activity has resulted in 85 publications which have been cited by more than 9,000 other publications, with an hindex of 48 and an i10-index of 77.

- Zhang DD, Hannink M. Distinct cysteine residues in Keap1 are required for Keap1-dependent ubiquitination of Nrf2 and for stabilization of Nrf2 by chemopreventive agents and oxidative stress. Mol Cell Biol. 2003 Nov;23(22):8137-51. PubMed PMID: <u>14585973</u>; PubMed Central PMCID: <u>PMC262403</u>.
- Lo SC, Li X, Henzl MT, Beamer LJ, Hannink M. Structure of the Keap1:Nrf2 interface provides mechanistic insight into Nrf2 signaling. EMBO J. 2006 Aug 9;25(15):3605-17. PubMed PMID: <u>16888629</u>; PubMed Central PMCID: <u>PMC1538563</u>.
- 3. Wilkins JM, McConnell C, Tipton PA, Hannink M. A conserved motif mediates both multimer formation and allosteric activation of phosphoglycerate mutase 5. J Biol Chem. 2014 Sep 5;289(36):25137-48. PubMedPMID: 25012655; PubMed Central PMCID: PMC4155678.
- 4. Jasmer KJ, Hou J, Mannino P, Cheng J, Hannink M. Heme oxygenase promotes B-Raf-dependent melanosphere formation [published online ahead of print, 2020 Jun 17]. *Pigment Cell Melanoma Res.* 2020;10.1111/pcmr.12905. doi:10.1111/pcmr.12905 (Contribution: 80%)

B. Positions and Honors

Positions and Employment

- 1990 1996 Assistant Professor, Biochemistry Department, University of Missouri
- 1996 2002 Associate Professor, Biochemistry Department, University of Missouri
- 2003 Professor, Biochemistry Department, University of Missouri
- 2004 Director, Life Sciences Fellowship Program, University of Missouri
- 2020 Associate Director for Education and Training, Ellis Fischel Cancer Center

Other Experience and Professional Memberships

- 2008 2010 Member, NCCAM Basic Science study section
- 2010 2011 Member, NIGMS ZRG-1 PO1 study section
- 2011 2013 Member, ZRG1 BMCT-C NCI study section
- 2017 2017 Member, NCI Chemo/Dietary Prevention Review
- 2012 2018 Member, NIGMS TWD-C study section

<u>Honors</u>

C. Contribution to Science

- Nuclear-cytoplasmic shuttling of the NF-kB transcription factors. Our laboratory demonstrated that IkB proteins both inhibit nuclear import and actively promote the nuclear export of the NF-kB transcription factor. We demonstrated that failure of IkBa to regulate nuclear localization and DNA-binding of the v-Rel protein is responsible for its ability to transform avian lymphoid cells. We characterized the role of the Ran GTPase in both nuclear import and nuclear export of the IkB proteins.
 - a. Sachdev S, Hannink M. Loss of IkappaB alpha-mediated control over nuclear import and DNA binding enables oncogenic activation of c-Rel. Mol Cell Biol. 1998 Sep;18(9):5445-56. PubMed PMID: <u>9710628</u>; PubMed Central PMCID: <u>PMC109129</u>.
 - Sachdev S, Bagchi S, Zhang DD, Mings AC, Hannink M. Nuclear import of IkappaBalpha is accomplished by a ran-independent transport pathway. Mol Cell Biol. 2000 Mar;20(5):1571-82. PubMed PMID: <u>10669735</u>; PubMed Central PMCID: <u>PMC85341</u>.
 - c. Lee SH, Hannink M. The N-terminal nuclear export sequence of IkappaBalpha is required for RanGTPdependent binding to CRM1. J Biol Chem. 2001 Jun 29;276(26):23599-606. PubMed PMID: <u>11319224</u>.
 - Lee SH, Hannink M. Characterization of the nuclear import and export functions of Ikappa B(epsilon). J Biol Chem. 2002 Jun 28;277(26):23358-66. PubMed PMID: <u>11970947</u>.
- 2. Regulation of anti-oxidant gene expression by the Keap1/Nrf2 signal transduction pathway. Our laboratory has published seminal papers on the Keap1/Nrf2 signaling pathway. The highlights of our published work include (1) demonstration that Keap1 functions as a substrate adaptor for a Cul3-dependent ubiquitin

ligase to target the Nrf2 transcription factor for proteosome-dependent degradation; (2) specific cysteine residues in Keap1 are the targets of electrophilic and reactive oxygen species (ROS); perturbation of the Cul3:Keap1 ubiquitin ligase complex results in increased steady-state levels of Nrf2 and activation of Nrf2 dependent transcription. In collaboration with a colleague at MU, Dr. Lesa Beamer, we have determined the molecular structure of the Keap1:Nrf2 interface. Recently, we have collaborated with Transtech Pharma to characterize molecules that target the Bach1 repressor.

- a. Zhang DD, Hannink M. Distinct cysteine residues in Keap1 are required for Keap1-dependent ubiquitination of Nrf2 and for stabilization of Nrf2 by chemopreventive agents and oxidative stress. Mol Cell Biol. 2003 Nov;23(22):8137-51. PubMed PMID: <u>14585973</u>; PubMed Central PMCID: <u>PMC262403</u>.
- b. Zhang DD, Lo SC, Cross JV, Templeton DJ, Hannink M. Keap1 is a redox-regulated substrate adaptor protein for a Cul3-dependent ubiquitin ligase complex. Mol Cell Biol. 2004 Dec;24(24):10941-53. PubMed PMID: <u>15572695</u>; PubMed Central PMCID: <u>PMC533977</u>.
- c. Zhang DD, Lo SC, Habib GM, Lieberman MW, and Hannink M. Ubiquitination of Keap1, a BTB-Kelch substrate adaptor for Cul3, targets Keap1 for degradation by a proteosome-independent pathway. J. Biol Chem 2005; 280:30091-9. PMID: 15983046
- d. Attucks OC, Jasmer KJ, Hannink M, Kassis J, Zhong Z, Gupta S, Victory SF, Guzel M, Polisetti DR, Andrews R, Mjalli AM, Kostura MJ. Induction of heme oxygenase I (HMOX1) by HPP-4382: a novel modulator of Bach1 activity. PLoS One. 2014;9(7):e101044. PubMed PMID: <u>25019514</u>; PubMed Central PMCID: <u>PMC4096395</u>.
- 3. Regulation of mitochondrial morphology and function by the Keap1/PGAM5 signaling pathway. We identified the phosphoglycerate mutase family member 5 (PGAM5) as a novel Keap1-interacting protein. We demonstrated that the PGAM5 protein localizes, with Keap1, to the outer membrane of mitochondria. We have characterized the serine/threonine phosphatase activity of PGAM5 and demonstrated that both the multimerization and phosphatase activity of PGAM5 is regulated through a highly conserved WDxNWD motif.
 - Lo SC, Hannink M. PGAM5, a Bcl-XL-interacting protein, is a novel substrate for the redox-regulated Keap1-dependent ubiquitin ligase complex. J Biol Chem. 2006 Dec 8;281(49):37893-903. PubMed PMID: <u>17046835</u>.
 - Lo SC, Hannink M. PGAM5 tethers a ternary complex containing Keap1 and Nrf2 to mitochondria. Exp Cell Res. 2008 May 1;314(8):1789-803. PubMed PMID: <u>18387606</u>; PubMed Central PMCID: <u>PMC2409987</u>.
 - c. Wilkins JM, McConnell C, Tipton PA, Hannink M. A conserved motif mediates both multimer formation and allosteric activation of phosphoglycerate mutase 5. J Biol Chem. 2014 Sep 5;289(36):25137-48. PubMed PMID: <u>25012655</u>; PubMed Central PMCID: <u>PMC4155678</u>.
- 4. Molecular and functional characterization of the BTB-Kelch family of ubiquitin ligase substrate adaptor proteins. The BTB-Kelch protein family is large protein family, with multiple members present in the genomes of all vertebrate species. The conserved structure of these proteins suggests a common function. Importantly, a number of the BTB-Kelch proteins are mutated in different human diseases. Based on our biochemical characterization of the Keap1 protein, we hypothesize that all BTB-Kelch proteins function as substrate adaptors for Cul3-dependent ubiquitin ligase complexes. We have used the Keap1 protein as a model for understanding how disease-associated mutations in other BTB-Kelch proteins disrupt their biochemical function and contribute to disease. We have collaborated with other scientists to determine how mutations in the KLHL9 protein contribute to a unique myopathy. We have collaborated with a plant science group at MU to characterize a Cul3 ubiquitin ligase complex involved in light sensing.
 - a. Li X, Zhang D, Hannink M, Beamer LJ. Crystal structure of the Kelch domain of human Keap1. J Biol Chem. 2004 Dec 24;279(52):54750-8. PubMed PMID: <u>15475350</u>.
 - b. Cirak S, von Deimling F, Sachdev S, Errington WJ, Herrmann R, Bönnemann C, Brockmann K, Hinderlich S, Lindner TH, Steinbrecher A, Hoffmann K, Privé GG, Hannink M, Nürnberg P, Voit T. Kelch-like homologue 9 mutation is associated with an early onset autosomal dominant distal myopathy. Brain. 2010 Jul;133(Pt 7):2123-35. PubMed PMID: <u>20554658</u>; PubMed Central PMCID:

PMC2892937.

c. Roberts D, Pedmale UV, Morrow J, Sachdev S, Lechner E, Tang X, Zheng N, Hannink M, Genschik P, Liscum E. Modulation of phototropic responsiveness in Arabidopsis through ubiquitination of phototropin 1 by the CUL3-Ring E3 ubiquitin ligase CRL3(NPH3). Plant Cell. 2011 Oct;23(10):3627-40. PubMed PMID: 21990941; PubMed Central PMCID: PMC3229139.

Complete List of Published Work in My Bibliography: http://www.ncbi.nlm.nih.gov/myncbi/1HUJhxwLL7fk6/bibliography/45526370/public/?sort=date&direction=asce nding

D. Research Support

Current Grants

Missouri Spinal Cord Injury and Disease Research Hannink (PI) 07/01/18 to 06/30/21 Developing a PROTAC strategy for Giant Axonal Neuropathy

The goal of this grant is to determine if Keap1 can be targeted to substrates of other members of the BTB-Kelch family and thus compensate for loss of gigaxonin in patients with Giant Axonal Neuropathy. Role: Principal Investigator

Bantam Pharmaceutical

Hannink (PI) Role of FAM210B and mitochondrial stress pathways in cancer

The goal of this grant is to determine the mechanism of action whereby the mitochondrial protein FAM210B confers resistance to a novel anti-cancer agent being developed by Bantam Pharmaceutical. Role: Principal Investigator

MU School of Medicine TRIUMPH 05/01/21 to 04/30/23 Hannink (PI) Molecular Mechanisms of Drug Resistance in Head and Neck Squamous Cell Carcinoma

The goal of this grant is to determine how the P2Y2R and Nrf2 signaling pathways contribute to resistance to cetuximab and EGFR inhibitors in head and neck squamous cell carcinoma. **Role: Principal Investigator**

NIH R01 LM013392 Popescu (PI) 05/01/20 to 02/29/24 Image-guided Biocuration of Disease Pathways from Scientific Literature

The goal of this grant is to develop an integrated informatics biocuration pipeline for automatic extraction of disease pathways using both figures and text of biomedical articles. Role: Co-I

NIH T32 GM008396

NIH National Institute for General Medical Sciences

Molecular Basis of Gene Expression and Signal Processing This is a training grant supported by NIGMS that provides stipends for six predoctoral trainees working with MU faculty in the general areas of signal transduction and gene expression. Role: Program Director/Principal Investigator

Hannink (PD/PI)

Hannink (PD/PI)

NIH T32 GM135744

Initiative for Maximizing Student Diversity

This is a training grant supported by NIGMS that provides stipends for minority graduate students to pursue research projects mentored by MU faculty in the life sciences. Role: Program Director/Principal Investigator

NIH T34 GM136493

Hannink (PD/PI)

06/01/20 to 05/31/25

02/01/20 to 01/31/25

07/01/17 to 06/30/22

07/01/19 to 12/31/21

Initiative for Maximizing Student Diversity

This is a training grant supported by NIGMS that provides stipends for minority undergraduate students to pursue research projects mentored by MU faculty in the life sciences. Role: Program Director/Principal Investigator

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors. Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Gillian Bartlett-Esquilant

eRA COMMONS USER NAME (credential, e.g., agency login): GILLIAN.BARTLETT

POSITION TITLE: Professor, Department of Family & Community Medicine

EDUCATION/TRAINING:

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
McGill University- Montreal, Quebec, Canada	BA	05/1994	Psychology
McGill University- Montreal, Quebec, Canada	MS	06/1996	Epidemiology
McGill University- Montreal, Quebec, Canada	PHD	05/2001	Epidemiology
University of Montreal- Montreal, Quebec, Canada	Postdoc	06/2002	Social & Prev Medicine

A. Personal Statement

In my research program and capacity building activities, I have adopted a participatory approach where possible. Participatory research engages community members, practitioners, health professionals, and organizational and institutional representatives directly affected by or implicated in a given health issue so that they are not situated on the periphery of the evidence production process; instead, they partner with academics to produce knowledge with the potential to offer practical solutions. This has been a critical philosophy, particularly for the aspects of my research program that involve vulnerable or hard to reach populations, allowing me to combine methods that engages stakeholders with extensive experience in program development using education technology. This approach is particularly useful in providing recommendations for development of innovations and interventions in areas that have previously faced significant challenges. It is this expertise that I will bring to the project to help ensure the optimal use of evidence from the pharmacogenetic testing to improve health care. In addition to an active and successful research program, I have a proven track record in graduate program development, critical appraisal training for residents and international research training courses. Aside from playing a key role in the development many training programs, since 2005 I have been primary supervisor for 7 medical students, 15 MSc trainees (14 already graduated, 7 with competitive scholarships), 8 PhD students (6 with external scholarships, 3 graduated and one winning the top dissertation prize in Canada - the Governor's Gold Medal) and 4 Postdoctoral Fellows who now all have successful academic positions. As an implementation scientist who uses participatory research approaches, I believe that respect and receptivity towards trainee feedback, experiences and abilities enriches the learning process. As much as possible, I encourage trainees to participate and lead interactive exchanges as part of the teaching experience. I am a strong advocate for optimizing the learning experience and I will bring this approach to this program.

B. Positions and Honors

Positions and Employment

2002-2005	Assistant Professor (Non-Tenure Track), Dept of Medicine, McGill
2005-2008	Assistant Professor (Non-Tenure Track), Dept of Family Medicine, McGill
2006-2009	McGill Research Director, Canadian College of Family Physicians
2007-2015	Chair, CIHR University-Industry Partnership Peer Review Committee
2009-2014	Associate Professor (Tenure Track), Dept of Family Medicine, McGill
2010-2013	Clinician Scholars Program Director, Dept of Family Medicine, McGill
2010-2019	Graduate Program Director, Dept of Family Medicine, McGill
2011-2013	Interdisciplinary Health PhD Program, Associate Director, Fac of Medicine
2014-2016	Associate Professor (Tenured), Dept of Family Medicine, McGill
2014-2020	McGill Research Director, Canadian College of Family Physicians

- 2014-2020 Research Director, Dept of Family Medicine, McGill
- 2015-2019 Chair, Committee for the Advancement of the Science of Family Medicine
- 2016-2019 Associate Chair (Research), Dept of Family Medicine, McGill
- 2016-2020 Professor (Tenured), Dept of Family Medicine, McGill
- 2017-2018 Chair, CIHR Sex-Gender Based Analysis Health Policy Review Committee
- 2019-2021 Executive Director, Network Coordinating Office for the Primary and Integrated Health Care Innovations Network (CIHR Strategy for Patient Oriented Research)
- 2019 Vice-President, North American Primary Care Research Group
- 2020 President, North American Primary Care Research Group

<u>Honors</u>

- 2014 Faculty Honour List for Educational Excellence, Faculty of Medicine, McGill
- 2014 Carrie M. Derick Award for Excellence in Graduate Teaching & Supervision, McGill
- 2017 President's Award, North American Primary Care Research Group
- 2018 Larry A. Green Visiting Scholar, Robert Graham Center, Washington DC, USA
- 2019 Fellow, International Society for Pharmacoepidemiology

Other Professional Experiences and Memberships

1996-Pres Member, McGill Institute for Gender, Sexuality, and Feminist Studies Member, International Institute of Research in Ethics & Biomedicine 2003-Pres 2006-Pres Member, North American Primary Care Research Group (Executive Board since 2015) Member, Comité d'éthique de la recherche et d'intégrité scientifique du FRSQ 2007-2009 Elected Representative for Faculty of Medicine, McGill Senate 2008-2011 Member, College of Family Physicians of Canada 2009-2020 Expert Member, Quebec Health and Welfare Commissioner's Forum 2011-2014 2011-Pres Member, International Society for Pharmacoepidemiology 2014-2016 Dokuz Eylul University Personalized Medicine and Pharmacogenomics/Genomics Research Centre-BIFAGEM International Scientific Advisory Board (Izmir, Turkey) 2014-2016 Institute of Public and Population Health Task Force Member, Tri-Agency Data Management Policy Advisory Committee 2014-2019 Co-Director (Knowledge Translation), Executive Committee, Le Réseau de recherche sur la 2016-2021 santé cardiométabolique, le diabète et l'obésité (CMDO) du FRQS Member, American Association for the Advancement of Science 2017-Pres 2017-Pres Co-Chair, International Society for Pharmacoepidemiology Special Interest Group on Genomics and Precision Medicine 2018-2020 Représentative des RUIS au comité directeur de l'Unité SRAP 2019-2020 Member-at-Large, Family Medicine Discovers Rapid-Cycle Scientific Discovery and Innovation (FMD RapSDI) Working Group (AAFP) 2019-Pres Member, Family Medicine Research Think Tank, USA 2020-Pres Member, Society for Teachers of Family Medicine 2020-Pres Member, Society for Medical Decision Making

C. Contributions to Science

- 1. Development of Deliberative Consultations as a Stakeholder Engagement Method (01/01/2010-Pres). In the development of a new qualitative methodology for implementation science, I have adopted a participatory approach combined with theories of democratic deliberation and ethnographic observation. Promoting this approach has resulted in one of my major contributions to research methods. To engage stakeholders, even vulnerable or hard to reach groups, I have adapted a deliberative consultation method to be used for new clinical, population and educational innovations in health care implementation. This has been published in several peer reviewed journals and included as a book chapter. I am also using this approach in other contexts to validate research agendas and engage stakeholders.
 - Gagnon J, Rahimzadeh V, Longo C, Nugus P, Bartlett G (2019) Understanding how professionals' cultures impact implementation of a pediatric oncology genomic test: Using ethnographic participant observation in deliberative stakeholder consultations. <u>Journal of Health Organization and Management</u> 33 (7/8), pg 919-928.

- Bartlett G, Longo C, Puzhko S, Gagnon J, Rahimzadeh V (2018) Deliberative Stakeholder Consultations: Creating Insights into Effective Practice-Change in Family Medicine. <u>Family Practice</u> 35(6) pg 749 – 752.
- c. Longo C, Rahmizadeh V, O'Doherty K, Bartlett G (2016) Addressing Ethical Challenges at the Intersection of Pharmacogenomics and Primary Care Using Deliberative Consultations. <u>Pharmacogenomics</u> 17(16):1795-1805. Epub 2016 Oct 21.
- d. Corradetti C, Bartlett G (2015. Democratizing Science. Public deliberation and the role of stakeholders as a new frontier in governance of science: comparing the British Columbia Biobank Deliberation and the DePGx Project. In D. Mascalzoni (Ed.), <u>Ethics, Law and Governance of Biobanking: National, European and International Profiles</u>. Dordrecht: Springer, pg 241-260.
- 2. Development of a role-playing game to determine health related quality of life-based treatment preferences for vulnerable children (01/01/2015-Pres). As part of my work in implementation of genomic medicine, I identified a lacuna in terms of information on what children and families' value in health-related quality of life for consideration in treatment decisions for terminally ill children. Given that my other methodological innovation for stakeholder engagement was not appropriate or ethical for such a vulnerable population, I developed a role-playing game to systematically assess health related quality of life preferences for children and families for therapeutic treatments and whether these preferences change with the introduction of pharmacogenomic test results. The game is in the validation phase has the possibility to significantly improve shared decision.
 - a. Rahimzadeh V, **Bartlett G**, Longo C, Crimi L, Macdonald ME, Jabado N, Ells C (2015) Promoting an Ethic of Engagement in Pediatric Palliative Care Research. <u>BMC Palliative Care</u> 14(50).
 - b. Rahimzadeh V, Bartlett G, Illes J (2019) Interactive role-playing and health-related quality of life assessment in children with neurocognitive sequelae: A global neuroethics research approach. D Stein and I Singh [Eds]. <u>Global Mental Health and Neuroethics</u>.
- 3. Integration of personalized medicine in primary care (01/01/2010-Present). I believe that personalized medicine, with an emphasis on genomics and genetics as well as patient characteristics, will be a major determinant in how medicine is practiced in the future; however, the importance for primary care has been underappreciated. I have published extensively on this topic and have completed several implementation science projects that evaluated the potential of pharmacogenomics in primary care. Strategically implementing personalized and precision medicine in a way that accounts for the unique characteristics of the family medicine and primary care context is essential and is a key part of my research program.
 - a. Issa A, Carleton B, Filipski K, Freedman A, Kimmel S, Liu G, Longo C, Maitland van der Zee A-H, Sansbury L, Zhou W, Bartlett G (2021) Pharmacoepidemiology: A Time for a New Multidisciplinary Approach to Precision Medicine. <u>Pharmacoepidemiology and Drug Safety</u> In Press.
 - b. Puzhko S, Gagnon J, Simard S, Knoppers BM, Siedlikowski S, Bartlett G (2019) Health professionals' perspectives on breast cancer risk stratification: understanding evaluation of risk versus screening for disease. <u>Public Health Reviews</u> 40 (2) pg 1-19.
 - c. Bartlett G. Precision Medicine in Primary Health Care (2017) M Verma, D Barh (Eds), Progress and Challenges in Precision Medicine. Elsevier: Academic Press. ISBN 978-0-12809-411-2.
 - d. Bartlett G, Rahimzadeh V, Longo C, Orlando C, Dawes M, Lachaine J, Bochud M, Paccaud F, Bergman H, Crimi L, Issa AM (2014) The future of genomic testing in primary care: the changing face of personalized medicine. <u>Personalized Medicine</u> 11(5) pg 477-486.
- 4. Building Research Capacity: Development and accreditation of MSc and PhD in Family Medicine and Primary Care ((01/06/2009-01/06/2019). One of my most significant accomplishments in teaching has been the leadership and vision I have provided in developing a new graduate program in the Department of Family Medicine at McGill University. This program is unique with its focus on family medicine research and I have been active in promoting the use of a thesis-based MSc to support research capacity building with options in bio-ethics and medical education research. I also led the development of the Clinician Scholars program (CSP) that is third year-enhanced program to teach research skills to family medicine residents. I was instrumental in getting the program accredited through the College of Family Physicians, for obtaining funding provincially and setting up the program so that the resident can obtain an MSc. The MSc has enrolled over 75 trainees to-date with almost a dozen clinician scientists. I also worked intensively on the development of a new PhD program that received full accreditation in August 2018 with over 50 candidates enrolled to date with a strong record of scholarship and graduation with honors. The focus is on

participatory research, patient oriented research and scientific communication. The expectation is that our training and trainees will significantly impact and move forward the discipline of primary care. I also created a program that enables our PhD trainees to support family medicine residents in acquiring scholarly skills such as critical appraisal and quality improvement and creating import research-clinic synergies.

- a. Raffoul M, **Bartlett G**, Phillips Jr RL (2019) Recruiting the Workforce for the Healthcare of Tomorrow. <u>Academic Medicine</u> 94 (5), pg 651-655.
- b. **Bartlett G**, Gagnon J. (2016) Physicians and statistics knowledge translation: mind the gap. <u>Canadian Medical Association Journal</u> 188(1) pg 1-2.
- c. Rodriguez C, **Bartlett G**, Boillat M, Dove M, Grad R, Lalla L, Pluye P, Tellier PP, Bergman H (2015) Manifesto for Family Medicine Educational Research. <u>Canadian Family Physician</u> 17(4) pg 533.
- d. Bartlett G, Rodriguez C, Boillat M. (2012) Encompassing research plurality: a family medicine graduate program. <u>Medical Education</u> 46 (11) pg 1115-6.
- 5. Evaluating the impact of community-based prescription medications with a focus on vulnerable populations (09/2002-Pres). Another significant contribution has been in the field of medication use and patient safety where I have initiated a program of research that focuses on optimizing medication utilization particularly for prescriptions dispensed in the community. This program of research, that continued the training and expertise I developed in my PhD, advanced the knowledge in the domain of epidemiological database studies of post-marketing drug utilization. My research has provided detailed information on medication use and how it may change over time and by type of prescriber. I have contributed to new statistical methods to model complicated aspects of medication exposure, such as estimating effects of cumulative dose or separating the impact of dose from duration of use and assessing the importance of the use time-dependent variables to account for confounding. These methods were shown to reduce residual confounding bias in estimating risk associated with medication use and provided new techniques to be used in future research. This is particularly relevant for the field of drug utilization studies where the drug exposures are often complex and continuously change. My focus has been primarily on post marketing observational studies on medication prescribing and consumption and the impact on health care utilization and health outcomes. A particular focus has been on the role of obesity on prescribing and outcomes.
 - a. Puzhko S, Aboushawareb S, Kudrina I, Schuster T, Rosenberg R, Barnett T, Renoux C, Bartlett G (2020) Excess body weight as a predictor of response to treatment with antidepressants in patients with depressive disorder. Journal of Affective Disorders 267, pg 153-170.
 - b. Longo C, Bartlett G, Schuster T, Ducharme F, Macgibbon B, Barnett T (2019) The role of weight status in the response to Step-2 maintenance therapies in children with asthma. <u>BMJ Open</u> <u>Respiratory Journal</u> 6, e000401.
 - c. Gagnon J, Lussier MT, Daskalopoulou SS, MacGibbon B, **Bartlett G** (2017) Antidepressant prescription practices among primary health care providers for patients with diabetes mellitus. <u>Current Research in Diabetes & Obesity Journal</u> 2 (4) pg 1-8.
 - d. Longo C, **Bartlett G**, MacGibbon B, Mayo N, Rosenberg E, Nadeau L, Daskalopoulus S (2013) The effect of obesity on antibiotic treatment failure: a historical cohort study. <u>Pharmacoepidemiology and Drug Safety</u> 22(9) pg 970-6.

Complete List of Published Work in MyBibliography <u>https://www.ncbi.nlm.nih.gov/myncbi/gillian.bartlett-esquilant.1/bibliography/public/</u>

D. Research Support

<u>Active</u> 424479

Dubé (PI)

02/01/2020-12/30/2020

Canadian Institutes of Health Research

Knowledge synthesis for mechanistic and targeted in-person and digital social-connection intervention for wellness and resilience in older adults in pandemic context and beyond

Project goals: To determine among older adults, who are the most vulnerable to the mental health effects of social isolation and what strategies are the most likely to succeed in preventing or mitigating these effects. Role: Co-Investigator

156043 Bartlett (PI) Fonds de Recherche du Québec, CMDO Intercenter Research Program

04/01/2020-03/30/2021

OPEN -- ASARED -- 1-53

Project goals: To identify the vision research and knowledge transfer priorities related to Big Data and AI. **Role: Principal Investigator** 03/01/2020-03/01/2021

Canadian Institutes of Health Research

Determining research priorities to improve the integration of care for individuals with complex care needs and their caregivers in New Brunswick

Developing a Vision and Strategic Plan to Support the Development and Implementation of a Big Data and

Artificial Intelligence Research Agenda focusing on Cardiometabolic Disease, Diabetes and Obesity

Project goals: To build capacity for engaging patients and their caregivers throughout the research process and to identify research priorities for individuals with complex care needs and their caregivers. Role: Co-Investigator

250839

392433

Wong, Bhattacharyya, Bartlett (Pls) Canadian Institutes of Health Research

Primary and Integrated Health Care Innovations Network Coordinating Office

Project goals: To support primary and integrated services across the health sector and beyond to improve the health of individuals with complex needs

Role: Principal Investigator; Director for Knowledge Translation

155872

Carlton (PI)

Genome Canada/Genome BC

Genomic and Outcomes Databank for Pharmacogenomic and Implementation Studies (Go PGx) Project goals: To save lives and improve the guality of life of children with cancer, by using genomics-based precision health strategies to reduce the most common and serious adverse drug reactions in these children. Role: Co-Investigator

156043

Vanasse (PI)

Canadian Institutes of Health Research

Trajectoires de soins et conditions propices aux soins ambulatoires Project goals: Describing patient care trajectories with chronic conditions to measure health outcomes. Role: Co-Investigator

Completed

248787

Bartlett (PI)

McGill Observatory on Health and Social Services Reforms 09/01/2018-08/31/2019 The Impact of Obesity on Health Care Trajectories: Evaluating Opportunities for Healthcare Intervention to **Optimize Outcomes for Depression**

Project goals: Pilot data to identify the most effective and efficient care pathways for people with obesity and depression to help decision-makers and stakeholders in the planning and organization of health services. Role: Principal Investigator

1553-81887

Simard, Knoppers, Bartlett (PI)

Québec Breast Cancer Foundation

Connaître et communiquer son histoire familiale pour mieux lutter contre le cancer du sein au Québec: Mise en place d'une campagne d'information

Project goals: To engage health care professionals to optimize communication tools for the risk stratification model for targeted breast cancer screening in primary care.

Project goals: Developing tools to help providers identify mutations in brain tumors, providing best treatment

Role: Principal Investigator for Deliberative Consultations

Role: Principal Investigator for GE3LS (ELSI)

Biomarkers for Pediatric Glioblastoma through Genomics and Epigenomics

243606 Genome Canada

strategy.

Jabado, Bartlett (PI)

09/01/2013-08/31/2018

November 18, 2021

04/01/2018-04/01/2021

08/01/2018-09/01/2023

06/01/2015-06/01/2018

03/01/2019-09/30/2021

Doucet (PI)

BIOGRAPHICAL SKETCH

NAME:

Phillips, Charlotte Longacre, PhD

eRA COMMONS USER NAME: PhillipsCL

POSITION TITLE:

Professor of Biochemistry and Child Health

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	COMPLETION DATE	FIELD OF STUDY
University of Central Florida, Orlando, FL	B.S.	05/1981	Biology
North Carolina State University, Raleigh, NC	Ph.D.	08/1987	Biochemistry
Duke University Medical Center, Durham, NC	Postdoctoral	03/1992	Connective Tissue Disorders

A. Personal Statement

I have the expertise and training needed to evaluate the effects of maternal myostatin on bone health in offspring with osteogenesis imperfecta (OI). I have a broad background in biochemistry, molecular biology, medical genetics, connective tissue disorders, extracellular matrix biology, biomechanical testing of mineralized and non-mineralized tissues, and more recently skeletal muscle biology and contractile function. Since 1989, I have extensively investigated the molecular, biochemical, physiological and biomechanical impact of type I collagen mutations responsible for OI in humans and mouse models. The focus of my laboratory is to investigate the molecular/biochemical pathogenesis of OI in mineralized and non-mineralized tissues, with a recent focus to develop alternative therapeutic strategies to enhance bone quality and biomechanical integrity.

My research laboratory and environment is committed to the education, training, and mentoring of future scientists. My research program owes its success to the excellent graduate and undergraduate students that have worked diligently. Since 2008, I have mentored (or am mentoring) 33 undergraduate research [7 underrepresented minority (URM)] students from several majors (Biochemistry, Biological Sciences, Chemistry, Physical Therapy), four Post-baccalaureate Research Education Program (MU-PREP; 4URM) students, six doctoral students (2 URM) and two post-doctoral fellows. Several of these students were mentored as part of specific undergraduate research programs including EXPRESS, NSF-REU, Life Sciences Undergraduate Research Program, Howard Hughes Medical Institute Research Fellows, CAFNR Undergraduate On-Campus Research, School of Arts and Science Honors Undergraduate Research Program, and the Discovery Program. In addition, I have served as a Faculty Facilitator in an 8-week Entering Mentoring Course (2009, 2011, 2012, & 2014) designed to prepare senior graduate students and post-doctoral fellows to serve as great mentors for the undergraduates that work in their labs/research teams. I have also developed and taught one-day workshops for the National Space and Biomedical Research Institute (NSBRI, 2012 & 2013) in Houston, Texas, entitled "Mentoring: Mentoring undergraduate Researchers", as part of the Postdoctoral Fellowship & Graduate Training Program. Since 2014, I have co-taught the course, "Ethical Conduct in Research", a professional ethics class, which is required for all training grant fellows and PREP students in the multidisciplinary Molecular Biology Program and Life Sciences Program, and for graduate students in the Departments of Biological Sciences, Biochemistry, Veterinary Pathobiology, and the Genetics Area Program. I am also currently the Director of Graduate Studies for the Department of Biochemistry, University of Missouri.

B. Positions and Honors

Positions and Employment

Research Associate/Post-doctoral Fellowship, Department of Medicine, Division of 4/1987-2/1992 Dermatology, Duke University Medical Center, Durham, NC (Supervisors: Dr. Sheldon Pinnell and Dr. Richard Wenstrup)

3/1992-11/1994	Assistant Research Professor, Department of Medicine, Division of Dermatology, Duke
	University Medical Center, Durham, NC
12/1994-9/2002	Assistant Professor, Departments of Biochemistry and Child Health, Division of
	Medical Genetics, University of Missouri-Columbia
9/2002-present	Associate Professor, Departments of Biochemistry and Child Health, Division of
_	Medical Genetics, University of Missouri-Columbia
1/2005-present	Adjunct Associate Professor of Dermatology, University of Missouri-Columbia

Academic and Professional Honors

National Boards

1996-present Clinical Molecular Genetics, American Board of Medical Genetics

NIH Study Section Membership

2005-2007 Musculoskeletal Engineering (MTE) study section

Honors (*for Teaching and Mentoring)

- 1984 Phi Lambda Upsilon Chemistry Honor Society
- 1985 Phi Kappa Phi Honor Society
- 1989 The Upjohn Company, Young Investigator Award
- 1993 Hulda Irene Duggan Arthritis Investigator
- ¹⁹⁹⁹ *Jane H. Hickman Teacher of the Year, School of Medicine
- 2003 *Excellence in Education: Pre-Clinical, Medical Student Affairs Council
- *William T. Kemper Fellowship for Teaching Excellence, William T. Kemper Foundation
- 2008 *Induction into the CAFNR Teaching Academy
- 2009 *Outstanding Undergraduate Research Mentor Award, MU Office of Undergraduate Research
- 2016 *Ann K. Covington Award for Mentorship Nominee

C. Contributions to Science (Graduate student co-authors in bold, *undergraduate co-authors* in bold and italics, <u>underrepresented minority student underlined</u>)

1. Enhancement muscle and bone strength through myostatin deficiency in osteogenesis imperfecta (OI). Our recent studies to enhance muscle and bone strength in OI by genetic and pharmacological means demonstrated that congenic myostatin deficiency resulted in improved muscle and bone strength in an OI mouse model. We further demonstrated that use of a decoy molecule for activin A IIB receptor (a myostatin receptor) to reduce available endogenous myostatin also improved both muscle and bone in OI mouse models. In the course of these studies, we also discovered that maternal myostatin deficiency impacts the health and developmental programming of muscle and bone strength in adult offspring, and that the prenatal period is a potential new therapeutic window.

- a. **Oestreich AK**, **Carleton SM**, Yao X, **Gentry BA**, *Raw CE*, Brown M, Pfeiffer FM, Wang Y, Phillips CL. Myostatin Deficiency Partially Rescues the Bone Phenotype of Osteogenesis Imperfecta Model Mice. Osteoporosis International, 27(1), 161-170, 2016 (PMID: 26179666; *doi: 10.1007/s00198-015-3226-7*)
- b. **Oestreich AK**, *Kamp WM*, <u>McCray MG</u>, Carleton SM, Karavassa N, Lenz KL, Jeong Y, Daghlas SA, Yao X, Wang Y, Pfeiffer FM, Ellersieck M, Schulz LC, Phillips CL. Decreasing Maternal Myostatin Programs Adult Offspring Bone Strength in a Mouse Model of Osteogenesis Imperfecta. Proc Natl Acad Sci U S A. 22;113(47):13522-13527, 2016 (PMID: 27821779; *doi: 10.1073/pnas.1607644113*)
- c. Jeong Y, Daghlas SA, Xie Y, Hulbert MA, Pfeiffer FM, Dallas MR, <u>Omosule CL</u>, Pearsall RS, Dallas SL, Phillips CL. Skeletal Response to Soluble Activin Receptor Type IIB in Mouse Models of Osteogenesis Imperfecta. Journal of Bone and Mineral Research; 2018 May 29. (PMID: 29813187; doi: 10.1002/jbmr.3473. [Epub ahead of print])

2. Muscle Function in Osteogenesis Imperfecta: Osteogenesis imperfecta (OI), a heritable bone disorder, is characterized by decreased bone mineral density (BMD), frequent fractures and skeletal dysplasia, and is due primarily to mutations in the type I collagen genes. Currently there is no cure, and treatment is

limited to surgical intervention and the use of bisphosphonates. Patients with OI report muscle weakness and easy fatigue. We were the first to evaluate muscle function in mouse models of OI. We demonstrated that the *oim* mouse (moderately severe OI) has an inherent muscle pathology and decreased contractile generating force, while the *G610C col1a2* OI mouse model does not exhibit compromised muscle, suggesting that muscle weakness in OI may be mutation specific and/or due to inactivity. We have evaluated pharmacologic agents (ActRIIB-mFc) for enhancing OI muscle function, and are the first investigators to evaluate exercise modalities as a potential therapeutic target for enhancing bone strength in OI mouse using the *G610C* mouse model.

- a. **Gentry BA**, Ferreira JA, *McCambridge AJ*, Brown M, and Phillips CL. Skeletal Muscle Weakness in Osteogenesis Imperfecta Model Mice. Matrix Biology 29(7):638-44, 2010 (PMCID:PMC2952678, *doi:10.1016/j.matbio.2010.06.006*)
- b. **Gentry BA**, Ferreira JA, Phillips CL, and Brown M. Hindlimb Skeletal Muscle Function in Myostatin Mice. Muscle & Nerve. 43(1):49-57, 2011. (PMID: 21082689, *doi: 10.1002/mus.21796*)
- c. **Jeong Y, Carleton SM**, **Gentry BA**, Yao X, Ferreira JA, **Salamango DJ**, Weis M, **Oestreich AK**, *Williams AM*, <u>McCray MG</u>, Eyre DR, Brown M, Wang Y, Phillips CL. Hindlimb Skeletal Muscle Function and Skeletal Quality and Strength in +/G610C Mice With and Without Weight-Bearing Exercise. J Bone Miner Res. 30(10):1874-86 2015 (PMID: 25829218, *doi: 10.1002/jbmr.2518)*
- d. **Jeong Y**, *Daghlas SA*, *Kahveci AS*, Gentry BA, Brown M, Pearsall RS, Phillips CL. ActRIIB-mFc differentially impacts murine osteogenesis imperfecta muscle function. Muscle Nerve 57(2):294-304, 2018. (PubMed PMID: 28555931, *doi: 10.1002/mus.25706*)

3. Osteogenesis imperfecta type I collagen mutations impact bone biomechanical and physiochemical properties and are influenced by both sex and the genetic background (modifier genes): We were the first group to characterize the impact of genetic background on bone biomechanical and physiochemical properties. We demonstrated that the bone strength is much weaker in OI mice on the C57Bl/6J compared to mice on the B6CH3 genetic background. We also demonstrated differences in the mineral/matrix and trace mineral composition of OI bone.

- a. Huntington CE, **Carleton SM**, McBride DJ, Winkelmann CT, Phillips CL, and JS Morris. Multi-element analysis of bone from the osteogenesis imperfecta model (OIM) mouse using thermal and fast neutron activation analysis. J. Radioanal. Nucl. Chem. 276(1):65-69, 2008.
- b. Carleton SM, McBride DJ, Carson WL, Buff CE, *Twenter KL*, *Rolwes KM*, Winkelmann CT, Morris JS, and Phillips CL. Role of Genetic Background in Determining Phenotypic Severity Throughout Postnatal Development and at Peak Bone Mass in COL1A2 Deficient Mice (*oim*). Bone 42:681-694, 2008. (PMCID:PMC2423326, *doi:10.1016/j.bone.2007.12.215*). PMID: 18313376. PubMedCentral PMCID: PMC2423326.
- c. **Carleton SM**, Whitford GM, and Phillips CL. Dietary Fluoride Restriction Does Not Alter Femoral Biomechanical Strength in cola2 Deficient (*oim*) Mice with the Type I Collagen Glomerulopathy. Journal of Nutrition 140 (10):1752-1756, 2010 (*doi: 10.3945/jn.109.120261*). PMID:20724489.
- d. Yao X, **Carleton SM**, **Kettle AD**, Melander J, Phillips CL, and Wang Y. Gender-Dependence of Bone Structure and Properties in Adult Osteogenesis Imperfecta Murine Model. Annals of Biomedical Engineering 41:1139-1149, 2013 (*doi:10.1007/s10439-013-0793-7*). PMID: 23536112. PubMedCentral PMCID: PMC3703620

4. **The** *oim* (*Col1a2* deficient) mouse synthesizes homotrimeric type I collagen and develops a kidney glomerulopathy: My laboratory has shown the physiological importance of type I collagen mutations in ono-skeletal tissues, as well. We found that the *oim* (*Col1a2* deficient) develops a kidney glomerulopathy and impaired kidney function post-natally due to the accumulation of homotrimeric type I collagen in the glomeruli. This homotrimeric collagen accumulates likely because it has greater resistance to degradation by metalloproteinases relative to normal heterotrimeric type I collagen. And this resistance to degradation by metalloproteinase plays a role in homotrimeric collagen synthesized by cancer cells.

- a. **Brodeur, AC**., Wirth, DA, Franklin, CL, Reneker, LW, Miner, JH, and Phillips, CL. Type I collagen glomerulopathy: postnatal collagen deposition follows glomerular maturation. Kidney International 71:985-993, 2007 (doi:10.1038/sj.ki.5002173). PMID:17361118
- b. Makareeva E , Han S, Vera JC, Sackett DL, Holmbeck K, Phillips CL, Visse R, Nagase H, and Leikin, S. Carcinomas Contain a Matrix Metalloproteinase-Resistant Isoform of Type I Collagen Exerting Selective Support to Invasion. Cancer Research 70(11): 4366–74, 2010 (doi: 10.1158/0008-5472.CAN-09-4057). PMID: 20463013. PubMedCentral PMCID: PMC2903388
- c. Han S, Makareeva E, Kuznetsova NV, DeRidder AM, Sutter MB, Losert W, Phillips CL, Visse R, Nagase H, and Leikin S. Molecular Mechanism of Type I Collagen Homotrimer Resistance to Mammalian Collagenases. Journal of Biological Chemistry 285(29):22276-22281, 2010 (doi: 10.1074/jbc.M110.102079)
- d. <u>Roberts-Pilgrim AM</u>, Makareeva, E, Myles MH, Besch-Williford CL, Brodeur AC, *Walker AL*, Leikin S, Franklin CL, and Phillips CL Deficient Degradation of Homotrimeric Type I collagen, α1(I)3 Glomerulopathy in oim Mice. Molecular Genetics and Metabolism 104:373-382, 2011 (doi:101016/j.ymgme.2011.07025). PMID3205245. PubMedCentral PMCID: PMC4483463

The public URL for Charlotte L. Phillips, PhD "My Bibilography" collection is:

http://www.ncbi.nlm.nih.gov/sites/myncbi/charlotte l.phillips.1/bibliograpahy/40657678/public/?sort=date&direction=ascending

D. Research Support (<u>Co-PI, Co-I & Collaborators in the current application are in bold and underlined</u>)

Ongoing Research Support

Clinical and Translational Research Funding Program Pilot Grant (Phillips, PI) 3/01/2019-3/31/2020 "Therapeutic Potential of Myostatin (GDF8) and Activin A Inhibition on Murine Osteogenesis Imperfecta"

The goal of this pilot study is to investigate the impact of post-natal anti- Myostatin (GDF8) and anti-Activin A monoclonal antibody treatment on muscle and bone volume and strength in two OI mouse models. Role: Principal Investigator

University of Missouri School of Medicine Bridge Funding (Phillips, PI) 8/01/2018-7/31/2019 This support is to provide funding to bridge the gap created by early termination of the March of Dimes Grant. These funds are allocated towards maintaining the oim, G610C and myostatin mouse lines and graduate student stipends. Role: Principal Investigator

Role: Principal Investigator

<u>Completed Research Support (last three years)</u>

March of Dimes (Phillips, PI; Schulz, Co-I)

"Impact of Maternal Myostatin and Uterine Environment on Offspring Bone Health"

The goal of this study is to use mysotatin deficient and osteogenesis imperfecta mouse models and embryo transfers to investigate the impact of intrauterine environment or pre-implantation programming on skeletal strength and geometry in adulthood.

Role: Principal Investigator

*Premature termination by March of Dimes on 7/31/2018

https://www.nature.com/articles/d41586-018-05875-7

NEWS 02 August 2018 **Scientists stunned as medical non-profit group abruptly ends research grants.** The US-based March of Dimes says it revoked awards to 37 researchers as part of a shift in its funding priorities.

6/01/16-5/31/2019*

Department of Child Health Pilot Funding Program (Phillips, PI)

Sears Trust Funding – 2017

"Developmental Programming of Bone by Myostatin: Preclinical Testing of a Therapeutic Strategy for Osteogenesis Imperfecta"

The goal of this pilot study is to demonstrate congenic myostatin deficiency in the +/G610C osteogenesis imperfecta (OI) mouse model during fetal development and throughout maturation will increase body and muscle mass, concomitant with improved femoral microarchitecture and biomechanical integrity. Role: Principal Investigator

Osteogenesis Imperfecta Foundation – Michael Geisman Fellowship 1/01/18-12/31/2018 "Preclinical Investigation of the Molecular Mechanism of Action of sActRIIB-mFc Receptor Decoy Therapy in Two Distinct Mouse Models of Osteogenesis Imperfecta"

The goal of this fellowship is to investigate the mechanism of action of sActRIIB-mFc in these two OI mouse models by evaluating at the molecular and cellular levels, osteoblast, osteocyte and osteoclast function. Role: Principal Investigator (Fellowship Sponsor; **Youngjae Jeong**, PhD)

University of Missouri Research Board (Phillips, PI) "ActRIIB-Fc Decoy and Osteogenesis Imperfecta Bone"

The goal of this pilot study is to determine optimal therapeutic dose of the receptor decoy, ActRIIB-Fc (RAP-031) during the rapid growth phase, and to demonstrate proof of ability and to acquire preliminary histomorphometric data of osteoblast and osteoclast function and activity in the osteogenesis imperfecta mouse (*oim*) model.

Role: Principal Investigator

Department of Child Health Pilot Funding Program, Sears Trust Funding – 2015 1/01/2016-12/31/2016 "Preclinical Investigation of the Molecular Basis of Skeletal Improvement with ActRIIB-mFc Receptor Decoy Therapy in Mouse Models of Osteogenesis Imperfecta"

The goal of this pilot study is to obtain preliminary results on the expression of 84 genes known to function in skeletal development, metabolism, and cellular differentiation in wildtype and osteogenesis imperfecta mouse femurs from control and ActRIIB-mFC treated mice using Murine Osteogenesis PCR Array (Qiagen, Valencia, CA).

Role: Principal Investigator

Research Council (Phillips, PI)

10/1/2015-9/30/2016

3/1/2016-2/28/2018

"Preclinical Analysis of the BMPR1A Receptor Decoy as a Novel Agent to Enhance Bone Strength in an Osteogenesis Imperfecta Mouse Model"

The goal of this pilot study is to obtain preliminary results on the impact of mBMPR1A-/ALK3-Fc on the on bone modeling/remodeling by analyses of serum bone formation and resorption markers in oim mice. Role: Principal Investigator

1/01/2018-12/31/2018

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors. Follow this format for each person. DO NOT EXCEED FIVE PAGES.

NAME: Amos-Landgraf, James M

eRA COMMONS USER NAME: JAMOS30

POSITION TITLE: Assistant Professor, Department of Veterinary Pathobiology, University of Missouri

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
Washington University, St. Louis, MO	A.B.	1991	Biology and Sociology
Case Western Reserve University, Cleveland, OH	Ph.D.	2005	Genetics
University of Wisconsin, Madison, WI	Postdoctoral	2010	Cancer Genetics

A. Personal Statement

I have a strong interest in the advancement of cancer biology training and have the background in human genetics and cancer genetics to successfully implement this program. I received my doctoral degree in human genetics and understanding genetic control of epigenetic processes under the mentorship of Huntington Willard (National Academy member). This interest led to my interest in the genetic control of cancer susceptibility using model systems. The work I pursued in my postdoctoral training under the mentorship of William Dove (National Academy member) led to my receipt of an American Cancer Society Fellowship to support my postdoctoral work. During my postdoctoral training I developed my pedagogical training in the HHMI supported STEM training program at the University of Wisconsin. Since joining the faculty here at the University of Missouri I have become members of the graduate training programs in the Molecular Pathogenesis and Therapeutics (MPT) graduate program currently serving on the executive committee, the Genetics Area program currently serving on the executive committee, and as a trainer on the NIH supported T32 training program in Comparative Medicine Program (MPT) in the College of Veterinary Medicine. I have successfully mentored doctoral students in both MPT and CMP, who have gone on to successful postdoctoral positions at Cedar Sinai and University of Luxembourg. These doctoral theses addressed the role of genetic susceptibility and the interaction with the gut microbiota using genetic and genomic approaches. I am strongly committed to graduate education and teach in the College of Veterinary Medicine, and specifically see a need for cancer biology and genetics training on this campus as it relates to precision medicine. I believe I can advance the training in cancer biology, genetics, and genomics and believe that it should be a valuable addition to the Medical school graduate umbrella training program.

B. Positions and Honors

Positions and Employment

1991-1992
Research Technician (E.D. Green), Washington University School of Medicine, St. Louis MO
1992-1993
Research Technician (S. Mader), Veterans Administration Hospital, Cleveland OH
1993-1997
Research Assistant (R.D. Nicholls), Genetics, Case Western Reserve University, Cleveland OH
Graduate Student (H.F. Willard), Genetics, Case Western Reserve University, Cleveland OH
Postdoctoral Fellow (W.F. Dove), Oncology, University of Wisconsin, Madison WI
Research Assistant Scientist, Oncology, University of Missouri, Columbia MO

Other Experience and Professional Memberships

2006-present International Mammalian Genome Society
2007-present American Association of Cancer Researchers
2010-present Genetics Society of America
1997-2002 American Society of Human Genetics

Honors and Awards

1997 Case Western Reserve University, Genetics Department Chairman's Award
2001 Society of Human Genetics Pre-doctoral Clinical Student Award
2002 Genetics Graduate Student Symposium presentation award winner. CWRU
2006 International Mammalian Genome Society, Genesis award, Charleston SC
2008-2009 American Cancer Society Postdoctoral Research Fellowship

B. Contribution to Science

- 1. My early work began largely in a technical position, investigating the mechanism of deletion that caused Prader-Willi and Angelman's syndrome. Prior to our team's work, the regions involved in the 3 Mb deletion were known only on a cytogenetic level with no evidence supporting a mechanism for this large chromosomal deletion. This publication was the first evidence that low copy repeated sequences in the cytogenetic regions involved in the common deletion region were likely causing PWS and AS deletion. I presented this work as a plenary presentation at the ASHG meeting, which I presented. This work has been cited over 230 times and is one of the fundamental papers showing low copy repeated sequences mediate chromosomal deletion and rearrangements.
 - a. James M Amos-Landgraf, Yonggang Ji, Wayne Gottlieb, Theresa Depinet, Amy E Wandstrat, Suzanne B Cassidy, Daniel J Driscoll, Peter K Rogan, Stuart Schwartz, Robert D Nicholls.(1999) Chromosome breakage in the Prader-Willi and Angelman syndromes involves recombination between large, transcribed repeats at proximal and distal breakpoints. The American Journal of Human Genetics 65 (2), 370-386
- 2. My second contribution to the scientific field investigated the genetic control of X inactivation in females. Studies at the time described the normal distribution of X inactivation in women absent of disease, but all of these studies were underpowered. Additionally, very few of these studies correlated with one another and the quantitative methods used had a large margin of error. My publication is the benchmark for understanding the population distribution of X inactivation ratios in normal women and has been referenced in over 150 publications. This paper created a foundation to evaluate the risk for X linked disease manifestation and carrier status in women. Additionally, I was awarded the predoctoral award from the American Society of Human Genetics for presentation of this work at the 2001 annual meeting.
 - a. **James M Amos-Landgraf**, Amy Cottle, Robert M Plenge, Mike Friez, Charles E Schwartz, John Longshore, Huntington F Willard (2006) X Chromosome–Inactivation Patterns of 1,005 Phenotypically Unaffected Females. The American Journal of Human Genetics 79 (3), 493-499
- 3. When I entered the field of mouse genetics to investigate the complex susceptibility to cancer the current mouse assembly of the genome was inadequate to characterize regions of the genome where mapped modifiers were present. We postulated that this modifier was structural, controlling the behavior of chromosome recombination resulting in LOH events and adenomagenesis. To attempt to characterize a structural modifier in the mouse genome I spent time in the laboratory of David Schwartz to help optically map the mouse genome to aid in developing a more accurate genome assembly to resolve structural differences in the mouse genome. Although we were unable to find structural differences related to cancer modifiers, our team's optical map contributed to a higher resolution assembly of the mouse genome. The optical maps that we generated resolved some large rearrangements that were present in the mouse genome assembly. My contribution was largely technical as a team member related to mouse curation and optical mapping. I presented these methods and findings at the IMGC in 2005 and the subsequent publication has been cited in over 260 publications.

- a. Deanna M Church, Leo Goodstadt, LaDeana W Hillier, Michael C Zody, Steve Goldstein, Xinwe She, Carol J Bult, Richa Agarwala, Joshua L Cherry, Michael DiCuccio, Wratko Hlavina, Yuri Kapustin, Peter Meric, Donna Maglott, Zoë Birtle, Ana C Marques, Tina Graves, Shiguo Zhou, Brian Teague, Konstantinos Potamousis, Christopher Churas, Michael Place, Jill Herschleb, Ron Runnheim, Daniel Forrest, James Amos-Landgraf, David C Schwartz, Ze Cheng, Kerstin Lindblad-Toh, Evan E Eichler, Chris P Ponting, Mouse Genome Sequencing Consortium (2009) Lineage-specific biology revealed by a finished genome assembly of the mouse. PLoS biology 7 (5), e1000112.
- 4. My continued contribution to science has been to understand the complex genetic, epigenetic and environmental interactions that contribute to the susceptibility of colon cancer. Prior to these publications existing mouse models of human colorectal cancer were insufficient to allow for longitudinal monitoring of tumor response and progression. Additionally, the phenotype of mouse did not correlate with the human disease with the majority of tumors in the mouse developing in the small intestine. Our publication reports on our development of an Apc mutant rat that recapitulates human colon adenoma development. We developed tools to measure colon tumor growth including through CT, endoscopy, as well as in whole mount tissue. We were able to perform colonoscopy on rats, individually annotate tumors, and monitor their progression. I developed allele specific quantitative pyrosequencing methods that were able to identify tumors that epigenetically silenced their wild type allele (b). This is the first example of monoallelic silencing leading to adenomagenesis, which may be a more common event than previously recognized. There have been reported cases of a substantial number of tumors in FAP patients where both a wild type and mutant allele are present indicating that epigenetic monoallelic silencing may be the driving mechanism of tumor suppressor loss. Although this model is less than a decade old it has gained support in several laboratories around the world and this work has been cited over 70 times (a.). This work was awarded the Genesis prize for best postdoctoral presentation at the International Mammalian Genome Conference in 2006 and was supported by an American Cancer Society postdoctoral award. I was the primary researcher on these projects. I also significantly contributed to work that revealed the role of the gut microbiota (c.), and diet (d.) on the early development of colonic adenomas in the Pirc rat. This has led to a greater understanding of how a complex microbiota can be manipulated and how they may influence the mechanism of early genetic events leading to cancer development.
 - a. James M Amos-Landgraf, Lawrence N Kwong, Christina M Kendziorski, Mark Reichelderfer, Jose Torrealba, Jamey Weichert, Jill D Haag, Kai-Shun Chen, Jordy L Waller, Michael N Gould, William F Dove. (2007) A target-selected Apc-mutant rat kindred enhances the modeling of familial human colon cancer. Proceedings of the National Academy of Sciences 104 (10), 4036-4041
 - b. James M Amos-Landgraf, Amy A Irving, Cory Hartman, Anthony Hunter, Brianna Laube, Xiaodi Chen, Linda Clipson, Michael A Newton, William F Dove (2012) Monoallelic silencing and haploinsufficiency in early murine intestinal neoplasms. Proceedings of the National Academy of Sciences 109 (6), 2060-2065.
 - c. Ericsson AC, Akter S, Hanson MM, Busi SB, Parker TW, Schehr RJ, Hankins MA, Ahner CE, Davis JW, Franklin CL, **Amos-Landgraf JM**, Bryda EC. Differential susceptibility to colorectal cancer due to naturally occurring gut microbiota. Oncotarget. 2015 Oct 20;6(32):33689-704.
 - d. Harris KL, Pulliam SR, Okoro E, Guo Z, Washington MK, Adunyah SE, **Amos-Landgraf JM** and Ramesh A. Western diet enhances benzo(a)pyrene-induced colon tumorigenesis in a Polyposis In Rat Coli (PIRC) rat model of colon cancer. Oncotarget. 2016; 7(20):28947-28960
 - e. Jacob E Moskowitz, Federica Andreatta, **James Amos-Landgraf.** The gut microbiota modulates differential adenoma suppression by B6/J and B6/N genetic backgrounds in Apc Min mice. Mammalian Genome. 2019 Oct;30(9-10):237-244
 - f. Moskowitz JE, Doran AG, Lei Z, Busi SB, Hart ML, Franklin CL, Sumner LW, Keane TM, **Amos-**Landgraf JM. Integration of genomics, metagenomics, and metabolomics to identify interplay

between susceptibility alleles and microbiota in adenoma initiation. BMC Cancer. 2020 Jun 29;20(1):600.

- 5. In human cancer, virtually all cancers, outside of sex specific cancers, occur at higher rates and earlier in life in men compared to women. Prior to our publication this had not been recognized in mouse models of CRC, but I observed a strong sex bias in the Pirc rats. In collaboration with Gijs van den Brink in the Netherlands, we determined that male hormones were promoting this effect in the Pirc rats. Dr. van den Brink believed that female hormones were protective, supported by epidemiological data in the nurse's heath study involving hormone replacement therapy. My group investigated the possibility that testosterone was driving the increase in males. Our publication shows that the latter is correct, in that castration of male rats reduced tumor multiplicities and adding back testosterone produced males that are indistinguishable from intact males. This is the first evidence that testosterone is acting to increase the susceptibility of males to colorectal cancer. I was the primary researcher and collaborator on these projects.
 - a. James M Amos-Landgraf, Jarom Heijmans, Mattheus CB Wielenga, Elisa Dunkin, Kathy J Krentz, Linda Clipson, Antwan G Ederveen, Patrick G Groothuis, Sietse Mosselman, Vanesa Muncan, Daniel W Hommes, Alexandra Shedlovsky, William F Dove, Gijs R van den Brink (2014) Sex disparity in colonic adenomagenesis involves promotion by male hormones, not protection by female hormones. Proceedings of the National Academy of Sciences 111 (46), 16514-16519
 - b. Meijer BJ, Wielenga MCB, Hoyer PB, **Amos-Landgraf JM**, Hakvoort TBM, Muncan V, Heijmans J, van den Brink GR. Colorectal tumor prevention by the progestin medroxyprogesterone acetate is critically dependent on postmenopausal status. Oncotarget. 2018 Jul 17;9(55):30561-30567.

Complete List of Published Work in MyBibliography:

https://www.ncbi.nlm.nih.gov/sites/myncbi/16Kjhxuztutslk/bibliography/58183657/public/?sort=date&direction=a scending

C. Additional Information: Research Support and/or Scholastic Performance

Current Research Support

5U42 OD010918 NIH	Franklin (PI)	02/01/2015-01/31/2020
Mutant Mouse Resource and The major goals of this project and characterizing genetically-	Research Center are to meet the needs of the research com engineered mice. Role: Co-I.	munity by preserving, distributing
5P40 OD011062 NIH Rat Resource and Research The overall goal of this program high quality, well characterized	Bryda (PI) Center n is to maintain a national rat resource and inbred, hybrid and genetically-engineered	06/01/2016-05/30/2021 research center that distributes rats. Role: Co-I.
5T32 OD011126 NIH Post-doctoral Training in Co Program to train veterinarians	Bryda & Franklin (Pls) mparative Medicine for competitive research careers in lab anin	07/15/2016-06/30/2021 nal medicine. Role: Co-PI
Completed Research Support	<u>t</u>	
1R44CA192460 NIH	Zand (PI)	03/15/2015-12/31/2019
Oxygen Mapping System for I	Enhanced Colonoscopic Neoplasm Dete	ction

OPEN -- ASARED -- 1-62
The goal of this project is to develop a new optical colonoscopy system for human use. The project uses rat and swine models of colon cancer for in-vivo optical colonoscopy to validate fluorescent methods of tissue oxygenation at the margins of early adenomas to aid in resection of tumors. Role: Co-I.

Industry Research GrantAmos-Landgraf (PI)06/01/2017-07/31/2018DNALite Therapeutics, Inc.

Efficacy of Gene Therapy Drugs in the Pirc Rat Colorectal Cancer Model

The aim of this project is to test the efficacy of gene therapy drug candidates developed by DNALite Therapeutics, Inc. in the Pirc Rat colorectal cancer model. Role: PI.

Industry Research Grant

Amos-Landgraf (PI)

05/01/2016-09/30/2017

Janssen Vaccines and Prevention, B.V.

Fusobacterium nucleatum induced potentiation of tumor development in the Pirc Rat colorectal cancer model

The aim of this research project is to develop an animal model that allows *F. nucleatum* colonization in the gut, subsequently showing increased colorectal tumor development suitable for testing efficacy of novel *F. nucleatum* targeted vaccine candidates. Role: PI.

BIOGRAPHICAL SKETCH

NAME:

Daniels, Mark Allen

eRA COMMONS USER NAME:

POSITION TITLE:

Associate Professor

danielsma

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	COMPLETION DATE	FIELD OF STUDY
University of Minnesota	B.S.	05/1998	Microbiology/Chemistry
University of Minnesota	Ph.D.	04/2002	Immunology
University of Minnesota	Post Doc.	05/2003	Immunology
University Hospital Basel, Switzerland	Post Doc.	12/2007	Immunology

A. Personal Statement:

Our lab is focuses on how we can apply the basic principles of lymphocyte biology and oncology to the treatment of leukemia/lymphoma and finding ways to use the immune system to treat various types of cancer. As a Ph.D. student in the Microbiology, Immunology and Cancer Biology Program at the University of Minnesota, my work explored important functional changes that occur along the course of T cell development and maturation. As a Cancer Research Institute Fellow at the University Hospital in Basel Switzerland, I expanded my research where I described the boundary that defines positive and negative selection. As PI I have continued to explore maturation dependent changes in essential T and B cell signaling pathways and have extended these finding to describe the biochemical mechanisms behind how their dysregulation lead to loss of tolerance or development of leukemia. In addition, my work explores the role of self in anti-tumor immune responses and engineers CAR and other types of T cells for use in tumor immunotherapy.

I have a strong commitment to education and mentoring that has spanned my career as an academic scientist. I teach two undergraduate courses in immunology where I introduce students to the basic concepts of immunology. More importantly, I explain to them how research can lead to discovery and the advancement of human health. I also direct and teach multiple classes in our graduate program. I have mentored 3 graduate students, one is completing post-doctoral training at the University of Innsbruck, Austria, one after completing 2 years of post-doctoral training at the University of Seattle is now in their 2nd year of med school at the Mayo Clinic. I have served on the thesis committee of 18 graduate students, 5 are from diverse underrepresented minorities (URM). I have had the great fortune of mentoring 10 undergraduate students. Of these, 6 were URM. This diverse group have been very successful in their chosen career paths. The first 2 (both URM) obtained MD's and are in the late stages of their residencies, one is in their first year of med school, one is a practicing dentist, one has completed their masters of public health. The rest are in the process of completing a PhD.

My commitment to education goes beyond the lab and classroom. In addition to the direct mentoring students, I serve as the Director of Graduate Studies for the Molecular Pathogenesis and Therapeutics Program. I am also a member of the Graduate Student Advisory Committee for the MD/PhD program. My service work in these positions includes recruiting students through various mechanism. Especially important, is the recruitment of URM students through the Prep-Scholar program, SACNAS and ABRCAMS. I also participate in an exchange program with students from South Africa that allows them a chance to do a summer research project in our lab. These venues allow us access to a broad range of talented students that enrich our graduate program.

B. Positions and Honors

Positions:

1999-2003	Teaching Specialist, Temporary Faculty and Curriculum Development Organic Chemistry
	Division, University of Minnesota, Minneapolis, MN.
2002-2003	Post Doctoral Fellow, Lab Medicine and Pathology University of Minnesota
2003-2008	Post Doctoral Fellow, Transplantation Immunology and Nephrology, Department of Research, University Hospital Basel
2008-2016	Assistant Professor. Department of Molecular Microbiology and Immunology.University of

Missouri, Columbia, MO

Joint appointment in Department of Surgery

- 2016- Associate Professor, Department of Molecular Microbiology and Immunology, University of Missouri, Columbia, MO Joint appointment in Department of Surgery
- 2018- Director of Graduate Studies Molecular Pathobiology and Therapeutics

Other experience and Memberships:

Memberships:

American Association for the Advancement of Science (2008-present)

- American Association of Immunologists (2002-present)
- <u>Review board and Ad Hoc Reviewer:</u> European Journal of Immunology, Immunology, PLOS One, Journal of Biomedicine and Biotechnology, Science Advances, EMBO Journal, Scientific Reports, PNAS, Science Immunology, Nature Communications

Immunology, Nature Communica

Editorial Board Member:

Journal of Immunology: Associate Editor (2015-present) Heliyon (Elsevier): Editorial Board (2015-present)

Honors:

1995-1998	Dean's List, College of Biological Sciences, University of Minnesota
1999-2001	NIH pre-doctoral training grant
2001	Bacaner Award for Outstanding Original Research in Basic Science
2002	Golden Pipetman Award for Top MICaB Graduate Student
2003-2006	National Cancer Research Institute Post Doctoral Fellowship Grant
2004	Best Research Article of the year for Department of Research,
	University of Basel
2006	Best Research Article of the year for Department of Research,
	University of Basel
2015	Ellis Fischel Leukemia Research Award

C. Contribution to Science:

My work is focused on the signals that control lymphocyte development, differentiation, memory and oncogenesis (lymphoma and leukemia). One set of most recent published work has pioneered a role for the location of the MAPK pathway (Ras/ERK) and the selection decision. I have extended this to signaling pathways that change their function upon lymphocyte development. Our most recent work (highly relevant for this application), was the first to identify a role for the scaffold molecule POSH in the regulation of the outcome of activation of CD8 and CD4 T cells. We have also gone on to find roles for POSH in B cell development and activation. In addition, we found that disruption of POSH function leads to death in a broad range of genetically diverse leukemia subtypes: *Cardwell LN, Guan Y, Teixeiro E, Daniels MA, POSH scaffold complex necessary for survival of broad range of B cell leukemia. 2018 submitted (see also BioRxiv); Guan Y, Cardwell LN, Cunningham CA, Teixeiro E, Daniels MA. Early T cell precursor leukemias depend on POSH for their survival. 2018 submitted (see also BioRxiv)*. Our ongoing work and this proposal focus on determining the mechanism of POSH function in leukemic T lymphocytes.

- a. Daniels MA, Teixeiro E, Gill J, Hausmann B, Roubaty D, Holmberg K, Werlen G, Holländer GA, Gascoigne NR, Palmer E. Thymic selection threshold defined by compartmentalization of Ras/MAPK signalling. Nature2006 Dec 7;444(7120):724-9.
- b. Cunningham CA, Knudson KM, Peng BJ, Teixeiro E, Daniels MA.* The POSH/JIP-1 scaffold network regulates TCR-mediated JNK1 signals and effector function in CD8(+) T cells. Eur J Immunol. 2013 Dec;43(12):3361-71. *Corresponding author.
- c. Cunningham CA, Cardwell LN, Guan Y, Teixeiro E, Daniels MA. POSH Regulates CD4+ T Cell Differentiation and Survival. J Immunol. 2016 May 15;196(10):4003-13. doi: 10.4049/jimmunol.1501728. Epub 2016 Apr 15. PMID: 27084103
- d. Daniels MA, Teixeiro E. TCR Signaling in T Cell Memory. Front Immunol. 2015 Dec 10;6:617. doi: 10.3389/fimmu.2015.00617. eCollection 2015. Review. PMID: 26697013

2. Along similar lines, my colaborations have lead to publications defining the signals and programs that determine T cell differentiation and memory development. Findings from these studies were among the first to connect specific sets pf signals from the TCR to the different programs that differentiate the development of short lived effector cells and long lived memory. Our published work has also benn at the forefront of a growing interest in the response of T cells to low affinity antigens and self that help to define the threshold of tolerance. This effort is highly complementary to our focus on the sensitivity/tolerance of T cells to self and tumor antigens. Our ultimate goal in these studies have been to improve tumor immunotherapy and treatments of autoimmunity.

- Teixeiro E, Daniels MA, Hamilton SE, Schrum AG, Bragado R, Jameson SC, Palmer E. Different T Cell Receptor Signals Determine CD8+ Memory Versus Effector Development. Science2009 Jan 23;323(5913):502.
- b. Knudson KM, Hamilton SE, Daniels MA, Jameson SC, Teixeiro E. Cutting edge: The signals for the generation of T cell memory are qualitatively different depending on TCR ligand strength. J Immunol. 2013 Dec 15;191(12):5797-801.
- c. Knudson KM, Goplen NP, Cunningham CA, Daniels MA*, Teixeiro E.* Low-affinity T cells are programmed to maintain normal primary responses but are impaired in their recall to low-affinity ligands. Cell Rep. 2013 Aug 15;4(3):554-65. *Co-corresponding authors
- d. Knudson KM, Pritzl CJ, Saxena V, Altman A, Daniels MA, Teixeiro E. NFκB-Pim-1-Eomesodermin axis is critical for maintaining CD8 T-cell memory quality.Proc Natl Acad Sci U S A. 2017 Feb 28;114(9):E1659-E1667

3. A large portion of my work aims to define how the development and maturation of T cells changes their response to self and foreign antigen. From these publications, T cell sensitivity, once thought to be a 'hard-wired' property of a cell, is now known to be a dynamic property regulated by maturation, antigen experience and additional yet to be discovered mechanisms. We were among the first to connect differential glycosylation to T cell sensitivity. We defined differentiation dependent variances in the contribution of the co-receptor to signaling efficiency and how this is translated into specific CD8 T cell responses. In a continued collaboration with the Gil and Schrum groups we are exploring the maturation dependent change in the affinity threshold necessary to induce a conformational change in CD3 ϵ (*manuscript in preparation*). In addition, a portion of this proposal is dedicated to the maturation dependent regulation of JNK and POSH. These data are being applied to the fundamental questions of lymphocyte development, leukemia oncogenesis, T cell memory and antitumor immune responses.

- a. Daniels MA, Jameson SC. Critical role for CD8 in T cell receptor binding and activation by peptide/major histocompatibility complex multimers. J Exp Med2000 Jan 17;191(2):335-46.
- b. Daniels MÁ, Devine L, Miller JĎ, Moser JM, Lukacher AE, Altman JD, Kavathas P, Hogquist KA, Jameson SC. CD8 binding to MHC class I molecules is influenced by T cell maturation and glycosylation. Immunity2001 Dec 1;15(6):1051-61.
- c. Daniels MA, Hogquist KA, Jameson SC. Sweet 'n' sour: the impact of differential glycosylation on T cell responses. Nature immunology. 2002; 3(10):903-10. PMID: 12352967
- d. Knudson KM, Pritzl CJ, Saxena V, Altman A, Daniels MA, Teixeiro E. NFκB-Pim-1-Eomesodermin axis is critical for maintaining CD8 T-cell memory quality. Proc Natl Acad Sci U S A. 2017 Feb 28;114(9):E1659-E1667. doi: 10.1073/pnas.1608448114. Epub 2017 Feb 13.PMID: 28193872

4. An additional contribution to science includes a number of methods that we have optimized for analysis of the biochemical events that determine the outcome of selection, activation and differentiation of T cells. My group designed, developed and patented cell permeable POSH inhibitors that we have used extensively to examine the role of POSH in normal and leukemic lymphocytes. Additionally, in collaboration with the Biochemical Engineering group of Dr. Bret Ulery, we have designed and developed POSH based nanoparticles (provisional patent submitted 1/2016) that can be delivered to specific cells in vivo. In addition to the basic science application of these materials, we have been using these POSH inhibitors to treat murine and human xeonografts of human leukemia in vivo. Dr. Ulery was invited to give a talk on this work at the highly prestigious

World Biomatierials Conference 2016 in Montreal. We are also working on the development of a predictive diagnostic to determine which patient samples are sensitive to our treatment regimen for the eventual translation to the treatment of autoimmunity and leukemia in the clinic.

- a. Mark A Daniels. "Cell permeable Inhibitors of the scaffold protein plenty of SH3 domains (POSH) or Sh3Rf1". The converted PCT application (PCT/US14/51019) was submitted for a full patent on 2/2016.
- b. Cunningham CA, Teixeiro E, Daniels MA*. In Vitro Analysis of Thymocyte Signaling. Methods Mol Biol. 2016;1323:169-78. doi: 10.1007/978-1-4939-2809-5 15. PMID: 26294408
- c. Cunningham CA, Teixeiro E, Daniels MA*. FTOC-Based Analysis of Negative Selection. Methods Mol Biol. 2016;1323:141-9. doi: 10.1007/978-1-4939-2809-5 12. PMID: 26294405
- d. Josiah D. Smith, Leah Cardwell, Erin Newcomer, Logan D. Morton, Rui Zhang, Fabio Gallazzi, Tom Phillips, Mark A. Daniels*, and Bret D. Ulery*. POSH Inhibitor Peptide Amphiphile Micelles as a Novel Leukemia Therapeutic Modality. 2016, World Biomaterials Congress

My complete list of publications can be found at NCBI My Bibliography here: http://www.ncbi.nlm.nih.gov/sites/myncbi/1vABFNGYggC5z/bibliography/48144940/public/?sort=date&direction =ascending

D. Current Research Support:

Mission Enhancement Program, University of Missouri Daniels (PI) 2008-Establish the how the molecular programs that establish T cell tolerance and sensitivity can be used to improve tumor immunotherapies. In addition how a specific subset of CD8 T cells can be generated and used to improve the outcome of cancer treatments. Role: PI

R01 ES022966 McKarns(PI) 08/01/2014 - 04/30/2019 This grant explores the interaction between components of the estrogen receptor signaling pathway and the transcription factor aryl hydrocarbon receptor (AhR) and their contribution to differentiation of immunosuppressive Tregs. Role: Co-I

DoD RT160149 Ulery (CoPI) Novel Immunomodulatory Peptide Polymers for VCA Rejection Prevention.

This grant explores the use of peptide polymers as a way to induce immune tolerance for the prevention of VCA rejection. Role: CoPI

MU-SOM Bridge Fund Daniels (PI) 03/01/2018-02/28/2019 This work focuses on the mechanism of POSH inhibitor function in human and canine leukemias and lymphomas.

KCALSI Nexus Research Grant: Role: CoPI; 01/01/2019-12/31/2019; Poly (amino acid) Amphiphile Nanoparticles for Improved Hematological Cancer Treatment.

LSC Early Concept Grant: Co-PI;

02/01/2019-01/31/2021 "Improving CAR T cells immunotherapy with ATHENA (Aptamer-based Tumor ENhanced Affinity) and tumorassociated antigen discovery."

08/01/2017-07/31/2019

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors. Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Parrish, Alan R

eRA COMMONS USER NAME: arparrish

POSITION TITLE: Associate Professor

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
University of Arizona, Tucson, AZ	B.S.	08/1994	Biochemistry
Texas A&M University, College Station, TX	Ph.D.	08/1997	Toxicology
University of Arizona, Tucson, AZ	Postdoctoral	02/1999	Toxicology

A. Personal Statement

I have served as director of graduate studies for Medical Pharmacology and Physiology since 2012 and have been involved in establishing the University of Missouri School of Medicine Translational Biosciences program since 2017. I have mentored 6 PhD students, 1 MD/PhD candidate and have served on over 30 dissertation committees. My research interests revolve around the role of oxidative stress and metals in disruption of cell adhesion. I began my career as an independent investigator the Texas A&M Health Science Center College of Medicine where my laboratory focused on metal-induced disruption of the cadherin/catenin disruption in acute kidney injury, and age-dependent loss of N-cadherin and alpha-catenin expression in the kidney as a factor in the increased susceptibility of the aging kidney to injury. In 2010, I moved my laboratory to the University of Missouri, where our group focused on the impact of alpha-catenin on metal (cisplatin)-induced acute kidney injury. We demonstrated that alpha-catenin expression regulates Fas-mediated apoptosis, but not necrosis. Most recently, we have extended our interest in metal-induced alterations in cell-cell adhesion to defining the impact of cadmium and lead on cadherin/catenin complexes in renal carcinoma cells. While the role of lead in renal cancer initiation is unclear, we are focused on tumor progression; specifically, dedifferentiation (EMT) of cancer cells into a migratory, invasive phenotype.

B. Positions and Honors

Positions and Employment

1997-1999	Research Assistant Professor; University of Arizona, College of Medicine, Department of Anesthesiology.
1999-2005	Assistant Professor; Texas A&M University Health Science Center, College of Medicine,
	Department of Medical Pharmacology and Toxicology.
2000-2010	Member, Intercollegiate Faculty of Toxicology.
	Member, Cardiovascular Research Institute.
	Associate Member, Center for Environmental and Rural Health
2005	Associate Professor; Texas A&M University Health Science Center, College of Medicine,
	Department of Medical Pharmacology and Toxicology.
2006-2010	Associate Professor; Texas A&M University Health Science Center, College of Medicine,
	Department of Systems Biology and Translational Medicine.
2010-	Associate Professor, Medical Pharmacology and Physiology, University of Missouri School of
	Medicine.
2010-	Associate Professor, Division of Nephrology, Internal Medicine, University of Missouri School of
	Medicine.

- 2012- Director of Graduate Studies, Medical Pharmacology and Physiology, University of Missouri School of Medicine.
- 2012- Vice Chair for Education, Medical Pharmacology and Physiology, University of Missouri School of Medicine.
- 2017- Co-Director, Translational Biosciences Graduate Program, University of Missouri School of Medicine.

<u>Honors</u>

- 2003 Distinguished Teaching Award, College of Medicine, TAMUS-HSC
- 2004 Excellence in Renal Research Award, American Physiology Society Renal Section

Other Experience and Professional Memberships

Memberships: Society of Toxicology

- Service: School of Medicine Curriculum Board (2011-2014), Chair 2013-2014 University of Missouri Graduate Faculty Senate (2016-) University of Missouri Research Council (2019-)
- Editorial Boards: Toxicology Letters (2003-2006), Cell Biology and Toxicology (2001-2008), Toxicology and Applied Pharmacology, Toxicology Reports (Associate Editor 2013-2017)
- Grant Review: VA Nephrology panel (ad hoc) PBKD (ad hoc) CMAD (ad hoc) American Diabetes Association (ad hoc) CDMRP (ad hoc) Oklahoma Center for Advancement of Science and Technology

C. Contribution to Science

- 1. My first contribution as an independent investigator was the demonstration that the cadherin/catenin complex was a molecular target of toxicants, including metals. We first demonstrated that oxidative stress disrupted the E-cadherin/catenin complex, without affecting protein expression of the components, in liver slices, an ex vivo system that maintains normal architecture and cellular heterogeneity. We then showed that under similar conditions, the N-cadherin/complex was not disrupted in biliary epithelium, suggesting that there were preferential cellular targets of oxidative-stress induced adhesion complex dysfunction. We showed that disruption of the cadherin/catenin complex was an early event in mercuric chloride-induced AKI, preceding increases in BUN and serum creatinine. These effects were not limited to toxicants, as ischemia-reperfusion injury also disrupted adhesion via MMP-mediated cleavage of cadherins.
 - a) **Parrish AR**, Catania JM, Orozco J, Gandolfi AJ. (1999) Chemically-induced oxidative stress disrupts the E-cadherin/catenin cell adhesion complex. *Toxicological Sciences* 51:80-86. PMID10496679.
 - b) Schmelz M, Schmid VJ, Parrish AR. (2001) Selective disruption of cadherin/catenin complexes by oxidative stress in precision-cut mouse liver slices. *Toxicological Sciences* 61:389-394. PMID11353148.
 - c) Jiang J, Dean D, Burghardt RC, Parrish AR. (2004) Disruption of cadherin/catenin expression, localization and interactions during HgCl₂-induced nephrotoxicity. *Toxicological Sciences* 80:170-182. PMID15084754.
 - d) Covington MD, Burghardt RC, Parrish AR. (2006) Ischemia-induced cleavage of cadherins in NRK cells requires MT1-MMP (MMP-14). American Journal of Physiology: Renal Physiology 290:F43-F51. PMID16077081.
- 2. Our laboratory has a long-standing interest in age-dependent renal dysfunction, specifically changes that underlie the increase severity of AKI in the elderly. We were the first to identify the age-dependent loss of

N-cadherin in the kidney; interestingly, this effect was not seen in other organs – brain, liver, testes – that express N-cadherin. The loss of α -catenin temporally precedes the decreased N-cadherin expression. We demonstrated that aging was associated with methylation of the N-cadherin promoter and have recently focused on the phenotypic changes induced by loss of $\alpha(E)$ -catenin in the proximal tubular epithelium. Knockdown of $\alpha(E)$ -catenin in vitro decreases cell-cell adhesion, an expected finding. Importantly, when $\alpha(E)$ -catenin is decreased, N-cadherin expression is ablated, similar to the observation we initially made in the rat kidney. While proliferation is not inhibited following $\alpha(E)$ -catenin knockdown and, in fact, is increased in the presence of exogenous growth factors, wound healing is significantly reduced due to a disruption in migration.

- a) Jung K-Y, Dean D, Jiang J, Gaylor S, Griffith WH, Burghardt RC, **Parrish AR**. (2004) Loss of Ncadherin and α-catenin in the proximal tubules of aging male Fischer 344 rats. *Mechanisms of Ageing and Development* 125:445-453. PMID 15178134.
- b) Akintola AD, Crislip ZL, Catania JM, Chen G, Zimmer WE, Burghardt RC, **Parrish AR**. (2008) Promoter methylation is associated with the age-dependent loss of N-cadherin in the rat kidney. *American Journal of Physiology: Renal Physiology* 294:F170-176. PMID 17959753.
- c) Nichols LA, Slusarz A, Grunz-Borgmann EA, Parrish AR. (2014) α(E)-catenin regulates BMP-7 expression and migration in renal epithelial cells. *American Journal of Nephrology* 39:409-417. PMID 24818804, Free PMC article.
- d) Nichols LA, Grunz-Borgmann EA, Wang X, Parrish AR. (2014) A role for the age-dependent loss of α(E)-catenin in regulation of N-cadherin expression and cell migration. *Physiological Reports*, Jun 11: 2(6). PMC4208646.
- **3.** Our laboratory has made contributions to understanding mechanisms leading underlying the increased severity of acute kidney injury in the aging kidney. We have delineated impact of the age-related loss of $\alpha(E)$ -catenin in increased sensitivity to apoptosis in proximal tubular epithelial cells. In the initial study, we demonstrated that knockdown of $\alpha(E)$ -catenin in cells increased the sensitivity to apoptotic cisplatin, staurosporine but not necrotic mercuric chloride stimuli. Caspase inhibitors block the increased sensitivity to cisplatin-induced apoptosis. We extended these findings to aged animals, in which increased injury was seen following cisplatin, but not mercuric chloride challenge. In addition, a marked increase in apoptosis was next examined. The loss of $\alpha(E)$ -catenin dramatically increases Fas expression in cells and Fas inhibitors attenuate increased cisplatin-induced apoptosis. In addition, a role for caspase-8 and -9 in $\alpha(E)$ -catenin knockdown cells was demonstrated. These results, combined with the migration studies previously discussed, indicated that loss of $\alpha(E)$ -catenin increases injury and decreases repair in the aging kidney.
 - a) Wang X, Grunz-Borgmann EA, **Parrish AR**. (2014). Loss of α(E)-catenin potentiates cisplatininduced nephrotoxicity via increasing apoptosis in renal tubular epithelial cells. *Toxicological Sciences* 141:254-262. PMC4271126.
 - b) Wang X, **Parrish AR**. (2015). Loss of α(E)-catenin promotes Fas mediated apoptosis in tubular epithelial cells. *Apoptosis*, 20:921-929. PMC4449812.
 - c) Wang X, Nichols L, Grunz-Borgmann EA, Sun Z, Meininger GA, Domeier TL, Baines CP, Parrish AR. Fascin2 regulates cisplatin-induced apoptosis in NRK-52E cells. *Toxicol Lett* 266:56-64. PMC7974922.
 - d) Grunz-Borgmann EA, Nichols LA, Wang X, **Parrish AR**. (2017) Twist2 is upregulated in early stages of repair following acute kidney injury. *Int J Mol Sci* 18:368. PMC5343903.

4. Our most recent work has focused on the role of heavy metals on renal cell carcinoma progression via epithelial-to-mesenchymal transition (EMT). We have recently demonstrated that acute challenge of renal

cell carcinoma cells (Renca cells) with non-cytotoxic concentrations of cadmium and lead induces molecular and phenotypic changes associated with EMT. The proposed studies are an extension of this work.

a) Akin R, Hannibal D, Loida M, Stevens EM, Grunz-Borgmann EA, **Parrish AR**. (2019). Cadmium and lead decrease cell-cell aggregation and increase migration and invasion in Renca renal cell carcinoma cells. *Int J Mol Sci* 20:6315. PMC6940727.

Complete List of Published Work in my Bibliography:

http://www.ncbi.nlm.nih.gov/sites/myncbi/alan.parrish.1/bibliography/40679002/public/?sort=date&direction=as cending

D. Research Support

Ongoing research support

University of Missouri, School of Medicine Bridge Funding Parrish, Alan R., Pl July 1, 2018-June 1, 2019 (in no cost extension) 50,000 in direct costs

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors. Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Christopher D. Hardin, PhD

eRA COMMONS USER NAME (credential, e.g., agency login): hardin

POSITION TITLE: Professor, Department of Nutrition & Exercise Physiology

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Cornell University, Ithaca, NY	BS	1983	Biology
University of Rochester, NY	MS	1986	Physiology
University of Cincinnati, Ohio	PhD	1989	Physiology & Biophysics

A. Personal Statement

From 1992 to 20007 my career was as a vascular physiologist studying metabolism and was NIH funded from 1992-2013. Since taking the department chair role in 2007, I have devoted the majority of my time to rebuilding a department into a multi-disciplinary, collaborative unit focused on human research related to prevention of heart disease and diabetes. The Nutrition and Exercise Physiology Department serves three colleges at MU and is a model of collaboration and translational research on the MU campus. I designed and oversaw the building of state-of-the-art human research facilities (MUNCH and MU-PAW – see Training Plan), which were built to compliment the MU School of Medicine Clinical Research Center (planned and built at the same time). NEP faculty are the primary users of the CRC for investigator initiated research. I have also focused on strengthening our two Ph.D. programs and the bridges with related Ph.D. programs on campus. In addition I have focused for over 20 years on enhancing diversity. I was co-PI on the MU-PREP program for 10 years and maintain a role on the advisory committee for this NIH post-bac grant for under-represented minority trainees. I have served on and led a variety of diversity committees and initiatives at MU and routinely serve on and chair the NHLBI K-award review panel for under-represented minority scientists. I stepped down as chair in December of 2020 and now focus on medical student education graduate student education and NIH review panels as well as re-establishing a research program.

B. Positions and Honors

1989-1991	Senior Fellow, Department of Radiology, University of Washington, Seattle
1991-1993	Research Assistant Professor, Department of Radiology,
	University of Washington, Seattle.
1993-1999	Assistant Professor, Department of Physiology, University of Missouri, Columbia, MO.
1999-2002	Associate Professor with tenure, Department of Physiology, University of Missouri, Columbia, MO.
2002-2005	Associate Professor with tenure, Department of Medical Pharmacology and Physiology, University of Missouri, Columbia, MO.
2005-present	Professor with tenure, Department of Medical Pharmacology and Physiology, University of Missouri, Columbia, MO.
2007-2020	Professor and Chair , Department of Nutrition and Exercise Physiology, School of Medicine, College of Human Environmental Sciences and College of Agriculture Food and Natural Resources, University of Missouri, Columbia, MO.
2020-present	Professor with tenure, Department of Nutrition and Exercise Physiology

Service, Awards and Honors

1999 **Outstanding Junior Faculty Member Award**, Dorsett L. Spurgeon Distinguished Medical Research Award (clinical or basic science) in the School of Medicine at the University of Missouri - keynote address at the School of Medicine Research Day. (*Research Award*).

1995	Harold Lamport Award, given by the APS to the outstanding investigator in cardiovascular
0004	physiology under the age of 36 years (Research Award).
2001	Charter Member, Order of Socrates, as recognition of master teachers repeatedly cited for
	excellence in teaching in the medical curriculum, University of Missouri School of Medicine.
	(Teaching Honor).
2002	Elected Fellow, Cardiovascular Section, American Physiological Society. (Research Honor).
2004-2006	Member, Council of the Gordon Research Conferences
2005-2007	Member, Awards Committee, American Physiological Society.
2005	Chancellor's Award for Research and Creative Activity, University of Missouri.
2005-2008	Member, Industry-Foundations Liaison Committee of the Cardiovascular Section of the
	American Physiological Society (Chair 2007-2008)
2006	Inaugural Outstanding Undergraduate Mentor Award, Office of Undergraduate Research,
	University of Missouri (<i>Teaching Award</i>).
2007-2008	Member, Cardiovascular Section Steering Committee of the American Physiological Society.
2007-2010	Steering Committee, Advanced Placement Annual Conference (APAC, via The College
	Board). The committee organizes the program as well as doing the evaluation of sessions.
2010`	Reviewer, National Science Foundation, Theoretical Biology May
2012	Judge, Annual Biomedical Research Conference for Minority Students, San Jose, CA,
	November 2012
2012	Reviewer, K01 and R25 RFAs to promote Faculty and Trainee Diversity, Bethesda, MD,
	October.
2012	Member, American Heart Association, Cell Function and Metabolism Study Section
2013	Faculty Service and Leadership Award, Honors College, University of Missouri
2014	Reviewer, P awards for Diabetes Centers, October
2015	Reviewer, K01 RFAs to promote Faculty and Trainee Diversity, Bethesda, MD, June.
2016	Reviewer, K01 RFAs to promote Faculty and Trainee Diversity, Bethesda, MD, March.
2016	Chair elect, Association of Nutrition Departments and Programs (ANDP)
2016	Chair, NIDDK P30 Diabetes Research Centers Study Section, Bethesda MD October
2016	Reviewer, NIDDK P20 Developmental Centers for Interdisciplinary Research in Benign Urology,
	June.
2016	Reviewer, Special Emphasis Panel, R21s for Accelerating Translation of Glycoscience:
	Integration and Accessibility, March.
2017	Invited Participant, American Society for Nutrition 2028 Strategic Visioning Group.
2017	Phase I Reviewer, American Heart Association Strategically Focused Research Network-
	Obesity, January; Phase II reviewer, February
2017	Reviewer, National Cancer Institute, P01 Review Panel
2017/18	Chair, Association of Nutrition Departments and Programs (ANDP)
2017-2021	Chair, K01 RFAs to promote Faculty and Trainee Diversity, 5 panels
2017-2019	Member, Oversight Committee of the American Heart Association Strategically Focused
	Obesity Research Network.
2017- 20	Councilor, Association of Chairs of Departments of Physiology (ACDP)
2018 - 2021	Member, American Society for Nutrition Publications Management Committee.
2019	Chair, NIDDK P30 Diabetes Research Centers, Chevy Chase, MD 28-29 Oct.
2020-2021	Chair, NIH NHLBI R03 Review Panel, 3 panels.

C. Contributions to Science

My research has generally focused on intermediary metabolism in muscle cells with a focus on smooth muscle cells. Primary areas of interest have been in the organization (structuring) of carbohydrate metabolism in cells as well as determinants of mitochondrial substrate selection in normal metabolism and in metabolic dysfunction.

Early work on the structuring of metabolism in smooth muscle cells focused on localized energy transduction between a membrane associate glycolytic pathway and the plasmalemmal calcium pump. The system used was a membrane fraction enriched in the Ca-ATPase.

- a) Hardin, C.D., Raeymaekers, F., and Paul, R.J. (1992). Comparison of endogenous and exogenous sources of ATP in supporting Ca²⁺-uptake in isolated smooth muscle plasma membrane vesicles (PMV). *Journal of General Physiology.* 99: 21-40.
- b) Hardin C.D., Paul, R.J., Raeymaekers, L., Steenart N.A.E., and Kranias, E.G. (1993). Regulation of glycolytically fueled Ca²⁺-uptake in smooth muscle plasmalemmal vesicles by phosphorylation. *American Journal of Physiology.* 263(34): H1326-H1333.
- c) Paul, R.J., Hardin, C.D., Raeymaekers, L., Wuytack, F., and Casteels, R. (1989). An endogenous glycolytic cascade can preferentially support Ca²⁺-uptake in smooth muscle plasma membrane vesicles. *FASEB Journal* 3: 2299-2301.

Because of the destructive nature of the membrane vesicle approach, multi-nuclear NMR spectroscopy was employed to assess the organization of metabolism. We found that despite sharing many common enzymes and intermediates, the flux of glycolysis, glycogenolyysis and gluconeogenesis did not mix indicating multiple functional compartments of metabolism within the cytoplasm.

- a) Hardin, C.D., and Kushmerick, M.J. (1994). Simultaneous and separable flux of pathways for glucose and glycogen utilization studied by ¹³C-NMR. *Journal of Molecular and Cellular Cardiology* 26: 1197-1210.
- **b)** Hardin, C.D. and Finder, D.R. (1998). Glycolytic flux in permeabilized freshly isolated vascular smooth muscle cells. *American Journal of Physiology:* 274(43): C88-C96.
- c) Hardin, C.D. and Roberts, T.M. (1997). Regulation of glycogen utilization, but not glucose utilization, by pre-contraction glycogen levels in vascular smooth muscle. *Biochemistry* 36(23): 6954-6959.
- d) Hardin, C.D. and Roberts, T.M. (1997). Differential regulation of glucose and glycogen metabolism in vascular smooth muscle by exogenous substrates. *Journal of Molecular and Cellular Cardiology* 29: 1207-1216.

To determine the structural basis for the compartmentation of cytoplasmic metabolism confocal immunofluorescence, siRNAs and other approaches established that microtubules and caveolae were key structural scaffolds for enzyme organization creating functionally separate compartments.

- a) Lloyd, P.G., and **Hardin, C.D.** (1999). The role of microtubules in the regulation of metabolism in isolated cerebral microvessels. *American Journal of Physiology: Cell Physiology* 277: C1250-1262.
- b) Vallejo, J, and **Hardin C.D**. (2004). Metabolic organization in vascular smooth muscle: distribution and localization of caveolin-1 and phosphofructokinase. *American Journal of Physiology: Cell Physiology* 286: C43-C54.
- c) **Hardin, C.D**. and Vallejo J. (2006). Caveolins in Vascular Smooth Muscle: Form Organizing Function. *Cardiovascular Research* 69(4): 808–815.
- d) Vallejo, J. and Hardin, C.D. (2005) Expression of caveolin-1 in lymphocytes induces caveolae formation and recruitment of phosphofructokinase to the plasma membrane *FASEB J.* Apr;19(6):586-7. http://www.fasebj.org/cgi/doi/10.1096/fj.04-2380fje;
- e) Vallejo, J. and **Hardin, C.D.** (2004) Caveolin-1 Functions as a Scaffolding Protein for Phosphofructokinase in the Metabolic Organization of Vascular Smooth Muscle *Biochemistry* 43(51):16224-32.

D. Additional Information: Research Support and/or Scholastic Performance

Selected previous grant support:

- 1. 2002-2013MU PREP Scholars Program (R25 GM 064120-01; minority postbac training grant). Role: Co-PI (co-PI with John David)
- 2. 2003-2009 NIH DK-60668: "Metabolic Organization by the Caveolae and Cytoskeleton".
- 3. 1998-2003 NIH DK-55039 "Diabetes & Bladder Smooth Muscle Metabolic Dysfunction".
- 4. 1997-2000 Established Investigator Grant "Vascular Substrate Utilization and Compartmentation", American Heart Association.
- 5. 1992-1996 NIH HL48783: "Integrated Vascular Smooth Muscle Metabolism".
- 6. 2004-2005 NIH R13-GM072436: "Gordon Conf. Macromolecular Organization & Cell Function"

Appendix B: Letters of Support and Collaboration

Dr. Mun Choi, President, UM System

Dr. Latha Ramchand, MU Provost

Dr. Steve Zweig, Dean, MU School of Medicine

Dr. Michael Chapman, Chair of Biochemistry, CAFNR, MU

Dr. Chi-Ren Shyu, Director of the MU Institute for Data Science and Informatics

Dr. Brenda Beernsten, Interim Chair of Veterinary Pathobiology, CVM, MU

Dr. Jill Kanaley, Chair of Nutrition and Exercise Physiology

Dr. David Schulz, Chair of Biological Sciences, A&S, MU



Office of the Provost

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July 7, 2021

Latha Ramchand, Provost Mun Choi, President

Dear Provost Ramchand and President Choi:

Attached for your review and approval is the revised, full proposal from the School of Medicine for the Translational Biosciences PhD. Since this request started prior to implementation of the CIM system, we have drawn up for you this signature page. I have reviewed it, as has Steven Chaffin at system.

Please let me know if you have questions or would like to discuss any of the details about the proposal.

Sincerely,

Matthew P. Mantens

Matthew P. Martens Senior Vice Provost

MPM: jb

Approve:

1 Aland

7/8/21 Date

Latha Ramchand, Ph.D. Provost, University of Missouri

Then y cho

7-8-21

Mun Y. Choi, Ph.D. President, University of Missouri

Date



Office of the Dean School of Medicine

One Hospital Drive, MA204, DC018.00 Columbia, MO 65212

> PHONE 573-882-1566 web medicine.missouri.edu/

July 7, 2021

Dear Drs. Bartlett and Hannink,

As the Dean of the School of Medicine, I strongly support the proposed Translational Biosciences PhD program. This program will span the breadth of the biomedical research, from basic science discoveries to improved clinical outcomes. It will strengthen the research infrastructure across the School of Medicine and will enhance the ability of MU to train scientists in relevant research areas to the School of Medicine and the NextGen Precision Health Initiative.

We are engaged in an aggressive hiring campaign to ensure that the University of Missouri remains one of the premier research institutes in the US. As part of this effort, we must enable our faculty members to successfully compete for federal grants that will translate ground-breaking biomedical research into improved health of the public. By investing in the Translational Biosciences PhD program, the School of Medicine will attract high-quality PhD trainees into this innovative program that emphasizes translational and implementation science.

This training program will be instrumental in increasing the research productivity and federal grants of our current and incoming faculty. Furthermore, the Translational Biosciences PhD program will enable highly competitive institutional training grants and individual fellowships.

You both are well suited to lead this effort with the breadth and complementary experiences you share. You have created innovative externally funded training programs in both the United States and Canada that have successfully trained a diverse group of scientists. This unique Translational Biosciences PhD program will advance our educational model by training researchers and providers who are prepared to meet the health care needs of the future.

The School of Medicine has committed to fund 20 candidates per year for the first year of their graduate studies. The PhD trainees will develop a solid base of skills and research competencies that will allow them to join a grant-funded laboratory or team. In subsequent years, the trainees will be funded by their supervisor or their own academic awards. With the expected increased grant submissions, manuscript production and completed research that can be attributed to PhD candidates, I expect to see a high return on our investment.

I look forward to assisting you both as you carry out this important work.

Best-regards,

Steven Zweig, MD, MSPH Hugh E. and Sarah D. Stephenson Dean

February 23, 2021 University of Missouri System

Dear Members of the Review Panel:

This letter is to confirm the excitement in the new umbrella graduate program of the MU School of Medicine (SoM) of the College of Agriculture, Food and Natural Resources (CAFNR) and, in particular its Division of Biochemistry.

Biochemistry is jointly administered both as a Division within CAFNR and a Department within SoM, with about half of our faculty associated with each college / school. In addition to participating in the new SoM Translational Biosciences Ph.D. program, Biochemistry will retain its independent PhD program to serve the needs in plant biochemistry that differ from the SoM mission in biomedical research.

There are foundational elements of biochemistry that are relevant in both domains. Thus, the Biochemistry and the Translational Bioscience programs will coordinate coursework and training so that activities in common are not duplicated, and such that faculty efforts are applied most efficiently. I would be happy to address any other concerns.

Milliagua

Michael S. Chapman Wurdack Professor and Chair, Department of Biochemistry



PHONE (573) 882-9007 EMAIL ShyuC@missouri.edu WEB http://muidsi.missouri.edu/

March 8, 2021

Dear Members of New Graduate Degree Review Panel,

This letter is to confirm the enthusiastic support of the new umbrella PhD program of the MU School of Medicine on behalf of the interdisciplinary graduate programs (Informatics PhD and MS in Data Science and Analytics) housed under the MU Institute for Data Science and Informatics (MUIDSI), which is managed by the Graduate School at MU.

MUIDSI has a long history of collaboration with SOM for multiple NIH T32 institutional training programs, such as on T32 GM008396 (PI: Dr. Hannink) and T32LM012410 (PI: Dr. Shyu). We expect to continue this collaboration in the context of the Translational Biosciences training program through this umbrella PhD program.

Moreover, data science and informatics is an important component of modern biomedical research training. MUIDSI's unique campus-wide position in research training for informatics and practical analytic skill building for data science will offer the new program a solid curriculum without duplicating efforts. MUIDSI's training programs are supported by more than 50 core faculty across the campus. We expect that many PhD graduate students in the Translational Biosciences PhD program will take classes offered by MUIDSI or work with core faculty in the Institute on collaborative research projects.

I am looking forward to assisting the campus build a strong translational biosciences training program and am happy to answer any questions.

Chieven Supe

Chi-Ren Shyu, Ph.D., FAMIA Director, Institute for Data Science and Informatics Professor, Electrical Engineering and Computer Science

UNIVERSITY Of MISSOURI

COLLEGE OF VETERINARY MEDICINE DEPARTMENT OF VETERINARY PATHOBIOLOGY

March 11, 2021

University of Missouri System

Dear Members of the Review Panel:

This letter is to confirm the commitment of the Department of Veterinary Pathobiology (VPB) to participate in the new graduate umbrella program of the MU School of Medicine (SOM).

We will work together with this new program to coordinate graduate recruitment and training activities, as we have done previously with our faculty partners in Molecular Microbiology and Immunology (MMI) in the SOM in administering our current joint graduate program in Molecular Pathogenesis and Therapeutics.

In addition to participating in the SOM's Translational Biosciences Ph.D. program, VPB will maintain its participation in the Pathobiology Area Program, which provides graduate training opportunities in a variety of fields, to meet the graduate training needs of our faculty who have diverse research interests.

We look forward to this new endeavor in graduate education at MU.

Brende V. Beenta

Brenda T. Beerntsen, Ph.D. Chair & Professor Veterinary Pathobiology



Nutrition and Exercise Physiology University of Missouri **College of Human Environmental Sciences**

204 Gwynn Hall Columbia, MO 65211-7700 PHONE (573) 882-4288 FAX (573) 882-0185

June 7, 2021

Dear Members of the Review Panel:

This letter is to confirm the support for the Translational Biosciences umbrella graduate program of the MU School of Medicine (SOM) from the Department of Nutrition and Exercise Physiology (NEP). NEP is jointly administered by the School of Medicine and the College of Agriculture, Food and Natural Resources (CAFNR) and Human Environmental Sciences (HES). This structure will change July 1, 2021 such that NEP will only be in CAFNR and SOM.

The Department of Nutrition and Exercise Physiology has a long history of outstanding undergraduate and graduate training programs that examine the impact of diet and physical activity in animal models as well as on human health. These training programs, that cover the subject areas of nutrition, dietetics, and exercise physiology, are supported by state-of-the-art facilities that include a research kitchen, an observational behavioral lab, exercise facilities and a clinical research lab.

There are foundational elements of Nutrition and Exercise Physiology that are shared with other disciplines, including biochemistry, physiology, immunology and microbiology. In addition to participating in the new SOM Translational Biosciences Ph.D. program, NEP will retain its independent PhD program to serve the needs in NEP that differ from the biomedical research in SOM. To minimize duplication of efforts that are not productive, NEP will coordinate coursework with the Translational Biosciences PhD program so that programs remain efficient.

I would be happy to address any other concerns.

Jill Kanaley

Jill Kanaley, PhD Professor and Interim Chair: Nutrition and Exercise Physiology HES Associate Dean of Research and Graduate Studies



The Division of Biological Sciences

105 Tucker Hall Columbia, MO 65211

PHONE 573-882-6659 FAX 573-882-0123 WEB biology.missouri.edu FACEBOOK Mizzou Biology TWITTER @MizzouBiology

March 10, 2021

Dear Members of the Review Panel:

This letter is to confirm the support for the new umbrella graduate program of the MU School of Medicine (SoM) from the Division of Biological Sciences (DBS) in the College of Arts and Science.

DBS resides solely within the College of Arts and Science and has a broad undergraduate and graduate training program and curriculum, including a research portfolio that overlaps with the SoM and the new umbrella program. Therefore, we are happy to participate in the new SoM Translational Biosciences Ph.D. program, and DBS will retain its independent Ph.D. program to serve the needs among Biology faculty and students that differ from the SoM mission in biomedical research.

There are foundational elements of biology that are relevant to both DBS and the umbrella program, and we recognize that reduplication of efforts is not productive. Thus, DBS and the Translational Bioscience programs will coordinate coursework and training to avoid these overlaps and the reduction in training efficacy and efficiency they would cause. Further, DBS is happy to participate in recruitment activities for the SoM umbrella program as relevant to the goals of the biomedical research enterprise.

Please let me know if you have any other questions about the role of DBS in this program, and I am happy to clarify.

David J. Schulz Professor and Director, Division of Biological Sciences

Appendix C: Translational Biosciences Program Course Information

Syllabus for MPP 8500 (basis for Molecular and Cellular Biosciences I) Syllabus for Data Design and Analysis Syllabus for MPP 8550 Skills in Translational Biosciences I and II Syllabus for LAB AN 9476

Summary of Coursework

Year 1: Fall Semester. All first-time students will take all of the courses listed below. During Fall Semester of Year 1, graduate students will take a total of 9 credit hours.

Course numbers for existing courses are provided below. When the Translational Biosciences program is approved, the course numbers for Program-specific courses will be changed from a departmental prefix (i.e., MPP or MICROB) to a program-specific prefix (TRABIO).

1. Molecular and Cellular Biosciences I: (MPP 8500; cross-listed as BIOCHM 8240); 3 credit hours: This will be a 3 credit-hour course that will cover the core concepts of genetics and biochemistry in the context of selected human diseases. Specific human diseases will be selected on the basis of how they exemplify particular aspects of genetics and biochemistry. This course will focus on the experimental approaches and data analyses as described in recent literature articles. Over the past three years, we have taught this course as 5-credit hour, one-semester course. The content of the existing course will be trimmed to fit into a 3-credit hour, one-semester course. A syllabus, a list of participating instructors and the required literature reading list for Fall 2020 Semester for the existing 5 credit-hour format of MPP 8500 is included in Appendix C.

2. Data Design and Analysis I: (Course is being developed; course number is not available); 3 credit hours: This new 3 credit-hour course will cover core concepts of statistical design and data analysis. The course will cover fundamental aspects of statistics as applied to biological problems and emphasize computational approaches, including R and Python, for data analysis. The instructors for this course will be Dr. Bartlett and Dr. Greg Petroski, a PhD statistician in Family and Community Medicine and the Medical Research Office. This course, which is being developed, will be modeled after a similar course (FMED 505) that Dr. Bartlett developed at McGill. A syllabus for Data Design and Analysis I is included in Appendix C.

3. Professional Skills for Translational Bioscientists: (MPP8550); 1 credit hour. This course will introduce students to a wide range of technical and professional skills that biomedical scientists need to have. This course will include 8 hours of class time devoted to Research Ethics, a component of research training required of all NIH training grants. The co-instructors of this course will be Dr. Alan Parrish and Dr. Gillian Bartlett. A syllabus of this course is included in Appendix C.

4. Rotation Research: (MICROB 8450); 1 credit hour: The goal of research rotations is to allow first-year graduate students to gain experience in the research laboratories that they are considering as potential mentors. Each rotation experience will be 8 weeks and each student will rotate in two different laboratories during their first semester. All faculty in the School of Medicine who have Doctoral Status or Graduate Faculty Status "A" are potential mentors for rotation research experiences. Each rotation experience is 1 credit-hour. A list of the 198 faculty members in the School of Medicine who have Doctoral Status or Graduate Faculty Status "A" is provided in Appendix E.

5: Research Seminar: (MPP 8412); 1 credit hour: The goal of the 1 credit-hour research seminar course is to expose first-year graduate students to the diverse research programs of faculty mentors at MU. There will also be a number of invited research seminars presented by faculty from other universities. All first-year students in each cohort will take the Research Seminar both semesters. This seminar will be directed by one or more members of the Executive Committee (Dr.

Gillian Bartlett, Dr. Mark Hannink, Dr. Mark Daniels, Dr. Charlotte Phillips, Dr. James Amos-Landgraf, Dr. Alan Parrish, and Dr. Chris Hardin).

Year 1: Spring Semester: Students will continue with the Professional Skills class, as well as continuing with Rotation Research and Research Seminar. Students will also take introductory 8000-level coursework offered by the different Emphasis Areas. All other courses listed below will be taken by all first-year students.

1. Professional Skills for Translational Bioscientists: (MPP8550); 1 credit hour. This course will introduce students to a wide range of technical and professional skills that biomedical scientists need to have. In the second semester, this course will emphasize how to communicate across disciplines. The co-instructors of this course will be Dr. Alan Parrish and Dr. Gillian Bartlett.

2. Rotation Research (MICROB 8450): 1 credit hour: In the Spring Semester, students will participate in one research rotation experience of 8 weeks, for one credit hour. At the semester midpoint, students will choose their primary faculty mentor and may begin their dissertation research. Students will be allowed to do a fourth research rotation, if needed. Students who are unable to identify a primary faculty mentor after four rotations will not be allowed to continue in the PhD program. All faculty in the School of Medicine who have Doctoral Status or Graduate Faculty Status "A" are potential mentors for rotation research experiences. A list of the 198 faculty members in the School of Medicine who have Doctoral Status or Graduate Faculty Status "A" is provided in Appendix E.

3: Research Seminar (MPP 8412): 1 credit hour: The goal of the 1 credit-hour research seminar course is to expose first-year graduate students to the diverse research programs of faculty mentors at MU. There will also be a number of invited research seminars presented by faculty from other universities. All first-year students in each cohort will take the Research Seminar both semesters. This seminar will be directed by one or more members of the Executive Committee (Dr. Gillian Bartlett, Dr. Mark Hannink, Dr. Mark Daniels, Dr. Charlotte Phillips, Dr. James Amos-Landgraf, Dr. Alan Parrish, and Dr. Chris Hardin).

4: **Emphasis Area Coursework; 6 credit hours (multiple courses):** The Emphasis Areaspecific courses that will be taken by first-year graduate students will be literature survey courses that introduce graduate students to the current research topics in each Emphasis Area. Students who are interested in multiple Emphasis Areas will be encouraged to take courses offered by different Emphasis Areas. The faculty in each Emphasis Area will be responsible for determining the specialized coursework for graduate students in a given Emphasis Area, such that the students will become experts in the relevant domain(s) of knowledge. Sample courses of study for five of the six Emphasis Areas is included in Appendix D. The Population and Precision Health Emphasis Area course of study is being developed. All of the courses listed in the Appendix are currently offered on the MU campus and one or more of the current instructors will be associated with the appropriate Emphasis Area. The number of Emphasis Area-specific credit hours will vary from 6 to 15 credit hours.

5. Selection of Emphasis Area: By the start of the second semester of their first year, graduate students will choose their Emphasis Area. In most cases, we anticipate that the students' primary research advisor will be a member of the Emphasis Area selected by the student. Students will be expected to choose the members of their Doctoral Program Committee by the end of their first year. Each Doctoral Program Committee will consist of at least four faculty, including one

faculty member with Graduate Faculty Status "A" who is from outside the School of Medicine. The student's primary faculty mentor will serve as chair of the Doctoral Program Committee. Throughout the course of their graduate training, the Doctoral Program Committee will have the primary responsibility for guiding the student's dissertation research.

Year 2: Fall Semester. Students will begin to take specialized courses appropriate for their respective Emphasis Area during their second year of graduate study. Further information on Emphasis Area-specific courses is listed in the Appendix. In addition to didactic coursework, the second-year students will also participate in a weekly Emphasis Area seminar series that brings together the faculty and students in that Emphasis Area. To develop the ability of students to communicate across disciplines, the students in each cohort year will also participate in a Translational Biosciences Journal Club.

1. Emphasis Area Coursework; 3-6 credit hours: The faculty in each Emphasis Area will be responsible for determining the specialized coursework for graduate students in a given Emphasis Area, such that the students will become experts in the relevant domain(s) of knowledge. Sample courses of study for five of the six Emphasis Areas is included in the Appendix. The Population and Precision Health Emphasis Area course of study is being developed. All of the courses listed in the Appendix are currently offered on the MU campus and one or more of the current instructors will be associated with the appropriate Emphasis Area. The number of required credit hours in each Emphasis Area vary, from 6 to 15 credit hours.

2: Emphasis Area Research Seminar; 1 credit hour: The Emphasis Area seminars will feature invited speakers from outside MU as well as presentations by faculty and students. Several of the current PhD programs already have departmental Research seminars, which will be repurposed as Emphasis Area Research Seminars. The other Emphasis Areas will develop a weekly Research Seminar program. Selected faculty from each Emphasis Area will be responsible for each Emphasis Area Research Seminar.

3: Translational Biosciences Journal Club, by cohort; 1 credit hour: The Translational Biosciences Journal Club will be a student-driven journal club, in which the students in each cohort will read and discuss research articles selected by the students on a rotating basis. Each cohort will have a faculty member who will serve as a facilitator. This faculty member will stay with a specific cohort through graduation. All faculty in the School of Medicine, including clinical faculty, will be eligible to serve as facilitators of the Translational Biosciences Journal Club.

4: Dissertation Research (MPP 9090): 1 credit hour: Students will continue with their dissertation research throughout the remainder of their course of study. The number of credit hours will vary each semester, depending on the other coursework requirements and if the student has passed the comprehensive exam. After passing the comprehensive exam, the minimum number of credit hours that full-time graduate students must register for drops to 2 per Fall or Spring semester and 1 credit hour in the Summer Semester.

Year 2: Spring Semester. Students will continue to take specialized courses appropriate for their respective Emphasis Area as well as participate in the weekly Emphasis Area seminars and the weekly Translational Biosciences Journal Club. During the Spring Semester of their second year, the graduate students will take a grant writing course in order to develop the professional skill of writing grant proposals and fellowships.

1. Emphasis Area Coursework; 3-6 credit hours: Emphasis Area coursework will continue in the Spring Semester of Year 2, as determined by the course of study as required by the Emphasis Area. The student's Doctoral Program Committee may suggest additional coursework.

2: Emphasis Area Research Seminar; 1 credit hour. The Emphasis Area research seminars will be held every semester. These seminars will feature invited speakers from outside MU as well as presentations by faculty and students.

3: Translational Biosciences Journal Club, by cohort: 1 credit hour. The Translational Biosciences Journal Clubs will be held every semester.

4: Dissertation Research (MPP 9090): 1 credit hour. Students will continue with their dissertation research throughout the remainder of their course of study. The number of credit hours will vary, depending on the other coursework.

5: Grant Writing for Biomedical Scientists (similar to LAB AN 9476): 3 credit hours. The grant-writing course taken by graduate students in the Translational Biosciences PhD program will be modeled after a grant-writing course that Dr. Hannink has taught with Dr. Elizabeth Bryda in Veterinary Pathobiology. A syllabus for the existing grant writing course, LAB_AN 9476, is included in Appendix C. Dr. Hannink and Dr. Tim Domeier (MPP) will be the co-instructors for the Grant Writing for Biomedical Scientists course.

Year 3: Completion of the Comprehensive Examination and Advancement to Candidacy: The comprehensive exam is a hallmark of every PhD program. Successful completion of the Comprehensive exam indicates that the student has advanced to Candidacy for the PhD degree. Graduate students in the Translational Biosciences PhD program will be expected to pass their comprehensive exam after their Emphasis Area coursework is complete. Typically, the comprehensive exam will be taken no later than the end of their third year.

Years 3-5: During years 3-5 of their graduate study, the graduate students will complete all required coursework in their Emphasis Area, while continuing with their Dissertation Research, Emphasis Area Research Seminars and the Translational Biosciences Journal Club.

Translational Biosciences - Fall 2020

Course Number: BIOCHM 8240 or MPP 8500

Location: 171 LSC and Zoom

Time: M T W Th F 9:00 to 9:50 (five credit hours)

Instructors:

Dr. Mark Hannink (hanninkm@missouri.edu); Biochemistry

Dr. Alan Parrish (parrishar@health.missouri.edu); Molecular Pharmacology and Physiology

Dr. Charlotte Phillips (PhillipsCL@missouri.edu); Biochemistry

Dr. Steve Van Doren (VanDorenS@missouri.edu); Biochemistry

Dr. Marc Johnson (marcjohnson@missouri.edu); Molecular Microbiology and Immunology

Dr. Mark Daniels (danielsma@health.missouri.edu); Molecular Microbiology and Immunology

Dr. Margaret Lange (LangeMJ@missouri.edu); Molecular Microbiology and Immunology

Dr. Mick Calcutt (CalcuttM@missouri.edu); Veterinary Pathobiology

Dr. Peter Cornish (cornishp@missouri.edu); Biochemistry

Dr. Tim Domeier (domeiert@health.missouri.edu); Molecular Pharmacology and Physiology

Dr. Erika Boerman (boermane@health.missouri.edu); Molecular Pharmacology and Physiology

Dr. Scott Zawieja (zawiejas@health.missouri.edu); Molecular Pharmacology and Physiology

Dr. Ted Kalogeris (kalogerist@health.missouri.edu); Molecular Pharmacology and Physiology

Dr. Mark Milanick (MilanickM@health.missouri.edu); Molecular Pharmacology and Physiology

Dr. Maike Krenz (krenzm@missouri.edu); Molecular Pharmacology and Physiology

If you require assistance because of a disability, refer to **Disability Assistance** below.

Description of Course: This course is designed for first-year graduate students in the biomedical sciences. This course has two goals: (1) to provide the students with a core knowledge of fundamental biochemistry and biology that is the underpinning of current biomedical research; (2) to provide students with the tools that will allow them to read, understand and critically analyze the primary biomedical literature. To this end, the course covers aspects of biochemistry, cell biology, virology, immunology, molecular biology and physiology. The course is taught using a combination of faculty lectures and primary research articles.

Grading: Four exams will be given, with the last during finals week. Each exam is worth 100 points. A total of 12 research articles will be read and discussed during class. At the end of each paper discussion, the students will be required to write up a short (1/2 page) summary of the paper, highlighting the strengths and weaknesses. 10 points will be assigned on the basis of each student's contribution to the discussion and 10 points assigned to the written summary. A total of 240 points will be based on the literature readings.

Attendance: This course is based on student involvement and thus attendance is expected. You cannot understand this material if you do not come to class and participate.

Academic integrity: Each student will be responsible for maintaining the highest level of academic integrity during the course, including presenting his/her own work on exams.

Disability assistance: If you need accommodations because of a disability, if you have emergency medical information to share with us, or if you need special arrangements in case the building must be evacuated, please inform me immediately.

To request academic accommodations (for example, a note taker or extended time on exams), students must also register with the Office of Disability Services

(<http://disabilityservices.missouri.edu>http://disabilityservices.missouri.edu), S5 Memorial Union, 882-4696. It is the campus office responsible for reviewing documentation provided by students requesting academic accommodations, and for accommodations planning in cooperation with students and instructors, as needed and consistent with course requirements. For other MU resources for students with disabilities, click on "Disability Resources" on the MU homepage.

Weekly Schedule for MPP8500/BIOCHM 8420; Fall 2020

	Date	Faculty Topic Week 1 - Week 5: Metabolism and eukaryote transcriptional regulation with a focus on Diabetes
Week 1	08 24	MH Introduction to course/TD introduction to Diabetes
	08 25	Tim Domeier: Diabetes
	08 26	Erika Boerman: Diabetes, COVID19; paper discussion
	08 27	Erika Boerman: Diabetes, COVID19; paper discussion
	08 28	Scott Zawieja: Diabetes; paper discussion
Week 2		Steve Van Doren: Bioenergetics and
WCCK Z	08 31	metabolism
		Steve Van Doren: Bioenergetics and
	09 01	metabolism
	00.02	Steve Van Doren: Bioenergetics and
	09 02	Stove Van Deren: Riconergetics and
	09 03	metabolism
	05 05	Steve Van Doren: Bioenergetics and
	09 04	metabolism
Week 3	09 07	Labor Day
		Ted Kalogeris: Lipid Metabolism in
	09 08	Diabetes
		Ted Kalogeris: Lipid Metabolism in
	09 09	Diabetes
	00.40	Ted Kalogeris: Lipid Metabolism in
	09 10	Diabetes
	09 11	ied Kalogeris: Paper Discussion
Week 4	09 14	Mark Milanick: Glucose Transport and Regulation in Diabetes

09 15	Mark Milanick:	Glucose	Transport and	Regulation	in Diabetes
				0	

- 09 16 Mark Milanick: Glucose Transport and Regulation in Diabetes
- 09 17 Mark Milanick: Paper Discussion
- 09 18 Mark Milanick: Paper Discussion

Week 5 09 21 Maike Krenz: Transcriptional Regulation by glucose and insulin

- 09 22 Maike Krenz: Dysregulation of gene expression in diabetes
- 09 23 Maike Krenz: Dysregulation of gene expression in diabetes
- 09 24 Maike Krenz: Paper Discussion
- 09 25 Maike Krenz: Paper Discussion

Week 6 - Week 8: Protein structure section, with a focus on Cystic Fibrosis

- Week 6 09 28 EXAM 1 (Diabetes section)
 - 09 29 CLP Genetics of single gene disorders
 - 09 30 MH Cell Biology of Protein Trafficking
 - 10 01 MH Paper Discussion
 - 10 02 MH Paper Discussion

Week 7 SVD: Thermodynamics, water, lipids and

- 10 05 bilayers
 - 10 06 SVD: Protein Structure
 - 10 07 SVD: Protein Structure
 - 10 08SVD: Protein Structure/Folding
SVD Pymol session to analyze CFTRClass will meet in Stanley Hall 146,
Class will meet in Stanley Hall 146,
from 8 to 8:4010 09structures/mutationsfrom 8 to 8:40
- Week 8 10 12 SVD: Transport across membranes
 - 10 13 SVD: Transport across membranes
 - 10 14 SVD: Molecular mechanisms for functional defects in CFTR
 - 10 15 SVD: Paper Discussion

Class will meet in Stanley Hall 146,10 16SVD: Paper Discussionfrom 8 to 8:40

Week 9 - Week 12 DNA Replication, Gene Transcription, Translation with a focus on Bacterial Pathogenesis

- Week 9 10 19 EXAM 2 (Cystic Fibrosis section)
 - 10 20 MC: Cell Structure
 - 10 21 MC: Cell Division
 - 10 22 SVD: Nucleic Acid Structure
 - 10 23 SVD: Nucleic Acid Structure

W

Week		
10	10 26	MC: DNA replication
	10 27	MC: DNA replication
		MC: Plasmid replication, genetic
	10 28	complementation
	10 29	MC: Paper Discussion
	10 30	MC: Paper Discussion
Week		
11	11 02	SVD: Transcription (biophysical and structural aspects)
	11 03	MC: Transcription
	11 04	MC: Transcription
	11 05	MC: Paper Discussion
	11 06	MC: Paper Discussion
Week		
12	11 09	MC: tRNA and Amino Acyl Transferases
		PC: Translation (class will be from 8 to
	11 10	8:50)
		PC: Translation (class will be from 8 to
	11 11	8:50) BC: Translation (class will be from 8 to
	11 12	
	11 12	PC: Paper Discussion (class will be from 8
	11 13	to 8:50)
		Week 13 - Week 15: Virology and Immunology with a focus on HIV (coronavirus
		biology will also be a topic this year)
Week		
13	11 16	EXAM 3 (Bacterial pathogenesis section)
	11 17	Marc Johnson: HIV
	11 18	Marc Johnson: HIV
	11 19	Marc Johnson: Paper Discussion

11 20 Marc Johnson: Paper Discussion

THANKSGIVING BREAK

THANKSGIVING BREAK

Week

14

- Maggie Lange: Innate Immune System: Recognition of Pathogens 11 30
 - 12 01 Maggie Lange: Innate Immune System: Recognition of Pathogens
 - 12 02 Maggie Lange: Innate Immune System: Recognition of Pathogens
 - 12 03 Maggie Lange: Paper Discussion
 - 12 04 Maggie Lange: Paper Discussion

Week

15

- 12 07 Mark Daniels: Immunology
 - 12 08 Mark Daniels: Immunology
 - 12 09 Mark Daniels: Paper Discussion
 - 12 10 Mark Daniels: Paper Discussion
 - 12 11 STOP DAY

EXAM 4 (Virology and Immunology) during Exam week

Course Outline Data Design & Analysis I

Learning outcomes

By the end of this course students should be able to understand how statistical methods are used by others; apply them including programming to existing data; and use them as a base for more advanced biostatistics or research methods courses.

Instructional method

The course is lecture based with interactive sessions. Students are expected to actively participate and to learn statistical programming.

Recommended Texts & Resources

<u>Modern Epidemiology</u> by TL Lash, TJ VerderWeele, S Haneuse, KJ Rothman; 4th Edition; Publisher: Wolters Kluwer, 2021

<u>Introduction to the Practice of Statistics</u> by DS Moore, GP McCabe, C Craig; 9th Edition; Publisher: MacMillan, 2007.

R Archive - https://cran.r-project.org/

Evaluation

Evaluation will be based on a series of written assignments, R-based practical exercises, class participation, weekly quizzes and a final presentation with a written component.

Course Content

Week	Analytic Topic	Design Topic	R – Tutorial
1	Introduction to Data	The Emergence of	Uploading data; browsing
	Analytics & Data	Epidemiology	data; cleaning data;
	Management: What is		displaying distributions;
	Statistics?		describing distributions;
			normal distributions
2&3	Looking at Data:	Causal Inference in	Scatterplots; least squares
	Relationships	Epidemiology;	regression; correlation;
		Measures of Disease	2X2 tables;
		Frequency; Measures of	
		Effect	

4 & 5	Producing Data: Sampling and Inference	Types of study design: Experimental vs non- experimental; Standardization of Rates	Merging data; applying weights; sampling
6 & 7	Probability: Study of Randomness	Objectives of study designs: precision and validity; strategies in study design: improving precision and validity	Matrices, data frames, reading in data and R packages, missing data, tables, descriptive graphs, preparing data; Data visualization; measure of variance;
8	From Probability to Inference	The role of statistics in study design: random variability, assessment and control of confounding	Inference: proportion.
9 & 10	Introduction to Inference	Fundamentals of data analyses: hypothesis testing; analyses of crude data	Test of means, estimating confidence intervals
11	Inference for Distributions	Fundamentals of data analyses continued: hypothesis testing; analyses of crude data	t-tests, f-tests
12	Inference for Count Data	Evaluation and Control of Confounding	Proportions with confidence intervals, 2X2 tables
13 & 14	Inference for Regression	Evaluation and Description of Effect Modification; principles of matching; multivariate modelling; interactions	Linear regression, multiple regression, creating complex data sets
15	Analysis of Variance	Analysis with multiple levels of exposure	ANOVA modeling

MPP 8550: Skills in Translational Biosciences I and II

Course Directors:

Alan R. Parrish, Ph.D., Associate Professor, Medical Pharmacology and Physiology Office: M401A, School of Medicine email: parrishar@health.missouri.edu

Gillian Bartlett, Ph.D. Professor, Family and Community Medicine Office: MA306, School of Medicine Email: gillian.bartlett@health.missouri.edu

Required Text:

None

Objectives:

Upon completion of the course, students will:

- Understand research ethics, including issues specifically related to biomedical research including experimental design, reproducibility, rigor and validation of experimental reagents and data sharing; these are key components that must be addressed in NIH application.
- 2. Understand how to critically review primary scientific literature, and to present key background/methods and results from recent research.
- 3. Understand the theory and practical application of modern research techniques; the laboratory sessions will expose students to state-of-the-art technologies

Course Schedule:

The courses will be held once per week during Fall and Spring Semesters.

Weeks 1 and 2, Fall Semester

Ethics 1: Mentor-Student Relationship & Individual Development Plans

Ethics 2: Experimental Design: Data Acquisition & Management I

Weeks 3 and 4, Fall Semester

Ethics 3: Experimental Design: Data Acquisition & Management I

Ethics 4: Publication-Authorship & Collaborative Research

Weeks 5 and 6, Fall Semester Evaluating Literature Bioinfomatics I: Data Repositories

Weeks 7 and 8, Fall Semester Bioinformatics II: Mutation Analysis (GWAS) In Vitro Methods I: Cell Fractionation

Weeks 9 and 10, Fall Semester In Vitro Methods II: Cell Culture In Vitro Methods III: Electrophysiology Weeks 11 and 12, Fall Semester Genetic Manipulation I: Crispr/Cas Genetic Manipulation II: In vivo models

Week 13 Fall Semester, Thanksgiving Break

Weeks 14 and 15, Fall Semester Genetic Manipulation III: siRNA Genetic Manipulation IV: Gene Delivery

SPRING SEMESTER

Weeks 1 and 2, Spring Semester Imaging I: Cellular Imaging: Confocal/Multiphoton Imaging II: Cellular Imaging: 2- Photon

Weeks 3 and 4, Spring Semester Imaging III: Cellular Imaging: Atomic Force Microscopy Imaging IV: Whole Body Imaging

Weeks 5 and 6, Spring Semester Gene Expression Analysis- RNAseq Bioinformatics III: Gene Network Analysis

Weeks 7 and 8, Spring Semester Professional Skills: How to Present Your Research Translational Biosciences: Biomarkers

Week 9 and 10, Spring Semester Proteome Analysis: Expression of Known Targets Proteome Analysis: Identification of Novel Targets

Week 11 Spring Semester; Spring Break

Weeks 12 and 13, Spring Semester Bioinformatics IV: Epidemiology Bioinformatics V: Population Health & Outcomes

Weeks 14 and 15, Spring Semester Translational Biosciences: Precision Medicine Papers due/Oral Presentations: Capstone Project

Grading

- 1. Journal Club participation: Each week, there will be an assigned paper and discussion during the second session. 150 points
- 2. Self-directed Learning Assignments: 150 points
- 3. Paper: 50 points. At the beginning of week 3, students will chosse a specific disease; a paper will be due at the end of the paper in which students provide an overview of epidemiology, molecular/cellular mechanism of disease, current therapy and strategies to address current gaps in knowledge
- 4. Presentation: 50 points

The final grades are based on the following point scale:

- A \geq 360points
- B 320-359 points
- C <u>< 319</u>

To drop the course, students must go through the registrar's office. Everyone who does so will be given a "Withdrew Passing" grade. All students on the class roster after this date must be given a grade for the course. An Incomplete (I) grade automatically becomes an F after a year; do not attempt to drop the course simply by stopping attendance at lectures, labs and exams. The academic calendar is available at

Academic Integrity

Academic integrity is fundamental to the activities and principles of a university. All members of the academic community must be confident that each person's work has been responsibly and honorably acquired, developed, and presented. Any effort to gain an advantage not given to all students is dishonest whether or not the effort is successful. The academic community regards breaches of the academic integrity rules as extremely serious matters. Sanctions for such a breach may include academic sanctions from the instructor, including failing the course for any violation, to disciplinary sanctions ranging from probation to expulsion. When in doubt about plagiarism, paraphrasing, quoting, collaboration, or any other form of cheating, consult the course instructor.

University of Missouri policies and procedures related to Students Rights & Responsibilities may be found at ossr.missouri.edu/index.html

Students with Disabilities:

If you anticipate barriers related to the format or requirements of this course, if you have emergency medical information to share with me, or if you need to make arrangements in case the building must be evacuated, please let me know as soon as possible.

If disability related accommodations are necessary (for example, a note taker, extended time on exams, captioning), please register with the Disability Center (<u>http://disabilitycenter.missouri.edu</u>), S5 Memorial Union, 573-882-4696, and then notify me of your eligibility for reasonable accommodations. For other MU resources for persons with disabilities, click on "Disability Resources" on the MU homepage.

Intellectual Pluralism

The proper expression of both academic rights and responsibilities is required for a reasoned and respectful debate that explores a diversity of views and perspectives about

complex, and often controversial topics. This is the essence of **intellectual pluralism**. The University community is committed to intellectual pluralism in its many dimensions: political, cultural, religious, international, disciplinary, economic, lifestyles – and to encouraging and supporting robust debates over matters of academic interest. Below, please find a sample statement addressing intellectual pluralism. This statement was adopted by the Faculty Council and recommended to our office for distribution to the faculty.

The University community welcomes intellectual diversity and respects student rights. Students who have questions or concerns regarding the atmosphere in this class (including respect for diverse opinions) may contact the Departmental Chair or Divisional Director; the Director of the Office of Students Rights and Responsibilities http://osrr.missouri.edu/ or the MU Equity Office (equity@missouri.edu);

All students will have the opportunity to submit an anonymous evaluation of the instructor(s) at the end of the course.

University of Missouri System Executive Order No. 38 lays out principles regarding the sanctity of classroom discussions at the university. The policy is described fully in Section 200.015 of the Collected Rules and Regulations. In this class, students may or may not make audio or video recordings of course activity – permission must be granted by individual faculty - except students permitted to record as an accommodation under Section 240.040 of the Collected Rules. All other students who record and/or distribute audio or video recordings of class activity are subject to discipline in accordance with provisions of Section 200.020 of the Collected Rules and Regulations of the University of Missouri pertaining to student conduct matters.

Those students who are permitted to record are not permitted to redistribute audio or video recordings of statements or comments from the course to individuals who are not students in the course without the express permission of the faculty member and of any students who are recorded. Students found to have violated this policy are subject to discipline in accordance with provisions of Section 200.020 of the Collected Rules and Regulations of the University of Missouri pertaining to student conduct matters.
LAB AN 9476: Grant and Manuscript Writing for Biomedical Researchers

Spring 2021

Meeting Day and Time: Tuesdays and Thursdays, 9-10:30 am, by Zoom.

Goals: To enable students to acquire the knowledge and tools necessary to prepare successful grant proposals and fellowship applications.

Objectives: At the end of the course, the student will be able to:

1. Be familiar with the components of a grant application and the grant application process.

2. Be familiar with the components of a fellowship application and the fellowship application process.

2. Prepare a R03-style grant application which incorporates effective experimental design.

3. Be familiar with the typical grant and manuscript review process and practice appropriate methods for responding to critiques.

Course Coordinator: Mark Hannink, Biochemistry, 440 E Life Sciences Center, Email: <u>HanninkM@missouri.edu</u>; Phone: 573-882-7971

Attendance: Attendance is required. One unexcused absence is allowed during the semester. In the event of circumstances beyond your control (e.g. serious illness, car accident, death in immediate family, professional meeting conflict, etc.) an excused absence may be granted at the Course Coordinator's discretion if legitimate documentation is provided.

Grading: This is a 3 credit course. Letter grades will be assigned based on attendance, timely submission of all assignments, active participation in class discussions, and importantly, the quality of all assignments.

Grant Application Assignment: Students are required to prepare a R03 style grant application to demonstrate their understanding of the material presented in this course. Detailed guidelines for this assignment will be distributed during the first class meeting. Late assignments will negatively impact the final grade. The grant applications will be evaluated by a mock study section panel consisting of faculty members and classmates and each application will be "reviewed" during mock study sections conducted during class time. In addition, students will be provided with written "critiques" of their applications and will be given the opportunity to address reviewer concerns by preparing a written response in a manner similar to that required in a revised grant application.

Schedule:

Date	Day	Торіс		
1/19	Tuesday	Introduction to class and discussion of Specific Aims assignment		
1/21	Thursday	Discussion on funding sources; Rigor and Transparency		
1/26	Tuesday	Draft of Specific Aims page is due; Discussion of Rigor and Transparency		
1/28	Thursday	Specific Aims presentations	Assigned Reviewers	
2/2	Tuesday	Specific Aims presentations	Assigned Reviewers	

2/4	Thursday	Specific Aims presentations	Assigned Reviewers
2/9	Tuesday	Specific Aims presentations	Assigned Reviewers
2/11	Thursday	Specific Aims presentations	Assigned Reviewers
2/16	Tuesday	Biostatistics	
2/18	Thursday	Biostatistics	
2/23	Tuesday	Biostatistics	
2/25	Thursday	Biostatistics	
3/2	Tuesday	Budget and grant form pages	
3/4	Thursday	Biosketch review	
3/9	Tuesday	How to review grants and write a grant review	
3/10	Wednesday	Draft proposals are due at 5 pm on Wed, March 10	
3/11	Thursday	Dr. Fungai Chanetsa: Insights from NIH	
3/16	Tuesday	Proposal Draft Review in class	Assigned Reviewers
3/18	Thursday	Proposal Draft Review in class	Assigned Reviewers
3/23	Tuesday	Proposal Draft Review in class	Assigned Reviewers
3/25	Thursday	Proposal Draft Review in class	Assigned Reviewers
3/30	Tuesday	NO CLASS - SPRING BREAK	Assigned Reviewers
4/1	Thursday	NO CLASS - SPRING BREAK	Assigned Reviewers
4/6	Tuesday	Proposal Draft Review in class (If needed)	Assigned Reviewers
4/8	Thursday	Open class to answer any questions about proposals	
4/13	Tuesday	Open class to answer any questions about proposals	
4/15	Thursday	F31 proposals: Completed Proposals are due	
4/20	Tuesday	F31 proposals	
4/22	Thursday	Mock Study Section	Faculty
4/27	Tuesday	Mock Study Section	Faculty
4/29	Thursday	Mock Study Section	Faculty
5/4	Tuesday	Mock Study Section	Faculty
5/6	Thursday	Mock Study Section	Faculty
5/14		Revisions due	

Appendix D: Emphasis Area Course Information

Emphasis Area Coursework for Biochemistry Emphasis Area Coursework for Cancer Biology Emphasis Area Coursework for Infection and Immunity Emphasis Area Coursework for Integrative Physiology Emphasis Area Coursework for Nutrition and Exercise Physiology

Appendix A: Emphasis Area Curricula

The Translational Biosciences PhD program will be organized around six Emphasis Areas. The Emphasis Areas of the Translational Biosciences PhD program are:

- Biochemistry and Biophysics
- Cancer Biology
- Infection and Immunity
- Integrative Physiology
- Nutrition and Exercise Physiology
- Population and Precision Health

Curriculum for five of these Emphasis Areas, including Biochemistry and Biophysics, Cancer Biology, Infection and Immunity, Integrative Physiology, and Nutrition and Exercise Physiology are listed below. The curriculum for the Population Health and Precision Medicine Emphasis Area is being developed. All PhD graduate students in the Translational Biosciences program will complete a total of 72 credit hours, including formal coursework and research credit hours. A minimum of 15 credit hours of formal coursework at the 8000 or 9000 level is required. Graduate students must maintain a GPA of 3.0 in their formal coursework. Research credit hours will be graded on a S/U basis.

Biochemistry and Biophysics Emphasis Area

After completion of the Program-specific course work, the Biochemistry and Biophysics Emphasis Area will require two additional courses, for a total of 6 credit hours, selected from the courses listed below. Participation in a Research Seminar (BIOCHM 8070) is also required.

BIOCHM 8434: Signaling in Molecular Cell Biology (3 hrs) BIOCHM 8432: Enzymology and Metabolic Regulation (3 hrs) BIOCHM 9432: Molecular Biology II (4 hrs) BIO SC 7982: Inherited Human Diseases (3hrs) BIO SC 8982: Advances in Human Genetic Disorders (2hrs) AN SCI 8415 - 01 Survey of Epigenetics (3hrs) BIO SC 8300: Advanced Plant Genetics (3 hrs) BIOCHM 8362: Introduction to Plant Metabolism (2 hrs) PLNT S 9415: Physiology of Plant Growth Responses to the Environment (3 hrs) BIOCHM 9468: Molecular Biology of Plant Growth and Development (3 hrs) PLNT S 9540: Genetics of the Plant-Microbe Interaction (3 hrs) CHEM 8150: Organic reaction mechanisms (3hrs) CHEM 8240: Analytical Mass Spectrometry (3hrs) CHEM 8160: Organic Spectroscopy (3hrs) CHEM 8265: Fluorescence spectroscopy (3hrs) INFO INST 8005: Bioinformatics Tools in Biological Research (3 hrs) PLNT S 8430: Introduction to Bioinformatics Programming (4 hrs)

Cancer Biology Emphasis Area

After completion of the Program-specific course work, graduate students in the Cancer Biology Emphasis Area will be required to successfully complete one of the required courses as well as one of the elective courses listed below. Participation in a Research Seminar (to be developed) is also required. Required (1 of 2): BIO-SC 8460: Advanced Cancer Biology VMS 8419: Advanced Topics in Cancer Biology and Clinical Oncology

Elective courses (at least 1 elective course is required): It is expected that students will choose courses that will complement their individualized research projects. Below is a list of acceptable courses but other courses may count toward the degree with approval from their committee.

AN SCI 8430: Introduction to Bioinformatics Programming AN SCI 8415: Survey of Epigenetics BIOCHM 8432: Enzymology and Metabolic Regulation BIOCHM 8434: Signaling in Molecular Cell Biology BIOCHM 9432: Molecular Biology II **BIOCHM 9462: Hormone Action** BIOL EN 8000: Scientific Discovery Leading to Life Science Innovations BIOL EN 8100: Design and Development of Biomedical Innovations BIOL EN 8280: Advanced Biological Transport Processes BIOL EN 8470: Ultrasensitive Biodetection BIOL EN 8570: Microscopic Imaging BIOL EN 8870: Molecular and Cell Mechanics BIO SC 8320: Developmental Genetics CHEM 8280: Bioanalytical Chemistry CHEM 8630: Radiopharmaceutical Chemistry CHEM 8640: Biological Radiochemistry LAB AN 9437: Pathology of Laboratory Animals LAB AN 9468: Laboratory Animal Biology MPP 8411: Mammalian Pharmacology and Physiology MPP 9426: Transmembrane Signaling MICROB 9407: Advanced Immunology INFO INST 8005: Applications of Bioinformatics Tools in Biological Research INFO INST 8150: Integrative Methods in Bioinformatics INFO INST 8190/8390: Computational Systems Biology **INFOINST 8310: Computational Genomics** INFOINST 8350: Integrative Methods in Bioinformatics **INFOINST 8450: Precision Medicine Informatics** PTH AS 8090: Advanced Pathology STAT 8410: Statistical Theory of Bioinformatics P HLTH 8420: Principles of Epidemiology

Infection and Immunity Emphasis Area:

After completion of the Program-specific course work, graduate students in the Infection and Immunity Emphasis Area will be required to take two Basic courses (at the 8000 level), two Advanced courses (at the 9000 level) and one elective at either the 8000 or 9000 level. Participation in a Research Seminar (MICROB 9087) is also required.

Basic courses:

MICROB 8303 Fundamental Virology (3 credit hrs) MICROB 8304 Immunology (3 credit hrs) MICROB 8404 Foundations in Bacteriology and Pathogenesis (3 credit hrs.)

Advanced courses

MICROB 9303 Adv. Virology (4 credit hrs) MICROB 9404 Adv. Bacterial Pathogenesis (4 credit hrs) MICROB 9407 Adv. Immunology (4 credit hrs) MICROB 9449 Infection and Immunity (4 credit hrs)

Integrative Physiology Emphasis Area:

After completion of the Program-specific course work, graduate students in the Integrative Physiology Emphasis Area will be required to take two of three Basic courses and one of three Advanced elective courses. Participation in a Research Seminar (MPP8412) is also required.

Basic courses (2)

MPP 8411 Mammalian Pharmacology and Physiology MPP 7424 Pharmacology and Translational Medicine OR MPP 9426 Transmembrane Signaling

Advanced Elective courses (1)

MPP 9430- Cardiovascular Physiology (1-3 hrs.) MPP 9434- Microvascular Circulatory Function (1-3 hrs.) MPP 9437- Neural Control of Circulation (1-3 hrs.)

Nutrition and Exercise Physiology Emphasis Area:

After completion of the Program-specific course work, graduate students in the Nutrition and Exercise Physiology Emphasis Area will be required to take 4 basic courses and 4 elective courses based on their research emphasis. Participation in a Research Seminar is also required.

Basic courses (4)

NEP 7970 Sports Nutrition (2 cr hrs) NEP 8030 Etiology of Obesity (3 cr hrs) NEP 8860 Exercise Endocrinology (3 cr hrs) NEP 8870 Exercise Metabolism (3 cr hrs)

NS Emphasis Area Electives (4)

NEP 7340 Human Nutrition II (3 cr hrs) NEP 8310 Nutritional Biochem of Lipids (3 cr hrs) NEP 8340 Nutrition in Human Health (3 cr hrs) AN SCI 9442 Vitamins and Minerals (3 cr hrs)

ExPhys Emphasis Area Electives (4)

MPP 7422 Medical Physiology (3 cr hrs) NEP 8001 Cardiovascular Disease and Exercise (4 cr hrs) NEP 8850 Advanced Exercise Physiology (3 cr hrs) V_BSCI 9435 Molecular Exercise Biology (3 cr hrs) Appendix E: Emphasis Area Faculty Information

Biochemistry and Biophysics Cancer Biology Infection and Immunity Integrative Physiology Nutrition and Exercise Physiology Population and Precision Health

BIOCHEMISTRY AND BIOPHYSICS EMPHASIS AREA

Last name, First Name	Primary Academic Department, College/School	Joint Appointments	Faculty Rank
Baldwin, Michael	MMI, SOM	Biochemistry, SOM	Associate Professor
Baker, Olga	Diochomistry SOM	Biochemistry, SOlvi	Professor
Bedmer, Lesa	BIOCHERIISLI'Y, SOIVI	Piechomistry SOM	Professor
Chanman Michael	Ricchomistry SOM	Biochemistry, SOW	Professor
Chap Shia lia	Biochemistry, SOM	Biochemistry, CAFNR	Professor
Cornich Dotor	Physics, Add	BIOCHEINISTRY, CAFINK	Accoriate Professor
Ductscher Susan	Biochemistry, SOM	VA Hospital	Associate Professor
Edwards Parry	Biochemistry, SOM	VA HOSPILAI	Associate Professor
Catos Kont	Chemistry, A&S	Piachomistry CAEND	Associate Professor
Gales, Kent	Piochomistry SOM	DIOCHEINISTI Y, CAFINK	Professor
Fork, Windin Hannink Mark	Biochemistry, SOM		Professor
Hoose Antie	Biochemistry, CAENIR		Associate Professor
Heng Viao	Biochemistry, CANNA Biochemistry, SOM		Associate Professor
King Gavin	Physics A&S	Riochemistry CAENP	Associate Professor
King, Gavin	Riochemistry CAENIR	DIOCHEITISTIY, CAFINA	Associate Professor
Lubaha Donnic	Biochemistry, CAFIN	Child Haalth SOM	Associate Professor
Mawhinney Thomas	Biochemistry, CAENIR	china nearth, solvi	Professor
Pock Scott	Biochemistry, CAENIR		Professor
Petris Mick	Ophthalmology SOM	Riochemistry CAENP	Professor
Philling Charlotte	Biochemistry SOM	Child Health SOM	Professor
Quinn Thomas	Biochemistry, SOM	china nearth, solvi	Professor
Stacey Gary	Plant Sciences CAENIR	Biochemistry CAENR	Professor
Sumper Lloyd	Biochemistry CAENR	biochemistry, carnin	Professor
Tanner John	Biochemistry, CAENIR	Biochemistry SOM	Professor
Thelen lav	Biochemistry, CAENR	biochemistry, solvi	Professor
Tinton Peter	Biochemistry, CAINA		Professor
Van Doren, Steven	Biochemistry, CAENR		Professor
Weisman Gary	Biochemistry, CAENIR		Professor
Zhang Shugun	Biochemistry, CAENR		Professor
	Physics A&S	Biochemistry CAENR	Professor
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CANCER BIOLOGY EMPHASIS AREA

Last name, First Name	name, First Name College/School		Faculty Rank
Amos-Landgraf, James	Vet Pathobiology, CVM		Associate Professor
Anderson, Carolyn	Chemistry, A&S	EFCC, SOM	Professor
Burke, Donald	MMI, SOM	Biochemistry, SOM	Professor
Bryan, Jeffrey	Vet Medicine & Surgery, CVM	EFCC, SOM	Professor
Chabu, Yves Chiswili	Biological Sciences, A&S		Assistant Professor
Edwards, Barry	Biochemistry, SOM		Associate Professor
Ericcson, Aaron	Vet Pathobiology		Assistant Professor
Gates, Kent	Chemistry, A&S	Biochemistry, CAFNR	Professor
Gil-Pages, Diana	MMI, SOM	Surgery, SOM	Associate Professor
Hannink, Mark	Biochemistry, SOM		Professor
Hoffman, Timothy	Medicine, SOM		Professor
Kaifi, Jussuf	Surgery, SOM		Assistant Professor
Khare, Sharad	Medicine, SOM	VA Hospital	Professor
Kimchi, Eric	Surgery, SOM		Associate Professor
Lange, Margaret	MMI, SOM		Assistant Professor
Li, Guangfu	Surgery, SOM		Associate Professor
Mitchem, Jon	Surgery, SOM		Associate Professor
Petris, Mick	Ophthalmology, SOM	Biochemistry, CAFNR	Professor
Quinn, Thomas	Biochemistry, SOM		Professor
Schrum, Adam	MMI, SOM	Surgery, SOM	Associate Professor
Shirwan, Haval	Child Health, SOM		Professor
Teixeiro-Pernas, Emma	MMI, SOM		Associate Professor
Washington, Karla	Fam Comm Medicine, SOM		Assistant Professor
Yolcu, Esma	Child Health, SOM		Professor

INFECTION AND IMMUNITY EMPHASIS AREA

Last name, First Name	Primary Academic Department, College/School	Joint Appointments	Faculty Rank
Adamovicz, Jeff	Vet Pathobiology, CVM		Associate Professor
Allen, Lee-Ann	MMI, SOM		Professor
Amos-Landgraf, James	Vet Pathobiology, CVM		Associate Professor
Anderson, Deborah	Vet Pathobiology, CVM		Professor
Baldwin, Michael	MMI, SOM		Associate Professor
Beernsten, Brenda	Vet Pathobiology, CVM		Professor
Brown, Charles	Vet Pathobiology, CVM	MMI, SOM	Professor
Brown, Pamela	Biological Sciences, A&S	MMI, SOM	Associate Professor
Bryda, Elizabeth	MMI, SOM		Professor
Burke, Donald	MMI, SOM	Biochemistry, SOM	Professor
Calcutt, Micheal	Vet Pathobiology, CVM	MMI, SOM	Professor
Cannon, John	MMI, SOM		Associate Professor
Cornelison, D	Biological Sciences, A&S	MMI, SOM	Professor
Daniels, Mark	MMI, SOM	Surgery, SOM	Associate Professor
Duan, Dongsheng	MMI, SOM	Neurology, SOM	Professor
Ericcson, Aaron	Vet Pathobiology, CVM		Assistant Professor
Franz, Alexander	Vet Pathobiology, CVM		Associate Professor
Gil-Pages, Diana	MMI, SOM	Surgery, SOM	Associate Professor
Gomez-Gutierrez, Jorge	Child Health, SOM	MMI, SOM	Associate Professor
Hahm, Bumsuk	MMI, SOM	Surgery, SOM	Associate Professor
Johnson, Marc	MMI, SOM		Professor
Lange, Margaret	MMI, SOM		Assistant Professor
Li, Guangfu	Surgery, SOM	MMI, SOM	Assistant Professor
Lorson, Christian	Vet Pathobiology, CVM	MMI, SOM	Professor
Ma, Wenjun	Vet Pathobiology, CVM	MMI, SOM	Associate Professor
McKarns, Susan	MMI, SOM	Surgery, SOM	Associate Professor
Petris, Michael	Biochemistry, CAFNR	MMI, SOM	Professor
Pintel, David	MMI, SOM		Professor
Schrum, Adam	MMI, SOM	Surgery, SOM	Associate Professor
Shirwan, Haval	Child Health, SOM	MMI, SOM	Professor
Skyberg, Jerrod	Vet Pathobiology, CVM		Associate Professor
Stich, Roger	Vet Pathobiology, CVM		Professor
Teixeiro, Emma	MMI, SOM	Surgery, SOM	Associate Professor
Xiu-Feng, Wan	MMI, SOM	Vet Pathobio, CVM	Professor
Yolcu, Emma	Child Health, SOM	MMI, SOM	Professor
Zaghounai, Habib	MMI, SOM	Neurology, SOM	Professor

NUTRITION AND EXERCISE PHYSIOLOGY EMPHASIS AREA

Last name, First Name	Primary Academic Department, College/School	Joint Appointments	Faculty Rank
Beversdorf, David	Neurology, SOM		Professor
Boerman, Erika	Med Pharm & Physiol, SOM		Assistant Professor
Bostick, Brian	Medicine, SOM		Assistant Professor
Bysani, Chandraseka	Medicine, SOM	Med Pharm & Physiol	Professor
Chen, Shiyou	Surgery, SOM	Med Pharm & Physiol	Professor
Cornelison, Dawn	Biologocal Sciences		Professor
Davis, Michael J	Med Pharm & Physiol, SOM		Professor
Domeier, Timoty	Med Pharm & Physiol, SOM		Associate Professor
Durante, William	Med Pharm & Physiol, SOM		Associate Professor
Fay, William	Medicine, SOM	Med Pharm & Physiol	Professor
Glinski, Vladislav	Path ology & Anatomical Sci		Associate Professor
Golda, Nicholas	Surgery, SOM		Associate Professor
Gole, Hope	Dermatology, SOM		Associate Professor
Govindarajan, Rajiv	Neurology, SOM		Professor
Hill, Michael	Med Pharm & Physiol, SOM		Professor
Katz, Marty	Ophthamology, SOM		Professor
Krenz, Maike	Med Pharm & Physiol, SOM		Associate Professor
Liu, Zhenghou	Medicine, SOM	Med Pharm & Physiol	Professor
Martinez-Lemus, Luis	Med Pharm & Physiol, SOM		Professor
McDonald, Kerry	Med Pharm & Physiol, SOM		Professor
Nagel, Susan	Ob, Gyn & Women's Health		Associate Professor
Nistala, Ravi	Medicine, SOM		Associate Professor
Parrish, Alan	Med Pharm & Physiol, SOM		Associate Professor
Polo-Parada, Luis	Med Pharm & Physiol, SOM		Associate Professor
Renexer, Lixing	Ophthamology, SOM		Associate Professor
Segal, Steven	Med Pharm & Physiol, SOM		Professor
Sowa, Grzegorz	Med Pharm & Physiol, SOM		Associate Professor
Thakar, Mahesh	Neurology, SOM		Professor
Upendran, Anandhi	ICATS	Med Pharm & Physiol	Professor
Whitt, Steven	Medicine, SOM		Professor
Wilden, Peter	Med Pharm & Physiol, SOM		Associate Professor

NUTRITION AND EXERCISE PHYSIOLOGY EMPHASIS AREA

Primary Academic Department, College/School	Joint Appointments	Faculty Rank
Nutrition & Ex Physiology, HES		Professor
Nutrition & Ex Physiology, HES		Assistant Professor
Nutrition & Ex Physiology, HES		Professor
Nutrition & Ex Physiology, HES	Medicine, SOM	Professor
Nutrition & Ex Physiology, HES		Professor
Nutrition & Ex Physiology, HES		Assistant Professor
Nutrition & Ex Physiology, HES		Assistant Professor
Nutrition & Ex Physiology, HES		Associate Professor
Nutrition & Ex Physiology, HES	Medicine, SOM	Professor
Nutrition & Ex Physiology, HES		Associate Professor
Nutrition & Ex Physiology, HES	Medicine, SOM	Associate Professor
Nutrition & Ex Physiology, HES		Associate Professor
	Primary Academic Department, College/School Nutrition & Ex Physiology, HES Nutrition & Ex Physiology, HES	Primary Academic Department, College/SchoolJoint AppointmentsNutrition & Ex Physiology, HES Nutrition & Ex Physiology, HES

POPULATION AND PRECISION HEALTH EMPHASIS AREA

Last name, First Name

Primary Academic Department, College/School

Joint Appointments

Faculty Rank/Position

Bartlett, Gillian Bath, Jonathan Edwards, Rebecca Everett, Kevin Kimminau, Kim Kruse, Robin Leary, Emily Lewis, Melissa Mehr, David McElroy, Jane Rolbiecki, Abigail Family & Comm. Medicine Surgery MOI Therapy Administration Family & Comm. Medicine Health Sciences Family & Comm. Medicine Orthopaedic Surgery Family & Comm. Medicine Family & Comm. Medicine Family & Comm. Medicine Professor Assistant Professor Director, Ther. Serv. Associate Professor Chief of Staff Emerita Professor Assistant Professor Assistant Professor Emerita Professor Associate Professor Assistant Professor

Appendix F: External Evaluation and Responses from Program Leadership

Reviewer #1: Dr. Gad Shaulsky. Dr. Shaulsky is Professor, Vice Chair and Program Director in Genetics & Genomics at Baylor College of Medicine (Houston, TX)

Reviewer #2: Dr. William C. Parks. Dr. Parks is Professor of Medicine and Biomedical Sciences, Director of the Doctoral Program in Biomedical and Translational Biosciences and Associate Dean, Graduate Research Education at Cedars-Sinai Medical Center (Los Angeles, CA).

Reviewer #3: Dr. Huntington F. Willard. Dr. Willard is Chief Scientific Officer, Genome Medical Inc.

All reviewers were asked to respond to four questions. The reviewers were also asked to provide additional comments, questions or concerns regarding the proposed doctoral program.

The response from Program Leadership of the proposed Translational Biosciences PhD program is organized into five sections, including the reviewer's comments and our responses to the four questions and a fifth section in which the additional comments and concerns by the reviewers are addressed.

Question 1: Will the proposed curriculum produce high-quality graduates who can make significant contributions in the field?

Dr. Shaulsky noted a concern with the absence of elective credits outlined in the "Program Design and Content" section.

Response: We agree that elective courses are an important part of graduate training. We will require students to take one elective in a different Emphasis Area or in a different PhD program. See Section 5. C. Program Design and Content, pages 26 to 31.

Dr. Parks had a number of concerns regarding the curriculum.

a. How will training and research opportunities in translational sciences be incorporated into coursework and dissertation? Dr. Parks suggestions included: including a 'translational' mentor (in addition to the research mentor); lectures that link basic cell processes to diseases; providing students with experiences in a clinical setting.

Response: We will encourage students to select dual mentors – one basic scientist and one clinical scientist. Our existing Molecular and Cell Biosciences course already emphasizes the link between basic cell processes and disease and we will explore additional ways to strengthen this link. We will encourage students to undertake research rotations with clinical scientists. See Section 5. D. Program Goals and Assessments, page 31.

b. The requirement for two first-author publications is too high. Dr. Parks recommended submission, not publication, of one first-author manuscript as an appropriate expectation for a dissertation by doctoral students.

Response: We changed the dissertation requirement to one first-author publication. See 5. D. Program Goals and Assessments, page 32.

c. Format of the comprehensive exam: Dr. Parks recommended that the comprehensive exam be completed at the end of Year 2, and that the format be that of an F31 proposal instead of an R21 proposal.

Response: We have made this change. See 5. D. Program Goals and Assessments, page 32.

d. Translational Journal Club: Dr. Parks recommended that more faculty, particularly clinical/translational faculty, be engaged with the Translational Journal Club. These faculty could bring in additional expertise and broaden the exposure of students to translational/clinical research problems.

Response: We have made this change. See Section 5. D. Program Goals and Assessments, page 31.

Dr. Willard had two comments. First, he suggested that the first semester course in cell and molecular biology bring in topics (and instructors with expertise in these topics) that are foundational for success in translational biosciences. Among the topics suggested by Dr. Willard for inclusion were: Big Data science, genomics, and mechanisms of disease. Dr. Willard suggested that a course that involves a deep exploration of one or more databases (such as the UK Biobank) would be an innovative way to expose students to the full spectrum of human and medical biosciences across all six emphasis areas. Dr. Willard suggested that this approach should also involve more faculty from the clinical departments.

Response: We have made this change. See Section 5. D. Program Goals and Assessments, page 31.

Dr. Willard's second comment was to emphasize opportunities for small group learning while reducing the number of traditional seminars and lectures.

Response: The Translational Journal club provides an opportunity for small group learning. We can also incorporate small group projects during the first-year coursework.

Question 2: Is there sufficient market for doctoral students interested in this area to allow the program to meet the proposed enrollment projections?

Dr. Shaulsky considered the marketing aspect of the proposed program to be the weakest element of the proposal. Dr. Shaulsky's recommendation was that projections for applications and enrollment should reflect a gradual increase in applications and enrollment, starting at 8 enrolled students in Year 1 and increasing gradually to 20 by Year 5.

Response: Both Dr. Shaulsky and Dr. Parks recommended that the program aim for a gradual increase in student enrollment. We have incorporated this change into the proposal. See our enrollment projections in Section 3.A.2 Student Demand for Program, pages 14 through 18.

Dr. Shaulsky noted that the proposal lacks a compelling plan for increasing program visibility or for encouraging more applications by providing incentives, such as inexpensive housing and other perks.

Response: We agree with Dr. Shaulsky and will incorporate these suggestions into our recruitment materials.

Dr. Parks was optimistic about the potential market of the proposed program. In Dr. Parks' experience, many undergraduate students who are interested in graduate research in the biomedical sciences are attracted to programs that emphasize translational sciences and related training.

Response: We agree with Dr. Parks.

Dr. Willard: Dr. Willard's short answer to this question was "absolutely, yes". Dr. Willard also raised concerns, including the need to clearly communicate the long-term benefits that a broad translational training program can offer students as well as the need to clearly differentiate the Translational Biosciences program from existing discipline-specific programs on the MU campus. Dr. Willard emphasized the need to emphasize the "Translational" elements of the program in all recruitment approaches (website, printed materials and campus visits).

Response: We agree with Dr. Willard and will incorporate these suggestions into the recruitment approaches.

Question 3: Do the courses, faculty and financial plan outlined in the proposal provide the necessary elements for the doctoral-level education in translational biosciences?

Dr. Shaulsky felt that the courses and the faculty were quite good. The plan by the SOM to recruit 40 new faculty members over the next five years supports the notion that there will be sufficient faculty talent and research topics among the SOM faculty to provide adequate training to the students in the Translational Biosciences program.

Dr. Shaulsky had a concern about the proposed recruitment of 20 students per year, starting in Year 1. Dr. Shaulsky felt that a more realistic approach is to gradually increase the number of students from 8 to 20 over five years. Dr. Shaulsky felt that the minimum number of enrolled students that would justify continuing the program after five years should be reduced, so that the program is allowed to grow and develop at a more realistic pace.

Response: We have incorporated this change into the proposal. See our enrollment projections in Section 3.A.2 Student Demand for Program, pages 14 through 18.

Dr. Parks had multiple concerns regarding the financial plan for the proposed program. These concerns include:

a: Staff support. The Translational Biosciences program will have two full-time staff members to support the program. The program, at steady-state, is expected to have about 100 doctoral students. Dr. Parks is the director of a similar program at Cedars-Sinai Medical Center (CSMC), which has a steady-state of 50 students. Dr. Parks devotes at least 50% of his effort in directing the program and has the assistance of 3.5 FTE in administrative support.

b: Dr. Parks urged that clinical faculty be fully involved in the program.

c: Dr. Parks emphasized the need for competitive stipends. Dr. Parks also pointed out that the cost-of-living in Columbia, Missouri be emphasized in recruitment materials.

d: Tuition: Dr. Parks was adamant that tuition needs to be waived for students in doctoral biomedical programs. Dr. Parks urged that the Translational Biosciences program follow the example of the DBBS program at Washington University in St. Louis (WUSTL), which waived the tuition for PhD students. In contrast, at the University of Washington, the research mentors were required to cover the cost of tuition for their PhD students. The mechanism(s) by which tuition costs will be covered should be clearly defined in the proposal and when the program is implemented.

e: Dr. Parks raised a number of concerns regarding the Financial Plan of the proposed program. These issues include:

1: Space needed for the program is not clearly defined. This program should have its own space for the dedicated administrators. In addition, the students need defined spaces, for meetings and study areas.

2: The source of funding for some of the anticipated expenses for the program are not clear. Will the funding come from the program or from the Dean's office?

3: The anticipated level of funding for the 2 administrative FTE's ((\$60K/yr for two positions) is too low.

4: The level of funding to support the effort of the directors and the faculty leadership is too low. The level of 15% FTE for each of the program directors is not sufficient and there should also be funding for the effort of other faculty leaders also.

5: The overall level of faculty effort (program directors, faculty leaders and instructors) is not reflected in the program's budget.

6: Stipend support is not accurately reflected in the budget. The amount of stipend support should be \$600K/year (20 students x \$30K stipend).

7: The budget assumes an annual increase in stipends. In most graduate programs, the annual stipend does not increase every year.

8: After a student's first year, where will the student's stipend come from? From the faculty mentor? Or will the program continue to provide some level of support?

9: Fringe benefits, including health care/health insurance, for graduate students is not specified in the budget.

10: The amount of the recruitment budget ranges from \$150K/per year to \$250K per year. This needs to be clarified.

11: Funds to support student activities, including a student association, group social activities and a program retreat should be defined in the budget.

Response: Dr. Parks has very specific concerns about the financial structure of the program. Some of these concerns, such as competitive stipends, have been addressed in the proposal. Some of his concerns, such as the amount of stipends, tuition waivers and recruitment budget, seem to result from his misreading of the budget. The budget in this proposal only includes the additional costs of expanding the number of PhD trainees in the SOM from 8 incoming students per year to 20 incoming students per year. Some of his concerns, such as funding for student association(s) and group social activities, will be included

in our expenditures even if they are not line items in the budget. Dr. Parks' overall concern about the financial structure of the program is that it is underfunded compared to the program that he directs at Cedars-Sinai Medical Center. The University of Missouri is a different institution than Cedars-Sinai Medical Center, such that number of staff needed and faculty effort may differ between the two institutions and programs. We recognize and value Dr. Parks experience with his program and will request additional funding if needed for the success of our program.

Dr. Willard felt that the proposal included all of the elements of a successful doctorallevel education in the biosciences. Dr. Willard felt that the financial model was appropriate in all respects but noted that additional creative efforts to attract additional funding may be required as the program matures. One of the challenges that Dr. Willard emphasized was that of emphasizing the "translational" aspects of the program, such that the program is defined as a distinct entity from current departmental-based programs both at MU and nationwide.

Response: We will emphasize the distinctive nature of the Translational Biosciences PhD program in our recruitment and communication strategies.

Question 4: How does this program compare with similar programs in the country and does the program have the potential to achieve a national reputation?

Dr. Shaulsky cautioned that the program, as proposed, did not place sufficient emphasis on "translational bioscience". Dr. Shaulsky pointed out several aspects of existing programs across the US that describe themselves as translational bioscience", including dual mentorship of students by a basic scientist and a clinical scientist as well as training elements that specifically are aimed at the application of laboratory findings to the clinic. As these elements are not strongly emphasized in the proposal, Dr. Shaulsky felt that the proposed program is better described as an **integrative** training program. As an integrative program, Dr. Shaulsky felt that the proposed program would be competitive with other interdisciplinary programs across the country.

Response: There was a difference of opinion between the reviewers on the "translational" nature of the proposed program. We have added elements suggested by the other reviewers that, in our view, strengthen the "translational" aspect of the program. We do not plan to change the name of the program.

Dr. Parks felt that the structure of the proposed program has the potential to earn a positive reputation.

Response: Taken together with Dr. Willard's comment (below), our recruitment and communication materials will emphasize the elements which make the program stand out at both the local and national level.

Dr. Willard felt that the proposed program has the potential to be successful as an "umbrella" program. Dr. Willard highlighted several elements that will be key to the success of the program, including strong leadership (which Dr. Willard and the other reviewers noted as a strength of the proposed program) as well as strong buy-in from faculty and department chairs.

Dr. Willard emphasized that the program should focus on the unique and distinctive aspects of the School of Medicine and of the University of Missouri. Dr. Willard cautioned that focusing on the financial benefits of the program would be the wrong approach.

Response: We appreciate Dr. Willard's viewpoint and will emphasize those unique and distinctive aspects of our program, of the SOM, and of the University of Missouri in our promotional materials.

Question 5: Other comments, suggestions, questions or concerns:

Dr. Shaulsky had a number of additional concerns:

a. The potential for internal competition between the proposed Translational Biosciences program and existing programs. Dr. Shaulsky felt that there was a lack of clarity for how the proposed program and the existing programs would collaborate on graduate training.

Response: We acknowledge the potential for internal competition that is raised by Dr. Shaulsky. We believe that this potential will need to be addressed by program leadership during the formative years of the program. Dr. Hannink has been a leader in graduate training on the MU campus for the past 15 years and has very good relationships with the leaders of the other programs. We do not believe that competition for students or resources will be a substantive issue at MU.

b. The proposed program needs to offer robust career development advice to the students, preferably through a dedicated career development center.

Response: We have developed a yearly career planning workshop called "Framing Your Future". We have supported the growth of a student-driven organization called "Alternative Career Exploration in the Sciences". If dedicated career development center is needed, we will work with the MU Graduate School and other life science departments on campus to develop such as center.

c. The term "umbrella" program has some negative connotations. Dr. Shaulsky recommended the use of terms such as "integrative" or "interdisciplinary". **Response:** We will emphasize "Translational", not "umbrella".

d. GRE scores should not be considered as part of the application packet. **Response:** Agreed. See details of the application on page 22.

e. The respective roles of the two program leaders should be further defined and a conflict resolution mechanism should be developed. The role of the executive committee needs to be clarified.

Response: Agreed. A mechanism for conflict resolution is described on Page 34.

f. Training elements that incorporate "team science" need to be part of the proposed program.

Response: Agreed. These elements will be part of the Translational Biosciences Journal Club. We have not provided granular detail of the content of the Journal club.

g. The program should seek accreditation by Missouri's Higher Learning Commission.

Response: There is no accreditation mechanism for biomedical graduate programs. The University of Missouri is accredited by the Higher Learning Commission. To maintain its accreditation by the Higher Learning Commission, the University of Missouri-Columbia requires that all degree-granting programs establish learning objectives for the program and individual courses and track the educational outcomes of the students. The University of Missouri-Columbia has a program review process that ensures all accreditation standards are met.

Dr. Parks had a number of additional concerns, several of which were in common with the concerns of Dr. Shaulsky.

a. How will existing interactions between SOM departments and training programs outside of the SOM be affected by the new program?

Response: Existing interactions will be maintained.

b. Can faculty be members of more than one emphasis area?

Response: Yes. This is stated in the proposal. See, for example, this statement on page 5: "An important feature of the Translational Biosciences PhD program will be that faculty and students will not be confined within departmental silos. Instead, research-active faculty will be encouraged to participate in multiple Emphasis Areas and graduate students will be allowed to join the lab of any research-active faculty member that participates in any of the Emphasis Areas.

c. The program should not emphasize growth over quality. It may be difficult to achieve the target goal of 20 incoming students per year. The goals for class size should be more flexible.

Response: We will change our projections to address this common concern of Dr. Shaulsky and Dr. Parks. See section 3. A. 2 Student Demand for Program, pages 14 to 18.

d. Dr. Parks had a significant concern about inactivating the program if the target recruitment goals were not attained.

Response: We have changed this section (page 20). If the new program does not exceed the current enrollment into SOM PhD programs at the end of five years, we will, in consultation with the Dean, Provost and UM Office of Academic Affairs, decide if any changes and/or investments designed to enhance the program are needed or if the program should be placed on an inactive status. If additional changes or investments are made, the program will then be reviewed on an annual basis to assess progress.

e. Dr. Parks pointed out that accreditation is offered through the Middle States Commission on Higher Education.

Response: Dr. Parks is not correct. The Middle States Commission on Higher Education is focused on the Mid-Atlantic states. The University of Missouri is accredited through the Higher Learning Commission.

f. Dr. Parks pointed out that program elements that impact student retention, will need to be established to address specific concerns of URM students and personal issues such as work concerns, relationship/marital issues, emotional & psychological issues, stress management, etc.

Response: We have included these elements in the retention section on page 24.

Dr. Willard, in his closing comments, emphasized the need for the features of the program to be distinctive, right from the beginning. In this regard, Dr. Willard suggested that it will be important, during the first few years of the program, to keep the students in the "new" program separate from the students in the pre-existing programs.

Response: We agree and will follow his advice.

Please see first tab for instructions.

GRADUATE PROGRAM PRO FORMA

UNIVERSITY OF MISSOURI - _____ Projection as of _____

(1)		PROFORMA: _	FORMA: Projection as of						
		Prepared by: _			Approved by: _				
	PROGRAM.	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
		FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29
(2)	Enrollment Projections Head Count Students - <i>new incoming</i> Head Count Students - <i>transfers within campus</i>		-	3	9	18	30	42	54
	Student Credit Hours		-	66	216	432	720	1,008	1,296
(3)	Tuition Rate/Credit Hour		402	415	427	440	453	467	481
(4)	Fee Rate/Credit Hour		120	124	71 920	131	135	139	143
(4)	Scholarship Allowances (\$)		-	21,311	71,005	125,525	211,705	244,223	525,421
(5)	Revenue Projections			******	******CALCULAT	ED CELLS ******	*****	-	-
	Tuition	-	-	27,361	92,233	190,000	326,166	470,331	622,853
	Supplemental & Other Fees	-	-	8,158	27,499	56,647	97,244	140,226	185,699
	Scholarship Allowances	-	-	(21,311)	(71,839)	(123,323)	(211,705)	(244,223)	(323,421)
	Net Luition and Fees	-	-	14,208	47,893	123,323	211,705	366,334	485,131
		\$0	\$0	\$14,208	\$47.893	\$123.323	\$211.705	\$366.334	\$485,131
	Recurring State Support					+	· · · · · · · · · · · · · · · · · · ·		
		\$0	\$0	\$14,208	\$47,893	\$123.323	\$211,705	\$366.334	\$485,131
(6)	Expenditure Projections Faculty Salaries detail Technical Salaries detail								
	Support Salaries detail	\$ 60,000	\$ 61,200	\$ 62,424	\$ 63,672	\$ 64,946	\$ 66,245	\$ 67,570	\$ 68,921
	Total Salaries	60,000	61,200	62,424	63,672	64,946	66,245	67,570	68,921
	Benefits Subtotal Salarios and Bonofits	18,000	18,360	18,727	19,102 \$82,774	19,484 \$84,430	19,873	\$87.841	20,676
	Operating Expense Computing Expenses NonCapital Maintenance & Repair	10,000	5,000	6,000	7,200	8,640	10,368	12,442	14,930
	Supplies Professional & Consulting	15,000	7,000	5,000	5,250	5,513	5,788	6,078	6,381
	Travel & Training Misc. Expenses (Graduate Stipends)	150,000 -	165,000 -	181,500 93,000	199,650 192,000	219,615 297,000	241,577 408,000	265,734 420,000	292,308 432,000
	Subtotal Operating Expense	175,000	\$177,000	\$285,500	\$404,100	\$530,768	\$665,733	\$704,253	\$745,619
(7)	One-time Expenditures (Startup Costs)								
(9)	Additional Space Costs								
	Subtotal One-time Expense	\$ -	\$0	\$0	\$0	\$0	\$0	\$0	\$0
	TOTAL EXPENDITURES	\$253,000	\$256,560	\$366,651	\$486,874	\$615,197	\$751,851	\$792,094	\$835,216
		(\$252,000)	(\$256 560)	(\$252 444)	(\$429.092)	(\$404.974)	(\$540,146)	(\$ 425 760)	(\$250.095)
	CUMULATIVE DIRECT MARGIN	(\$253,000)	(\$258,580) (\$509,560)	(\$862,004)	(\$1,300,985)	(\$1,792,859)	(\$2,333,005)	(\$2,758,765)	(\$3,108,850)
(9)	Subtract: Revenue from Transfers within Campus								
	NET MARGIN TO THE CAMPUS	(\$253,000)	(\$256,560)	(\$352,444)	(\$4 <u>38,982)</u>	(\$4 <u>91,874)</u>	(\$5 <u>40,146)</u>	(\$425,760)	(\$350,085)
	CUMULATIVE NET MARGIN TO THE CAMPUS	(\$253,000)	(\$509,560)	(\$862,004)	(\$1,300,985)	(\$1,792,859)	(\$2,333,005)	(\$2,758,765)	(\$3,108,850)
(10)	Campus Overhead Allocation	\$-	\$-	\$ 5,676	\$ 18,576	\$ 37,152	\$ 61,920	\$ 86,688	\$ 111,456
	MARGIN AFTER	(\$253.000)	(\$256 560)	(\$358 120)	(\$457 558)	(\$529.026)	(\$602.066)	(\$512.448)	(\$461 541)
	CUMULATIVE MARGIN	(1200,000)	(1200,000)	(1000,120)	(0.101,000)	(1020,020)	(0002,000)		(0101,041)
	AFTER CAMPUS OVERHEAD	(\$253,000)	(\$509,560)	(\$867,680)	(\$1,325,237)	(\$1,854,263)	(\$2,456,329)	(\$2,968,777)	(\$3,430,318)

(11) Assumptions:

Executive Summary New Degree Program, B.S. in Biomedical Engineering, UMKC

The Bachelor of Science in Biomedical Engineering (BSBME) degree is a four-year undergraduate degree consisting of 127 credit hours. Interest in BSBME degrees from high school students has seen tremendous growth in the last two decades and is a pathway to a needed career, graduate research degrees and medical school. Within the School of Computing and Engineering at UMKC (SCE), computing and engineering academic and research programming related to bio and health technologies has increased at an astounding rate with more than 20% of the research and its related coursework being within biomedical engineering. The BSBME degree also fits perfectly within Kansas City's role in the "Animal Health Corridor", the local research hospitals, St. Luke's and Children's Mercy, and the UMKC's Health Science Campus, including the schools of Medicine, Dentistry, Pharmacy and Nursing. Faculty responsible for the BSBME program will consist of professors and medical professionals from multiple schools and departments on UMKC's campus (including engineering, medicine, pharmacy, dentistry, nursing, and the bio sciences) all of whom will be included in teaching classes, providing research opportunities, participating in seminar series, and guest lecturing for the BSBME program.

According to nationally published data, the Healthcare and Social Assistance Industry has been the largest and the fastest growing employment sector in the greater Kansas City area. The healthcare sector of the greater Kansas City area comprises 11.5 percent of the region's jobs and represents the fastest-growing industry, averaging over 3000 new jobs per year over the last decade. Recent data published by the Economic Development Corporation of the City of Kansas City, Missouri shows that out of the top twenty-one (21) employers in the Kansas City area, eight (8) top employers are in the medical and healthcare service sectors. The health care sectors of the greater Kansas City (MO & KS) area have a combined workforce of more than 200,000 and contribute more than \$10 billion annually to the regional economy. The greater Kansas City area depends on biomedical engineering professionals to ensure access to the cutting-edge medical and health care technologies leading to the highest levels of medical treatments, drugs, equipment, and assessment technologies. This needed workforce and the healthcare challenges due to an aging population will drive the need for new, cost-effective innovations in medical devices, biomaterials, and data analytics. The proposed BSBME degree will bolster the technical competency of the healthcare industry in the Kansas City area and provide the workforce for jobs that will make significant contributions to the continued growth and economic development of this field and the region.

Job growth for graduates with a Bachelor of Science in Biomedical Engineering is high in the Kansas City area, as well as across Kansas and Missouri. Problem solving is the backbone of any engineering discipline and is reinforced throughout the entire BSBME curriculum, making these students excellent potential employees for a variety of jobs outside of healthcare, such as become entrepreneurs, technology assessment specialists, and doctors.

The BSBME program will require little to no initial resources to begin matriculating students. SCE's new research facility has the necessary labs for the academic and research associated with the degree. SCE has sufficient faculty expertise and staff for this degree. The program will be revenue positive from year one and will grow in net revenue each of the following three years, at which time SCE will make the decision whether to go steady-state in size or continue growing.

No. 2

Recommended Action - BS in Biomedical Engineering - University of Missouri- Kansas City

It was recommended by the University of Missouri System Office of Academic Affairs, endorsed by President of the University of Missouri Mun Choi, recommended by the Academic, Student Affairs and Research & Economic Development Committee, moved by Curator_____, seconded by Curator_____that the following action be approved:

that the University of Missouri – Kansas City be authorized to submit the attached proposal for a BS in Biomedical Engineering to the Coordinating Board for Higher Education for approval.

Roll call vote of the Committee:	YES	NO
Curator Graves		
Curator Hoberock		
Curator Layman		
Curator Wenneker		
The motion		
Roll call vote of Board:	YES	NO
Curator Brncic		
Curator Chatman		
Curator Graham		
Curator Graves		
Curator Hoberock		
Curator Holloway		
Curator Layman		
Curator Wenneker		
Curator Williams		
The motion		

New Degree Program Proposal:

Bachelor of Science in Biomedical Engineering

University of Missouri – Kansas City November 2021 Board of Curators Meeting

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Executive Summary

The Bachelor of Science in Biomedical Engineering (BSBME) degree is a four-year undergraduate degree consisting of 127 credit hours. Interest in BSBME degrees from high school students has seen tremendous growth in the last two decades and is a pathway to a needed career, graduate research degrees and medical school. Within the School of Computing and Engineering at UMKC (SCE), computing and engineering academic and research programming related to bio and health technologies has increased at an astounding rate with more than 20% of the research and its related coursework being within biomedical engineering. The BSBME degree also fits perfectly within Kansas City's role in the "Animal Health Corridor", the local research hospitals, St. Luke's and Children's Mercy, and the UMKC's Health Science Campus, including the schools of Medicine, Dentistry, Pharmacy and Nursing. Faculty responsible for the BSBME program will consist of professors and medical professionals from multiple schools and departments on UMKC's campus (including engineering, medicine, pharmacy, dentistry, nursing, and the bio sciences) all of whom will be included in teaching classes, providing research opportunities, participating in seminar series, and guest lecturing for the BSBME program.

According to nationally published data, the Healthcare and Social Assistance Industry has been the largest and the fastest growing employment sector in the greater Kansas City area. The healthcare sector of the greater Kansas City area comprises 11.5 percent of the region's jobs and represents the fastest-growing industry, averaging over 3000 new jobs per year over the last decade. Recent data published by the Economic Development Corporation of the City of Kansas City, Missouri shows that out of the top twenty-one (21) employers in the Kansas City area, eight (8) top employers are in the medical and healthcare service sectors. The health care sectors of the greater Kansas City (MO & KS) area have a combined workforce of more than 200,000 and contribute more than \$10 billion annually to the regional economy. The greater Kansas City area depends on biomedical engineering professionals to ensure access to the cutting-edge medical and health care technologies leading to the highest levels of medical treatments, drugs, equipment, and assessment technologies. This needed workforce and the healthcare challenges due to an aging population will drive the need for new, cost-effective innovations in medical devices, biomaterials, and data analytics. The proposed BSBME degree will bolster the technical competency of the healthcare industry in the Kansas City area and provide the workforce for jobs that will make significant contributions to the continued growth and economic development of this field and the region.

The Burning Glass reports show job growth for graduates with a Bachelor of Science in Biomedical Engineering as high in the Kansas City area, as well as across Kansas and Missouri. Problem solving is the backbone of any engineering discipline and is reinforced throughout the entire BSBME curriculum, making these students excellent potential employees for a variety of jobs outside of healthcare as well. Many will become entrepreneurs, technology assessment specialists, doctors and more. The BSBME program will require little to no initial resources to begin matriculating students. SCE's new research facility already has the necessary labs for both the academic and research associated with such a degree. SCE already has sufficient faculty expertise and staff for this degree. The program will be revenue positive from year one and will only grow in net revenue each of the following three years, at which time SCE will make the decision whether to go steady-state in size or continue growing.

1. Introduction

The Bachelor of Science in Biomedical Engineering (BSBME) degree is a four-year undergraduate degree consisting of 127 credit hours. The BSBME degree program is designed to provide a four-year undergraduate education in the broad field of biomedical engineering. Biomedical engineering is a discipline that combines biological and chemical sciences with multiple fields of engineering, including mechanical and electrical. The proposed biomedical engineering program provides an extensive curriculum that prepares graduates for careers and/or advanced study in engineering, health care, medicine, dentistry, biotechnology, bioinformatics, and pharmaceutical fields.

UMKC's long history of excellence in health science, life science and biological sciencerelated disciplines, together with the rapidly growing disciplines of computing, engineering and other STEM fields, provides a very strong platform to start this new interdisciplinary undergraduate degree in biomedical engineering. There has been a high volume of collaborative academic and research projects among the faculty members and researchers from SCE and the academic units of the UMKC's Hospital Hill campus.

In recent years, the interest in computing and engineering academic and research collaboration related to bio and health technologies is increasing at an astounding rate. The proposed BSBME would provide a very effective platform to strengthen and institutionalize these collaborative efforts in engineering, computer science, and bio and health technology-related education, outreach, and research.

Typically, in any metropolitan city of the size and characteristics of Kansas City, more than one university offers degrees in biomedical engineering and technology to serve the needs of industry and academia. This BSBME degree will be the first and only such degree in Kansas City. An undergraduate degree in biomedical engineering will fit perfectly with UMKC's current strength in medical, health and biological science, and technology. This degree will also fit perfectly with Kansas City's role in the "Animal Health Corridor", the research hospitals, St. Luke's and Children's Mercy, and the UMKC's Health Science Campus, the schools of Medicine, Dentistry, Pharmacy and Nursing,

UMKC's School of Computing and Engineering (SCE) is Kansas City's only accredited school for engineering and computer science, and Kansas City has been the center of healthcare service and biotechnology companies in the region for many decades. Not

having degree programs in Biomedical Engineering is a serious disservice to the population of this region. There is also an urgent need to increase representation of female and minority students in STEM disciplines. Typically, BSBME programs have a much higher percentage of female and minority students than the traditional engineering degree programs. The goal of diversifying the STEM degree programs at SCE will be greatly enhanced with this new degree offering.

It should be noted that no big investments are necessary to start and maintain this program. Additional resources (including new faculty hires) will only be needed as the enrollments and revenues grow. Approximately 90% of the required and elective courses are currently offered at UMKC. Currently, SCE has more than 15 faculty that perform research in the biomedical fields and are qualified by degrees and expertise to teach BSBME courses. These faculty members in SCE are working with faculty in other participating units to develop several new courses that will fulfill the elective options within the BSBME. In the current four-year plan, a total of six new required courses would need to be created. These courses would need to be taught by faculty with expertise in the area of biomedical engineering. Initially, SCE will not need to hire any new faculty to implement the new program; the hiring of new faculty will occur as the undergraduate population grows.

The person responsible for the BSBME program is Dr. Katherine Bloemker, Assistant Dean of Academic Affairs in the School of Computing and Engineering. Dr. Bloemker is also Teaching Faculty in the Civil & Mechanical Engineering Department and will assist with the teaching in the BSBME program due to her academic experience and research in Biomechanics and Bio-Design.

Contact Information: Phone: (816) 235-5639, E-mail: bloemkerk@umkc.edu.

2. University Mission & Program Analysis

2.A. Alignment with University Mission & Goals

The BSBME supports SCE's goal of increasing degree and discipline options in the STEM fields. The BSBME Program is highly supported by Dean Truman. See attached Letter of Support: <u>LOS BSBME MSBMS - Truman.pdf.</u> The BSBME helps to support Chancellor Agrawal's vision of increasing the size of UMKC.

The UMKC Mission Statement reads as follows:

"<u>As an urban research university, our mission at the University of Missouri-Kansas City</u> is to promote learning through the discovery, preservation and dissemination of <u>knowledge of public value across a broad spectrum of disciplines and fields of study</u>. UMKC celebrates the individual and embodies diversity and inclusion by intertwining these goals with innovation to enable transformational impact aimed at bringing cultural, social, health and economic prosperity to the metropolitan, regional and global communities we serve." The BSBME supports the University vision to promote interdisciplinary education and research. The proposed BSBME is aligned with UMKC's overall Mission particularly in the first line (underlined above). This program is, by definition, comprised of a broad spectrum of disciplines and fields of study. Students who complete the BS in Biomedical Engineering will take courses in a wide range of disciplines, including Biology, Chemistry, Computer Science, Electrical Engineering, Mathematics, Mechanical Engineering, Physiology, and Statistics.

The goals for the BSBME program are listed in the following table:

Goal	Students have the fundamental technical and scientific skills
1:	that prepare them for immediate employment in or the pursuit
	of an advanced degree related to Biomedical Engineering
Goal	Students apply the necessary problem-solving skills for
2:	contributing to and advancing in industry
Goal	Students apply the necessary design skills for successfully
3:	contributing to and advancing in industry
Goal	Students apply the necessary application skills in sub-
4:	specialties of Biomedical Engineering to operate in a
	competitive global community

These goals map onto the five pillars of the UMKC Strategic Plan as follows:

- Provide exceptional student learning, success and experience
 All four of the program goals align with this pillar.
- 2. Become a thriving discovery enterprise
 - Goals 3 and 4 align with this pillar.
- 3. Transform our community and region with impactful engagement
 Goals 2 and 3 align with this pillar.
- 4. Foster an environment of invigorating multiculturalism, globalism, diversity and inclusion
 - Goal 4 aligns with this pillar.
- 5. Develop a strong and resilient people, process and physical infrastructure *All four of the program goals align with this pillar.*

UMKC's Schools of Medicine and Dentistry partner with leading hospitals in Kansas City to provide students and residents with outstanding medical education. New avenues of health care, medical education, and services will be possible if UMKC and its partner hospitals can extend the collaboration to biomedical equipment and biotechnology companies and research organizations in the region and across the nation. The School of Pharmacy has a mission of shaping the future of healthcare and improving lives. The School of Biological and Chemical Science (SBCS) faculty members are working to develop interdisciplinary and collaborative approaches to education and research to ensure that graduates are ready to immediately contribute to the demands of a 21st century workplace. Most of the Pharmacy and SBCS graduates become part of the healthcare and biotechnology workforce. The School of Nursing and Health Studies has been making continuous efforts to remain a premier academic institution by updating and upgrading its curriculum in response to the changing health care landscape, which has become a data science and biotechnology-driven sector. The proposed BSBME degree program would directly serve these missions.

2.B. Duplication & Collaboration within Campus, Across System

Within the UM System, only UM-Columbia currently offers a BS degree in Biomedical Engineering. Missouri S&T only offers a minor in Biomedical Engineering. The proposed BSBME degree at UMKC is unique and comprehensive due to its interdisciplinary nature and the diverse combination of focus areas and interests. In addition, the proposed BSBME program would be the only such undergraduate program in the greater Kansas City area.

Construction was just recently completed on the new engineering lab building for SCE with an anticipated full open of all labs in Spring 2021. The Robert W. Plaster Free Enterprise and Research Center (FERC) is a 57,800 square-foot facility which will house a variety of cutting-edge research and teaching labs, including a structural high-bay, bio-nano-clean room, unmanned vehicle suite, advanced 3-D printing including bioprinting, augmented and virtual reality training, gait (motion capture) laboratory, big data, and renewable energy labs amongst many others. This new facility provides SCE with the ability to build and foster laboratory and research capabilities necessary for a world-class biomedical engineering program.

The uniqueness of the BSBME program comes from UMKC's proximity to the health care companies and hospitals located in Kansas City along with the UMKC Health Science Campus (Schools of Medicine, Dentistry, Pharmacy, and Nursing). The School of Computing and Engineering currently has significant ongoing research with all four Health Science schools accounting for 20% of SCE's \$35-40m, 3-yr research portfolio. St. Luke's and Children's Mercy Hospitals have verbally agreed to create year-long internship positions for juniors and seniors in the BSBME program. These internships will be in parallel to the coursework the students are taking, which can only be accomplished if the educational component (faculty and labs) is in close proximity to the facilities. Additionally, the School of Medicine will encourage the premed and medical students to take several of the courses related to biotechnology.

With the expertise of the biomedical faculty across the UM System, all of the biomedical programs can be enhanced substantially by coordinating with the other

universities. Specifically, the range of elective offerings can be augmented by using system-wide courses from UM-Columbia and Missouri S&T (and they can use UMKC courses). The biomedical faculty in SCE have already reached out to faculty at UM-Columbia and Missouri S&T to develop a course-sharing strategy. It was determined through these conversations that the biomedical program at UMKC and UM-Columbia can be mutually beneficial due to the differences in expertise on each campus.

UMKC currently excels in the area of biomechanics with a number of mechanical and civil engineering faculty already teaching elective courses and performing research in that subject area. UM-Columbia stated the need for more biomechanics-focused elective courses. UMKC would be able to share courses such as Biomechanics, Biodynamics, and Experimental Biomechanics of Human Motion. The biomechanics faculty at UMKC are already in the process of adding more elective courses which could be added to this list.

In addition to biomechanics, UMKC is in the process of building expertise in the area of biomaterials. Two senior level and graduate courses are currently offered with a number of others in the pipeline in the next year or two. This will be a great opportunity for course sharing with other UM-System biomedical programs as these additional elective offerings become available.

UM-Columbia currently excels in the areas of bioengineering and biomedical imaging and suggested the ability to share elective courses with UMKC students; these courses include Biomedical Imaging, Tissue Engineering, and Bioprocessing. This would allow UMKC students to gain valuable elective experience in an area that is not currently available on campus.

In addition, UM-Columbia currently offers undergraduate classes which are mainly online, such as Biomedical Instrumentation and Biomedical Senior Design. These are two required courses that UMKC will need to add to the curriculum by year 3 and 4 of the program. Course sharing with UM-Columbia could allow UMKC the luxury of continuing to use these online courses long-term or deciding to add regular faculty to teach these required courses as the program and revenue grows.

Finally, UM-Columbia offers a completely online certificate program which consists of four classes, including an extremely beneficial regulatory course, which would be extremely useful to UMKC biomedical students.

The proposed BSBME program at UMKC requires 127 credit hours, which on par with competitive programs in the region. The following table shows the opportunities and requirements at the regional universities. Please note that the UMKC program is equal to or less than all of the other public universities in credit hour requirements.

University	Program	Credit Hours
K-State	Bachelors in Biomedical Engineering	128 credit hours
KU	Certificate in Bioengineering	30 credit hours
Wichita State	Bachelors in Biomedical Engineering	128 credit hours
UM-Columbia	Bachelors in Biomedical Engineering	127 credit hours
WashU	Bachelors in Biomedical Engineering	120 credit hours
SLU	Bachelors in Biomedical Engineering	124 credit hours

3. Business-Related Criteria & Justification

3.A. Market Analysis

3.A.1. Rationale & Workforce Demand for the Program

According to data published by Economic Modeling Specialist International for the period of 2004-2014, the Healthcare and Social Assistance Industry has been the largest and the fastest growing employment sector in the greater Kansas City area. There is a very important reason why the Kansas City employment data for the period of 2004-2014 is emphasized here. Due to economic slowdown, almost every sector in Kansas City and across the nation lost jobs between 2009 and 2011, but the health care industry in the Kansas City area added jobs during that very difficult economic situation. For the post-2014 period, the employment numbers and the workforce requirements of the health care and bio-technology related industries have further increased. Recent data published by the Economic Development Corporation of the City of Kansas City area, eight (8) top employers are in the medical and healthcare service sectors¹.

Overall, the health care sectors on the Kansas and Missouri sides of the greater Kansas City area have a combined workforce of more than 200,000 and contribute more than \$10 billion annually to the regional economy. Not only is the economy of this region heavily dependent on the health care industry, but the greater Kansas City area population depends on the health care service providers and professionals in the area to ensure their access to state-of-the-art medical treatment and health care technologies.

The healthcare sector is an important part of the greater Kansas City area's economy. It makes up 11.5 percent of the region's jobs, and is the fastest-growing industry, averaging over 3000 new jobs per year over the last decade. This trend is expected to continue, particularly as the Baby Boom generation ages; the proportion of the area's

¹ https://www.edckc.com/workforce-talent/major-employers/

population aged 65 or older is expected to reach 18 percent by the year 2030². This and other healthcare challenges will drive the need for new, cost-effective innovations in medical devices, biomaterials, and data analytics. The proposed BSBME degree will bolster the technical competency of the health care industry in the Kansas City area and provide jobs that would make significant contributions to the continued growth and economic development of this field.

The Burning Glass reports show job growth for graduates with a Bachelor of Science in Biomedical Engineering as high in both the Kansas City area, as well as across Kansas and Missouri. This is compared to an average job growth nationwide. Potential employers of graduates of a biomedical engineering degree program include biotech companies, bioanalytics firms, medical device companies, health industries, laboratories, government agencies, Veteran's Affairs, the computing industry, consulting groups, medical centers, and higher education.

The reports show top job industries for graduates in Biomedical Engineering as public administration; health care and social assistance; professional, scientific, and technical services; and manufacturing. Potential job titles include biomedical engineer, research associate, hospital management, data analyst, medical technician, scientific technician, project management, and medical coding.

Biomedical engineers in reality have very diverse career paths. They are trained to be analytical, creative problem solvers. Many have careers as bio device designers, sensor and material designers, biomedical researchers, technical business analysts, entrepreneurs, data analysts, doctors, medical management and much more. Many graduates use this technical training as a springboard into medical research, medical administration, medical technology consultancy, health administration, healthrelated software, and medical facilities designers.

The diversity in job titles and companies for these graduates makes it difficult for companies (databases) such as Burning Glass to capture the real number of jobs that are available for biomedical engineers. These graduates often land in companies outside of the traditional biomedical field that span the gambit of architecture (medical facility design) to Wall Street (medical startup evaluations). These jobs are nearly impossible to collect from traditional data sources.

Some key competencies of these potential employers include biomedical engineering, mechanical engineering, problem solving, research, biotechnology, medical technology, planning, communication skills, chemistry, physics, technical writing, medical imaging, data analysis, and project management.

The degree program prepares graduates in these competency areas through the curriculum. Students are required to take multiple courses in biomedical engineering, mechanical engineering, chemistry, and physics. Problem solving is the

² http://kcworkforce.com/Assets/reports/HealthCare_IndustryReport2013.pdf

backbone of any engineering discipline and is reinforced throughout the entire curriculum. Technical Writing is covered in the second written communication skills course as well as in upper-level engineering courses with lab and design reports. Research, communication skills, and project management are covered in numerous courses, culminating in the capstone design course taken during the last semester of the senior year.

For specific details in the Burning Glass Reports, see the market analysis in the appendix.

In the attachments, there are seven letters of support for the BSBME program. Four of these letters are from external entities including: two area hospitals (St. Luke's Hospital and Children's Mercy Hospital), one local medical technology company (RBC Medical Innovations), and one from the Kansas City Animal Health Corridor (KCAHC).

The letter from Dr. John Spertus at St. Luke's Mid-America Heart Institute indicates numerous ways in which the biomedical engineering students will be able to collaborate with professionals at the hospital "through technology transfer, internships, and research." He also notes that "biodevices, biomaterials and bioinformatics have been projected to be a trillion-dollar market in the coming years." Dr. Spertus adds that with this growth, the market will be in high need of trained biomedical engineering graduates.

The letter from Dr. Mark Hoffman at Children's Mercy Hospital points out that graduates with degrees in biomedical engineering "will be in demand as Children's Mercy, Cerner and other local employers seek to hire people who can effectively work in the space between the clinical and technical." In addition, Dr. Hoffman has expressed that he will advocate for collaborative opportunities, such as internships and student projects, to allow for biomedical engineering students to gain practical experience working at Children's Mercy.

There is also a letter from Corbin Reagan, the Director of Engineering at RBC Medical Innovations, which is a medical technology engineering company located in the Kansas City metro region (Lenexa, Kansas). Mr. Reagan specifically expresses that RBC has hired a number of UMKC engineering graduates in the past and has been very pleased with their knowledge and skillsets. With these newly proposed biomedical engineering programs, RBC would have additional motivation to hire UMKC graduates. In addition, RBC would be able to partner with the biomedical engineering students through internships, research collaborations, and senior design projects.

The Kansas City Animal Health Corridor (KCAHC) currently works in partnership with regional academic institutions to pipeline skilled talent into the animal health industry. The letter from Kimberly Young, the president of KCAHC, commits to work "with UMKC faculty and staff to share student resumes with regional animal health employers." This partnership will open up a vast array of employment opportunities to the future UMKC biomedical engineering graduates. Although we did not provide specific letters, it should be noted that MRI Global, formerly Midwest Research Institute, and Stower's Research Institute are both located next door to campus. Both Institutes are involved in high level biomedical research and have expressed interest in biomedical engineering graduates to help bolster their research teams.

In addition to the provided external letters of support, there are three internal letters of support including letters from: Jennifer Lundgren, Provost of UMKC; Kevin Truman, Dean of SCE; and Mary Anne Jackson, Dean of the School of Medicine.

3.A.2. Student Demand for the Program

Biomedical engineering is an extremely popular field for graduating high school students across the US. SCE fields many questions from prospective students about the possibility of studying biomedical engineering as an undergraduate degree. Although we do not have statistics, anecdotally it has been a question that arises frequently. Currently, the best option we can recommend to those students is to pursue the BS degree in a traditional engineering field (such as mechanical or electrical) and then gain exposure to biomedical engineering topics through senior electives and graduate programs.

The KC STEM Alliance is an independent agency managed through the School of Computing and Engineering and serves as SCE's primary K-12 outreach program. Funding to support the Alliance comes from a multi-year grant from the Ewing Marion Kauffman Foundation and from area STEM related companies, grants, and other non-profit agencies and organizations. The KC STEM Alliance is currently serving more than 90.000 students in the area with programming such as Project Lead the Way (STEM coursework and programming for area K-12 schools) and KC FIRST (competitive robotics





programming), as well as several other programs aimed to engage young people in STEM learning.
The Project Lead the Way (PLTW) high school program consists of three separate curriculum tracks: Biomedical, Engineering, and Computer Science. The following table and accompanying figure show the number of Kansas City area high school students participating in PLTW in the Biomedical Track, the Engineering Track, and the Computer Science Track.³ Note that Biomedical is nearly as high in participation in KC area high school students as is general engineering which encompasses all of the other engineering disciplines (mechanical, electrical, civil, etc.).

Year	Biomedical	Engineering	Computer Science
	Enrollment	Enrollment	Enrollment
2016-2017	4,227	5,736	1,717
2017-2018	4,017	5,744	1,680
2018-2019	4,253	5,046	1,984
2019-2020	4,816	4,959	2,408
4 year AVG	4,328	5,371	1,947

In the 2019-2020 academic year the undergraduate enrollments in SCE for all engineering disciplines (ME, CE, and ECE) was 588 students and for computer science was 339 students. The SCE enrollments are 11% and 17% of the average PLTW enrollments in engineering and computer science, respectively. Hypothetically, if we follow a similar trend to engineering for biomedical and assume 10% of the PLTW students would enroll in the biomedical engineering program at UMKC that puts total enrollments at 432 total students. Out of conservatism and understanding that some of these students will choose more traditional medical or biological paths we can bump that percentage down to 5% and that still puts enrollment at 216 students which is almost 50% above our five-year estimate at 146 students. To meet our projection, we would only need to get 3.4% of these PLTW students which is substantially lower than our comparable engineering and computer science program percentages. In addition, there are definitely some students in the engineering track in PLTW that we are losing due to the fact that we do not currently have degrees in biomedical engineering which would potentially add to this population even further.

If we look at only the 2019-2020 school year and break it out into specific PLTW Biomedical courses across the KC metro region, there were 2,275 in the Principles of Biomedical Science course, 1,270 in the Human Body Systems course, 518 in the Medical Interventions course, and 253 in the Biomedical Innovation course which is the senior level course in the track. Using this data, we came up with our initial estimate for incoming freshmen is 25 students which is 10% of the enrollment in this senior course in the KC metro area.

³ https://www.kcstem.org/about/what-we-do/project-lead-the-way-2020-21/

It is also important to note that the Biomedical Engineering discipline historically has been able to attract a very high number of female students as compared to other engineering disciplines. Recently published data presented a national average of 40.9% bachelor's degrees awarded to female students in biomedical engineering versus an average of 19.9% in all engineering disciplines.⁴

Currently in SCE, numerous biomedical elective courses are already offered. The demand for these courses has been consistently high and comparable to other elective courses in our traditional engineering disciplines. For example, in the biomedical courses offered over the past two years just in the mechanical engineering program (Biomaterials, Biomechanics, Biodynamics, Experimental Biomechanics of Human Motion, and Biomedical Device Design), there has been an average of 31 total undergraduate students enrolled (in both 2019 and 2020).

Undergraduate enrollment over the past three years at a few select regional universities is summarized in the following table.

University	Program	Enrollment		
		2018	2019	2020
K-State	Bachelors in Biomedical Engineering	42	79	85
KU	Certificate in Bioengineering	26	49	38
Wichita State	Bachelors in Biomedical Engineering	237	232	190
UM-Columbia	Bachelors in Biomedical Engineering	26	71	191

The enrollment projections shown in the following table have an estimated starting enrollment of 25 students with a growth of 10 students per year from there forward and a retention rate of 75% per year for the undergraduate program. See attachment: *BS Biomed Proforma.xlsx*.

Table 1a. Student Enrollment Projections (anticipated total number of students enrolled in the program during the first five fall semesters following implementation.)

Year:	1	2	3	4	5
Full-time	25	54	85	119	146
Part-time	0	0	0	0	0
Total	25	54	85	119	146

⁴ https://www.asee.org/papers-and-publications/publications/collegeprofiles/15EngineeringbytheNumbersPart1.pdf

Table 1b. New Student Enrollment Projections (anticipated number of students enrolled in the program during the first five fall semesters following implementation that are new to the University.)

Fiscal Year:	1	2	3	4	5
Full-time	25	54	85	119	146
Part-time	0	0	0	0	0
Total	25	54	85	119	146

Table 1c. Projected Number of Degrees Awarded

Year:	1	2	3	4	5	6	7	8	9	10
# of Degrees Awarded	0	0	0	11	15	19	23	28	32	36

In addition to specific demand indicated for a biomedical engineering degree, these enrollment projections are also in line with what we have seen from other UMKC computing and engineering programs. In 2019-2020, SCE had an undergraduate enrollment of 249 in Electrical & Computer Engineering, 121 in Civil Engineering, 339 in Computer Science, 70 in Information Technology, and 218 in Mechanical Engineering.

The undergraduate enrollments in SCE (including Electrical & **Computer Engineering**, **Civil Engineering**, **Computer Science**, Information Technology, and Mechanical Engineering) have grown from 490 in 2008 to 1,140 in 2019 with retention rates increasing from 60% to 82% and full-time students increasing



from 47% to 79%. Growth of SCE over the past 10 year is shown in the figure.

3.B. Financial Projections

A pro forma worksheet with financial projections is included, see attachment: <u>BS</u> <u>Biomed Proforma.xlsx</u>.

3.B.1. Additional Resources Needed

Costs include faculty and support salaries and benefits; start-up packages; course development; non-capital equipment; supplies; travel and training; and miscellaneous expenses. Hiring of an adjunct faculty member is planned for year 1 and second in year 2. Hiring of an additional full-time faculty member is planned for years 3, 4, and 5.

3.B.2. Revenue

The sources of revenue include tuition and fees for new students. No financial support is being provided by the university. No external funds are being used.

3.B.3. Net Revenue

Annual revenue will exceed annual expenses and the program will break even in the first year.

Table 2 Financial Pro	iections for Pro	nosed Program fo	r Vears 1 Through 5	
Table 2. Financial I To	jections ior i ro	poseu i rogram ic	n icais i iniugn J.	

	Year 1	Year 2	Year 3	Year 4	Year 5
1. Expenses per year					
A. One-time					
New/Renovated Space	0	0	0	0	0
Equipment	0	0	0	0	0
Library	0	0	0	0	0
Consultants	0	0	0	0	0
Others (start-up costs)	0	0	60000	120000	150000
Total one-time	0	0	60000	120000	150000
B. Recurring					
Faculty	7650	15606	111427	211074	306382
Staff	5100	5202	53060	54122	55204
Benefits	2809	3462	58209	92765	128047
Equipment	0	0	12732	12989	13249
Library	0	0	0	0	0
Other (includes payroll outside of	41900	82247	108487	135671	163944
program)					
Total recurring	57459	106544	343914	506621	666827
Total expenses (A+B)	57459	106544	403917	626621	816827
2. Revenue per year					
Tuition/Fees	252630	554018	896930	1275957	1600568
Institutional Resources	0	0	0	0	0
State Aid – CBHE	0	0	0	0	0
State Aid – Other	0	0	0	0	0
Total revenue	252630	554018	896930	1275957	1600568
3. Net revenue (loss) per year	195172	447474	493013	649336	783741
4. Cumulative revenue (loss)	181799*	629273	1122286	1771622	2555363

NOTE: *Takes into account \$13,373 in expenditures in year 0 for support salary and course development.

A reduced enrollment analysis was completed to validate the financial strength of the new program. A prediction of 50% enrollment from our original estimates in the proforma was completed. Even at these low enrollment numbers, the BSBME program was still financially viable, showing satisfactory positive net revenue by the second year. For specific details, see the attachment: <u>BME reduced enrollment</u> <u>analysis.pdf</u>.

3.B.4. Academic and Financial Viability

Although revenues are positive even with the starting enrollment of 25 students, for steady-state viability, SCE believes that the BSBME program needs a total enrollment of 100 students. This provides approximately 25 per class which keeps all courses at a single section but provides a large enough cohort for the students to receive a positive and meaningful academic experience.

Viability	Minimum Enrollment
Academic	100
Financial	100
Overall	100

Table 3. Enrollment for Academic and Financial Viability

3.C. Business Plan: Marketing, Student Success, Transition & Exit Strategies

3.C.1. Marketing Plan

UMKC and SCE recruiting units across campus will support marketing of the BSBME program to area high school students. The BSBME also will be included in existing marketing (mass email, printed pieces, websites, social media). SCE has a dedicated MCOM staff person who works in conjunction with SCE to market our programs.

Once the program is formally launched, the Dean of SCE will appoint a Degree Program Director or Chair who will serve as the point person to work with MCOM regarding recruitment and marketing efforts. At the preliminary stage to ensure its successful start, the Dean (Kevin Truman) and the Assistant Dean (Katherine Bloemker) will coordinate with MCOM directly and serve as the point persons for the proposed BS degree in Biomedical Engineering.

There were 46 high schools in the metro KC region that taught the Project Lead the Way Biomedical track in 2019-2020. The partnership with the KC STEM Alliance will be our main focus for marketing the new biomedical undergraduate program to high school students. We would mainly market directly to the metro KC region (as we do with our current engineering programs). We would also specifically target the Kansas side since there is no biomedical engineering undergraduate program at the University of Kansas, which is the closest other major university to the West.

3.C.2. Student Success Plan

In order to ensure high retention and graduation rates for BME students, there are a number of resources that will be available to all students including advising, career

services, support services, faculty mentorship, research opportunities, and student organizations. Each of these resources is laid out in detail in the following:

- Roo Advising, Mobility Escalators, and Career Services

- Biomedical Engineering students will have access to all resources offered in Roo Advising, Mobility Escalators, and Career Services.
 - Roo Advising provides centralized, professional advisors ensuring that the students will remain on track for a four-year graduation. They will also advise the students on the BSBME/MSBME opportunity and the professional and career advantages of pursuing an MSBME as an add-on to the BSBME.
 - Business/Engineering Mobility Escalator is an enhancement to Roo Advising focusing on professional and career mentoring and counseling. These mentors and counselors provide guidance on careers, ethics, and workplace dynamics. In this escalator, the BSBME and MSBME students will be entwined with the business counselors that can provide a multitude of services and career possibilities for these students. These counselors and mentors will help guide these students to the appropriate BME related career, whether it be research, biotech, professional schools, biotech firms or startups.
 - **Career Services** professionals are available to help the students explore and prepare for applying and placement in internships and jobs. The Bloch School of Management and the School of Computing and Engineering have partnered on Career Fairs for several years with over 140 companies attending the last career fair. This will only grow as we invite the biomedical related firms from the Kansas City region to join the Career Fair.

- SCE and Health Sciences Support Services

- The BSBME/MSBME students will have access to all current SCE support services.
 - SCE Student Affairs team is dedicated and works in concert with the UMKC Centralized Services. The SCE Student Affairs Team has direct, connected access to the students, faculty, companies and other UMKC schools and can provide a personalized approach consisting of guidance, connecting, and preparing individual students, academically and professionally.
 - **Guiding** students through their 4-yr curriculum.
 - **Connecting** the students with biotech, bioengineering and biomedical companies, internships, and UG/Grad research.
 - See below for a description of SCE's Career Connections Program.

- **Preparing** each student with customized professional school preparation and career guidance.
- Since the implementation of the SCE Student Affairs team, SCE has seen improved retention from 50% in 2008 to an average of 79% from 2016-2021. SCE's goal has been to be a "pump and not a filter"; so, every action is with that goal in mind. Every student admitted and entering SCE should be a future graduate.

• Faculty mentors

- Each BME student will be assigned a faculty mentor to help with career and/or research guidance.
 - Mentors will be available from multiple disciplines including, engineering, natural sciences, and health sciences. Students will have the opportunity to select their faculty mentor(s) based on their specific biomedical areas of interest.

• Undergraduate (and Graduate) Research Opportunities

- Undergraduate students in the biomedical program will have access to a multitude of undergraduate and graduate research opportunities.
- Many current mechanical, electrical, and software engineering undergraduate and graduate students participate in biomedical engineering research within the Schools of Pharmacy, Dentistry and Medicine.
 - Approximately 25% of SCE's current funded research is within the Schools of Pharmacy, Dentistry and Medicine.
- With the addition of biomedical engineering, the number of research opportunities, courses, internships and contacts to the Schools of Biological Sciences, Medicine, Dentistry and Pharmacy will increase dramatically.

• Student Chapter of the Biomedical Engineering Society

- Once the Biomedical Engineering program is approved and matriculates its first cohort of students, it is planned to add a student chapter of the Biomedical Engineering Society (BMES).
- As with all of SCE's current societies, this engineering society will provide a place for biomedical engineering students to connect with other students and companies, attend conferences, participate in student events, and have the potential for leadership opportunities.

In order to help BME students with job placement, there are a number of resources that will be available to all students including career services, career connections,

career fairs, internship opportunities, and mobility escalators. Each of these resources is laid out in detail in the following:

- UMKC and SCE Career Services

- Biomedical Engineering students will have access to all services currently offered in the UMKC Career Services.
- Biomedical Engineering Students will have access to all services provided by the SCE Student Affairs Team and their faculty mentors. With the help of the SCE Student Affairs Team over the last 5 years:
 - 79% average retention of SCE students.
 - 80% of all SCE Juniors and Seniors have interned or had research opportunities.
 - 90+% of all SCE Seniors have had jobs as of graduation.

• SCE's Career Connections Program

All students in SCE (and UMKC) including those within the BME program have the ability to participate in SCE's Career Connections program. The SCE Student Affairs team brings in professionals from companies to provide insights into their day-to-day jobs (work) for BME professionals. These degree program related companies and their employees, in this case bio-related companies, are used to help students explore as many career possibilities as possible. There will be a variety of regional, bio-related companies included in the Career Connections Program.

• Career Fairs

- One of the best places for students to connect with potential employers is career fairs. SCE participates in a career fair each year with the Bloch School of Management.
 - The last career fair held on campus for just business and engineering had over 140 companies and has proven to be an exceptional resource for students to connect directly with the regional and national job market.
 - Once the BME programs are in place, more biomedical focused companies will be invited to this career fair.

• SCE's high employment placement rates

- It is expected that the biomedical engineering students will track with all other SCE engineering disciplines, which historically have extremely high employment placement rates, averaging 92% over the last five years, with placements locally and nationwide.
- This placement rate is due to all the prescribed, personal UMKC and SCE support services, possible internships, career

connections, industrial capstone design projects, advisory boards and more.

• UMKC Business and Engineering Mobility Escalator

 The Business and Engineering Mobility Escalator will be a good pipeline for BME students to find those connections between engineering, health sciences, and business, preparing them for biomedical related workplace(s), a research career or professional schools such as medicine, dentistry or pharmacy.

3.C.3. Transition Plan

The individual primarily responsible for the BSBME program is Assistant Dean Katherine Bloemker. However, once the program is implemented a Degree Program Committee (DPC) will be formed comprised of current faculty with expertise in the biomedical fields. Having this standing committee will ensure a seamless transition in the event where any of the primary individuals can no longer fulfill the necessary duties for managing the program's day-to-day needs.

3.C.4. Exit Strategy

If the situation arises that the program is underperforming expectations and financial viability is compromised, the Degree Program Committee (DPC) will be charged with providing a plan of action to improve enrollments and/or decrease expenditures. A three-year window will be allowed following the implementation of the action plan. Following the three years, if the revenues from the program are still not exceeding the expenditures, the Dean will decide whether a hiatus or discontinuation of the program is needed.

4. Institutional Capacity

The BSBME program will require little to no initial resources (see the attached pro forma) to begin matriculating students. SCE's new research facility already has the necessary labs for both the academic and research associated with such a degree. SCE already has sufficient faculty expertise and staff for this degree. The addition of this degree will place a very small additional financial burden on SCE of approximately \$15k and \$25k in first two years. The program will be revenue positive from year one and will only grow in net revenue each of the following three years at which time SCE will make the decision whether to go steady-state in size or continue growing.

Initially, the Bachelor of Science in Biomedical Engineering (BSBME) will not place any new burden on the School of Computing and Engineering (SCE). The BSBME degree will be jointly administered, staff and faculty, by the SCE Departments of Civil and Mechanical Engineering (CME) and Computer Science Electrical Engineering (CSEE). Once the program has grown, SCE leadership will decide if a separate department is optimal. SCE already has 6-7 faculty with advanced degrees or specialty research programs in the field of biomedical devices, biosensors, biomaterials, bioimaging, biomechanics and bioinformatics. These faculty coupled with other experts in other UMKC schools can cover the teaching (already teaching most of the proposed courses as electives) and research needs of the BSBME for the first several years. New faculty will only be added once the program has sufficiently increased enrollments and needs more expertise.

Being in Kansas City, SCE can also rely on community experts as adjunct faculty that have expertise in areas where SCE faculty may not. These adjuncts provide a realworld education that students cannot typically get from a non-urban located university. Additionally, these adjuncts often provide internships and career guidance that is extremely beneficial for the students and ultimately SCE's recruitment efforts.

This degree is in large demand within SCE. Many students already pursue an emphasis in biomedical engineering by taking a large number of biomedical electives taught within SCE. SCE's enrollment will increase with the offering of this new degree with very little in up-front investments.

5. Program Characteristics

5.A. Program Outcomes

Achievement of the goals listed in section 2.A is assessed by the following Student Learning Outcomes (SLOs). Note that each outcome has specific goals mapped to it.

SLO 1:	Students will be able to use mathematics and	G1, G2
	biostatistical methods to solve problems.	
SLO 2:	Students will be able to analyze fluid flow properties	G1, G2
	of thermal-fluid systems.	
SLO 3:	Students will be able to design and implement	G1, G3
	biomedical engineering components.	
SLO 4:	Students will be able to analyze biomedical systems	G1, G2, G4
	and solve systems problems.	
SLO 5:	Students will be able to investigate characteristics of	G1, G3, G4
	biomaterials.	
SLO 6:	Students will be able to use measurements to solve	G1, G2, G4
	biomedical engineering problems.	

The full six-year assessment plan can be found in the attachment: <u>BSBME Assessment</u> <u>Plan.pdf</u>.

5.B. Program Design & Content

The mapping of courses to the SLOs can be found in the attachment: <u>BSBME</u> <u>Curriculum Map.xlsx</u>.

The four-year program plan with suggested sequence of courses can be found in the attachment: <u>BSBME 4 Year Prgm Plan.pdf</u>.

The full list of courses with pre-requisites included can be found in the attachment: *BSME Proposed Classes.pdf.*

The four-year course rotation for each course in the program can be found in the attachment: <u>BSBME 4 Year Course Rotation.xlsx</u>.

5.C. Program Structure

5.C.1. Program Structure Form

- 1. Total Credits Required for Graduation: 127
- 2. Residence requirements, if any: None

3. General education

- a. Total general education credits: 34*
 - *Calculus course is 4 credit hours, Additional 3 credit hours for the MO Constitution requirement. See attachment: <u>BSBME</u> <u>Proposed Classes.pdf</u>.

Course	Hrs	Course	Hrs	Course	Hrs
MATH 266 Accelerated	4*	Critical Thinking in	3	First Semester	3
Calculus I (Math)		Arts & Humanities		Experience	
CIV-ENGR 275	3	Critical Thinking in	3	Written	3
Engineering Statics		Social & Behavioral		Communication I	
(Critical Thinking in the		Sciences			
Natural Sciences)					
MEC-ENGR 492	3	Culture and	3	Oral	3
Mechanical Design	C	Diversity	C	Communication	
Synthesis I OR					
COMP-SCI 304WI Ethical		POL-SCI 210 OR HIST	3*	Written	3
Issues in Computing and		101 OR HIST 102 -		Communication II	
Engineering (Civic		MO Const.			
Engagement)		Requirement			

Courses (specific course or distribution area and credit hours):

4. Major Requirements

- a. Total credits specific to degree: 103**
 - i. **10 credit hours fulfill both general education and math/engineering requirements. See attachment: <u>BSBME</u> <u>Proposed Classes.pdf.</u>

Course	Hrs	Course	Hrs	Course	Hrs
MATH 266 Accelerated Calculus I <i>(Math Pathway)</i>	4**	CIV-ENGR 275 Engineering Statics (Critical Thinking in the Natural Sciences)	3**	BME 1XX Intro to Biomedical Engineering	1
MATH 268 Accelerated Calculus II	3	CIV-ENGR 276 Strength of Materials	3	BME 1XX 3D Modeling and 3D Printing for Biomedical Engineering	1
MATH 250 Calculus III	4	ECE 216 Engineering Computation	3	BME 3XX Biomedical Inst. & Meas. Lab	4
MATH 345 Differential Equations	3	ECE 276 Circuit Theory I	3	BME 3XX Biomedical Systems Physiology	3
CHEM 211 General Chemistry	4	ECE 277 Circuit Theory I Lab	1	BME 3XX Biomedical Transport	3
CHEM 211L General Chemistry Lab	1	ECE 380 Signals and Systems	3	BME 4XX Biomedical Design Synthesis (Capstone Design)	3
CHEM 212R General Chemistry II	4	ECE 381 Signals and Systems Lab	1	Biomedical Technical Elective***	3
CHEM 212LR General Chemistry II Lab	1	ECE 420 Advanced Engineering Computation	2	Biomedical Technical Elective***	3
PHYS 240 Physics for Science and Engineering I	5	MEC-ENGR 299 Thermodynamics OR ME 285 Dynamics	3	Biomedical Technical Elective***	3
PHYS 250 Physics for Science & Engineering II	5	MEC-ENGR 351 Fluid Mechanics	3		
BIOL 108 General Biology I	3	MEC-ENGR 406 Introduction to Biomaterials	3		
BIOL 108L General Biology I Lab	1	MEC-ENGR 492 Mechanical Design Synthesis I OR	3**		
BIOL 202 Cell Biology	3	COMP-SCI 304WI Ethical Issues in Computing and Engineering (Civic Engagement)			
BIOL 304 Biostatistics I	3				
HLSC 120 Anatomy and Physiology I	4				

Courses (specific course or distribution area and credit hours):

5. Free elective credits

- a. Total free elective credits: 0***
 - i. ***There are no free electives, however there are 9 credit hours of technical electives that the students can select from a number of options in multiple disciplines. See page 2 of attachment: <u>BSBME 4 Year Prgm Plan.pdf</u>.
- 6. **Requirement for thesis, internship or other capstone experience:** All senior students are required to take a capstone design class: Biomedical Design Synthesis.

7. Any unique features such as interdepartmental cooperation:

Required courses in the BSBME program will be taught by faculty members from both the Civil & Mechanical Engineering Department as well as the Computer Science Electrical Engineering Department. Technical Elective courses can come from a variety of degree programs including: Engineering, Biology, and Chemistry.

5.D. Program Goals and Assessment

The student learning outcomes are assessed in the courses listed on the curriculum map with the letter A (see attachment: <u>BSBME Curriculum Map.xlsx</u>). Data is collected from the instructor of each course. Depending on the course, this data could be performance on a project, an exam question, a presentation, or a homework assignment. This performance data is provided to the program coordinator and the assessment coordinator for SCE (Assistant Dean Katherine Bloemker). Each student activity performance is broken into 3 categories (unacceptable, acceptable, and excellent). The target for achievement in all courses is that 80% of the students meet the acceptable or excellent level for the student activity relating to the particular outcome. The Degree Program Committee (DPC) will be responsible for program oversight.

In addition to regular campus assessment from HLC, the BSBME program will undergo routine accreditation through the EAC of ABET alongside SCE's five other currently accredited programs. ABET is a standing agenda item at all faculty meetings and all undergraduate faculty are well versed in the requirements needed to sustain ABET accreditation requirements and maintaining programmatic continuous improvement. The faculty in SCE are all individually involved in ABET accreditation measures, including course assessment, student work collection, PEO reviews, student survey reviews, and frequent interaction with advisory boards. It is planned that once implemented, the BSBME program will follow an assessment plan and structure very similar to those of the other five programs. As mentioned previously, average undergraduate retention rates in SCE are about 82%. The goal for the BSBME program would be for both retention and graduation rates to be at or above the SCE average, definitely above 80%.

Placement rates for undergraduate engineering students in SCE is extremely high, nearing 90%. This is mainly due to the fact that over 90% of SCE's undergraduate students work at an internship while attending school. Many of those internships turn directly into full-time employment upon graduation. The goal for BSBME would be to stay at or above the current placement rates in SCE. However, it is assumed that a majority of the BSBME students will go on to the expedited MS program so placement out of the BSBME program will not focus on immediate employment, but either employment or graduate school.

5.E. Student Preparation

High school students planning to apply to SCE are strongly encouraged to take a college preparatory program that emphasizes mathematics, science, and communication skills.

First-time college student applicants to the undergraduate program will be admitted if they obtain:

- 1. An ACT mathematics score of at least 25 and
- 2. An ACT composite score of at least 24

First-time college student applicants who do not meet the above criteria but do meet UMKC general admission requirements will have their applications reviewed by a committee for admission. Applicants who are not admitted to SCE but do meet UMKC general admission requirements may be admitted to University College.

Students without the prerequisite preparation must take the needed coursework before enrolling in courses required for the bachelor's degree. Students seeking readmission must have been in good academic standing when last enrolled. Otherwise, re-admission requires a formal review by the undergraduate program committee.

Transfer applicants must have at least 24 credits of transferable college credit and an overall 2.0 GPA on a 4.0 scale in all coursework, which includes repeated coursework, attempted at previous institutions. Transfer applicants without a 2.0 or higher college GPA must submit a petition for admission.

5.F. Faculty and Administration

More than thirty existing faculty members from the Schools of Biological and Chemical Sciences, Computing and Engineering, Dentistry, Medicine, Nursing and Health Sciences, and Pharmacy are identified to offer courses and research projects related to biomedical engineering. See attachment for specific names and expertise areas: *Faculty Members for Biomedical Engineering v2.pdf*. It is estimated that near 100% of the credit hours in the program will be assigned to full-time faculty members. As needed, and as enrollments grow, adjunct instructors can be used for some elective courses, but it is planned that the required courses will be taught by full-time faculty members.

There will be select courses **that are team taught by medical professionals and biomedical engineering faculty**, but those specific courses are to be developed as the program progresses. There has been tremendous interest from the Health Science faculties to be involved and to be co-teachers in these courses; Pharmacy, Medicine, Dentistry, Nursing and Bio Sciences. The planned curriculum is infused with collaboration between engineering faculty and medical professionals. In each year, it is planned that students will have direct access to medical professionals through specific courses, experiences, field trips, projects, and seminars. The 5-year progression of these activities is as follows:

Year 1: "Intro to Biomedical Engineering"

- physician and medical professional guest lectures and speakers in addition to the technical bioengineering topics needed

Year 2: "3D Modeling and Printing for Biomedical Engineering"

- physician and medical professional guest lectures and speakers in addition to the technical bioengineering topics needed

Year 3: Field trips within required courses

- to the Health Science Campus and the research labs (Vision Center, Orthopedic Surgery, Center for Mineralized Tissue, School of Pharmacy, CMH, Truman, St. Luke's) in order to discuss current and future biomedically engineered needs such as devices, software, imaging, drug delivery, informatics, personalized medicine, telemedicine, augmented reality and more.
- to develop potential ideas for projects, independent studies and directed reading courses.

Year 4: Capstone Design course

- industry, medical, and research sponsored projects (SCE has 15-20 industry projects a year for its current capstone design courses.)

Year 5 (5-year BSMS): Graduate Biomedical Engineering Seminar

- will include presentations from physicians and medical professionals in addition to bioengineers and biomedical researchers. Each week will bring a different topic or research area that pertains to the many facets of the biomedical engineering profession.

Assistant Dean Katherine Bloemker will be the primary point person for the program. In addition to Dr. Bloemker, a degree program committee (DPC) will be formed to help keep tracks of activities, students, and advising for the proposed BSBME Degree.

To start the degree program in Fall 2021, no new faculty is needed. New faculty hires will not be needed until students reach the 3rd year of the program – planned for Fall 2023. At that point, the department plans to hire an adjunct professor as well as a tenure-track professor to teach a portion of the required courses. Although the pro forma indicates hiring of an additional faculty member by year 4 and another by year 5, future hiring of tenure-track faculty will be based solely on growth in headcount and revenue generated.

5.G. Alumni and Employer Survey

SCE plans to complete senior exit and alumni surveys for the BSBME program, just as is done in all other accredited programs in the school. Currently, all graduating seniors in the SCE programs are required to fill out a senior exit survey through Qualtrics. The survey asks about student outcomes, student experience, whether they have an engineering job or are planning to go to graduate school, whether they plan to or have taken the FE (Fundamentals of Engineering Exam – the first step towards licensure), and whether they plan to become licensed after their four years of experience is achieved.

In addition to the survey, all graduating seniors have a face-to-face senior exit interview with either their faculty advisor or the department chair before graduating. This interview allows the students to elaborate on their responses to the survey questions as well as give other feedback from their experience in the program. Once per accreditation cycle an alumni survey is sent out to all alumni from the SCE programs. The survey asks about student outcomes, whether they have an engineering job, whether they have a graduate degree, and whether they plan to or have become licensed. In addition to these surveys, the Dean of SCE routinely hosts lunches for alumni engagement for the school. At these lunches the Dean gives a state of the school. In addition, the alumni are informed about continuing education opportunities and upcoming alumni events.

SCE also plans to create an advisory board for the BSBME program, exactly like is currently done in all other accredited programs in the school. The advisory board members will represent employers of the program. The advisory board members are involved in maintaining a strong program. Since the advisory board members have a personal interest in SCE, their participation in developing objectives assures them that SCE is an association with which they can be proud. Following the procedures currently used in SCE, the advisory board will meet twice per semester to discuss the state of the program. These meetings generally include a school update from the dean or chairperson, an ABET update, board committee reports, board focus points for the year, and other announcements. Once per year the advisory board meets with undergraduate students in each of their respective engineering programs. In addition, the faculty in the engineering programs also meet with their respective advisory boards once per year.

5.H. Program Accreditation

SCE currently had three undergraduate programs accredited through the EAC of ABET (Civil Engineering, Electrical & Computer Engineering, and Mechanical Engineering) and two accredited programs through the CAC of ABET (Computer Science and Information Technology). SCE plans to have the Biomedical Engineering program accredited through the EAC of ABET. The major curriculum requirements for ABET accreditation of a Biomedical Engineering Program which have been planned into the Four-year plan are: (1) A minimum of 30 credit hours in math and basic sciences, including calculus, differential equations, statistics, biology, human physiology, chemistry and calculus-based physics, with experimental experience. (2) A minimum of 45 credit hours in engineering topics, including engineering, computer science, engineering design, and utilizing modern engineering tools. (3) A broad education component. (4) A culminating engineering design experience. (5) Solving biomedical engineering problems. (6) Analyzing, modeling, designing, and realizing biomedical engineering devices, systems, components, or processes. (7) Making measurements on and interpreting data from living systems.

Accreditation through the EAC of ABET cannot be sought until the first students have graduated from the program which is expected May 2025. SCE's current programs are not up for their next comprehensive review until 2025, so at that time the BSBME will be proposed for accreditation.

6. Appendices

- A. Curriculum Documents
- B. Faculty Documents
- C. Assessment Documents
- D. Financial Documents
- E. Burning Glass Reports
- F. Letters of Support

BACHELOR OF SCIENCE IN BIOMEDICAL ENGINEERING

FIRST YEAR

FALL SEMESTER	HOURS	SPRING SEMESTER	HOURS				
MATH 266 Accelerated Calculus I (UMKC Essentials)	4	MATH 268 Accelerated Calculus II	3				
CHEM 211 General Chemistry	4	PHYS 240 Physics for Science and Engineering I	5				
CHEM 211L General Chemistry Lab	1	CHEM 212R General Chemistry II	4				
BME 1XX Intro to Biomedical Engineering	1	CHEM 212LR General Chemistry II Lab	1				
First Semester Experience (UMKC Essentials)	3	Oral Communication (UMKC Essentials)	3				
Written Communication I (UMKC Essentials)	3						
Total	16	Total	16				

SECOND YEAR

FALL SEMESTER	HOURS	SPRING SEMESTER	HOURS
MATH 250 Calculus III	4	MATH 345 Differential Equations	3
PHYS 250 Physics for Science & Engineering II	5	ECE 216 Engineering Computation	3
BIOL 108 General Biology I	3	BIOL 202 Cell Biology	3
BIOL 108L General Biology I Lab	1	CE 276 Strength of Materials	3
CE 275 Engineering Statics (UMKC Essentials)	3	BME 1XX 3D Modeling and 3D Printing for Biomedical	1
		Engineering	
		Critical Thinking in Arts & Humanities (UMKC	3
		Essentials)	
Total	16	Total	16

THIRD YEAR

FALL SEMESTER	HOURS	SPRING SEMESTER	HOURS
BIOL 304 Biostatistics I	3	ME 299 Thermodynamics OR ME 285 Dynamics	3
ECE 380 Signals and Systems	3	BME 3XX Biomedical Inst. & Meas. Lab	4
ECE 381 Signals and Systems Lab	1	ECE 276 Circuit Theory I	3
ME 351 Fluid Mechanics	3	ECE 277 Circuit Theory I Lab	1
HLSC 120 Anatomy and Physiology I	4	ECE 420 Advanced Engineering Computation	2
Written Communication II (Technical Writing	3	Critical Thinking in Social & Behavioral Sciences	3
recommended) (UMKC Essentials)		(UMKC Essentials)	
Total	17	Total	16

FOURTH YEAR

FALL SEMESTER	HOURS	SPRING SEMESTER	HOURS
ME 492 Mechanical Design Synthesis I OR CS 304WI	3	BME 4XX Biomedical Design Synthesis (Capstone	3
Ethical Issues in Computing and Engineering (Civic		Design)	
Engagement) (UMKC Essentials)			
BME 3XX Biomedical Systems Physiology	3	BME 3XX Biomedical Transport	3
ME 406 Introduction to Biomaterials	3	Biomedical Technical Elective*	3
Biomedical Technical Elective*	3	Biomedical Technical Elective*	3
Culture and Diversity (UMKC Essentials)	3	POL-SCI 210 OR HIST 101 OR HIST 102 - MO Const.	3
		Requirement	
Total	15	Total	15

Total Credits to Graduate 127

*Biomedical Technical Elective Options – CHOOSE Courses from this list (or any 400 level advisor approved course in MEC-ENGR, CIV-ENGR, EC-ENGR, BIOL, or CHEM):

- **BIOL 206 Genetics**
- BIOL 441 Biochemistry (pre-req: Organic Chemistry)
- **BIOL 452 Bioinformatics**
- **BIOL 401 Biostatistics II**
- ECE 401 Nanoelectromagnetics and Plasmonics
- ME 401 Introduction to Biomaterials
- ME 411 Introduction to Biomechanics
- ME 412 Biodynamics
- ME 413 Experimental Methods in Biomechanics
- ME 401 Biomedical Device Design
- ME 401 Imaging to Modeling
- ME 401 Introduction to Polymers and Soft Materials
- ME 401 Biomaterials Surface Science
- ME 401 Advanced Thermodynamics

Math Courses (for ABET must include calculus, diff eq and statistics)

Course and Description	CR	Pre-reqs
MATH 266 Accelerated Calculus I (UMKC Essentials)	4	Math 120 or both Math 110
An accelerated first course in calculus focusing on application of differential calculus		& Math 125 or
and basic vector and matrix calculations.		ALEKS assessment score of
		76% or higher
MATH 268 Accelerated Calculus II	3	MATH 266
An accelerated second course in calculus focusing on application of integral		
calculus, analytic geometry, and vector analysis.		
MATH 250 Calculus III	4	MATH 268 or MATH 220
Vectors, solid analytic geometry, vector functions and multiple variable functions,		
partial derivatives, multiple integrals, line and surface integrals with applications.		
MATH 345 Differential Equations	3	MATH 250
First order equations, linear second order differential equations, Taylor series and		
power series solutions, Laplace transforms, elementary systems of differential		
equations, numerical methods, and Fourier series and boundary value problems.		
BIOL 304 Biostatistics	3	MATH 110 or STAT 235
Introduction to the concepts of probability, statistical reasoning, and experimental		
design in the biological sciences. The course emphasizes the application of		
inferential statistics to biological experiments including the use of relevant statistical		
computer packages.		

17 credit hours

Science Courses (for ABET must include biology, human physiology, chemistry, calc-based physics)

Course and Description	CR	Pre-reqs
CHEM 211 General Chemistry	4	Prerequisite: A working
Stoichiometry, gas laws, thermochemistry, atomic structure, molecular shapes and		knowledge of college
bonding theories.		algebra.
CHEM 2111 Conoral Chemistry Lab	1	Co-requisite: Chem 211
Introduction to the laboratory techniques used in studying the chemical properties of	1	Co-requisite. Chem 211
substances. Some quantitative techniques are included.		
CHEM 212R General Chemistry II	4	Prerequisite: Chem
Liquids and solids, solutions, equilibrium, kinetics, electrochemistry and		211/211L
thermodynamics. Introductory course to all advanced work in chemistry.		Co-requisites: CHEM 212LR
CHEM 212LR General Chemistry II Lab	1	Prerequisite: Chem
Introduction to analysis and synthesis. Descriptive chemistry of the more common		211/211L
elements.		Co-requisites: CHEM 212R
PHYS 240 Physics for Science and Engineering I	5	Co-requisites: MATH 210 or
Introduction to mechanics, wave motion and sound and heat and thermodynamics.		MATH 266
PHYS 250 Physics for Science & Engineering II	5	Prerequisites: PHYSICS
Introduction to electricity and magnetism, light and optics and modern physics. Four		240. Co-requisites: MATH
hours lecture and two hours laboratory per week.		220 or MATH 268
BIOL 108 General Biology I	3	High School Biology and
Fundamental studies in biology emphasizing the unity and diversity of life. Topics		Chemistry background
include the basic chemistry of biological processes, cell types and organelles,		nignly recommended
energy narvesting and energy producing pathways, cell and life cycles, genetics,		
anotics speciation and phylogenetic analysis		
BIOL 108L General Biology LLab	1	Co-requisite BIOLOGY 108
Basic laboratory studies in Biology emphasizing the unity and diversity of life	-	
Structure, function, heredity, development, ecology and evolution will be explored.		
BIOL 202 Cell Biology	3	BIOL 108 and CHEM 212R
Basic concepts of cellular and subcellular structure and function, including		
supramolecular and organelle structure and organization, bioenergetics, cell growth		
and cellular communication.		
HLSC 120 Anatomy and Physiology I	4	None listed in Pathway

This course examines the structure and function of the human body from the molecular to the organism level as they interact among all body systems across the life span. Instructors also attempt to correlate course materials with the clinical aspects of the application of physiological knowledge. Co-requisite laboratory exercises provide practical application of theoretical concepts. In this first term of two-term course, molecular biology, biochemistry, cellular biology, and histology are studied as well as the integumentary, musculoskeletal, and nervous systems.	
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31 credit hours (labs in chem, physics, biology, and physiology)

Math + *Basic Science: Total Credits (for ABET must be more than 30 and include experimental experience)* = 48 credit hours

Engineering Topics Courses (for ABET must be more than 45 and include engineering, computer science, design and utilize modern engineering tools)

Course and Description	CR	Pre-reqs
CE 275 Engineering Statics (UMKC Essentials)	3	PHYSICS 240
Fundamentals of statics; static equilibrium; internal forces; introduction to elements		
of mechanics of elastic materials, and properties of areas.		
ECE 216 Engineering Computation	3	MATH 110 or higher or
Development, analysis and synthesis of structured computer programs for solving		ALEKS score of 51% or
engineering problems in the Python, MATLAB, and C languages. Introduction to		higher
algorithms and data structures.		
CE 276 Strength of Materials	3	CIV-ENGR 275
The course introduces and emphasizes the concepts and analysis methods for		
stress and strain, torsion, bending and shear stresses in beams, combined stresses,		
and deflection theory using a calculus based methodology. Introduction to buckling		
and energy methods may be included.		
ECE 276 Circuit Theory I	3	PHYSICS 250 and E&C-
Kirchoff's circuit laws, Ohm's Law, nodal and mesh analyses, source		ENGR 241 or MATH 250 &
transformations, superposition, Thevenin and Norton equivalents, transient analysis		MATH 345
of 1st and 2nd order systems. AC circuit analysis, phasors, impedance, sinusoidal		
steady-state responses, operational amplifiers and PSpice.		
ECE 2// Circuit Theory I Lab	1	Co-requisite: E&C-ENGR
Introduction to the use and limitations of basic instruments used in electrical testing		270
and measurement. Experimental techniques and laboratory safety. Data gathering,		
unperting theoretical concents developed in E%C ENCR 276		
ME 251 Fluid Meshanics	2	MEC ENCE 272 or MATH
Vie SSI Fluid Mechanics	5	345
concepts of the statics and dynamics of fluids, with emphasis on principles of		343
are covered briefly. Thorough treatment of pine flow		
ME 200 Thermodynamics	2	MATH 268 and PHYSICS
Fluid properties, work and heat first law, second law, entropy, applications to vapor	5	250
and ideal das processes		200
OR		OR
ME 285 Dynamics		
Fundamentals of engineering dynamics including kinematics and kinetics of		CIV-ENGR 275
narticles and rigid bodies. Analysis based on forces and accelerations as well as		
energy and momentum methods		
FCE 380/381 Signals and Systems (with Lab) OR BME 3XX Biomedical Signals and	4	E&C-ENGR 341R or MATH
Systems	-	250 & MATH 345
Continuous and discrete-time signals and systems frequency response. Fourier		
analysis of discrete and continuous signals and systems and use of z. Fourier		
Discrete Fourier, and Fast Fourier Transforms.		

ECE 420 Advanced Engineering Computation OR BME 4XX Biomedical Machine Learning	2	E&C-ENGR 216
Programming and computational analysis principles and techniques for various problems in embedded programming, applied computation, and signal processing.		
ME 401 Introduction to Biomaterials OR BME 4XX Biomaterials Current and new technical developments in mechanical engineering.	3	None listed in Pathway
ME 492 Mechanical Design Synthesis I Introduction to and application of the Engineering Design Process including: product development, needs identification, benchmarking, information gathering, concept generation, creativity methods, concept selection, professional and ethical	3	3D modeling experience recommended
responsibilities, and computer-aided design and rapid prototyping applications. A comprehensive design project including 3D CAD models and functioning prototypes is required.		OR
OR		
CS 304WI Ethical Issues in Computing and Engineering (Civic Engagement) (UMKC Essentials)		Roo Writer
Societal and ethical obligations of computer science, information technology, and electrical/computer engineering practice. Topics include obligations of professional practice, electronic privacy, intellectual property, ethical issues in networking, computer security, computer reliability, and whistle-blowing.		

31 credit hours

New Biomedical Engineering Courses

Course and Description	CR	Pre-reqs
BME 1XX Intro to Biomedical Engineering	1	None
BME 1XX 3D Modeling and 3D Printing for	1	None
Biomedical Engineering		
BME 3XX Biomedical Inst. & Meas. Lab	4	TBD
BME 3XX Biomedical Transport	3	TBD
BME 3XX Biomedical Systems Physiology	3	TBD
BME 4XX Biomedical Design Synthesis (Capstone	3	Senior Status
Design)		

15 credit hours

Engineering Credits: 46 credit hours (without technical electives included)

Technical Electives (400 level: can include Engineering, Biology, Chemistry, etc.)

Course and Description	CR	Pre-reqs		
BME 4XX Technical Elective	3	Varies – Senior Status		
BME 4XX Technical Elective	3	Varies – Senior Status		
BME 4XX Technical Elective	3	Varies – Senior Status		

9 credit hours

Engineering Credits: 55 credit hours (with technical electives included)

General Education Courses

General Education Credits: 34 credit hours (NOTE 10 credit hours double count for math, computer science, and engineering: MATH 266, CE 275, & ME 492 or CS 304WI)

	Fall 21	Spring 22	Fall 22	Spring 23	Fall 23	Spring 24	Fall 24	Spring 25
1st year - Fall		V	v	v	V	V	V	V
MATH 266 Accelerated Calculus I (UMKC Essentials)	×	X	x	X	x	X	x	X
HEM 2111 Concerned Chemistry Lab	Ĵ	×	v	×	×	×	×	×
ME 1XX Intro to Biomedical Engineering	x	^	x	^	x	^	x	^
First Semester Experience (UMKC Essentials)	x		x		x		x	
/ritten Communication I (UMKC Essentials)	x	х	x	х	x	х	x	х
st year - Spring								
IATH 268 Accelerated Calculus II		х		х		х		х
HYS 240 Physics for Science and Engineering I	х	Х	х	х	х	Х	х	Х
CHEM 212R General Chemistry II	х	х	х	х	х	х	х	х
CHEM 212LR General Chemistry II Lab	Х	х	х	Х	х	Х	х	Х
BME 1XX 3D Modeling and 3D Printing for Biomedical		x		x		x		x
bral Communication (UMKC Essentials)	х	x	х	x	х	x	х	x
nd year - Fall								
1ATH 250 Calculus III	х	х	х	х	х	х	х	х
HYS 250 Physics for Science & Engineering II	х	х	х	х	х	х	х	х
HOL 108 General Biology I	Х	х	х	х	х	х	х	Х
HOL 108L General Biology I Lab	х	х	х	х	х	х	х	Х
CE 275 Engineering Statics (UMKC Essentials)	Х	Х	х	Х	х	Х	х	х
nd year - Spring	٦.							
AATH 345 Differential Equations	X	X	X	X	X	X	X	X
SCE 216 Engineering Computation	X V	X	X	X	X	X	X	X
BIOL 202 Cell Biology	- [×]	X	х	x	х	X	х	X
	-	^		^		^		^
Critical Thinking in Arts & Humanities (UMKC Essentials)	х	х	х	х	х	х	х	х
ord year - Fall	-							
BIOL 304 Biostatistics I	Х		Х		Х		Х	
CE 380/381 Signals and Systems (with Lab) OR BME 3XX Biomedical Signals and Systems	х		х		х		х	
AE 351 Fluid Mechanics	x		x		x		x	
Written Communication II (Technical Writing recommended)								
UMKC Essentials)	Х	Х	х	Х	Х	Х	х	Х
HLSC 120 Anatomy and Physiology I	Х		Х		Х		х	
Brd year - Spring	7							
Essentials)	х	х	х	х	х	х	х	х
ECE 276 Circuit Theory I	1	х		х		х		х
ECE 277 Circuit Theory I Lab		х		х		х		х
ME 299 Thermodynamics OR ME 285 Dynamics		х		х		х		Х
ECE 420 Advanced Engineering Computation OR BME 4XX		v		v		v		x
BME 3XX Biomedical Inst. & Meas. Lab	1	~		~		X		x
4th year - Fall								
ME 492 Mechanical Design Synthesis I OR CS 304WI Ethical								
Issues in Computing and Engineering (Civic Engagement)	Y		¥		¥		¥	
UMAC Essentials)	Ŷ	x	x	x	x	x	x	x
BME 3XX Biomedical Systems Physiology	- Â	~	~	~	~	~	x	~
ME 401 Introduction to Biomaterials OR BME 4XX	1						~	
Biomaterials	х		х		х		х	
3ME 4XX Technical Elective	_						х	Х
							х	х
3ME 4XX Technical Elective								
BME 4XX Technical Elective	7							
BME 4XX Technical Elective Ith year - Spring 3ME 4XX Biomedical Design Synthesis (Capstone Design)]							x
BME 4XX Technical Elective Ith year - Spring BME 4XX Biomedical Design Synthesis (Capstone Design) POL-SCI 210 OR HIST 101 OR HIST 102 - MO Const.		v	v	v	v	v	v	x
BME 4XX Technical Elective Ith year - Spring BME 4XX Biomedical Design Synthesis (Capstone Design) POL-SCI 210 OR HIST 101 OR HIST 102 - MO Const. Requirement*** BME 3XX Biomedical Transport	x	x	x	x	x	x	x	X X X
BME 4XX Technical Elective 4th year - Spring BME 4XX Biomedical Design Synthesis (Capstone Design) POL-SCI 210 OR HIST 101 OR HIST 102 - MO Const. Requirement*** 3ME 4XX Biomedical Transport 3ME 4XX Technical Elective	×	x	x	x	x	x	x x	X X X X

	Faculty Member	Expertise	Unit	Contribution		
1.	Katherine Bloemker, Ph.D., Assistant Dean, In Charge of Developing the Proposal for the BS in Biomedical Engineering Degree Program	3D modeling and computer-aided design, Mechanical design synthesis, Biomechanics, and Musculoskeletal modeling	SCE, CME	1 course/year		
2.	Erin Bumann, D.D.S., Ph.D., Assistant Professor of Oral and Craniofacial Sciences	Developmental mechanisms that control the size and shape of the jaw skeleton, strategy for estimating species-specific contributions in chimeras and xenografts, and molecular mechanism and clinical significance of calciotropic hormones in the regulation of mineralized tissue growth in the craniofacial skeleton.	SOD	1 course/year		
3.	Kun Cheng, Ph.D., Curators' Distinguished Professor of Pharmacology and Pharmaceutical Sciences.	Development of novel checkpoint inhibitors for various cancers, Development of targeted drug delivery systems for macromolecules, Development of novel polymers for targeted drug delivery, Discovery of molecular ligands for specific cells and receptors, Development of anti- tumor prodrugs for improving target-ability and efficiency, Development of novel therapeutics for liver fibrosis, and BBB drug delivery	SOP	1 course/year		
4.	Baek-Young Choi, Ph.D., Associate Professor of Computer Science	Cloud computing and software- defined networks, Network algorithms and protocols, and Data storage and management systems.	SCE, CSEE	1 course every two year		
5.	Masud Chowdhury, Ph.D., Associate Dean, In Charge of Developing the Proposal for the MS in Biomedical Engineering Degree Program.	Micro and Nano Technologies for Computing, Biomedical, Energy Applications.	SCE, CSEE	1 course/year		
6.	Akin Cil, M.D., Professor, Franklin D. Dickson/Missouri Endowed Chair in Orthopaedics Surgery	Orthopaedic and Biomechanics Research in collaboration with the School of Computing and Engineering.	SOM	1 course/year		
7.	Timothy Cox, Ph.D., Endowed Professor in Musculoskeletal Tissues	Musculoskeletal Tissues	SOD	1 course/year		
8.	Sarah Dallas, Ph.D., Lee M. and William Lefkowitz Endowed Professor in the UMKC School of Dentistry, Department of Oral and Craniofacial Sciences	Bone cell, Osteocyte, Osteoblast function, Aging and bone-muscle crosstalk, Live cell and intravital imaging approaches, Protein and molecular biology, Mouse genetic approaches	SOD	research, seminar series, and/or guest lectures		

9. Reza Derakhshani, Ph.D., Professor of Electrical and Computer Engineering.	Biometrics, Biomedical signal and image processing, and Computational intelligence	SCE, CSEE	2 course/year
10. Ahmed Hassan, Ph.D., Assistant Professor of Electrical and Computer Engineering.	Nano-electromagnetics, Bio- electromagnetics, Inverse scattering algorithms, Experimental microwave imaging, and Terahertz imaging	SCE, CSEE	2 course/year
11. Mary Anne Jackson, M.D., Dean, Professor - University of Missouri - Kansas City School of Medicine	Pediatrics, Infections Disease	SOM	research, seminar series, and/or guest lectures
12. Mark Johnson, Ph.D., Professor and Chair of the Department of Oral and Craniofacial Sciences and Director, UMKC Center of Excellence in the Study of Dental and Musculoskeletal Tissues (CEMT).	molecular basis of human disease, molecular genetics of osteoporosis, biochemical crosstalk between skeletal muscles and osteocytes, Animal Phenotyping, Imaging and Loading, Skeletal Imaging, and In vitro-In vivo Mechanical Loading Core.	SOD	1 course/year
13. Karl Kador, Ph.D., Assistant Professor of Biomedical Sciences and Ophthalmology	Injuries and diseases of the optic nerve. Tissue engineering methods to create and transplant new cells to replace diseased and dead cells in order to restore vision.	SOM	1 course/year
14. Faisal Khan, Ph.D., Associate Professor of Electrical and Computer Engineering.	Pulsed power, Ultrasound based SOH detection, Powering implantable electronics, and Bioelectronics.	SCE, CSEE	2 course/year
15. Gregory King, Ph.D., Associate Professor of Mechanical Engineering.	Musculoskeletal biomechanics, Biomedical signal processing, and Kinematics and kinetics of human motion.	SCE, CME	2 course/year
16. Peter Koulen, Ph.D., Professor, Felix and Carmen Sabates / Missouri Endowed Chair in Vision Research, Director of Basic Research, Vision Research Center	Biomedical Informatics, Community and Family Medicine, Medical Humanities and Social Sciences, Neurology, Obstetrics and Gynecology, Oncology - Adult, Orthopaedic Surgery, Psychiatry, Surgery, Imm unology, Neuroscience, Pharmacol ogy, Pharmaceutical Science, Ophthalmology	SOM	research, seminar series, and/or guest lectures
17. Chi Lee, Ph.D., Professor of Pharmacology and Pharmaceutical Sciences.	Development and evaluation of transdermal/transmucosal drug delivery systems, and study on drug transport and membrane phenomena, and development and	SOP	1 course/year

	evaluation of the model cell lines and computer modeling processes.		
18. Yugyung Lee, Ph.D., Professor of Computer Science	Medical informatics, Big data analytics and applications, Distributed computing, Cloud computing, Machine learning/data mining, Software engineering, Mobile computing and applications, and Semantic web	SCE, CSEE	2 course/year
19. Zhu Li, Ph.D., Associate Professor of Electrical and Computer Engineering.	Image and Signal Processing, Audio-visual analytic, Video adaptation, Source-channel coding, and Distributed optimization issues of the wireless video networks	SCE, CSEE	2 course/year
20. Stefan Lohfeld, Ph.D., Assistant Professor of Oral and Craniofacial Sciences.	Maxillofacial implants, orthopedic implants, bone tissue engineering, and arterial access and closure device to support stroke interventions.	SOD	1 course/year
21. Ken Mitchell, Ph.D., Associate Professor of Computer Science	Network performance modeling and analysis, Capacity planning for service-oriented architectures, Scheduling in wireless networks, and Dynamic processes in complex networks.	SCE, CSEE	1 course/year
22. Farid Nait-Abdesselam, Ph.D., Professor of Computer Science	Cybersecurity, Network Security, and Artificial Intelligence	SCE, CSEE	1 course/year
23. Mark Nichols, Ph.D., Chair, Associate Professor - Department of Biomedical and Health Informatics, Director of Research Development, School of Medicine	Biomedical Sciences, Biomedical and Health Informatics	SOM	research, seminar series, and/or guest lectures
24. Zahra Niroobakhsh, Ph.D., Assistant Professor of Mechanical Engineering	Fluid dynamics of non- Newtonian flows, Bulk and interfacial rheology, Polymers and Soft Matters, Ternary/binary phase diagrams, Small Angle X-ray Scattering (SAXS), Surface tension measurement, and Microfluidics and microscale experiments	SCE, CME	1 course/year
25. Mostafizur Rahman, Ph.D., Assistant Professor of Electrical and Computer Engineering.	Neuromorphic computing to mimic mammalian brain's capabilities, Beyond CMOS computing with emerging nanoscale devices, and novel integration techniques, Nanoscale 3-D integrated circuits, Proof-of-concept nanoscale experimental prototyping, and	SCE, CSEE	1 course/year

	Manufacturing and thermal aware circuit design.		
26. Aaron Reed, Ph.D., Director of Course Development and Assessment	Molecular Biology and Biochemistry	SBC	1 course/year
27. Sejun Song, Ph.D., Associate Professor of Computer Science	Embedded real-time systems and controller area networks, Mobile operating systems and mobile cloud computing, and Wireless/sensor networks.	SCE, CSEE	1 course every two year
28. Antonis Stylianou, Ph.D., Assistant Professor of Mechnaical Engineering	Computational joint biomechanics, Musculoskeletal modeling, Multibody dynamics, Orthopedics, and Non-linear time series analysis	SCE, CME	2 course/year
29. Gary Sutkin, M.D., Professor, Associate Dean of Women's Health, Victor and Caroline Schutte Chair in Women's Health	Biomedical and Health Informatics, Obstetrics and Gynecology	<mark>SOM</mark>	research, seminar series, and/or guest lectures
30. Ganesh Thiagarajan, Ph.D., Professor of Civil Engineering	Bone biomechanics (experimental and finite element methods), Bone mechanotransduction, Blast behavior of structures, Experimental structural engineering, Structural engineering in bridges, and Dynamic (seismic) modeling and design of structures	SCE, CME	1 course/year
31. Md. Yusuf Sarwar Uddin, Ph.D.	Data Analytics, Health Informativs, and Big Data	SCE, CSEE	1 course every two year
32. John Spertus, M.D., Professor, St. Lukes	Center for Cardiac Health, Health Outcomes and Data Science	SOM	TBD

The Biomedical Engineering BS program faculty drafted the following goals:

Goal 1:	Students have the fundamental technical and scientific skills that prepare
	them for immediate employment in Biomedical Engineering
Goal 2:	Students apply the necessary problem-solving skills for contributing to
	and advancing in industry
Goal 3:	Students apply the necessary design skills for successful contributing to
	and advancing in industry
Goal 4:	Students apply the necessary application skills in sub-specialties of
	Biomedical Engineering to operate in a competitive global community

Achievement of the previously listed goals is assessed by the following Student Learning Outcomes (SLOs). Note that each outcome has specific goals mapped to it.

SLO 1:	Students will be able to use mathematics and biostatistical	G1, G2
	methods to solve problems.	
SLO 2:	Students will be able to analyze fluid flow properties of thermal-	G1, G2
	fluid systems.	
SLO 3:	Students will be able to design and implement biomedical	G1, G3
	engineering components.	
SLO 4:	Students will be able to analyze biomedical systems and solve	G1, G2, G4
	systems problems.	
SLO 5:	Students will be able to investigate characteristics of biomaterials.	G1, G3, G4
SLO 6:	Students will be able to use measurements to solve biomedical	G1, G2, G4
	engineering problems.	

The six-year assessment plan is shown here:

Year Cycle	Assessment	Review/Evaluation	Implement
			Improvements/Changes
2021-2022	SLO1 and SLO2	N/A	N/A
2022-2023	SLO3 and SLO4	SLO1 and SLO2	N/A
2024-2025	SLO5 and SLO6	SLO3 and SLO4	SLO1 and SLO2
2025-2026	SLO1 and SLO2	SLO5 and SLO6	SLO3 and SLO4
2026-2027	SLO3 and SLO4	SLO1 and SLO2	SLO5 and SLO6
2027-2028	SLO5 and SLO6	SLO3 and SLO4	SLO1 and SLO2

NOTE: Biomedical Engineering has decided to assess on a three-year cycle, however in the case of an outcome threshold not being met in a certain cycle, that outcome will be assessed immediately again in the next cycle so that the improvement will not take three-years to go into effect in the curriculum.

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	1st year - Fall							I = Introduced		
	MATH 266 Accelerated Calculus I (UMKC Essentials)	1						D = Developed/reinforced, with opportunities to practice		
	CUEM 211 Council Chamister							M - Master		
	CHEM 211 General Chemistry							IVI = IVIdStely		
	CHEM 211L General Chemistry Lab						1	A = Assessment evidence collected		
	BME 1XX Intro to Biomedical Engineering			1						
	BME TAX into to Biomedical Engineering	-								
	First Semester Experience (UMKC Essentials)									
	Written Communication I (UMKC Essentials)									
		1								-
	1st year - Spring									
	MATH 268 Accelerated Calculus II	T			-					
	PHVS 240 Physics for Science of Production 1	<u> </u>								-
	Pri 15 240 Physics for Science and Engineering I									
	CHEM 212R General Chemistry II	L	D	Ì		D	Ì			
	CHEM 212LR General Chemistry II Lab						D			1
	DMC IVY 2D M. J. E		I	-	-	I	<u> </u>			
	DME 1AA 3D Modeling and 3D Printing for Biomedical		Ì				Ì			
	Engineering	-	I	1			I			L
	Oral Communication (UMKC Essentials)		Ì	Ì		Ì	Ì			
		r	1	1		1	1			
ES					<u> </u>					
ß	2nd year - Fall									
2	MATH 250 Calculus III	D	1 -	1		1 -	1			
2	BUVE 250 Blowing for Samon & P.									-
0	FTLLS 230 Physics for Science & Engineering II									
ž.	BIOL 108 General Biology I		Ì	Ì		1	Ì			
ž.	BIOL 108L General Biology I Lab						1			
5		h			-		+			
~	CE 275 Engineering Statics (UMKC Essentials)			D						
		L	L	L		L	L			
	2nd year - Spring									
	MATH 246 Differential Description	-								
	MA1H 545 Differential Equations	D								
	ECE 216 Engineering Computation				D					
	BIOL 202 Cell Biology					D				
	DIOL 202 CEII DRINEY				<u> </u>	0				
	CE 276 Strength of Materials		L	L		D	L			
	and the second									1
	Critical Thinking in Arts & Humanities (UMKC Essentials)									
		1								
	3rd year - Fall									
	BIOL 304 Biostatistics I	M/A								
	ECE 280/281 Signals and Sustame (with Lab) OP DME 2VV									
	Discussional Signals and Systems (with Eab) OK BME SXX				N4/A					
	Biomedical Signals and Systems	-			WI/A					
	ME 351 Fluid Mechanics		M/A							
	Written Communication II (Technical Writing recommended)									
	(UMKC Essentials)									
	HI SC 120 Anatomy and Physiology I			D						
	HLSC 120 Anatomy and Physiology I			D						
	HLSC 120 Anatomy and Physiology I			D						
	HLSC 120 Anatomy and Physiology I 3rd year - Spring			D						
	HLSC 120 Anatomy and Physiology I 3rd year - Spring Critical Thinking in Social & Behavioral Sciences (IJMKC			D						
	HLSC 120 Anatomy and Physiology I 3rd year - Spring Critical Thinking in Social & Behavioral Sciences (UMKC Fecential:)			D						
	HLSC 120 Anatomy and Physiology 1 3rd year - Spring Critical Thinking in Social & Behavioral Sciences (UMKC Essentials)			D						
	HLSC 120 Anatomy and Physiology I 3rd year - Spring Critical Thinking in Social & Behavioral Sciences (UMKC Exercitals) ME 299 Thermodynamics OR ME 285 Dynamics			D						
	HLSC 120 Anatomy and Physiology I 3nd year - Spring Critical Thurking in Social & Behavioral Sciences (<i>UMKC</i> <i>Learnidal</i>) ME 299 Thermodynamics OR ME 285 Dynamics BME 3XX Biomedical Inst. & Mess. Lab			D			M/A			
	HLSC 120 Anatomy and Physiology 1 3nd year - Spring Critical Thinking in Social & Behavioral Sciences (UMKC Exemutal) ME 299 Thermodynamics OR ME 285 Dynamics BME 202X Biomedical Inst. & Mens. Lab EC: 242 Course Theorem Theorem Technology EC: 242 Course Theorem Technology			D			M/A			
	HLSC 120 Anatomy and Physiology I 3nd year - Spring Critical Thinking in Social & Behavioral Sciences (UMKC <i>Exernital</i>) ME 299 Thermodynamics OR ME 285 Dynamics BME 3XX Biomedical Inst. & Mess. Lab ECE 276 Curcuit Theory ECE 277 Circuit Theory Lab			D	M		M/A			
	HLSC 120 Anatomy and Physiology 1 3nd year - Spring Critical Thinking in Social & Behavioral Sciences (UMKC Exemutal) ME 299 Thermodynamics OR ME 282 Dynamics BME 3XX Biomedical Inst. & Mens. Lab ECE 276 Circuit TheoryECE 277 Circuit Theory Lab ECE 420 Advances Engineering Computation OR BME 4XX			D	M		M/A			
	HLSC 120 Anatomy and Physiology I 3nd year - Spring Critical Thinking in Social & Behavioral Sciences (UMKC Exemutal) ME 299 Thormodynamics OR ME 285 Dynamics BME 3XX Biomedical Inst. & Moas. Lab ECE 276 Circuit Theory ECE 277 Circuit Theory Lab ECE 420 Advanced Engineering Computation OR BME 4XX Biomedical Machine Learning			D	M		M/A			
	HLSC 120 Anatomy and Physiology 1 3rd year - Spring Circled Thinking in Social & Behavioral Sciences (UMKC Exertifue) ME 299 Thermodynamics OR ME 285 Dynamics BME 3XX Biomedical Inst. & News. Lab BKE 3XX Biomedical Inst. & News. Lab ECE 276 Circuit TheoryECE 277 Circuit Theory Lab ECE 420 Advanced Engineering Computation OR BME 4XX Biomedical Machine Learning			D	M		M/A			
	HLSC 120 Anatomy and Physiology 1 Jnd year - Spring Critical Thinking in Social & Behavioral Sciences (<i>UMKC</i> <i>Escutial</i>) ME 299 Thermodynamics OR ME 285 Dynamics BME 33XX BioimRodical Inst. A Mean. Lab ECE 276 Careful A Mean. Lab ECE 276 Careful A Mean Computation OR BME 4XX Biomedical Machine Learning			D	M		M/A			
	HLSC 120 Anatomy and Physiology 1 3rd year - Spring Crited Thinking in Social & Behavioral Sciences (UMKC Exonital) ME 299 Thermodynamics OR ME 285 Dynamics BME 3XX Biomedical Inst. & Meas. Lab ECE 276 Creati TheoryECE 277 Creati Theory Lab ECE 420 Advanced Engineering Computation OR BME 4XX Biomedical Machine Learning 4rd year Fall			D	M		M/A			
	HLSC 120 Anatomy and Physiology 1 3nd year - Spring Critical Thinking in Social & Behavioral Sciences (UMKC <u>Exentials</u>) ME 299 Thermodynamics OR ME 285 Dynamics BME 23XX Bismedical Inst. & Mem. Lab ECE 276 Circuit TheoryECE 277 Circuit Theory Lab ECE 420 Advanced Engineering Computation OR BME 4XX Bismedical Machine Learning 4th year - Fall ME 492 Mechanical Design Synthesis 1 OR CS 304WI Ethical ME 492 Mechanical Design Synthesis 1 OR CS 304WI Ethical			D	M		M/A			
	HLSC 120 Anatomy and Physiology 1 3rd year - Spring Critical Thinking in Social & Behavioral Sciences (UMKC Exemutal) ME 299 Thormodynamics OR ME 285 Dynamics BME 3XX Biomedical Inst. & Meas. Lab ECE 276 Carcuit Theory/ECE 277 Circuit Theory Lab ECE 420 Advanced Engineering Computation OR BME 4XX Biomedical Machine Learning 4th year - Fall ME 492 Muchanical Design Synthesis I OR CS 304WI Ethical losses in Computing and Engineering (Civic Engigement)				M		M/A			
	HLSC 120 Anatomy and Physiology 1 3nd year - Spring Crites Thinking in Social & Behavioral Sciences (UMKC Econtal) ME 299 Thermosphanniss OR ME 285 Dynamics BME 3XX Biomedical Inst. & Meas. Lab ECE 276 Circuit Theory-ECE 277 Circuit Theory Lab ECE 420 Advanced Engineering Computation OR BME 4XX Biomedical Machine Learning 4th year - Fall ME 492 Mechanical Design Synthesis I OR CS 304WI Ethical Isaues in Computing and Engineering (Crivic Engagement) (UMRC Sciencida)			D	M		M/A			
	HLSC 120 Anatomy and Physiology 1 3rd year - Spring Critical Thinking in Social & Behavioral Sciences (UAIKC Enomialy) ME 299 Thermodynamics OR ME 285 Dynamics BME 33X Biomedical Inst. A Mens. Lab ECE 276 Carcin: Honory/ECE 277 Carcuit Theory Lab ECE 276 Carcin: Honory/ECE 277 Carcuit Theory Lab ECE 240 Advanced Engineering Computation OR BME 4XX Biomedical Machine Learning 4th year - Fall ME 492 Mechanical Design Synthesis 1 OR CS 304W1 Ethical Issues in Computing and Engineering (Crive Engingement) (UMIKC Essentials) Culture and Diversity (UMIKC Essentials)			D	M		M/A			
	HLSC 120 Anatomy and Physiology 1 Jat year - Spring Critical Thinking in Social & Behavioral Sciences (UMKC Exemutal) ME 299 Thermodynamics OR ME 285 Dynamics BHE 3XX Biomedical Inst. & Mens. Lab ECE 276 Creatin TheoryECE 277 Creatif Theory Lab ECE 420 Advanced Engineering Computation OR BME 4XX Biomedical Machine Learning thyear - Fall ME 492 Mechanical Design Synthesis I OR CS 304WI Ethical Issues in Computing and Engineering (Crivic Enginement) (UMKC Essential) Culture and Diversity (UMKC Essentials) BME 3XX Biomedical Systems Physics/show			D	× ×					
	HLSC 120 Anatomy and Physiology 1 Jol year - Spring Critical Thinking in Social & Behavioral Sciences (UMKC Executive) ME 299 Thermodynamics OR ME 285 Dynamics BME 3XX Biomedical Inst. & Mens. Lab ECE 276 Certification of the State of the			D	M		M/A			
	HLSC 120 Anatomy and Physiology 1 3rd year - Spring Critical Thinking in Social & Behavioral Sciences (UMKC Execution) ME 299 Thermodynamics OR ME 285 Dynamics BME 3XX Biomedical Inst. & News. Lab ECE 276 Creati TheoryECE 277 Circuit Theory Lab ECE 420 Advanced Engineering Computation OR BME 4XX Biomedical Machine Learning 4th year - Fall ME 492 Mechanical Design Synthesis I OR CS 304 WI Ethical Issues in Computing and Engineering (Cvice Engineerint) (UMKC Essential) Culture and Diversity (UMKC Essentials) BME 3XX Biomedical Systems Physiology ME 401 Introduction to Biomaterink OR BME 4XX Biomaterink			D	M		M/A			
	HLSC 120 Anatomy and Physiology 1 3nd year - Spring Critical Thinking in Social & Behavioral Sciences (UMKC Exercutial) ME 299 Thermodynamics OR ME 285 Dynamics BME 32XX Bismedical Inst. & Mens. Lab ECE 276 Great Theory ECE 277 Great Theory Lab ECE 276 Great Theory ECE 277 Great Theory Lab ECE 240 Advanced Engineering Computation OR BME 4XX Bismedical Machine Learning 4th year - Fall Me 4v2 Mechanical Design Synthesis 1 OR CS 304WI Ethical Instead Diversity (UMKC Exsential) Culture and Diversity (UMKC Exsential) Definition of the State of the State of the State ME 32X Homedel Systems Physiology ME 401 Introduction to Biomaterials OR BME 4XX Biomaterials			D	M		M/A			
	HLSC 120 Anatomy and Physiology 1 3rd year - Spring Crited Thinking in Social & Behavioral Sciences (UMKC Extential) ME 299 Thormodynamics OR ME 285 Dynamics BME 3XX Biomedical Inst. & News. Lab ECE 276 Casual TheoryECE 277 Creati Theory Lab ECE 420 Advanced Engineering Computation OR BME 4XX Biomedical Machine Learning 4th year - Fall MK 4592 (Achiencial Design Synthesis 1 OR CS 304WI Ethical Isouss in Computing and Engineering (Cvice Engagement) (UMKC Scientula) Culture and Diversity (UMKC Extentials) BME 3XX Biomedical Systems Physiology ME 401 Introduction to Biomaterials Net 4XX Biomaterials BME 4XX Homodella Systems's Physiology			D	M M M*	M/A M*	M/A	Depends on which area the elective is taken		
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COURSE

DEPT	NO.	COURSE NAME
ME	401	Biomedical Device Design
ME	401	Imaging to Modeling
ME	401	Advanced Topics in Heat Transfer
ME	401	Advanced Topics in Fluid Mechanics
ME	401	Additive Manufacturing
ME	401	Robotics and Unmanned Systems
ME	401	Robotic System Identification
ME	401	Advanced Dynamics and Modeling
ME	401	Biomaterials
ME	401	Multiphase Flow
ME	401	Turbulent Flow
ME	401	Applied Computational Fluid Dynamics
ME	401	Fracture and Fatigue
ME	401	Material Selection
ME	401T	Turbomachines
ME	411	Introduction to Biomechanics
ME	412	Biodynamics
ME	413	Experimental Biomechanics of Human Motion
ME	415	Feedback Control Systems
ME	424	Non-Metallic Engineering Materials
ME	425	Failure Analysis
ME	426	Introduction to Manufacturing Management
ME	433	Advanced Thermodynamics
ME	440	Heating and Air Conditioning
ME	444	Composite Materials
ME	451	Powerplant Design
ME	454	Power Generation Systems
ME	457	Mechatronic System Design
ME	458	Modern Control Systems
ME	467	Fuel Cells and Renewable Energy Systems
ME	484	Vibration Analysis
ME	486	Applied Finite Element Analysis
ME	493	Intermediate Dynamics
ME		

(1)

NEW PROGRAM PRO FORMA

UNIVERSITY OF MISSOURI - Kansas City

PROFORMA: BS Biomedical Engineering

Projection as of 10/21/20

			Prepa	ared by: J	leff Ross			Ар	proved by:	S. L	indenbaum						
	Academic Level:	UNDERGRADUATE	<s< td=""><td>elect</td><td></td><td></td><td></td><td>Uni</td><td>iversitv full vie</td><td>ew</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></s<>	elect				Uni	iversitv full vie	ew							
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			F	FY21	FY22		FY23		FY24		FY25		FY26		FY27		FY28
(2)	Enrollment Projections																
	Head Count Students - new incoming				25	5	54		85		119		146		174		201
	Head Count Students - transfers within campus				-		-		-		-		-		-		-
	Student Credit Hours				813	5	1,747	¢	2,773	~	3,867	¢	4,756	¢	5,644	¢	6,533
(3)	Fac Bate/Credit Hour (see Rim Tullion & Fees Tai) 			\$ 262.54	+ ⊅ 1 ¢	200.19	¢ ¢	293.95	э с	299.03	ф Ф	305.63	ф ф	311.95	96	310.19
(4)	Tuition Discount Rate (%)			-	9 33.0 ² 5.0 ⁹	ι γ	5.0%	φ	5.0%	φ	5.0%	Ψ	5.0%	Ψ	5.0%	ę	5.0%
(.)					0.0		0.070		0.070		0.070		0.070		0.070		0.070
(5)	Revenue Projections					*	****	*****	**CALCULATE	D C	ELLS ******	****	*****				
	Tuition			-	229,564	1	503,433		815,035		1,159,455		1,454,427		1,760,734		2,078,711
	Supplemental & Other Fees			-	36,363	3	79,744		129,102		183,658		230,382		278,901		329,269
	Scholarship Allowances			-	(13,296	5)	(29,159)		(47,207)		(67,156)		(84,240)		(101,982)		(120,399)
	Net Tuition and Fees			-	252,630)	554,018		896,930		1,275,957		1,600,568		1,937,653		2,287,581
	Other Income																
	TOTAL PROGRAM REVENUE			\$0	\$252,630)	\$554,018		\$896,930		\$1,275,957		\$1,600,568		\$1,937,653		52,287,581
	Recurring State Support																
	Recurring State Support																
	TOTAL REVENUE			\$0	\$252,630)	\$554,018		\$896,930	:	\$1,275,957		\$1,600,568	:	\$1,937,653	:	2,287,581
(6)	Expenditure Projections																
	Faculty Salaries (inc. Adjuncts)		\$	-	\$ 7,650) \$	15,606	\$	111,427	\$	211,074	\$	306,382	\$	312,510	\$	318,760
	Technical Salaries																
	Support Salaries		\$	5,000	\$ 5,100) \$	5,202	\$	53,060	\$	54,122	\$	55,204	\$	56,308	\$	57,434
	Total Salaries		\$	5,000	\$ 12,750) \$	20,808	\$	164,487	\$	265,196	\$	361,586	\$	368,818	\$	376,195
	Benefits		\$	2,181	\$ 2,809) \$	3,462	\$	58,209	\$	92,765	\$	128,047	\$	130,608	\$	133,220
	Payroll Outside of Program		\$	-	\$ 33,740) \$	73,951	\$	99,997	\$	127,012	\$	155,112	\$	184,285	\$	214,564
	Subtotal Salaries and Benefits		\$	7,181	\$ 49,299	9 \$	98,221	\$	322,693	\$	484,973	\$	644,745	\$	683,711	\$	723,978
	Operating Expense		¢		0	6		¢		6		¢		6		6	
	NonCapital Maintenance & Repair		ф Ф	-	s -	9 6	-	¢ ¢		9 6		ф С		9 6		9 6	
	Noncapital Equipment		\$	_	s -	\$	_	\$	10.612	ŝ	10.824	ŝ	11.041	\$	11,262	ŝ	11,487
	Supplies		\$	-	\$ -	\$	-	\$	2,122	\$	2,165	\$	2,208	\$	2,252	\$	2,297
	Professional & Consulting		\$	-	\$ -	\$; -	\$	-	\$	-	\$	-	\$	-	\$	-
	Travel & Training		\$	-	\$ 3,060) \$	3,121	\$	3,184	\$	3,247	\$	3,312	\$	3,378	\$	3,446
	Misc. Expenses		\$	-	\$ 5,100) \$	5,202	\$	5,306	\$	5,412	\$	5,520	\$	5,631	\$	5,743
	Subtotal Operating Expense			-	\$8,160)	\$8,323		\$21,224		\$21,649		\$22,082		\$22,523		\$22,974
(7)	One-time Expenditures (Startup Costs)																
	Course Development		\$	6,192													
	Start-up							\$	60,000	\$	120,000	\$	150,000	\$	90,000	\$	30,000
(0)																	
(8)	Additional Space Costs																
	Subtotal One-time Expense		\$	6,192	\$0)	\$0		\$60,000		\$120,000		\$150,000		\$90,000		\$30,000
				640.070	A = 7 4 5 4		A400 544		A 400 047	_	AAAA AA4		A040.007	_	4700.004		4770 050
	TOTAL EXPENDITORES			\$13,373	\$57,455	,	\$106,544		\$403,917		\$626,621		\$816,827	_	\$796,234		\$776,952
														_			
	DIRECT MARGIN			(\$13,373)	\$195,172	2	\$447,474		\$493,013		\$649,336		\$783,741		51,141,418		51,510,629
	CUMULATIVE DIRECT MARGIN			(\$13,373)	\$181,799	•	\$629,273		\$1,122,286		\$1,771,622		\$2,555,363		\$3,696,782		5,207,411
	Subtract					1		1				1					
(9)	Revenue from Transfers within Campus				s	- \$	-	\$	-	s	-	ŝ	-	\$	-	s	
(-)					Ŧ					Ť				Ţ		Ŧ	
	NET MARGIN TO THE CAMPUS			(\$13,373)	\$195,172	2	\$447,474		\$493,013		\$649,336		\$783,741	••	\$1,141,418		51,510,629
	CUMULATIVE NET MARGIN TO THE CAMPUS			(\$13,373)	\$181,799	•	\$629,273		\$1,122,286		\$1,771,622		\$2,555,363		\$3,696,782		5,207,411
						_								_		_	
(10)	Campus Overhead Allocation (\$40/SCH)		\$	-	\$ 33,813	3 \$	74,152	\$	120,048	\$	170,779	\$	214,226	\$	259,343	\$	306,178
												1					
				(\$42.272)	6464 354		\$272 200		\$272.004		\$470 EF7		\$500 54F		\$992.070		1 204 454
				(#13,373)	\$101,355	1	\$313,322		\$372,904		ə410,00/		acca,515		φ002,076		,,204,451
	AFTER CAMPUS OVERHEAD			(\$13,373)	\$147,986	5	\$521,309		\$894,273		\$1,372,830		\$1,9 <u>42,34</u> 5		2,824,421		4,028,872

(11) Assumptions:

Key Assumptions

 Program begins in Fall 2021
 Tuition (See Pro Forma Tuition Assumptions tab) - Retention rate is 75% based on 3yr Avg. for Undergraduate SCE. Assuming initial cohort of 25 plus 10 new students each year. Targeted 200 students in year 8 but SCE expects considerably more
Tuition discount rate of 5% to cover GTA's and graduate student stipends

130 SCH to complete course, expected completion in 4 academic years
 Supplemental fees assessed only to SCE courses. 62 SCH are SCE.
 Added placeholder for Academic Advisor/administrator stipend in Yr1
 Price and expense growth projected at 2% per annum

Headcount - New tenure track faculty in year 3,4 and 5 for a total of 3. Staff position in year 3 and 1 adjunct for year 1, 5,6 &7 and 2 adjuncts for years 2-4.
In addition, new faculty are TT and startup costs of \$150,000 each spread over three years begin in year 3,4 and 5
Marketing costs - SCE Continuing Ed expected to support marketing program with MCM included in existing marketing (mass email; printed pieces). Conservatively, included \$5000 per year for yrs 0-1 to kick off the program and half that rate beginning in yr 2 as a steady run rate.

Source: Labor Insight (Burning Glass Technologies)

Occupation Analysis - Biomedical Engineer

Designs solutions to problems in medicine and biology to improve patient care. Combines engineering with medical and biological knowledge. May develop medical products designed to replace biological functions, such as prosthetic limbs or artificial hearts, or design equipment such as X-rays and surgical tools.

Common job titles: Biomedical Engineer, Supervisory Biomedical Engineer, Clinical Engineer, Senior Biomedical Engineer, Biomechanical Engineer

Active Selections: Kansas City, MO-KS (Metropolitan Statistical Area), Biomedical Engineer









Job Qualifications

No experience data available for this report with your selected filters.

Education Level



Frequency Requested

Certification	Occasionally	Sometimes	Often
American Board for Engineering and Technology (ABET) Accredited	0	0	Θ
Security Clearance	0	0	٥

Top Skills

Specialized Skills

Biomedical Engineering
Mechanical Engineering
Medical Technology
Appointment Setting
Onboarding
Quality Management
Scheduling

Baseline Skills

Research
Planning
English
Communication Skills
Physical Abilities
Multi-Tasking
Verbal / Oral Communication



November 18, 2021

Skills Explorer

Occupational Skills for Biomedical Engineer



An occupation's Defining skills represent the day-to-day tasks and responsibilities of the job. An employee needs these skills to qualify for and perform successfully in this occupation.

Skill	Skill Type	Occupat ional Skills Categor y	Sala ry Pre miu m	Job Postings Request ing Last 12 months	Projecte d Growth 2 Years	Location Quotient
Biomedical Engineering	Specialized	Defining		5	-3.9%	0.4 💙
Research	Baseline	NA		3	0% 😽	0.6 😽
Planning	Baseline	NA		3	0% 💊	0.9 🗕
English	Baseline	NA		3	0% 💊	2.4 🙈
Mechanical Engineering	Specialized	Defining	~	3	0% 💊	0.7 💙
Medical Technology	Specialized	NA		3	0% 💊	2.8 🙈
Appointment Setting	Specialized	NA		3	0% 💊	3.2 🕱
Onboarding	Specialized	NA		3	0% 😽	4.4 🙈
Communication Skills	Baseline	NA		2	0% 💊	0.3 😽
Physical Abilities	Baseline	NA		2	0% 💊	0.7 💙
Multi-Tasking	Baseline	NA		2	0% 💊	1.5 🔨
Verbal / Oral Communication	Baseline	NA		2	0% 💊	1.5 🔨
Building Effective Relationships	Baseline	NA		2	0% 💊	1.6 🙈
Meeting Deadlines	Baseline	NA		2	0% 😽	2.7 🙈
People Management	Baseline	NA		2	0% 💊	3.9 🙈
Quality Management	Specialized	Necessary		2	0% 💊	0.9 🗕
Scheduling	Specialized	Necessary		2	0% 💊	1.1 💳
Chemistry	Specialized	Necessary		2	0% 💊	1.3 ^
Physics	Specialized	Defining	~	2	0% 💊	1.4 ^
Technical Support	Specialized	Necessary		2	0% 💊	1.2 💻
Technical Writing / Editing	Specialized	Necessary		2	0% 💊	1.4 ^
Budgeting	Specialized	Necessary	~	2	0% 😽	1.3 ^
Customer Contact	Specialized	NA		2	0% 💊	2.1 🙈
Equipment Repair	Specialized	NA		2	0% 💊	2.4 🙈
Repair	Specialized	Defining		1	0% 💊	0.2 😽
Project Management	Specialized	Necessary	~	1	0% 💊	0.3 😽
Data Analysis	Specialized	Necessary	>	1	0% 📏	0.5 举
------------------	-------------	-----------	---	---	------	-------
Patient Safety	Specialized	Necessary		1	0% 😽	0.8 💙
Staff Management	Specialized	NA		1	0% 💊	0.8 💙

Learn more about Occupational Skill Categories

Top Requested Skills for Biomedical Engineer

Skill	Skill Type	Occupational Skills Category	Salary Premium	Job Postings Requesting Last 12 months	Projected Growth ^{2 Years}	Location Quotient
Biomedical Engineering	Specialized	Defining		5	-3.9% 💊	0.4 🗡
Research	Baseline	NA		3		0.6 😽
Planning	Baseline	NA		3		0.9 🗖
English	Baseline	NA		3		2.4 🔦
Mechanical Engineering	Specialized	Defining	~	3		0.7 💙
Medical Technology	Specialized	NA		3		2.8 🔦
Appointment Setting	Specialized	NA		3		3.2 🔦
Onboarding	Specialized	NA		3		4.4 🕿
Communication Skills	Baseline	NA		2		0.3 😽
Physical Abilities	Baseline	NA		2		0.7 💙
Multi-Tasking	Baseline	NA		2		1.5 ^
Verbal / Oral Communication	Baseline	NA		2		1.5 ^
Building Effective Relationships	Baseline	NA		2		1.6 🔦
Meeting Deadlines	Baseline	NA		2		2.7 🔦
People Management	Baseline	NA		2		3.9 🔦
Quality Management	Specialized	Necessary		2		0.9 🗖
Scheduling	Specialized	Necessary		2		1.1 🗖
Chemistry	Specialized	Necessary		2		1.3 ^
Physics	Specialized	Defining	~	2		1.4 ^
Technical Support	Specialized	Necessary		2		1.2 -
Technical Writing / Editing	Specialized	Necessary		2		1.4 ^
Budgeting	Specialized	Necessary	~	2		1.3 ^
Customer Contact	Specialized	NA		2		2.1 🛠
Equipment Repair	Specialized	NA		2		2.4 🙈
Repair	Specialized	Defining		1		0.2 😽
Project Management	Specialized	Necessary	~	1		0.3 😽

Data Analysis	Specialized	Necessary	~	1	0.5 😽
Patient Safety	Specialized	Necessary		1	0.8 💙
Staff Management	Specialized	NA		1	0.8 💙



Employers & Industries

Top Industries



Others

Assistance



Top Locations



State	Job Postings Last 12 months	Median Salary	Time to Fill _{Days}	Location Quotient
Saint Louis City, MO	10	\$75k	45	2.5 🔌
Johnson, KS	2	\$57k	45	0.3 😽
Leavenworth, KS	2	\$96k	45	5.5 🔦
Boone, MO	1	\$60k	45	0.6 😽
Jackson, MO	1	\$77k	45	0.2 💙
Saint Louis, MO	1	\$77k	45	0.1 😽





Related Jobs







Source: Labor Insight (Burning Glass Technologies)

Occupation Analysis - Biomedical Engineer

Designs solutions to problems in medicine and biology to improve patient care. Combines engineering with medical and biological knowledge. May develop medical products designed to replace biological functions, such as prosthetic limbs or artificial hearts, or design equipment such as X-rays and surgical tools.

Common job titles: Biomedical Engineer, Supervisory Biomedical Engineer, Clinical Engineer, Senior Biomedical Engineer, Biomechanical Engineer

Active Selections: KS, MO, Biomedical Engineer

Overview







Job Qualifications Years of Experience

Education Level



Frequency Requested

Certification	Occasionally	Sometimes	Often
American Board for Engineering and Technology (ABET) Accredited	0	Θ	0
Security Clearance	0	\odot	0
Biomedical Equipment Technician (BMET)	Θ	0	0
Driver's License	٥	0	0

Top Skills

Specialized Skills

Biomedical Engineering
Repair
Project Management
Chemistry
Appointment Setting
Customer Contact
Onboarding

Baseline Skills

Planning	
Communication Skills	
Research	
English	
Troubleshooting	
Preventive Maintenance	
Writing	



Skills Explorer

Occupational Skills for Biomedical Engineer



An occupation's Defining skills represent the day-to-day tasks and responsibilities of the job. An employee needs these skills to qualify for and perform successfully in this occupation.

Skill	Skill Type	Occupat ional Skills Categor y	Sala ry Pre miu m	Job Postings Request ing Last 12 months	Projecte d Growth 2 Years	Location Quotient
Biomedical Engineering	Specialized	Defining		14	-3.9%	0.3 😽
Planning	Baseline	NA		11	0% 😽	0.8 💙
Repair	Specialized	Defining		8	0% 💊	0.4 😽
Project Management	Specialized	Necessary	~	7	0% 😽	0.5 😽
Communication Skills	Baseline	NA		6	0% 💊	0.2 😽
Research	Baseline	NA		6	0% 😽	0.3 😽
English	Baseline	NA		6	0% 💊	1.2 🗖
Chemistry	Specialized	Necessary		6	0% 💊	1 🗖
Appointment Setting	Specialized	NA		6	0% 💊	1.5 🔨
Customer Contact	Specialized	NA		5	0% 😽	1.3 ^
Onboarding	Specialized	NA		5	0% 💊	1.8 🙈
Troubleshooting	Baseline	NA		4	0% 😽	0.2 😽
Mechanical Engineering	Specialized	Defining	~	4	0% 😽	0.2 😽
Data Analysis	Specialized	Necessary	~	4	0% 😽	0.5 😽
Physics	Specialized	Defining	~	4	0% 😽	0.7 💙
Patient Safety	Specialized	Necessary		4	0% 💊	0.8 🗸
Medical Technology	Specialized	NA		4	0% 💊	0.9 💻
Preventive Maintenance	Baseline	NA		3	0% 💊	0.3 😽
Writing	Baseline	NA		3	0% 💊	0.3 😽
People Management	Baseline	NA		3	0% 💊	1.4 ^
Patient Care	Specialized	Necessary		3	0% 💊	0.4 😽
Project Planning and Development Skills	Specialized	NA		3	0% 😽	0.9 🗕
Problem Solving	Baseline	NA		2	0% 😽	0.1 😽
Physical Abilities	Baseline	NA		2	0% 💊	0.2 💙
Multi-Tasking	Baseline	NA		2	0% 💊	0.4 😽
Microsoft Excel	Software and Programmin	NA		2	0% 💊	0.4 😣

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	g					
Verbal / Oral Communication	Baseline	NA		2	0% 💊	0.4 💙
Building Effective Relationships	Baseline	NA		2	0% 💊	0.4 💙
Self-Starter	Baseline	NA		2	0% 💊	0.9 💻
Meeting Deadlines	Baseline	NA		2	0% 💊	0.7 🗡
Quality Management	Specialized	Necessary		2	0% 💊	0.2 💙
Scheduling	Specialized	Necessary		2	0% 💊	0.3 😽
Technical Support	Specialized	Necessary		2	0% 🛰	0.3 😽
Technical Writing / Editing	Specialized	Necessary		2	0% 💊	0.4 😽
Budgeting	Specialized	Necessary	~	2	0% 😽	0.3 😽
Biotechnology	Specialized	NA		2	0% 😽	0.4 😽
Equipment Repair	Specialized	NA		2	0% 💊	0.6 😽
Clinical Research	Specialized	NA	~	2	0% 😽	0.5 🗡
Radiology	Specialized	NA	~	2	0% 😽	0.5 😽
Organizational Skills	Baseline	NA		1	0% 😽	0.1 😽
Time Management	Baseline	NA		1	0% 😽	0.2 😽
Presentation Skills	Baseline	NA		1	0% 💊	0.2 😽
Listening	Baseline	NA		1	0% 💊	1 -
Staff Management	Specialized	NA		1	0% 💊	0.2 😽
Customer Service	Specialized	NA		1	0% 💊	0.2 😽
Medical Imaging	Specialized	Distinguishi ng		1	0% 💊	0.2 😽

Learn more about Occupational Skill Categories

Top Requested Skills for Biomedical Engineer

Skill	Skill Type	Occupational Skills Category	Salary Premium	Job Postings Requesting Last 12 months	Projected Growth 2 Years	Location Quotient
Biomedical Engineering	Specialized	Defining		14	-3.9% 💊	0.3 😽
Planning	Baseline	NA		11		0.8 💙
Repair	Specialized	Defining		8		0.4 😽
Project Management	Specialized	Necessary	~	7		0.5 😽
Communication Skills	Baseline	NA		6		0.2 😽
Research	Baseline	NA		6		0.3 😽
English	Baseline	NA		6		1.2 -
Chemistry	Specialized	Necessary		6		1.0 🗖

Appointment Setting	Specialized	NA		6	1.5 ^
Customer Contact	Specialized	NA		5	1.3 ^
Onboarding	Specialized	NA		5	1.8 🔦
Troubleshooting	Baseline	NA		4	0.2 💙
Mechanical Engineering	Specialized	Defining	~	4	0.2 💙
Data Analysis	Specialized	Necessary	~	4	0.5 💙
Physics	Specialized	Defining	~	4	0.7 🗸
Patient Safety	Specialized	Necessary		4	0.8 🗸
Medical Technology	Specialized	NA		4	0.9 -
Preventive Maintenance	Baseline	NA		3	0.3 😽
Writing	Baseline	NA		3	0.3 😽
People Management	Baseline	NA		3	1.4 ^
Patient Care	Specialized	Necessary		3	0.4 💙
Project Planning and Development Skills	Specialized	NA		3	0.9 -
Problem Solving	Baseline	NA		2	0.1 😽
Physical Abilities	Baseline	NA		2	0.2 😽
Multi-Tasking	Baseline	NA		2	0.4 😽
Microsoft Excel	Software and Programming	NA		2	0.4 😽
Verbal / Oral Communication	Baseline	NA		2	0.4 💙
Building Effective Relationships	Baseline	NA		2	0.4 😽
Self-Starter	Baseline	NA		2	0.9 -
Meeting Deadlines	Baseline	NA		2	0.7 💙
Quality Management	Specialized	Necessary		2	0.2 😽
Scheduling	Specialized	Necessary		2	0.3 😽
Technical Support	Specialized	Necessary		2	0.3 😽
Technical Writing / Editing	Specialized	Necessary		2	0.4 😽
Budgeting	Specialized	Necessary	\checkmark	2	0.3 😽
Biotechnology	Specialized	NA		2	0.4 😽
Equipment Repair	Specialized	NA		2	0.6 😽
Clinical Research	Specialized	NA	~	2	0.5 😽
Radiology	Specialized	NA	~	2	0.5 💙
Organizational Skills	Baseline	NA		1	0.1 😽
Time Management	Baseline	NA		1	0.2 😽

Presentation Skills	Baseline	NA	1	0.2 😽
Listening	Baseline	NA	1	1.0 🗖
Staff Management	Specialized	NA	1	0.2 😽
Customer Service	Specialized	NA	1	0.2 😽
Medical Imaging	Specialized	Distinguishing	1	0.2 😽



November 18, 2021

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Employers & Industries

Top Industries

2digit



Top Employers







Top Locations

View: Demand Salary	Time to Fill Location Quotie	ent View By: State	Metro Area (MSA)	County
Scottsbluff N E B	RASKA Grand Island Lincoln	Waterloo IOWA Cedar Ra	pids Davenport Chic	ago South Bend
Fort Collins Denver	United States	Atching and a second se	Peoria ILLINOIS	Lafayette INDIANA Bloomington
Pueblo		Kansas City MISSOURI Springfield	sincentre	Evansville KENTU
nta Fe Je Amarillo E W X I C O	O K L A H O M A	Fort Smith	Jonesbc. Jackson Bartlett	Clarksville Demand Low Average
Lubbock	Denton Fort Worth Dallas	Tyler Shreveport *	MISSISSIPPI	High Very High
State	Job Postings Last 12 months	Median Salary	Time to Fill _{Days}	Location Quotient
Missouri	13	\$77k	N/A	0.3 😽
Kansas	4	\$77k	N/A	0.2 😽





Related Jobs







VALIDATE: EMPLOYMENT POTENTIAL

PROJECT CRITERIA

Validate	Programs
States	Kansas, Missouri
Degree Level	Bachelor's degree
Time Period	10/1/2020 - 9/30/2021
Selected Programs	Bioengineering and Biomedical Engineering (14.0501)
Career Outcomes mapped to Selected Programs of Study	Biomedical Engineer, Engineering Manager, Product Development Engineer

HOW MANY JOBS ARE THERE FOR GRADUATES OF THIS PROGRAM?

For your project criteria, there were 1,984 job postings in the last 12 months.

Compared to:

- 1,104,615 total job postings in your selected location
- 302,683 total job postings requesting a Bachelor's degree in your selected location

The number of jobs is expected to grow over the next 10 years.

GROWTH BY GEOGRAPHY

Geography	Selected Occupations	Total Labor Market	Relative Growth
Kansas, Missouri	2.52 %	3.55 %	Average
Nationwide	-0.93 %	3.70 %	Average



HOW HAS EMPLOYMENT CHANGED FOR CAREER OUTCOMES OF YOUR PROGRAM?

Employment data between years 2020 and 2030 are projected figures.

POSTINGS TRENDS



DETAILS BY OCCUPATION

Occupation Group	Postings	LQ	Employment (2020)	Employment Growth (2019 - 2020)	Projected Employment Growth (2020-2030)
Engineering Managers	1,851	0.80	3,615	-9.60%	0.70%
Mechanical and Related Engineers	105	0.80	90	-42.30%	-1.10%
Chemical, Biomedical, and Related Engineering	28	0.50	118	-41.30%	10.20%

HOW VERSATILE IS THIS DEGREE FOR MY GRADUATES?

Graduates of this program usually transition into any of the 3 different occupation groups:

Occupations Group	Market Size (postings)	Percentage of Career Outcome demand	
Engineering Managers	1,851	93.30%	

Mechanical and Related Engineers	105	5.29%
Chemical, Biomedical, and Related Engineering	28	1.41%



WHAT SALARY WILL MY GRADUATES FIND UPON GRADUATION?

The median salary in Kansas and Missouri for graduates of your program is \$90K

This average salary is Above the average living wage for your region of \$31K



Salary numbers are based on Burning Glass models that consider advertised job posting salary, BLS data, and other proprietary and public sources of information.

Occupation Group	0-2 Years	3-5 Years	6+ Years
Chemical, Biomedical, and Related Engineering	\$78K	NA	NA
Mechanical and Related Engineers	\$57K	\$76K	NA
Engineering Managers	\$72K	\$85K	\$99K

WHERE IS DEMAND FOR MY PROGRAM?



TOP LOCATIONS BY POSTING DEMAND

Location	Postings
	10 507
California	19,587
Texas	7,500
New York	5,391
Massachusetts	4,093
Washington	4.076
Illinois	4,042

Florida	4,032
Colorado	3,596
Georgia	3,480
Virginia	3,130

VALIDATE: COMPETITIVE LANDSCAPE

PROJECT CRITERIA

Validate	Programs
States	Kansas, Missouri
Degree Level	Bachelor's degree
Time Period	10/1/2020 - 9/30/2021
Selected Programs	Bioengineering and Biomedical Engineering (14.0501)
Career Outcomes mapped to	Biomedical Engineer, Engineering Manager, Product Development
Selected Programs of Study	Engineer

OVERVIEW

	#	% Change (2016-2020)
Degrees Conferred	161	11%
Number of Institutions	4	33%
Average Conferrals by Institution	40	-16.67%
Median Conferrals by Institution	44	2.33%

MARKET SHARE BY PROGRAM



Bioengineering and Biomedical Engineering

Program	Conferrals	Market Share (%)
	(2020)	
Bioengineering and Biomedical Engineering	161	100.00%

MARKET SHARE BY INSTITUTION TYPE

_



	Conferrals	
Institution Type		Market Share (%)
	(2020)	

Public	55	34.16%
Private	106	65.84%

TOP INSTITUTIONS

Institution	School Type	Market Share (2020)	Market Share Change	Conferrals (2020)	Conferrals Change (2016-2020)
Washington	Duivete		14.040/	50	10,100/
University in St Louis	Private	36.65%	-14.04%	59	-19.18%
Saint Louis University	Private	29.19%	-0.67%	47	9.30%
Wichita State	Dublic	25 470/	6.02%	4.1	46 420/
University	PUDIIC	25.47%	6.03%	41	40.43%
University of	Dublic	0.700/	9 700/	1.4	100 00%
Missouri-Columbia	Public	ð./U%	8.70%	14	100.00%

TOP PROGRAMS

Program	Market Share	Market Share Change	Conferrals	Conferrals Change
	(2020)		(2020)	(2016-2020)
Bioengineering and	100 00%	0.00%	161	11 010/
Biomedical Engineering	100.00%	0.00%	101	11.01/0

Note: Competitive Landscape reports are based on IPEDS data, which are reported in the CIP 2010 taxonomy. As a result, new programs in CIP 2020 will not have completion data until the release of 2020 data in Fall, 2021.

VALIDATE: MARKET ALIGNMENT

PROJECT CRITERIA

Validate	Programs
_	
States	Kansas, Missouri
Degree Level	Bachelor's degree
Time Period	10/1/2020 - 9/30/2021
Selected Programs	Bioengineering and Biomedical Engineering (14.0501)
Career Outcomes mapped to	Biomedical Engineer, Engineering Manager, Product Development
Selected Programs of Study	Engineer

JOB POSTINGS BY ADVERTISED EDUCATION (%)



JOB POSTINGS BY INDUSTRY (%)



Other

JOB POSTINGS BY EXPERIENCE REQUESTED (%)



TOP TITLES

Experience Level: All Experience

Title	Postings	Market Share (%)
Project Engineer	66	4.56%
Engineering Manager	57	3.94%
Senior Project Engineer	42	2.90%
Product Engineer	39	2.70%
Engineering Project Manager	18	1.24%
Director Of Engineering	16	1.11%
It Project Manager - Infrastructure Platform And Engineering	14	0.97%
Power Delivery Project Manager	14	0.97%
Chief Engineer	11	0.76%
Product Development Engineer	11	0.76%
Engineering Program Manager	10	0.69%
Manager, Engineering	10	0.69%
Plant Engineering Manager	10	0.69%
Enterprise Engineering Support Project Program Manager	9	0.62%
Customer Engineering	8	0.55%

Manager

TOP EMPLOYERS HIRING

Experience Level: All Experience

Employer	Postings	Market Share (%)
The Boeing Company	53	3.67%
Vmware Incorporated	31	2.14%
KPMG	27	1.87%
Mpulse Mobile	25	1.73%
Honeywell	24	1.66%
Humana	23	1.59%
Kiewit Corporation	23	1.59%
Black & Veatch	18	1.24%
Spirit AeroSystems	15	1.04%
Dell	14	0.97%
Travelers	14	0.97%
MasterCard Worldwide	13	0.90%
Accenture	12	0.83%
CBRE Group	12	0.83%
Hntb	12	0.83%



School of Computing and Engineering

Office of the Dean

April 23, 2020

Jennifer Lundgren, Ph.D., F.AED Interim Provost University of Missouri – Kansas City 358 Administrative Center 5115 Oak Street Kansas City, MO 64110

Dear Interim Provost Lundgren,

I would like to state my support for the Bachelor of Science and Master of Science in Biomedical Engineering (BSBME & MSBME) degree proposals by UMKC's School of Computing and Engineering.

UMKC's long history of excellence in the health, life, and biological sciences combined with the rapidly growing disciplines in computing and engineering provide a very strong platform to start these new interdisciplinary degrees in biomedical engineering. The BSBME and MSBME degree programs support the University's vision to promote interdisciplinary education and research. In addition, these programs will help to support Chancellor Agrawal's vision of increasing the size of UMKC.

The BSBME and MSBME programs will share common faculty as well as common elective courses. In addition, there is no upfront cost for either program. We would like to start the MSBME program in the fall semester of 2020 and the BSBME program in the fall semester of 2021. We have already identified approximately 20 faculty members from several UMKC academic units to offer the required and technical elective courses for both programs. No new faculty hires will be needed for either program until the fall semester of 2023. New faculty hires will be required in fall 2023 to accommodate the growth in student population, to add expertise for junior and senior undergraduate courses and technical electives for graduate students, and to add focal areas for interdisciplinary research. Biomedical engineering is at the intersection of the health sciences and every traditional engineering program.

These degree programs will enhance our ability to attract high achieving students in the biomedical field. Your support will allow us to serve the needs of students in the Kansas City metropolitan and regional areas who are considering pursuing undergraduate and graduate degrees in biomedical engineering.

Sincerely,

Kevin Truman, Ph.D., F.ASCE Dean, School of Computing and Engineering

Room 534 Flarsheim Hall | 5110 Rockhill Road | Kansas City, MO 64110 o: 816-235-1285 | f: 816-235-5159 | sce@umkc.edu

OPEN -- ASARED

November 30, 2020

Kevin Z. Truman, Ph.D., F.ASCE Dean, School of Computing and Engineering 534 Flarsheim Hall University of Missouri – Kansas City 5110 Rockhill Road Kansas City, MO 64110

Dear Dean Truman,

I would like to state my support for the proposed Bachelor of Science and Master of Science in Biomedical Engineering (BSBME & MSBME) degrees within UMKC's School of Computing and Engineering.

More than 700 medical and allied health students train at the UMKC School of Medicine (SOM). Internationally known for its BA/MD program, our MD program recently doubled in size. On completion of training, these graduates enter the healthcare workforce in the Greater Kansas City community, or pursue specialty training. The potential to recruit qualified BSBME graduates to our programs, would bring additional diversity to the MD, Physician Assistant and Anesthesia Assistant programs.

Clinical training at the SOM is provided to more than 400 residents and fellows at programs at Truman Medical Centers, Inc, Saint Luke's Hospital, Children's Mercy, and eventually at our new rural health campus at Mosaic Life Care in Saint Joseph, Missouri. Dedicated time for scholarly research is required as a component of their training. The proposed biomedical engineering programs offer opportunities for impactful research opportunities that will be sought-after by these physician trainees. Following training, these practitioners and subspecialists begin their careers at other academic institutions across the US. Those who have trained or collaborated with our biomedical engineering programs will add credentials that will increase their potential for recruitment to other respected universities adding prestige to UMKC.

Faculty at the UMKC School of Medicine and the School of Computing and Engineering (SCE) have a consistent history of collaboration. Dr. Gary Sutkin, the Victor and Caroline *Schutte* Chair in *Women's* Health, collaborates with biomedical engineering faculty to study ways to improve safety in the operating room in this highly funded research. A shared endowed professorship (Franklin D. Dickson/Missouri Endowed Associate Professor of Orthopedic Research)) was created between the SOM Department of Orthopedic Surgery and SCE and the Margaret Suzanne Neal/Missouri Endowed Chair in Orthopedic Surgery, has a role in both institutions.

I see these programs having the potential to attract high achieving students and enhance expertise of our undergraduate and graduate level trainees in the School of Medicine as well as those of our research faculty. Expanding our footprint in the biomedical fields in the Kansas City metropolitan and regional areas, will allow us to demonstrate national and global healthcare innovation and leadership.

Sincerely,

Mary Anne Jackson, MD Dean and Professor of Pediatrics



November 25, 2020

Dear Dr. Bloemker,

I am writing on behalf of RBC Medical Innovations to express support for University of Missouri Kansas City's pursuit of Bachelor of Science and Master of Science in Biomedical Engineering degree programs. RBC Medical Innovations' interest of a Biomedical Engineering program lies in our business being in the field of medical technology engineering and our proximity to UMKC. RBC has over 25 years of experience and have supported 7 of the 10 largest medical device companies in the world on a wide range of projects in the field of medical devices. Additionally, RBC Medical Innovations is in Lenexa, Kansas a suburb to Kansas City, Missouri and less than a 30-minute drive to the UMKC campus and UMKC School of Computing and Engineering. In general, we are enthusiastic at the potential for the Kansas City area to grow in its resources, capability, and talent related to medical technology and medical device engineering.

RBC has the capacity to support UMKC's Biomedical Engineering program in the following ways. First, RBC traditionally hires 2-4 full-time "entry level" engineers per year. For entry level positions we consider engineers from a variety of engineering disciplines including Biomedical. RBC has hired in the past UMKC engineering students and have been very pleased with the skillset, competency, and knowledge of UMKC graduates. As a result, we would consider qualified candidates graduating from the Biomedical program from UMKC for our full-time entry level engineering positions in the future. Additionally, internships, research collaborations, and senior design/capstone projects with members of the program would all be considerations assuming the work was mutually beneficial for the student and RBC.

If desired, we are open to continuing dialogues with UMKC as they develop their program to provide additional information for the type of skillsets and experience that we look for in new full-time hires, interns, and research collaborators. If there are other ways we could potentially provide support to the program please do not hesitate to contact us.

Best,

Corbin Reagan, Director of Engineering

RBC Medical Innovations

creagan@rbccorp.com



saintlukeshealthsystem.org



November 30, 2020

Kevin Z. Truman, Ph.D., F.ASCE Dean, School of Computing and Engineering University of Missouri – Kansas City 5110 Rockhill Road Kansas City, MO 64110

Dear Dean Truman,

I would like to state my support for the proposed Bachelor of Science and Master of Science in Biomedical Engineering (BSBME & MSBME) degrees within UMKC's School of Computing and Engineering (SCE). UMKC has a long history of excellence in the health, life, and biological sciences, and I know SCE has continued to grow in enrollments, sponsored research and community engagement.

As one who has worked in the health science/medical space for >20 years and been able to support my cardiac based outcomes research program with continuous extramural funding throughout that time, I am consistently struck by the unrealized potential of our remarkable assets at UMKC. A large component of this unrealized potential is the lack of sufficient faculty to help fully exploit our opportunities.

To address this need, I believe that a very strong platform in interdisciplinary degrees in biomedical engineering through the SCE could be immensely helpful. The proposed BSBME and MSBME programs can support the University's vision to promote interdisciplinary education and research. Specifically, I as well as my colleagues within St. Lukes's Health System need locally based biomedical engineering programs that merges engineering, computer science, biosciences and medicine. We at St. Luke's have numerous ways to interact with these programs, its students, faculty and equipment, through technology transfer, internships, and research. Biodevices, biomaterials and bioinformatics have been projected to be a trillion dollar market in the coming years. This market will be in great need of biomedical engineering professionals. St. Lukes is just now entering the world of 3-D bioprinting. With SCE's recent investments in 3-D bioprinting and its cleanroom for that printing, several units within St. Luke's will be looking to intern, hire and collaborate with the biomedical engineering students and faculty.

Dean Truman has already identified approximately 20 faculty members from several UMKC academic units who can offer the initial courses for both programs and no new faculty hires will be needed until Fall 2023. St. Luke's personnel look forward to being on the advisory committees for further development of the academic and research missions, to help in hiring new faculty and to add focal areas for interdisciplinary research.

Of course, I would be even more supportive of earlier hires so that more faculty could be available to support collaborative research projects and further enhance our extramural funding. I am hopeful that many of the MS students (and Ph.D. students) will be interested in research and I believe that there is ample opportunity for support of this research with the growing data science and biotechnology resources of UMKCs School of Medicine, Children's Mercy, and Saint Luke's Hospitals.

Your support allows UMKC to serve the needs of students in our and region who are considering pursuing undergraduate and graduate degrees in biomedical engineering.

Sincerely,

Joh Sped

John A. Spertus, MD, MPH Lauer/Missouri Endowed Chair and Professor, University of Missouri – Kansas City; Clinical Director of Cardiovascular Outcomes Research, Saint Luke's Mid America Heart Institute

4401 Wornall Road, Kansas City, MO 64111 • Phone: (816) 932-2000 • saintlukeshealthsystem.org



December 1, 2020

30 W. Pershing Road Suite 200 Kansas City, MO 64108 816.221.2121 fax : 816.842.2865 kcadc@thinkKC.com



Kevin Z. Truman, Ph.D., F.ASCE Dean, School of Computing and Engineering 534 Flarsheim Hall University of Missouri – Kansas City 5110 Rockhill Road Kansas City, MO 64110

Dear Dean Truman,

On behalf of the Kansas City Animal Health Corridor (KCAHC), I would like to state my support for the proposed Bachelor of Science and Master of Science in Biomedical Engineering (BSBME & MSBME) degrees within UMKC's School of Computing and Engineering.

The KCAHC stretches from Columbia and St. Joseph, Missouri, to Manhattan, Kansas. Within this area, there are over 300 companies and 20,000 people working in animal health. The companies located in the KCAHC are responsible for 56 percent of total worldwide animal health, diagnostics, and pet food sales and represent the largest concentration of animal health companies and service providers in the world. For more information about the KCAHC, please visit <u>http://kcanimalhealth.thinkkc.com</u>.

Since its founding 15 years ago, the KCAHC's mission has remained the same: Support the growth of existing companies in the KCAHC and create an environment where new companies can grow and thrive. We accomplish this goal through the implementation of strategic priorities that are approved by the Board. Representatives of the KCAHC Board are executives from the major animal health companies in the region and the Dean of the Veterinary College at Kansas State University and the University of Missouri.

The KCAHC offers industry-leading workforce development solutions to complement the benefits of its globally unique animal health industry concentration. In partnership with regional academic institutions, the Corridor ensures that the KCAHC is pipelining skilled talent into the animal health industry today and for many years to come.

The addition of the BSBME & MSBME degree programs will enhance UMKC's ability to attract high achieving students in the biomedical field. This will serve the needs of the biomedical fields in the Kansas City region.

The KCAHC staff commits to working with UMKC faculty and staff to share student resumes with regional animal health employers. Furthermore, the KCAHC staff commits to making necessary industry connections to ensure that the program offerings are successful and continue to meet industry needs.

Should you require additional information regarding the KCAHC's endorsement of this program, please feel free to call or email me.

Sincerely,

Kun young

Kimberly Young President Kansas City Animal Health Corridor young@thinkKC.com M: 816.654.3617




December 2, 2020

Kevin Z. Truman, Ph.D., F.ASCE Dean, School of Computing and Engineering 534 Flarsheim Hall University of Missouri – Kansas City 5110 Rockhill Road Kansas City, MO 64110

Dear Dean Truman,

I would like to express my strong support for the proposed Bachelor of Science and Master of Science in Biomedical Engineering (BSBME & MSBME) degrees within UMKC's School of Computing and Engineering.

As the Chief Research Information Officer at Children's Mercy Kansas City and an adjunct Professor in Pediatrics and Biomedical and Health Informatics at UMKC, I work closely with clinical and technical experts at both organizations. I often witness issues that would benefit from the unique skills of a well-trained biomedical engineer. My other professional experience includes 16 years at Cerner where I was the Vice President of Genomics and Research and led a group of engineers. I am thrilled to learn of the progress that you have made toward establishing much-needed programs in Biomedical Engineering. This is the right time for UMKC to connect your strengths in engineering with those in healthcare and the biological sciences in launching this new program.

Graduates from this program will be in demand as Children's Mercy, Cerner and other local employers seek to hire people who can effectively work in the space between the clinical and technical. In my experience I always prefer to hire people with proven ability to work across these areas, by definition the students completing these programs will have that interdisciplinary background. At Children's Mercy we see data science, 3D printing, advanced visualization, drug delivery and other technical innovation as growth areas. We have just opened a new nine story research building with the design philosophy of 50% wet lab and 50% dry lab. Included in the dry lab areas is a Maker Space to encourage our clinical and scientific faculty to collaborate with technical experts. We also have a new data center, advanced bioinformatics capabilities, world class instrumentation and other resources relevant to biomedical engineering. We face a clear need to recruit staff and faculty as we grow in these areas and have been very successful when recruiting talent already familiar with the community.

As the program progresses, I will advocate for collaborative opportunities for your students to gain practical experience working with us. I will also work with the leadership of the Children's Mercy Research Institute to identify faculty who would be able to serve as guest lecturers and mentors. We have made exciting progress in pediatric data science, augmented reality visualization and other areas of interest to your future students. I would also like to see us serve as a setting in which your students could perform work related to their theses, one of the best ways for our faculty to evaluate prospective hires.

These degree programs will enhance UMKC's ability to attract high achieving students in the biomedical field. This program will serve the needs of the biomedical fields in the Kansas City metropolitan and regional areas as well as the nation and world. Please let me know how I can be supportive of the program as it progresses.

Sincerely,

Mark Hoffman

Mark Hoffman, Ph.D.

Chief Research Information Officer – Children's Mercy Hospital, Children's Research Institute

Assoc. Professor Biomedical and Health Informatics, University of Missouri Kansas City

O: 816-302-1310 M: 816-920-1931, mhoffman@cmh.edu

October 11, 2021

Mauli Agrawal, Ph.D. Chancellor University of Missouri-Kansas City 5100 Rockhill Road Kansas City, MO 64110

Dear Chancellor Agrawal:

I would like to state my support for the Bachelor of Science and Master of Science in Biomedical Engineering (BSBME & MSBME) degree proposals by UMKC's School of Computing and Engineering. UMKC's long history of excellence in the health, life, and biological sciences combined with the rapidly growing disciplines in computing and engineering provide a very strong platform to start these new interdisciplinary degrees in biomedical engineering.

One of the main missions of University Health is to serve as an academic medical center. We are intent on continuing to be a true academic health center and we do this by investing in research and advancing intellectual collaboration whenever possible. We already have research collaborations with many entities, including the UMKC Health Sciences Campus, and would love to expand these collaborations. The BSBME and MSBME degree programs at UMKC will allow our doctors and researchers to collaborate directly with faculty and students to enhance our current therapeutic research studies. These collaborations will also allow us to start new research initiatives in emerging fields such as, drug design and delivery, state-of-the-art orthopedics, bio- and nano- materials, and bone and tissue engineering.

In addition to the research potential, the biomedical engineering programs at UMKC will provide University Health, and the entire Kansas City metropolitan area, with a highly qualified workforce in the biomedical field. With the ever-changing nature of the health sciences field, young and innovative biomedical engineers will have the ability to bring much needed insight and new technology to this region's hospitals. We, at University Health, need these talented graduates to help us continue to advance in state-of-the-art biomedical solutions that will better serve the patients of our community.

These new biomedical programs at UMKC will provide University Health with a multidisciplinary workforce, research collaborators, and biomedical entrepreneurs, which we need to enhance our academic research and help the Kansas City community. These programs will allow UMKC to serve not only the needs of students in the Kansas City metropolitan area, but ultimately our patients at University Health.

Sincerely. rlie Shields

President and Chief Executive Officer



2401 Gillham Road Kansas City, Missouri 64108 (816) 234-3000

Paul D. Kempinski, MS, FACHE President and Chief Executive Officer Phone: (816) 234-3650 Fax: (816) 842-6107

October 19, 2021

C. Mauli Agrawal, Ph.D. Chancellor University of Missouri-Kansas City 5115 Oak Street Kansas City, MO 64112

Dear Chancellor Agrawal,

I am writing to state my support for the proposed Bachelor and Master of Science degree programs in Biomedical Engineering (BME) at the University of Missouri-Kansas City (UMKC). UMKC has always been well known for its excellence in the health sciences, including medicine, nursing, dentistry, and pharmacy. Partnering UMKC's excellence in health sciences with the more recent growth of the computing and engineering programs at UMKC's School of Computing and Engineering provides a strong foundation to build top Biomedical Engineering programs that capitalize on the strengths at UMKC and partner organizations and serve as an important asset to the Kansas City region, state of Missouri and beyond.

The UMKC BME faculty, undergraduate students, and graduate students will be a tremendous asset to Children's Mercy's research initiatives. Children's Mercy recently opened a new \$200M, 375,000 sq. ft. research facility that supports our pediatric translational research programs. Our researchers welcome the opportunity to include these engineering faculty and students within our research teams. Additionally, we will offer our researchers and doctors as mentors, instructors, adjunct faculty, and partners in those areas where it makes sense, such as biomaterials, biodevices, bio-related augmented and virtual reality, orthopedics, and innovative drug design, production, and delivery.

The main goal at Children's Mercy is to ensure we are leading in cutting-edge research, so our children are receiving the best care and outcomes possible. With the ever-changing nature of the health sciences field, young and innovative biomedical engineers can bring much-needed insight and new technology to this region's hospitals. Through multidisciplinary collaboration, Children's Mercy doctors and researchers coupled with UMKC's faculty, students, and graduates, there is unlimited potential for biomedical innovation. Children's Mercy cannot do this alone and we need biomedical engineers, ranging from undergraduates to Ph.Ds., to supplement our doctors and researchers so we can serve our patients in the best way possible.

I am extremely excited for the opportunities the new BME programs at UMKC will provide to the Kansas City medical community. Not only will we be able to start new research partnerships with the researchers and faculty, but graduates of these programs will provide tremendous growth in the biomedical tech sector in

this region. Having high-level biomedical engineers studying, researching, and practicing right here in our backyard creates endless opportunities for collaboration and innovation in the medical field which will directly impact the level of care we can give our patients at Children's Mercy.

Sincerely,

6

Paul Kempinski, MS, FACHE President and Chief Executive Officer Alice Berry, DDS, and Katharine Berry, MD, Endowed Chair In Executive Leadership

November 24, 2020

Dear Colleagues,

The School of Computing and Engineering at the University of Missouri-Kansas City has developed two synergistic academic program proposals: a Bachelor of Science in Biomedical Engineering (BSBME) and a Master of Science in Biomedical Engineering (MSBME). This letter serves to communicate my *strong* support for these two programs, along with my assessment of their impact on our community, region, and state.

The School of Computing and Engineering (SCE) at UMKC has a history of high-quality academic programs and cutting-edge research. With the collaboration of faculty in our health sciences programs (School of Medicine, School of Dentistry, School of Pharmacy, and School of Nursing and Health Sciences) and our community healthcare partners (e.g., Truman Medical Center, Children's Mercy Hospital, St. Luke's), the SCE is poised for growth and academic innovation. These degree programs will complement outstanding academic and research programs currently offered at UMKC. Our urban location, coupled with strong regional healthcare partnerships differentiate these programs from similar programs offered throughout our University System, although collaboration in coursework and research opportunities with UM Columbia and S&T are expected.

As you can see from the proposal, there is a strong market in the Kansas City metropolitan area, as well as the broader bi-state (MO, KS) region for these programs. Internship and career placement opportunities for students are robust. These programs will strengthen the already solid reputation of SCE, and our health sciences programs, as well as and expand external funding opportunities from federal and industry sources.

I am confident in the ability of SCE to deliver these programs, integrate them with our existing academic and research opportunities within the UM System, as well as our regional healthcare assets, and make a positive impact on our regional and state economies, as well as our national and international reputation in biomedical research.

Best regards,

Jenife D. Julgen

Jennifer D. Lundgren Provost and Executive Vice Chancellor

Executive Summary New Degree Program, M.S. in Biomedical Engineering, UMKC

The Master of Science in Biomedical Engineering (MSBME) degree is a two-year graduate degree consisting of 30 credit hours. Interest from undergraduate students and working professionals has seen tremendous growth in the last decade and is a pathway to an elevated career, graduate (PhD) research degree or medical school. Within the School of Computing and Engineering (SCE), computing and engineering academic and research programming related to bio and health technologies has increased with more than 20% of the research and its related coursework being within biomedical engineering. The MSBME degree also fits within Kansas City's role in the "Animal Health Corridor"; the local research hospitals, St. Luke's and Children's Mercy; and UMKC's Health Science Campus, including the schools of Medicine, Dentistry, Pharmacy and Nursing. Faculty responsible for the MSBME program will consist of professors and medical professionals from multiple schools and departments on UMKC's campus (including engineering, medicine, pharmacy, dentistry, nursing, and the bio sciences) all of whom will be included in teaching classes, providing research opportunities, participating in seminar series, and guest lecturing for the MSBME program.

According to nationally published data, the Healthcare and Social Assistance Industry has been the largest and the fastest growing employment sector in the greater Kansas City area. The healthcare sector of the greater Kansas City area comprises 11.5 percent of the region's jobs and is the fastest-growing industry, averaging over 3000 new jobs per year over the last decade. Recent data published by the Economic Development Corporation of the City of Kansas City, Missouri shows that out of the top twenty-one (21) employers in the Kansas City area, eight (8) top employers are in the medical and healthcare service sectors. The health care sectors of the greater Kansas City (MO and KS) area have a combined workforce of more than 200,000 and contribute more than \$10 billion annually to the regional economy. The greater Kansas City area depends on biomedical engineering professionals to ensure access to cutting-edge medical and health care technologies leading to the highest levels of medical treatments, drugs, equipment, and assessment technologies. This needed workforce and the health care challenges due to an aging population will drive the need for new, cost-effective innovations in medical devices, biomaterials, and data analytics. The proposed MSBME degree will bolster the technical competency of the healthcare industry in the Kansas City area and provide workforce for jobs that will make significant contributions to the continued growth and economic development of this field and the region.

The Burning Glass reports show job growth for graduates with a Master of Science in Biomedical Engineering as high in the Kansas City area as well as across Kansas and Missouri. Problem solving is the backbone of any engineering discipline and is reinforced throughout the entire MSBME curriculum, making these students excellent potential employees for a variety of jobs outside of health care as well. Many will become entrepreneurs, technology assessment specialists, doctors and more.

The MSBME program will require little to no initial resources to begin matriculating students. SCE's new research facility already has the necessary labs for both the academics and the research associated with such a degree. SCE already has sufficient faculty expertise and staff for this degree. The program will be revenue positive from year one and will only grow in net revenue each of the following three years at which time SCE will make the decision whether to go steady-state in size or continue growing.

No. 3

Recommended Action - MS in Biomedical Engineering - University of Missouri- Kansas City

It was recommended by the University of Missouri System Office of Academic Affairs, endorsed by President of the University of Missouri Mun Choi, recommended by the Academic, Student Affairs and Research & Economic Development Committee, moved by Curator_____, seconded by Curator_____that the following action be approved:

that the University of Missouri – Kansas City be authorized to submit the attached proposal for a MS in Biomedical Engineering to the Coordinating Board for Higher Education for approval.

Roll call vote of the Committee:	YES	NO
Curator Graves		
Curator Hoberock		
Curator Layman		
Curator Wenneker		
The motion		
Roll call vote of Board:	YES	NO
Curator Brncic		
Curator Chatman		
Curator Graham		
Curator Graves		
Curator Hoberock		
Curator Holloway		
Curator Layman		
Curator Wenneker		
Curator Williams		
The motion		

New Degree Program Proposal:

Master of Science in Biomedical Engineering

University of Missouri – Kansas City November 2021 Board of Curators Meeting

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Executive Summary

The Master of Science in Biomedical Engineering (MSBME) degree is a two-year graduate degree consisting of 30 credit hours. Interest in MSBME degrees from undergraduate students and working professionals has seen tremendous growth in the last decade and is a pathway to an elevated career, graduate (PhD) research degree or medical school. Within the School of Computing and Engineering at UMKC (SCE), computing and engineering academic and research programming related to bio and health technologies has increased at an astounding rate with more than 20% of the research and its related coursework being within biomedical engineering. The MSBME degree also fits perfectly within Kansas City's role in the "Animal Health Corridor"; the local research hospitals, St. Luke's and Children's Mercy; and UMKC's Health Science Campus, including the schools of Medicine, Dentistry, Pharmacy and Nursing. Faculty responsible for the MSBME program will consist of professors and medical professionals from multiple schools and departments on UMKC's campus (including engineering, medicine, pharmacy, dentistry, nursing, and the bio sciences) all of whom will be included in teaching classes, providing research opportunities, participating in seminar series, and guest lecturing for the MSBME program.

According to nationally published data, the Healthcare and Social Assistance Industry has been the largest and the fastest growing employment sector in the greater Kansas City area. The healthcare sector of the greater Kansas City area comprises 11.5 percent of the region's jobs and is the fastest-growing industry, averaging over 3000 new jobs per year over the last decade. Recent data published by the Economic Development Corporation of the City of Kansas City, Missouri shows that out of the top twenty-one (21) employers in the Kansas City area, eight (8) top employers are in the medical and healthcare service sectors. The health care sectors of the greater Kansas City (MO and KS) area have a combined workforce of more than 200,000 and contribute more than \$10 billion annually to the regional economy. The greater Kansas City area depends on biomedical engineering professionals to ensure access to cutting-edge medical and health care technologies leading to the highest levels of medical treatments, drugs, equipment, and assessment technologies. This needed workforce and the health care challenges due to an aging population will drive the need for new, cost-effective innovations in medical devices, biomaterials, and data analytics. The proposed MSBME degree will bolster the technical competency of the healthcare industry in the Kansas City area and provide workforce for jobs that will make significant contributions to the continued growth and economic development of this field and the region.

The Burning Glass reports show job growth for graduates with a Master of Science in Biomedical Engineering as high in the Kansas City area as well as across Kansas and Missouri. Problem solving is the backbone of any engineering discipline and is reinforced throughout the entire MSBME curriculum, making these students excellent potential employees for a variety of jobs outside of health care as well. Many will become entrepreneurs, technology assessment specialists, doctors and more.

The MSBME program will require little to no initial resources to begin matriculating students. SCE's new research facility already has the necessary labs for both the academics and the research associated with such a degree. SCE already has sufficient faculty expertise and staff

for this degree. The program will be revenue positive from year one and will only grow in net revenue each of the following three years at which time SCE will make the decision whether to go steady-state in size or continue growing.

1. Introduction

The Master of Science in Biomedical Engineering (MSBME) degree is an interdisciplinary graduate degree consisting of 30 credit hours, with a 24 credit hour expedited option for current UMKC students. The MSBME degree program is designed to provide advanced training in different fields of biomedical engineering. The program requires students to establish the necessary foundation and advanced skills in one or more of the following fields of biomedical engineerings, (ii) Biomedical Signal Processing, (iv) Bioelectronics and Medical Devices, or (v) Biomedical Computation, Modeling, and Analytics.

UMKC's long history of excellence in health science, life science and biological science- related disciplines, together with the rapidly growing disciplines of computing, engineering and other STEM fields, is expected to provide a very strong platform from which to start this new interdisciplinary graduate degree in biomedical engineering. There has been a high volume of collaborative projects among faculty members and researchers from SCE and the academic units of UMKC's Hospital Hill campus. In recent years, interest in academic and research collaboration related to bio and health technologies is increasing at an astounding rate among the faculty members of the STEM disciplines. The proposed MSBME would provide a very effective platform from which to strengthen and institutionalize these collaborative efforts in engineering, computer science, and bio and health technology-related education, outreach, and research. Typically, in a metropolitan city of the size and characteristics of Kansas City, graduate and professional degrees in biomedical engineering and technology are needed to serve the biotechnology needs of industry, research and academia. A graduate degree in biomedical engineering will fit perfectly with UMKC's current strength in medical, health and biological science, and technology.

UMKC's School of Computing and Engineering (SCE) is Kansas City's only accredited school for engineering and computer science, and Kansas City has been the center of health care service and biotechnology companies in the region for many decades. Not having degree programs in Biomedical Engineering is a serious deficiency that needs to be addressed in order to better serve the population of this region. There is also an urgent need to increase representation of female and minority students in our STEM disciplines. The goal to increase both women and minorities in STEM will be greatly enhanced as biomedical-related degrees attract larger percentages of these populations than the traditional engineering and computing disciplines.

It should be noted that no big investments are necessary to start and maintain this program. Additional resources (including new faculty hires) will only be needed as the enrollments and revenues grow. All of the required and elective courses are currently offered by different units of UMKC. Faculty members in SCE are working with a few faculty members from other participating units to develop several new courses, which will fulfill requirements within the MSBME. Therefore, there are no additional expenses foreseen for the initiation of this program. The current courses have sufficient extra capacity to accept the additional anticipated students as the program reaches steady state. Additional elective courses may be developed in the future as enrollment numbers grow to improve the curriculum.

The main person responsible for the MSBME program is Dr. Masud Chowdhury, Associate Dean of Faculty Affairs in the School of Computing and Engineering. Dr. Chowdhury is also a faculty member in the Computer Science Electrical Engineering Department and will assist with some of the teaching in the MSBME program due to his academic experience and research in the biomedical field. Dr. Katherine Bloemker, Assistant Dean of Faculty Affairs in the School of Computing and Engineering, will also assist Dr. Chowdhury with some of the assessment and curricular aspects pertaining to the MSBME program.

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2. University Mission & Program Analysis

2.A. Alignment with University Mission & Goals

The MSBME supports SCE's goal of increasing degree and discipline options in the STEM fields. The MSBME Program is highly supported by Dean Truman. See attached Letter of Support: *LOS BSBME MSBMS - Truman.pdf.* The MSBME helps to support Chancellor Agrawal's vision of increasing the size of UMKC.

The UMKC Mission Statement reads as follows:

"As an urban research university, our mission at the University of Missouri-Kansas City is to promote learning through the discovery, preservation and dissemination of knowledge of public value across a broad spectrum of disciplines and fields of study. UMKC celebrates the individual and embodies diversity and inclusion by intertwining these goals with innovation to enable transformational impact aimed at bringing cultural, social, health and economic prosperity to the metropolitan, regional and global communities we serve."

The MSBME supports the university's vision to promote interdisciplinary education and research. The proposed MSBME is aligned with UMKC's overall mission particularly in the first line (underlined above). This program is by definition comprised of a broad spectrum of disciplines and fields of study. Students who complete the MS in Biomedical Engineering will have the opportunity to take courses in a wide range of disciplines, including Biology, Chemistry, Dentistry, Electrical Engineering, Mathematics, Mechanical Engineering, Medicine, Pharmacy, Physiology, and Statistics.

The goals for the MSBME program are listed in the following table:

Goal 1:	Students have the advanced education to facilitate specialization in Biomedical Engineering.
Goal 2:	Students have the specialized education and communication skills to prepare them for advanced career paths.

These goals map onto the five pillars of the UMKC Strategic Plan as follows:

- 1. Provide exceptional student learning, success and experience
 - Both of the program goals align with this pillar.
- 2. Become a thriving discovery enterprise
 - Goal 1 aligns with this pillar.
- 3. Transform our community and region with impactful engagement
 - Goal 2 aligns with this pillar.
- 4. Foster an environment of invigorating multiculturalism, globalism, diversity and inclusion
 - Goal 2 aligns with this pillar.
- 5. Develop a strong and resilient people, process and physical infrastructure *Both of the program goals align with this pillar.*

UMKC's Schools of Medicine and Dentistry partner with leading hospitals in Kansas City to provide students and residents with outstanding medical education. New avenues of health care, medical education, and services will be possible if UMKC and its partner hospitals can extend the collaboration to biomedical equipment and biotechnology companies and research organizations in the region and across the nation. The School of Pharmacy has a mission of shaping the future of healthcare and improving lives. The School of Biological and Chemical Science (SBCS) faculty members are working to develop interdisciplinary and collaborative approaches to education and research to ensure that graduates are ready to immediately contribute to the demands of a 21st century workplace. Most of the Pharmacy and SBCS graduates become part of the health care and biotechnology workforce. The School of Nursing and Health Studies has been making continuous efforts to remain a premier academic institution by updating and upgrading its curriculum in response to the changing healthcare landscape, which has become a data science and biotechnology-driven sector. The proposed MSBME degree program would directly serve these missions.

2.B. Duplication & Collaboration within Campus, Across System

Within the University of Missouri System there is no other MS degree that exactly duplicates the proposed MSBME degree. However, there is some overlap in terms of focus areas with the bioengineering graduate program of the Department of Biomedical, Biological and Chemical Engineering (BBCE) of the University of Missouri - Columbia. The proposed MSBME degree is unique and comprehensive due to its interdisciplinary nature and the diverse combination of focus areas and interests from five participating academic schools across the UMKC campus. In the greater Kansas City area the proposed MSBME degree would be the only such graduate program. The only graduate program similar to the proposed MSBME degree in the State of Missouri is offered by Washington University in St. Louis.

Construction was just recently completed on the new engineering lab building for SCE with an anticipated full opening of all labs in the Spring 2021. The Robert W. Plaster Free Enterprise and Research Center (FERC) is a 57,800 sf facility which will house a variety of cutting-edge research and teaching labs including a structural high-bay, bio-nano-clean room, unmanned vehicle suite, advanced 3-D printing including bioprinting, motion capture laboratory, big data, and renewable energy labs amongst many others. This new facility provides SCE with the ability to build and foster laboratory and research capabilities necessary for a world-class biomedical engineering program.

The uniqueness of the MSBME program from UMKC comes from UMKC's proximity to the health-care companies and hospitals located in Kansas City along with the UMKC Health Science campus (Schools of Medicine, Dentistry, Pharmacy, and Nursing). The School of Computing and Engineering currently has significant ongoing research with all four Health Science schools accounting for 20% of SCE's \$35-40m, 3-yr research portfolio. St. Luke's and Children's Mercy Hospitals have verbally agreed to create year-long internship positions for students in the MSBME program. These internships will parallel the coursework the students are taking, which can only be accomplished if the educational component (faculty and labs) is in close proximity to the facilities. Additionally, the School of Medicine will encourage the pre-med and medical students to take several of the courses related to biotechnology.

With the expertise of the biomedical faculty across the UM System, all of the biomedical programs can be enhanced substantially by coordinating with the other universities. Specifically the range of elective offerings can be augmented by using system-wide courses from UM-Columbia and Missouri S&T (and they can use UMKC courses). The biomedical faculty in SCE have already reached out to faculty at UM-Columbia and Missouri S&T to develop a course-sharing strategy. It was determined through these conversations that the biomedical program at UMKC and UM-Columbia can be mutually beneficial due to the differences in expertise on each campus.

UMKC currently excels in the area of biomechanics and biomaterials with a number mechanical and civil engineering faculty already teaching elective courses in those subject area. UM-Columbia stated the need for more biomechanics-focused elective courses. UMKC would be able to share courses such as Biomechanics, Biodynamics, and Experimental Biomechanics of Human Motion. The biomechanics faculty at UMKC are already in the process of adding more elective courses which could be added to this list.

In addition to biomechanics, UMKC is in the process of building expertise in the area of biomaterials. Two senior level and graduate courses are currently offered with a number of others in the pipeline for launching in the next year or two. This will be a great opportunity for course sharing with other UM-System biomedical programs, as these additional elective offerings become available.

UM-Columbia currently excels in the areas of bioengineering and biomedical imaging and suggested the ability to share elective courses such as Biomedical Imaging, Tissue Engineering, and Bioprocessing. This would allow UMKC students to gain valuable elective experience in an area that is not currently available on campus.

In addition, UM-Columbia offers a completely online certificate program which consists of four classes, including an extremely beneficial regulatory course that would be particularly useful to UMKC biomedical students.

The proposed MSBME program at UMKC requires 30 credit hours (with a 24 credit hour expedited program for UMKC BS/MS fast-track students and professional and graduate students in other disciplines), which is competitive in comparison to regional universities. The following table shows the requirements and credentials available at these regional universities. Note that only two of the regional institutions offers specifically "Biomedical Engineering."

University	Program	Credit Hours
KU	Masters in 5 separate Biomedical Specialties*	30 credit hours
Wichita State	Masters in Biomedical Engineering	30 credit hours
UM-Columbia	Masters in Biological Engineering	30 credit hours
WashU	Masters in Biomedical Engineering	30 credit hours

* KU Specialties: Biomaterials & Tissue Engineering, Biomechanics & Neural Engineering, Biomedical Product Design & Development, Biomolecular Engineering, and Computational Bioengineering

3. Business-Related Criteria & Justification

3.A. Market Analysis

3.A.1. Rationale & Workforce Demand for the Program

According to data published by Economic Modeling Specialist International for the period of 2004-2014, the health care and social assistance Industry has been the largest and the fastest growing employment sector in greater the Kansas City area. There is a very important reason why the Kansas City employment data for the period of 2004-2014 is highlighted. Due to economic slowdown, almost every sector in Kansas City and across the nation had lost jobs between 2009 and 2011, but the health care industry in the Kansas City area kept adding jobs even during that very difficult economic situation. For the post-2014 period, the employment numbers and the workforce requirements of the healthcare and bio-technology industries have further increased. Recent data published by the Economic Development Corporation of City of Kansas City, Missouri shows that out of the top twenty-one (21) employers of the Kansas City area, eight (8) top employers are in the medical and healthcare service sectors¹.

Overall, the health care sectors on the Kansas and Missouri sides of the greater Kansas City area have a combined workforce of more than 200,000 and contribute more than \$10 billion annually to the regional economy. Not only is the economy of this region heavily dependent on the health care industry, but the greater Kansas City area population depends on the health care service providers and professionals in the area to ensure their access to state-of-the-art medical treatment and health care technologies.

The healthcare sector is an important part of the greater Kansas City area's economy. It makes up 11.5 percent of the region's jobs and is the fastest-growing industry, averaging over 3000 new jobs per year over the last decade. This trend is expected to continue, particularly as the Baby Boom generation ages; the proportion of the area's population aged 65 or older is expected to reach 18 percent by the year 2030.² This and other health care challenges will drive the need for new, cost-effective innovations in medical devices, biomaterials, and data analytics. The proposed MSBME degree will bolster the technical competency of the healthcare industry in the Kansas City area and provide jobs that would make significant contributions to the continued growth and economic development of this field.

The Burning Glass reports show job growth for graduates with a Master of Science in Biomedical Engineering as high in both the Kansas City area, as well as across Kansas and Missouri. This is compared to an average job growth nationwide. Potential employers of graduates of a biomedical engineering degree program include biotech companies, bioanalytics firms, medical device companies, health industries, laboratories, government

¹ <u>https://www.edckc.com/workforce-talent/major-employers/</u>

² http://kcworkforce.com/Assets/reports/HealthCare_IndustryReport2013.pdf

agencies, Veteran's Affairs, the computing industry, consulting groups, medical centers, and higher education.

The reports show top job industries for graduates in Biomedical Engineering as public administration; health care and social assistance; professional, scientific, and technical services; and manufacturing. Potential job titles include biomedical engineer, research associate, hospital management, data analyst, medical technician, scientific technician, project management, and medical coding.

Biomedical engineers in reality have very diverse career paths. They are trained to be analytical, creative problem solvers. Many have careers as bio device designers, sensor and material designers, biomedical researchers, technical business analysts, entrepreneurs, data analysts, doctors, medical management and much more. Many graduates use this technical training as a springboard into medical research, medical administration, medical technology consultancy, health administration, health-related software, and medical facilities designers.

The diversity in job titles and companies for these graduates makes it difficult for companies (databases) such as Burning Glass to capture the real number of jobs that are available for biomedical engineers. These graduates often land in companies outside of the traditional biomedical field that span the gambit of architecture (medical facility design) to Wall Street (medical startup evaluations). These jobs are nearly impossible to collect from traditional data sources.

Some key competencies of these potential employers include biomedical engineering, mechanical engineering, biomedical research, biotechnology, medical planning, medical imaging, communication skills, data analysis, and project management.

The degree program prepares graduates in these competency areas through the curriculum. All students are required to take multiple elective courses in such topics as Biomedical Engineering, Mechanical Engineering, and Biotechnology. In addition, all students are required to take one course in statistics or biostatistics, which enforces their data analytics skills. Biomedical research, communication skills, and project management are covered in numerous elective courses, specifically any course requiring a culminating project. Students who elect to do the thesis option rather than the course option will gain even further enhanced research and communication skills.

For specific details in the Burning Glass Reports, see the market analysis in the appendix.

In the attachments, there are seven letters of support for the MSBME program. Four of these letters are from external entities including: two area hospitals (St. Luke's Hospital and Children's Mercy Hospital), one local medical technology company (RBC Medical Innovations), and one from the Kansas City Animal Health Corridor (KCAHC).

The letter from Dr. John Spertus at St. Luke's Mid-America Heart Institute indicates numerous ways in which the biomedical engineering students will be able to collaborate with professionals at the hospital "through technology transfer, internships, and research." He also notes that "biodevices, biomaterials and bioinformatics have been projected to be a trillion dollar market in the coming years." Dr. Spertus adds that with this growth, the market will be in high need of trained biomedical engineering graduates.

The letter from Dr. Mark Hoffman at Children's Mercy Hospital points out that graduates with degrees in biomedical engineering "will be in demand as Children's Mercy, Cerner and other local employers seek to hire people who can effectively work in the space between the clinical and technical." In addition, Dr. Hoffman has expressed that he will advocate for collaborative opportunities, such as internships and student projects, to allow for biomedical engineering students to gain practical experience working at Children's Mercy.

There is also a letter from Corbin Reagan, the Director of Engineering at RBC Medical Innovations, which is a medical technology engineering company located in the Kansas City metro region (Lenexa, Kansas). Mr. Reagan specifically expresses that RBC has hired a number of UMKC engineering graduates in the past and has been very pleased with their knowledge and skillsets. With these newly proposed biomedical engineering programs, RBC would have additional motivation to hire UMKC graduates. In addition, RBC would be able to partner with the biomedical engineering students through internships, research collaborations, and senior design projects.

The Kansas City Animal Health Corridor (KCAHC) currently works in partnership with regional academic institutions to pipeline skilled talent in to the animal health industry. The letter from Kimberly Young, the president of KCAHC, commits to work "with UMKC faculty and staff to share student resumes with regional animal health employers." This partnership will open up a vast array of employment opportunities to the future UMKC biomedical engineering graduates.

Although we did not provide specific letters, it should be noted that MRI Global, formerly Midwest Research Institute, and Stower's Research Institute are both located next door to campus. Both Institutes are involved in high level biomedical research and have expressed interest in biomedical engineering graduates to help bolster their research teams.

In addition to the provided external letters of support, there are three internal letters of support including letters from: Jennifer Lundgren, Provost of UMKC; Kevin Truman, Dean of SCE; and Mary Anne Jackson, Dean of the School of Medicine.

3.A.2. Student Demand for the Program

The high concentration of thriving hospitals, health care services and management, biomedical research, health informatics, and other biotechnology-related companies and organizations in the greater Kansas City area makes it a very timely and appealing degree program for both regular full-time and professional part-time students. If approved, the proposed MSBME would the first MS degree in Biomedical Engineering with the five above-mentioned concentration areas in the greater Kansas City, which is one of the largest population centers of this region with a very large workforce in the health and medical service sectors. Therefore, this new degree program would advance UMKC's strategic mission to become "Kansas City's university" and a regional and national leader in life science and medical science-related education and research.

A large number of our STEM graduates who are interested in biomedical engineering- related careers pursue graduate education in institutes outside the State of Missouri due to the lack of such opportunity here in the Kansas City area. SCE can promote the MSBME degree to our own STEM undergraduate students both as a regular MS degree option and as a fast-track BS-MS degree option.

The main demand for the MS program will be from the BS students who continue on to the expedited five-year program (which is why you see the large enrollment jump after four years). In addition, the Health Sciences Campus as well as the School of Computing and Engineering at UMKC will provide a pipeline for professional and graduate students from Medicine, Nursing, Dentistry, Pharmacy, Biological Sciences, Computing and Engineering, and other STEM disciplines who are interested in the Biomedical field. There is an expedited one-year program for these UMKC graduate and professional students and an engineering undergraduate degree is not required for the MS.

There is a widespread practice among many medical and dentistry students to take one year off to pursue research or additional graduate degrees outside their primary degree programs. The one-year expedited MS in Biomedical Engineering would be a great option for the professional and graduate students from the disciplines of Medicine, Nursing, Dentistry, Pharmacy and Biological Sciences to obtain an additional MS degree in Biomedical Engineering in parallel to their primary degrees. This one-year option will attract graduate students from schools of computing and engineering. Moreover, among the international students of SCE there is a high demand for a dual-MS degree because it improves their prospects of having good careers and obtaining work visas or necessary immigration statuses in the US.

Currently in SCE, numerous biomedical elective courses are already offered. The demand for these courses has been consistently high and comparable to other elective courses in our traditional engineering disciplines. For example, in the biomedical courses offered over the past two years (Biomaterials, Biomechanics, Biodynamics, Experimental Biomechanics of Human Motion, and Biomedical Device Design) in the mechanical engineering program alone, there has been an average of 18 total graduate students enrolled (in both 2019 and 2020).

University	Program	Enrollment		
		2018	2019	2020
KU	Masters in 5 separate Biomedical Specialties*	27	24	17
Wichita State	Masters in Biomedical Engineering	17	18	19

Graduate enrollment over the past three years at a couple of select regional universities is summarized in the following table.

The enrollment projections shown in the following table have an estimated starting enrollment of 8 students with a growth of 1 to 2 students per year until year 4 where growth bumps up to 10 students per year due to the graduating BSBME students at year 4. It is anticipated that nearly 50% of the BSBME program graduates will pursue the BS/MS 5 year track to BSBME and MSBME degrees, hence the large jump in the year 4 enrollments. A retention rate of 85.7% was used per year for the graduate program, which is very similar for the current SCE graduate programs. See attachment: <u>MS Biomed Proforma.xlsx</u>.

Table 1a. Student Enrollment Projections (anticipated total number of students enrolledin the program during the first five fall semesters following implementation)

Year:	1	2	3	4	5
Full-time	8	16	19	29	47
Part-time	0	0	0	0	0
Total	8	16	19	29	47

Table 1b. New Student Enrollment Projections (anticipated number of students enrolled in the program during the first five fall semesters following implementation <u>that are new to</u> <u>the University</u>)

Fiscal Year:	1	2	3	4	5
Full-time	8	16	19	29	47
Part-time	0	0	0	0	0
Total	8	16	19	29	47

Table 1c. Projected Number of Degrees Awarded

Year:	1	2	3	4	5	6	7	8	9	10
# of Degrees Awarded	0	7	8	9	17	26	26	26	26	26

In addition to specific demand indicated for a biomedical engineering graduate degree, these enrollment projections are also in line with what we have seen from other UMKC computing and engineering programs. Fall 2019 SCE master's degree enrollment was 67 in Electrical Engineering (EE), 34 in Civil Engineering (CE), 227 in Computer Science (CS), and 29 in Mechanical Engineering (ME). Fall 2020 enrollment is currently 67 in EE, 28 in CE, 165 in CS, and 34 in ME. The total enrollments (undergraduate and graduate) in SCE have grown from 865 in 2008 to 1,755 in 2019. Growth of SCE over the past 10 years is shown in the figure.



3.B. Financial Projections

A pro forma worksheet with financial projections is included, see attachment: <u>MS Biomed</u> <u>Proforma.xlsx</u>.

3.B.1. Additional Resources Needed

No additional resources will be needed until the program grows in year 3-4. SCE currently has enough qualified faculty, courses and laboratories in the biomedical field to accommodate this program in years 1-2. Additional resources will only be needed as the enrollments and revenues grow. Costs include faculty and support salaries and benefits; non-capital equipment; computing expenses; supplies; travel and training; and miscellaneous expenses. Hiring of an adjunct faculty member is planned for year 3.

3.B.2. Revenue

The sources of revenue include tuition and fees for new students. No financial support is being provided by the university. No external funds are being used.

3.B.3. Net Revenue

Annual revenues will exceed annual expenses each year as shown in the following table.

 Table 2. Financial Projections for Proposed Program for Years 1 Through 5.

	Year 1	Year 2	Year 3	Year 4	Year 5
1. Expenses per year	l	l	l	·	l
A. One-time					
New/Renovated Space	0	0	0	0	0
Equipment	0	0	0	0	0
Library	0	0	0	0	0
Consultants	0	0	0	0	0
Others	0	0	0	0	0
Total one-time	0	0	0	0	0
B. Recurring		•	•	•	•
Faculty	0	0	7004	7144	7287
Staff	3060	3121	3184	3247	3312
Benefits	1334	1361	1924	1963	2002
Equipment	7140	7282	7428	7576	7728
Library	0	0	0	0	0
Other	5100	2601	2653	2706	2760
Total recurring	16634	14366	22193	22637	23090
Total expenses (A+B)	16634	14366	22193	22637	23090
2. Revenue per year	1	1	1	1	1
Tuition/Fees	50348	101786	122528	196535	321131
Institutional Resources	0	0	0	0	0
State Aid – CBHE	0	0	0	0	0
State Aid – Other	0	0	0	0	0
Total revenue	50348	101786	122528	196535	321131
3. Net revenue (loss) per year	33714	87419	100335	173897	298041
4. Cumulative revenue (loss)	24405*	111825	212160	386057	684098

NOTE: *Takes into account \$9,308 in expenditures in year 0 for support salary and miscellaneous expenses.

A reduced enrollment analysis was completed to validate the financial strength of the new program. A prediction of 50% enrollment from our original estimates in the proforma was completed. Even at these low enrollment numbers, the MSBME program was still financially viable, showing satisfactory positive net revenue by the second year. For specific details, see the attachment: <u>BME reduced enrollment analysis.pdf</u>.

3.B.4. Academic and Financial Viability

Although revenues are positive even with the starting enrollment of 8 students, for steadystate viability SCE believes that the MSBME program needs a total enrollment of 25 students. This provides approximately 12 per class which keeps all courses at a single section, but is a large enough graduate cohort for the students to receive a positive and meaningful academic experience.

Viability	Minimum Enrollment
Academic	25
Financial	25
Overall	25

Table 3. Enrollment for Academic and Financial Viability

3.C. Business Plan: Marketing, Student Success, Transition & Exit Strategies

3.C.1. Marketing Plan

Once the program is formally launched, the Dean of SCE will appoint a Degree Program Director or Chair, who will also serve as the point person to work with MCOM regarding recruitment and marketing efforts. At the preliminary stage, the Dean (Kevin Truman), the Associate Dean (Masud Chowdhury), and the Assistant Dean (Katherine Bloemker) will work with MCOM directly and serve as the point persons for the proposed MS degree in Biomedical Engineering.

There is a large group of biotechnology and health care professionals in Kansas City – working in many hospitals, research organizations and with health and medical service providers – who do not have any graduate degree in the fields in which they are working. These professionals have undergraduate degrees in various engineering and bio-related fields other than biomedical engineering. There is a significant number of UMKC alumni in the Kansas City area and the new program can be marketed to alumni who desire to continue their studies at UMKC. The program will be marketed specifically to these working professionals to allow them advance in their careers with their newly-acquired MSBME degree. Many current graduate students of the Schools of Medicine, Dentistry, Pharmacy and Nursing would be interested in having a second MS degree in Biomedical Engineering. In many universities it is a common practice for medical students to take a year off to pursue biomedical research or related graduate course work. It is anticipated that a good number of graduate students UMKC's Hospital Hill campus and other medical and health science-related schools in this region can be attracted to the MSBME program. Additionally, this program will be marketed heavily to our undergraduates through the BS/MS program. An advanced degree in biomedical engineering will help these undergraduates find their job of choice or to pursue a PhD. SCE Continuing Education, UMKC ISAO, and other recruiting units across the campus will support marketing of the MSBME program to the above mentioned audiences. MSBME will be included in existing marketing (mass email, printed pieces, websites, social media). SCE has a dedicated MCOM staff person who works in conjunction with SCE to market the program.

There were 46 high schools in the metro KC region that taught the Project Lead the Way Biomedical track in 2019-2020. The partnership with the KC STEM Alliance will be our main focus for marketing the new biomedical undergraduate program to high school students. While marketing the undergraduate program, we will also specifically market the expedited five-year BS/MS program. This fast-track option is extremely attractive to high school students (and their parents) and has proved to be very successful in our current engineering disciplines. We would mainly market directly to the metro KC region (as we do with our current engineering programs). We would also specifically target the Kansas side since there is no biomedical engineering undergraduate program at the University of Kansas, which is the closest other major university to the West.

3.C.2. Student Success Plan

In order to ensure high retention and graduation rates for BME students, there are a number of resources that will be available to all students including advising, career services, support services, faculty mentorship, research opportunities, and student organizations. Each of these resources is laid out in detail in the following:

- Roo Advising, Mobility Escalators, and Career Services
 - Biomedical Engineering students will have access to all resources offered in Roo Advising, Mobility Escalators, and Career Services.
 - **Roo Advising** provides centralized, professional advisors ensuring that the students will remain on track for a four-year graduation. They will also advise the students on the BSBME/MSBME opportunity and the professional and career advantages of pursuing an MSBME as an add-on to the BSBME.
 - Business/Engineering Mobility Escalator is an enhancement to Roo Advising focusing on professional and career mentoring and counseling. These mentors and counselors provide guidance on

careers, ethics, and workplace dynamics. In this escalator, the BSBME and MSBME students will be entwined with the business counselors that can provide a multitude of services and career possibilities for these students. These counselors and mentors will help guide these students to the appropriate BME related career, whether it be research, biotech, professional schools, biotech firms or startups.

• **Career Services** professionals are available to help the students explore and prepare for applying and placement in internships and jobs. The Bloch School of Management and the School of Computing and Engineering have partnered on Career Fairs for several years with over 140 companies attending the last career fair. This will only grow as we invite the biomedical related firms from the Kansas City region to join the Career Fair.

- SCE and Health Sciences Support Services

- The BSBME/MSBME students will have access to all current SCE support services.
 - SCE Student Affairs team is dedicated and works in concert with the UMKC Centralized Services. The SCE Student Affairs Team has direct, connected access to the students, faculty, companies and other UMKC schools and can provide a personalized approach consisting of guidance, connecting, and preparing individual students, academically and professionally.
 - **Guiding** students through their 4-yr curriculum.
 - **Connecting** the students with biotech, bioengineering and biomedical companies, internships, and UG/Grad research.
 - See below for a description of SCE's Career Connections Program.
 - **Preparing** each student with customized professional school preparation and career guidance.
 - Since the implementation of the SCE Student Affairs team, SCE has seen improved retention from 50% in 2008 to an average of 79% from 2016-2021. SCE's goal has been to be a "pump and not a filter"; so, every action is with that goal in mind. Every student admitted and entering SCE should be a future graduate.

• Faculty mentors

- Each BME student will be assigned a faculty mentor to help with career and/or research guidance.
 - Mentors will be available from multiple disciplines including, engineering, natural sciences, and health sciences. Students will have the opportunity to select their faculty mentor(s) based on their specific biomedical areas of interest.

• Undergraduate (and Graduate) Research Opportunities

- Undergraduate students in the biomedical program will have access to a multitude of undergraduate and graduate research opportunities.
- Many current mechanical, electrical, and software engineering undergraduate and graduate students participate in biomedical engineering research within the Schools of Pharmacy, Dentistry and Medicine.
 - Approximately 25% of SCE's current funded research is within the Schools of Pharmacy, Dentistry and Medicine.
- With the addition of biomedical engineering, the number of research opportunities, courses, internships and contacts to the Schools of Biological Sciences, Medicine, Dentistry and Pharmacy will increase dramatically.

• Student Chapter of the Biomedical Engineering Society

- Once the Biomedical Engineering program is approved and matriculates its first cohort of students, it is planned to add a student chapter of the Biomedical Engineering Society (BMES).
- As with all of SCE's current societies, this engineering society will provide a place for biomedical engineering students to connect with other students and companies, attend conferences, participate in student events, and have the potential for leadership opportunities.

In order to help BME students with job placement, there are a number of resources that will be available to all students including career services, career connections, career fairs, internship opportunities, and mobility escalators. Each of these resources is laid out in detail in the following:

- UMKC and SCE Career Services

- Biomedical Engineering students will have access to all services currently offered in the UMKC Career Services.
- Biomedical Engineering Students will have access to all services provided by the SCE Student Affairs Team and their faculty mentors. With the help of the SCE Student Affairs Team over the last 5 years:
 - 79% average retention of SCE students.
 - 80% of all SCE Juniors and Seniors have interned or had research opportunities.
 - 90+% of all SCE Seniors have had jobs as of graduation.

• SCE's Career Connections Program

 All students in SCE (and UMKC) including those within the BME program have the ability to participate in SCE's Career Connections program. The SCE Student Affairs team brings in professionals from companies to provide insights into their day-to-day jobs (work) for BME professionals. These degree program related companies and their employees, in this case bio-related companies, are used to help students explore as many career possibilities as possible. There will be a variety of regional, bio-related companies included in the Career Connections Program.

• Career Fairs

- One of the best places for students to connect with potential employers is career fairs. SCE participates in a career fair each year with the Bloch School of Management.
 - The last career fair held on campus for just business and engineering had over 140 companies and has proven to be an exceptional resource for students to connect directly with the regional and national job market.
 - Once the BME programs are in place, more biomedical focused companies will be invited to this career fair.

• SCE's high employment placement rates

- It is expected that the biomedical engineering students will track with all other SCE engineering disciplines, which historically have extremely high employment placement rates, averaging 92% over the last five years, with placements locally and nationwide.
- This placement rate is due to all the prescribed, personal UMKC and SCE support services, possible internships, career connections, industrial capstone design projects, advisory boards and more.

• UMKC Business and Engineering Mobility Escalator

 The Business and Engineering Mobility Escalator will be a good pipeline for BME students to find those connections between engineering, health sciences, and business, preparing them for biomedical related workplace(s), a research career or professional schools such as medicine, dentistry or pharmacy.

3.C.3. Transition Plan

The individuals primarily responsible for the MSBME program are Associate Dean Masud Chowdhury and Assistant Dean Katherine Bloemker. However, once the program is implemented a Degree Program Committee (DPC), comprised of current faculty with expertise in the biomedical fields, will be formed. Having this standing committee will ensure a seamless transition in the event that any of the primary individuals can no longer fulfill the necessary duties for managing the program's day-to day-needs.

3.C.4. Exit Strategy

If the situation arises that the program is underperforming expectations and financial viability is compromised, the Degree Program Committee (DPC) will be charged with providing a plan of action to improve enrollments and/or decrease expenditures. A three-year window will be allowed following the implementation of the action plan. Following the three years, if the revenues from the program are still not exceeding the expenditures, the Dean and his leadership team will decide whether a hiatus or discontinuation of the program is needed.

4. Institutional Capacity

The MSBME program will require no initial resources (see the attached pro forma) to begin matriculating students. SCE's new research facility already has the necessary labs for both the academic and research associated with such a degree. SCE already has sufficient faculty expertise and staff for this degree. The addition of this degree will place a very small financial burden on SCE of approximately \$10k and \$16k in the first two years. The program will be revenue positive from year one and will only grow in net revenue each of the following years, at which time SCE will make the decision whether to go steady state in size or continue growing.

Initially, the MSBME will not place any new burden on SCE. The MSBME degree will be jointly administered, staff and faculty, by the SCE Departments of Civil and Mechanical Engineering (CME) and Computer Science Electrical Engineering (CSEE). Once the program has grown, SCE leadership will decide if a separate department or administration team is optimal. SCE already has 6-7 faculty with advanced degrees or specialty research programs in the field of biomedical devices, biosensors, biomaterials, bioimaging, biomechanics and bioinformatics. These faculty coupled with other experts in other UMKC schools can cover the teaching and research needs of the MSBME for the first several years. New faculty will only be added once the program has sufficiently increased enrollments and needs further expertise.

Being in Kansas City, SCE can also rely on community experts as adjunct faculty that have expertise in areas where SCE may not. These adjuncts provide a real-world education that students cannot typically get from a non-urban located university. Additionally, these adjuncts often provide internships and career guidance that is extremely beneficial for the students and ultimately SCE's recruitment efforts.

This degree is in large demand within SCE. Many students already pursue a master's- level emphasis in biomedical engineering by taking a large number of biomedical electives taught within SCE. SCE's enrollment will increase with the offering of this new degree with very little in up-front investments.

5. Program Characteristics

5.A. Program Outcomes

Achievement of the goals listed in section 2.A is assessed by the following Student Learning Outcomes (SLOs). Note that each outcome has specific goals mapped to it.

SLO 1:	Students will be able to formulate solutions to complex biomedical problems.	G1
SLO 2:	Students will be able to employ advanced mathematical skills.	G1, G2
SLO 3:	Students will be able to demonstrate enhanced written, graphical, and/or oral technical communication skills.	G2

The full six-year assessment plan can be found in the attachment: <u>MSBME Assessment</u> <u>Plan.pdf</u>.

5.B. Program Design & Content

The mapping of courses to the SLOs can be found in the attachment: <u>MSBME Curriculum</u> <u>Map.xlsx</u>.

The full list of courses with pre-requisites included can be found in the attachment: <u>MSBME</u> <u>Proposed Classes.pdf</u>.

The three-year course rotation for each course in the program can be found in the attachment: <u>MSBME 3 Year Course Rotation.xlsx</u>.

5.C. Program Structure

There are two proposed pathways for the MSBME degree. The first is a 30 credit hour MS degree for new students to UMKC, called the "Regular MSBME Degree". The second is a 24 credit hour expedited MS degree for current UMKC students, called the "Expedited MSBME Degree". This one-Year MSBME degree option will be open to two types of students: (1) fast-track BS/MS Biomedical Engineering students, and (2) all the professional and graduate students from Medicine, Nursing, Dentistry, Pharmacy, Biological Sciences, Computing and Engineering, and other STEM disciplines. See the attachment: <u>MSBME Proposed Courses.pdf</u>.

Proposed Degree Options:

- 1. Regular MSBME Degree with Thesis and Course Options for New Students (10 Courses: 30 Credit Hours)
 - a. Required Courses:
 - 1. Three Courses (9 Credit Hours).
 - b. Technical Elective Courses:
 - 1. Seven Courses (21 Credit Hours) for the MSBME Course Option.
 - 2. Five Courses (15 Credit Hours) for the MSBME Thesis Option.
 - c. Thesis: Equivalent to Two Courses (6 Credit Hours) <u>for the MSBME Thesis</u> <u>Option</u>.
- 2. Expedited (1 Year) MSBME Degree for fast-track BS/MS students from the BSBME program (8 Courses: 24 Credit Hours)
 - a. Required Courses:
 - 1. One Course (3 Credit Hours): Only the statistics/biostatistics course is required since the other two normally required courses for the Regular MSBME are already required in the BSBME program so those 6 credit hours are double counted for the Expedited plan.
 - b. Technical Elective Courses:
 - 1. Seven Courses (21 Credit Hours) for the MSBME Course Option.
 - 2. Five Courses (15 Credit Hours) for the MSBME Thesis Option.
 - a. Thesis: Equivalent to Two Courses (6 Credit Hours) <u>for the</u> <u>MSBME Thesis Option</u>.
- 3. Expedited (1 Year) MSBME Degree for Current UMKC Professional and Regular Graduate Students in Medical and STEM Disciplines (8 Courses: 24 Credit Hours)
 - a. Required Courses:
 - 1. Three Courses (9 Credit Hours): Same as required courses in the Regular MSBME
 - b. Technical Elective Courses:
 - 1. Five Courses (15 Credit Hours) for the MSBME Course Option.
 - 2. Three Courses (9 Credit Hours) for the MSBME Thesis Option.
 - a. Thesis: Equivalent to Two Courses (6 Credit Hours) <u>for the</u> <u>MSBME Thesis Option</u>.
 - 3. Remaining 6 Credit Hours (to complete the 30 Credit Hour requirement for the MS Degree): students enrolled in any other graduate or professional level STEM discipline at UMKC can double count up to 6 Credit Hours between MSBME and the other STEM graduate degree

5.C.1. Program Structure Form -

- 1. Total Credits Required for Graduation: 30/24
- 2. Residence requirements, if any: None

3. General education

a. Total general education credits: 0

4. Major Requirements

a. Total credits specific to degree: 30/24

Required Courses (specific course or distribution area and credit hours):

Course	Hrs	Course	Hrs	Course	Hrs
ECE 380 Signals and Systems	3**	ME 406/5506 - Introduction to Biomaterials	3**	Biology 4XX/5XXX - Biostatistics II	3*
				MEDB 5501 - Biostatistics I	3*
				CS 465R/5565 - Introduction to Statistical Learning	3*

*Students can chose any one of the 3 listed statistics courses.

**Fast-track BS/MS students are already required to take these 2 courses in the BS program, so they are waived from the MS program.

NOTE: For a list of technical electives see the attachment: <u>MSBME Proposed Courses.pdf</u>.

5. Free elective credits

a. Total free elective credits: 0

6. **Requirement for thesis, internship or other capstone experience**:

None

7. Any unique features such as interdepartmental cooperation:

Required and elective courses in the MSBME program will be taught by faculty members from both the Civil and Mechanical Engineering Department as well as the Computer Science Electrical Engineering Department. Technical Elective courses can come from a variety of degree programs, including Engineering, Biology, Chemistry, Medicine, Dentistry, and Pharmacy.

5.D. Program Goals and Assessment

The student learning outcomes are assessed in the courses listed on the curriculum map with the letter A (see attachment: <u>MSBME Curriculum Map.xlsx</u>). Data is collected from the instructor of each course. Depending on the course, this data could be performance on a project, an exam question, a presentation, or a homework assignment. This performance data is provided to the program coordinator and the assessment coordinator for SCE (Assistant Dean Katherine Bloemker). Each student activity performance is broken into three categories (unacceptable, acceptable, and excellent). The target for achievement in all courses is that 80% of the students meet the acceptable or excellent level for the student activity relating to the particular outcome. The Degree Program Committee (DPC) will be responsible for program oversight.

As mentioned previously, average graduate retention rates in SCE are about 85%. The goal for the MSBME program would be for both retention and graduation rates at or above the SCE average, definitely above 80%.

The goal for MSBME would be to stay at or above the current job placement rates in SCE. However, it is assumed that many of the MSBME students may go on to further their education or further their research aspirations. This will be slightly different than the current traditional graduate engineering programs in SCE.

5.E. Student Preparation

The MSBME is open to applicants with a bachelor or equivalent degree in STEM fields including engineering, computer science, life science, medical science, and physical science disciplines. Applicants who have a bachelor degree in non-STEM field but have more than three years of working experience in biomedical and healthcare sectors are also eligible to apply.

The GRE is not required for the applicants. New international applicants are required to satisfy TOEFL or other similar English language proficiency requirements. The MSBME will be primarily administered by SCE. However, as an interdisciplinary graduate degree program it will include courses and research projects offered by SCE, the Schools of Biological Science, Dentistry, Medicine, Nursing, Pharmacy, and any other units that have biomedical-related curricular and research activities. Admission into the MSBME degree program will be open to both full-time and part-time graduate students.

5.F. Faculty and Administration

More than thirty existing faculty members from the Schools of Biological and Chemical Sciences, Computing and Engineering, Dentistry, Medicine, Nursing and Health Sciences, and Pharmacy are identified to offer courses and research projects related to biomedical engineering. See attachment for specific names and expertise areas: *Faculty Members for*

<u>Biomedical Engineering v2.pdf</u>. It is estimated that near 100% of the credit hours in the program will be assigned to full-time faculty members. As needed, and as enrollments grow, adjunct instructors can be used for some elective courses, but it is planned that the required courses will be taught by full-time faculty members.

There will be select courses **that are team taught by medical professionals and biomedical engineering faculty**, but those specific courses are to be developed as the program progresses. There has been tremendous interest from the Health Science faculties to be involved and to be co-teachers in these courses; Pharmacy, Medicine, Dentistry, Nursing and Bio Sciences. The planned curriculum is infused with collaboration between engineering faculty and medical professionals. Specifically, students in the MSBME program will participate in a **Graduate Biomedical Engineering Seminar** which will include presentations from physicians and medical professionals in addition to bioengineers and biomedical researchers. Each week will bring a different topic or research area that pertains to the many facets of the biomedical engineering profession.

Associate Dean Masud Chowdhury and Assistant Dean Katherine Bloemker will be the primary points of contact for the program. In addition to Dr. Chowdhury and Dr. Bloemker, a degree program committee (DPC) will be formed to help keep tracks of activities, students, and advising for the proposed MSBME Degree.

To start the degree program in Fall 2021, no new faculty is needed. This is because the new hires for the BSBME program will provide the base for teaching both undergraduate and graduate courses in biomedical engineering. These new hires will serve to add to and strengthen the technical focus areas, thereby building a comprehensive graduate program in Biomedical Engineering. As the pro forma indicates, hiring of an additional adjunct faculty by year 3 will be necessary to cover some of the basic courses so that the tenure-track faculty can teach advanced courses in their specific areas of expertise. However, any future hiring of faculty will be based on growth in headcount and revenue-generated.

5.G. Alumni and Employer Survey

SCE plans to complete alumni surveys for the MSBME program just as is done in all other programs in the school. Once per accreditation cycle an alumni survey is sent out to all alumni from the SCE programs. The survey asks about student outcomes, whether they have an engineering job, whether they have a graduate degree, and whether they plan to or have become licensed. In addition to these surveys, the Dean of SCE routinely hosts lunches for alumni engagement for the school. At these lunches the Dean gives a state of the school. In addition the alumni are informed about continuing education opportunities and upcoming alumni events.

SCE also plans to create an advisory board for the MSBME program, exactly like is currently done in all other programs in the school. The advisory board members will represent local employers of the program. The advisory board members are involved in maintaining a strong program. Since the advisory board members have a personal interest in SCE, their participation in developing objectives assures them that SCE is an association of which they can be proud. Following the procedures currently used in SCE, the advisory board will meet
twice per semester to discuss the state of the program. These meetings generally include a school update from the dean or chairperson, board committee reports, board focus points for the year, and other announcements. Once per year the advisory board meets with students in each of their respective engineering programs. In addition, the faculty in the engineering programs also meet with their respective advisory boards once per year.

5.H. Program Accreditation

No special accreditation is needed other than the standard requirements for the traditional graduate programs.

6. Appendices

- A. Curriculum Documents
- B. Faculty Documents
- C. Assessment Documents
- D. Financial Documents
- E. Burning Glass Reports
- F. Letters of Support

Courses for MS in Biomedical Engineering

	Required: 3 Courses (9 Cre	dit Hours)	-	
	Couse and Description	Status	CR	Prerequi- site
1.	ECE 380 Signals and Systems (to be replaced by BME 4XX - Introduction to Biomedical Signals and Systems) Course Developers and Instructors: Reza De- rakhshani and Ahmed Hassan (SCE, ECE) Catalog Descriptions: This course provides an intro- duction to biomedical signals and systems and a common understanding of the natures and activities of these sig- nals and systems to students from all background. In this course, the physiological processes and features of vari- ous biomedical phenomena that are accompanied by or manifest themselves as different types of signals will be discussed. The course also recognizes the fact that a good understanding of the biomedical systems would make it easy to understand the corresponding processes and signals.	 New Course Approved Planned to start in Spring 2021 as a special topic. 	3	None
2.	 ME 406/5506 - Introduction to Biomaterials Course Developers and Instructors: Zahra Nirobakhsh (CME, SCE), Stefan Lohfeld (Dentistry), and Karl Kador (Medicine). Catalog Descriptions: The course covers the basics of materials science and principles of biological systems followed by implantable medical devices and artificial organs, tissue engineering and bioprinting application, and drug delivery. The course will be co-instructed by faculties from School of Engineering, Medicine, Pharmacy, and Dentistry. This course does not require a background in any particular field of study. 	 Existing Course Introduced in Fall 2019. Will be offered again in Fall 2020 (Pathway Class Number: 45049) 	3	None
3.	Students are required to take one of the following three courses as the third required course. Multiple alternatives are listed to accommodate students of all backgrounds.			
a)	Biology 4XX/5XXX – Biostatistics -2 Course Director & Instructor: Aaron Reed (Biology) Catalog Description: Introduction to the advanced concepts of probability, statistical reasoning, and experi- mental design in the biological sciences. The course em- phasizes the application of inferential statistics to biologi- cal experiments including the use of relevant statistical computer packages.	A new course will be introduced for the graduate students as the advanced version of the existing course, Biology 304 - Biostatistics 1 (of- fered every Fall).	3	MATH 110 or STAT 235
b)	MEDB 5501 – Biostatistics I Course Director & Instructor: TBD (Bioinformatics) Catalog Description: Introduction to statistical concepts and analytic methods as applied to health science. Course includes lectures and hands on computer laboratory.	Existing course, of- fered once every year.	3	200 Level Calculus or Statistics
c)	CS 465R/5565 - Introduction to Statistical Learning Course Director & Instructor: Kenneth Mitchell (SCE, CS)	Existing course, of- fered twice a year (Fall and Spring)	3	CS 394R

Catalog Description: This course provides a practical in-	
troduction to analytical techniques used in data science	
and prepares students for advanced courses in machine	
learning. Topics covered include multivariate distributions,	
information theory, linear algebra (eigenanalysis), super-	
vised/unsupervised learning, classification/regression, lin-	
ear/non-linear learning, introduction to Bayesian learning	
(Bayes rule, prior, posterior, likelihood), parametric/non-	
parametric estimation. Prerequisites: COMP-SCI 394R.	

	Technical Electives: Course Option MS Students: 7 Courses (21 Credit Hours) Thesis-Option MS Students: 5 Course (15 Credit Hours) + Thesis (6 Credit Hours)					
	Couse and Description	Status	CR	Prerequi- site		
1.	MEC-ENGR 5511 Introduction to Biomechanics Course Developer and Instructor: Gregory King Catalog Description: This course is to provide students with an introduction to the engineering principles of biomechanics.	Existing course, of- fered every fall se- mester	3	Instructor's consent		
2.	MEC-ENGR 5513 Experimental Biomechanics of Human Motion Course Developer and Instructor: Gregory King Catalog Description: The purpose of this course is to provide an opportunity for students to gain a hands-on, in-depth understanding of the experimental measure- ment and analysis techniques used to quantify the bio- mechanics of human motion.	Existing course, of- fered every other spring semester	3	MEC-ENGR 5511		
3.	MEC-ENGR 5512 – Biodynamics Course Developer and Instructor: Antonis Stylianou Catalog Description: Introduction to musculoskeletal biomechanics including: computational biomechanics, movement simulation, motor control and musculoskele- tal tissues.	Existing course, of- fered every spring semester	3	MEC-ENGR 5511		
4.	MEC-ENGR 5501 – Special Topics (Introduction to Poly- mers and Soft Materials)	Existing course, of- fered once every year.	3	Instructor's consent		
5.	MEC-ENGR 5XXX - Computational Biomechanics and Modeling	New course under development. The concept has been approved. Planned for Fall 2022	3	TBD		
6.	CIV-ENGR 5622 - Theory of Elasticity Course Developer and Instructor: Ganesh Thiagarajan Catalog Description: Stress and strain at a point. Gen- eral equations of elasticity. Plane stress, plain strain problems; torsion of prismatic bars. Energy methods.	Existing Course	3			

7.	CIV-ENGR 5XXX - Cellular and Tissue Mechanics and Mechanobiology. Course Developer and Instructor: Ganesh Thiagarajan and Antonis Stylianou (SCE, CME). Catalog Description: Stress and strain at a point. Gen- eral equations of elasticity. Plane stress, plain strain problems; torsion of prismatic bars. Energy methods	New course under development. The concept has been approved. Planned for Spring 2022	3	TBD COMP-SCI
0.	Catalog Description: This course teaches students fun- damental theory and practice in the field of knowledge discovery and management and also provides them with hands-on experience through application develop- ment.	fered every spring		5551, COMP- SCI 461.
9.	CS 5566 -Introduction to Bioinformatics Course Developer and Instructor: Deendayal Dinakar- pandian Catalog Description: This course introduces students to the field of Bioinformatics with a focus on understand- ing the motivation and computer science behind exist- ing Bioinformatic resources, as well as learning the skills to design and implement new ideas.	Existing Course. The instructor left UMKC in 2018. New faculty fulltime or adjunct need to be hired.	3	COMP-SCI 303, a course or background in Biology (Genomics or Meta Models pre- ferred).
10.	CS 5567 - Machine Learning for Data Scientists/Bioin- formatics Course Developer and Instructor: Deendayal Dinakar- pandian Catalog Description: This course teaches the theoretical basis of methods for learning from data, illustrated by examples of applications to several domains.	Existing Course. The instructor left UMKC in 2018. New faculty fulltime or adjunct need to be hired.	3	COMP-SCI 303,COMP- SCI 394R. Recom- mended preparation: COMP-SCI 5565.
11.	CS 5XXX - IOT and Cognitive Robotics Course Developers: Yugyung Lee, Baek-Young Choi, and Sejun Song (SCE, CS).	New Course, under development (con- cept is approved)	3	TBD
12.	CS 5XXX - AI for Cybersecurity Course Developers: Farid Nait-Abdesselam and Wajeb Gharibi	New Course, under development (con- cept is approved)	3	TBD
13.	ECE 484 Digital Image Processing Course Instructor: Zhu Li (SCE, ECE) Catalog Description: Fundamentals of digital image pro- cessing hardware and software, including digital image acquisition, display, compression, transforms and seg- mentation. Recommended preparation: Experience in a high-level programming language.	Existing course, of- fered every fall	3	ECE380
14.	ECE 5582 Computer Vision Course Developer and Instructor: Zhu Li (SCE, ECE) Catalog Description: The image is an essential form of information representation and communication in mod- ern society. This course focuses on topics of computer vision, teaching computer how to understand images. Topics include image formation, color and texture fea- tures, key points detection, aggregation, subspace methods in image modeling, and deep learning image classification, with many applications in photography, media and entertainment, education, defense and med- icine	Existing course, of- fered every fall	3	Instructor's consent

15.	ECE 430: Microelectronic circuits Course Instructor: Faisal Khan (SCE, ECE) Catalog Description: The analysis and design of feed- back amplifiers, oscillators and of microelectronic cir- cuits that employ diodes, MOSFETs and BJTs in current mirrors, amplifiers with active loads, differential amplifi- ers, operational amplifiers, and CMOS Logic gates. The use of CAD (Spice) in the analysis and design of feed- back amplifiers and microelectronic circuits.	Existing course, of- fered every fall		ECE 330, ECE 331
16.	ECE 5532 – Biomedical Instrumentation Catalog Description: Biomedical objectives, physical and engineering principles; optimal equipment design and actual performance of biomedical instrumentation; con- siders practical instrumentation problem solutions and unsolved problems.	Existing course. Has not been offered last few years due to lack of faculty mem- bers.	3	ECE 330
17.	ECE 5316 - Artificial Neural and Adaptive Systems Course Developers and Instructors: Reza Derakhshani Catalog Description: This graduate course is a hands-on introduction to theory and applications of neurocompu- ting, including: classification, function approximation, supervised and unsupervised learning, time series anal- ysis, and adaptive filtering using different feed-forward and recurrent artificial neural networks.	Existing course, of- fered every fall	3	ECE 341R or CS 5590I
18.	ECE 5590: Supervised Learning, Machine Learning. Course Developers and Instructors: Reza Derakhshani Catalog Description: This course covers the applica- tions of machine learning techniques to the modern bi- omedical and biometric problems. In order to do so, the course will be presented in two parts. For the first part, a quick coverage of the most important pattern recog- nition and machine learning topics will be given. The second part will consist of select case studies and will be project-based. Students will be presented with a number of biomedical and biometric research problems and will be guided to find solutions to the assignments using the knowledge and the skills garnered during the first part of the class, as well as additional reading as- signments.	Existing course, of- fered once every year	3	Instructor's consent, or 5590CI. Intermediate knowledge of multivari- ate calculus, probability, and linear al- gebra. Basic skills in MATLAB pro- gramming.
19.	ECE 401/5590 Nanoelectromagnatics and Plasmonics Course Developers and Instructors: Ahmed Hassan Catalog Description: This course is an introductory course in Nanoelectromagnetics and Plasmonics de- signed for senior undergraduate and graduate students. The course will focus on studying the interaction of elec- tromagnetic waves, from DC to optical frequencies, with nanoscale structures. Four main areas will be covered in the course: (i) Material properties of different nanostruc- tures, (ii) electromagnetic theory for studying nanostruc- tures, (iii) computational electromagnetic techniques for analyzing the response of nanostructures, and (iv) the design of novel nanoscale sensors for chemical and bio- medical applications.	Existing course, of- fered every Fall		ECE 302
20.	ECE 5XXX - Mathematical Physiology	New course under development.	3	TBD

			1	
		The concept has been approved.		
21.	ECE 5XXX - Low-Power Implantable Electronics for Bio- medical Applications Course Developers: Masud Chowdhury, Faisal Khan and Mostafizur Rahman (SCE, ECE)	New course under development. Proposal has been approved. Planned for Spring 2021	3	ECE 330 or ECE 334 or ECE442
22.	ECE 5XXX - Biomedical Sensing Devices (new course) Course Developers: Ahmed Hassan and Masud Chow- dhury (SCE, ECE).	New course under development. Proposal has been approved. Planned for Fall 2021	3	ECE 330 or ECE 334 or ECE442
23.	ECE 5XXX - Biomedical Imaging Course Developer: Zhu Li (SCE, ECE).	New course under development. The concept has been approved. Planned for Spring 2022	3	TBD
24.	ECE 5XXX - VLSI for Prosthetics Course Developers: Masud Chowdhury, Faisal Khan, Mostafizur Rahman (SCE, ECE) and Collaborators from School of Medicine.	New course under development. The concept has been approved. Planned for Fall 2022	3	TBD
25.	ECE 5XXX - Artificial Organs Course Developers: Faisal Khan (SCE, ECE) and Collab- orators from School of Medicine.	New course under development. The concept has been approved. Planned for Fall 2022	3	TBD
26.	BIO-SCI 5760 - Physiology of Mineralized Oral Tissues Course Developer and Instructor: Mark Johnson and Timothy Cox, School of Dentistry. Catalog Description: A study of the physiology of the oral hard tissues with emphasis on the mechanisms of the growth, remodeling, and healing of maxillomandib- ular bones and on the mechanism of dentinogenesis.	Existing Course, of- fered every semes- ter including sum- mer.	2	Instructor's consent
27.	BIO-SCE 5710 - Genetics and Biochemistry of Cranial Facial Biology Course Developer and Instructor: Erin Bumann Catalog Description: Biochemistry of oral structures and the effect of oral diseases on these structures	Existing Course, of- fered every semes- ter including sum- mer.	2	Instructor's consent
28.	ECE 420 - Advanced Engineering Computation OR BME 5XX Biomedical Machine Learning Course Directors: Zhu Li and Reza Derakhshani (ECE, SCE), Instructor: Matthew Kayrish (Adjunct) Catalog Description: Programming and computational analysis principles and techniques for various problems in embedded programming, applied computation, and sig- nal processing.	Existing course of- fered in every spring (2 CR). A 3 CR grad- uate section, BME 5XXX will be added.	3	E&C-ENGR 216

DEPT	COURSE NO.	COURSE NAME	Fall 2020	2021	584.2021 584.62	2022	Eall.2022 Spring	2023
ME	401/5501	Introduction to Biomaterials	X		X		X	
ECE/BME	400/5590	Introduction to Biomedical Signals and Systems		Х		Х		Х
ECE/BME	420/5590	Advanced Engineering Computation/ Biomedical Machine Learning		Х		Х		Х
Biology	4XX/5XXX	Biostatistics 2		Х		Х		Х
MEDB	5501	Biostatistics 1	Х		Х		х	
CS	465R/5565	Introduction to Statistical Learning	Х	Х	Х	Х	х	Х
ME	5511	Introduction to Biomechanics	Х		Х		Х	
ME	5512	Biodynamics		Х		Х		Х
ME	5513	Experimental Biomechanics of Human Motion		Х				Х
ME	5501	Special Topic - Introduction to Polymers and Soft Materials			Х		Х	
ME	5XXX	Computational Biomechanics and Modeling			Х		Х	
CE	5622	Theory of Elasticity		Х		Х		Х
CE	5XXX	Cellular and Tissue Mechanics and Mechanobiology.				Х		Х
CS	5560	Knowledge Discovery and Management		Х		Х		Х
CS	5566	Introduction to Bioinformatics				Х		Х
CS	5567	Machine Learning for Data Scientists/Bioinformatics			Х		х	
CS	5XXX	IOT and Cognitive Robotics				Х		Х
CS	5XXX	Al for Cybersecuirty		Х		Х		Х
ECE	484	Digital Image Processing	Х		Х		Х	
ECE	5582	Computer Vision	Х		Х		Х	
ECE	430	Microelectronics	Х		Х		Х	
ECE	5532	Biomedical Instrumentation			Х		Х	
ECE	5316	Artificial Neural and Adaptive Systems	Х		Х		Х	
ECE	5590	Supervised Learning, Machine Learning		Х		Х		Х
ECE	401/5590	Nanoelectromagnatics and Plasmonics	Х		Х		Х	
ECE	5590	Mathematical Physiology				Х		Х
ECE	5590	Low-Power Implantable Electronics for Biomedical Applications			Х		х	
ECE	5590	Biomedical Sensing Devices		Х		х		
ECE	5590	Biomedical Imaging				Х		Х
ECE	5590	VLSI for Prosthetics				Х		Х
ECE	5590	Artificial Organs				Х		Х
BIO-SCI	5760	Physiology of Mineralized Oral Tissues	Х	Х	Х	Х	Х	Х
BIO-SCI	5710	Genetics and Biochemistry of Cranial Facial Biology		Х	Х	Х	Х	Х

COURSE

DEPT	NO.	COURSE NAME
ME	401	Biomedical Device Design
ME	401	Imaging to Modeling
ME	401	Advanced Topics in Heat Transfer
ME	401	Advanced Topics in Fluid Mechanics
ME	401	Additive Manufacturing
ME	401	Robotics and Unmanned Systems
ME	401	Robotic System Identification
ME	401	Advanced Dynamics and Modeling
ME	401	Biomaterials
ME	401	Multiphase Flow
ME	401	Turbulent Flow
ME	401	Applied Computational Fluid Dynamics
ME	401	Fracture and Fatigue
ME	401	Material Selection
ME	401T	Turbomachines
ME	411	Introduction to Biomechanics
ME	412	Biodynamics
ME	413	Experimental Biomechanics of Human Motion
ME	415	Feedback Control Systems
ME	424	Non-Metallic Engineering Materials
ME	425	Failure Analysis
ME	426	Introduction to Manufacturing Management
ME	433	Advanced Thermodynamics
ME	440	Heating and Air Conditioning
ME	444	Composite Materials
ME	451	Powerplant Design
ME	454	Power Generation Systems
ME	457	Mechatronic System Design
ME	458	Modern Control Systems
ME	467	Fuel Cells and Renewable Energy Systems
ME	484	Vibration Analysis
ME	486	Applied Finite Element Analysis
ME	493	Intermediate Dynamics
ME		

	Faculty Member	Expertise	Unit	Contribution
1.	Katherine Bloemker, Ph.D., Assistant Dean, In Charge of Developing the Proposal for the BS in Biomedical Engineering Degree Program	3D modeling and computer-aided design, Mechanical design synthesis, Biomechanics, and Musculoskeletal modeling	SCE, CME	1 course/year
2.	Erin Bumann, D.D.S., Ph.D., Assistant Professor of Oral and Craniofacial Sciences	Developmental mechanisms that control the size and shape of the jaw skeleton, strategy for estimating species-specific contributions in chimeras and xenografts, and molecular mechanism and clinical significance of calciotropic hormones in the regulation of mineralized tissue growth in the craniofacial skeleton.	SOD	1 course/year
3.	Kun Cheng, Ph.D., Curators' Distinguished Professor of Pharmacology and Pharmaceutical Sciences.	Development of novel checkpoint inhibitors for various cancers, Development of targeted drug delivery systems for macromolecules, Development of novel polymers for targeted drug delivery, Discovery of molecular ligands for specific cells and receptors, Development of anti- tumor prodrugs for improving target-ability and efficiency, Development of novel therapeutics for liver fibrosis, and BBB drug delivery	SOP	1 course/year
4.	Baek-Young Choi, Ph.D., Associate Professor of Computer Science	Cloud computing and software- defined networks, Network algorithms and protocols, and Data storage and management systems.	SCE, CSEE	1 course every two year
5.	Masud Chowdhury, Ph.D., Associate Dean, In Charge of Developing the Proposal for the MS in Biomedical Engineering Degree Program.	Micro and Nano Technologies for Computing, Biomedical, Energy Applications.	SCE, CSEE	1 course/year
6.	Akin Cil, M.D., Professor, Franklin D. Dickson/Missouri Endowed Chair in Orthopaedics Surgery	Orthopaedic and Biomechanics Research in collaboration with the School of Computing and Engineering.	SOM	1 course/year
7.	Timothy Cox, Ph.D., Endowed Professor in Musculoskeletal Tissues	Musculoskeletal Tissues	SOD	1 course/year
8.	Sarah Dallas, Ph.D., Lee M. and William Lefkowitz Endowed Professor in the UMKC School of Dentistry, Department of Oral and Craniofacial Sciences	Bone cell, Osteocyte, Osteoblast function, Aging and bone-muscle crosstalk, Live cell and intravital imaging approaches, Protein and molecular biology, Mouse genetic approaches	SOD	research, seminar series, and/or guest lectures

9. Reza Derakhshani, Ph.D., Professor of Electrical and Computer Engineering.	Biometrics, Biomedical signal and image processing, and Computational intelligence	SCE, CSEE	2 course/year
10. Ahmed Hassan, Ph.D., Assistant Professor of Electrical and Computer Engineering.	Nano-electromagnetics, Bio- electromagnetics, Inverse scattering algorithms, Experimental microwave imaging, and Terahertz imaging	SCE, CSEE	2 course/year
11. Mary Anne Jackson, M.D., Dean, Professor - University of Missouri - Kansas City School of Medicine	Pediatrics, Infections Disease	SOM	research, seminar series, and/or guest lectures
12. Mark Johnson, Ph.D., Professor and Chair of the Department of Oral and Craniofacial Sciences and Director, UMKC Center of Excellence in the Study of Dental and Musculoskeletal Tissues (CEMT).	molecular basis of human disease, molecular genetics of osteoporosis, biochemical crosstalk between skeletal muscles and osteocytes, Animal Phenotyping, Imaging and Loading, Skeletal Imaging, and In vitro-In vivo Mechanical Loading Core.	SOD	1 course/year
13. Karl Kador, Ph.D., Assistant Professor of Biomedical Sciences and Ophthalmology	Injuries and diseases of the optic nerve. Tissue engineering methods to create and transplant new cells to replace diseased and dead cells in order to restore vision.	SOM	1 course/year
14. Faisal Khan, Ph.D., Associate Professor of Electrical and Computer Engineering.	Pulsed power, Ultrasound based SOH detection, Powering implantable electronics, and Bioelectronics.	SCE, CSEE	2 course/year
15. Gregory King, Ph.D., Associate Professor of Mechanical Engineering.	Musculoskeletal biomechanics, Biomedical signal processing, and Kinematics and kinetics of human motion.	SCE, CME	2 course/year
16. Peter Koulen, Ph.D., Professor, Felix and Carmen Sabates / Missouri Endowed Chair in Vision Research, Director of Basic Research, Vision Research Center	Biomedical Informatics, Community and Family Medicine, Medical Humanities and Social Sciences, Neurology, Obstetrics and Gynecology, Oncology - Adult, Orthopaedic Surgery, Psychiatry, Surgery, Imm unology, Neuroscience, Pharmacol ogy, Pharmaceutical Science, Ophthalmology	SOM	research, seminar series, and/or guest lectures
17. Chi Lee, Ph.D., Professor of Pharmacology and Pharmaceutical Sciences.	Development and evaluation of transdermal/transmucosal drug delivery systems, and study on drug transport and membrane phenomena, and development and	SOP	1 course/year

	evaluation of the model cell lines and computer modeling processes.		
18. Yugyung Lee, Ph.D., Professor of Computer Science	Medical informatics, Big data analytics and applications, Distributed computing, Cloud computing, Machine learning/data mining, Software engineering, Mobile computing and applications, and Semantic web	SCE, CSEE	2 course/year
19. Zhu Li, Ph.D., Associate Professor of Electrical and Computer Engineering.	Image and Signal Processing, Audio-visual analytic, Video adaptation, Source-channel coding, and Distributed optimization issues of the wireless video networks	SCE, CSEE	2 course/year
20. Stefan Lohfeld, Ph.D., Assistant Professor of Oral and Craniofacial Sciences.	Maxillofacial implants, orthopedic implants, bone tissue engineering, and arterial access and closure device to support stroke interventions.	SOD	1 course/year
21. Ken Mitchell, Ph.D., Associate Professor of Computer Science	Network performance modeling and analysis, Capacity planning for service-oriented architectures, Scheduling in wireless networks, and Dynamic processes in complex networks.	SCE, CSEE	1 course/year
22. Farid Nait-Abdesselam, Ph.D., Professor of Computer Science	Cybersecurity, Network Security, and Artificial Intelligence	SCE, CSEE	1 course/year
23. Mark Nichols, Ph.D., Chair, Associate Professor - Department of Biomedical and Health Informatics, Director of Research Development, School of Medicine	Biomedical Sciences, Biomedical and Health Informatics	SOM	research, seminar series, and/or guest lectures
24. Zahra Niroobakhsh, Ph.D., Assistant Professor of Mechanical Engineering	Fluid dynamics of non- Newtonian flows, Bulk and interfacial rheology, Polymers and Soft Matters, Ternary/binary phase diagrams, Small Angle X-ray Scattering (SAXS), Surface tension measurement, and Microfluidics and microscale experiments	SCE, CME	1 course/year
25. Mostafizur Rahman, Ph.D., Assistant Professor of Electrical and Computer Engineering.	Neuromorphic computing to mimic mammalian brain's capabilities, Beyond CMOS computing with emerging nanoscale devices, and novel integration techniques, Nanoscale 3-D integrated circuits, Proof-of-concept nanoscale experimental prototyping, and	SCE, CSEE	1 course/year

	Manufacturing and thermal aware circuit design.		
26. Aaron Reed, Ph.D., Director of Course Development and Assessment	Molecular Biology and Biochemistry	SBC	1 course/year
27. Sejun Song, Ph.D., Associate Professor of Computer Science	Embedded real-time systems and controller area networks, Mobile operating systems and mobile cloud computing, and Wireless/sensor networks.	SCE, CSEE	1 course every two year
28. Antonis Stylianou, Ph.D., Assistant Professor of Mechnaical Engineering	Computational joint biomechanics, Musculoskeletal modeling, Multibody dynamics, Orthopedics, and Non-linear time series analysis	SCE, CME	2 course/year
29. Gary Sutkin, M.D., Professor, Associate Dean of Women's Health, Victor and Caroline Schutte Chair in Women's Health	Biomedical and Health Informatics, Obstetrics and Gynecology	<mark>SOM</mark>	research, seminar series, and/or guest lectures
30. Ganesh Thiagarajan, Ph.D., Professor of Civil Engineering	Bone biomechanics (experimental and finite element methods), Bone mechanotransduction, Blast behavior of structures, Experimental structural engineering, Structural engineering in bridges, and Dynamic (seismic) modeling and design of structures	SCE, CME	1 course/year
31. Md. Yusuf Sarwar Uddin, Ph.D.	Data Analytics, Health Informativs, and Big Data	SCE, CSEE	1 course every two year
32. John Spertus, M.D., Professor, St. Lukes	Center for Cardiac Health, Health Outcomes and Data Science	SOM	TBD

The Biomedical Engineering MS program faculty drafted the following goals:

Goal 1:	Students have the advanced education that facilitates specialization in Biomedical
	Engineering.
Goal 2:	Students have the specialized education and communication skills that prepare them for
	advanced career paths.

Achievement of these goals is assessed by the following Student Learning Outcomes (SLOs). Note that each outcome has specific goals mapped to it.

SLO	Students will be able to formulate solutions to complex biomedical	G1
1:	problems.	
SLO	Students will be able to employ advanced mathematical skills.	G1, G2
2:		
SLO	Students will be able to demonstrate enhanced written, graphical,	G2
3:	and/or oral technical communication skills.	

The six-year assessment plan is shown here:

Year	Assessment	Review/Evaluation	Implement
Cycle			Improvements/Changes
2020-2021	SLO1	N/A	N/A
2021-2022	SLO2	SLO1	N/A
2022-2023	SLO3	SLO2	SLO1
2023-2024	SLO1	SLO3	SLO2
2024-2025	SLO2	SLO1	SLO3
2025-2026	SLO3	SLO2	SLO1

NOTE: Biomedical Engineering has decided to assess on a 3 year cycle, however in the case of an outcome threshold not being met in a certain cycle, that outcome will be assessed immediately again in the next cycle so that the improvement will not take 3 years to go into effect in the curriculum.

DEPT	COURSE NO.	COURSE NAME	Complex Biomedical Engineering Problems	Employ advanced Math/Statistics/Programming Skills	Enhanced Techincal Communication					
ME	401/5501	Introduction to Biomatorials	Δ							
ECE/BME	400/5590	Introduction to Biomedical Signals and Systems	A		А					
ECE/BME	420/5590	Advanced Engineering Computation/ Biomedical Machine Learning		A	A					
Biology	4XX/5XXX	Biostatistics 2		Α	А					
MEDB	5501	Biostatistics 1		A	A	l = Introduo	ed			
CS .	465R/556	Introduction to Statistical Learning		Δ	Δ	D = Develo	ned/reinfor	red with or	I nortunities	to practic
MF	5511		D	D		M - Maste	ny		sportantics	
	5511		M	U		IVI – IVIASLE	у			
	5512									
ME	5501	Special Topic - Introduction to Polymers and Soft				A - A32331				
ME	EVVV	Materials		54	Ν4					
	5777	Theory of Electicity		IVI	IVI					
CE	5022	Callular and Tissue Mashanias and Mashanahialary								
CE	5888	Cellular and Tissue Mechanics and Mechanobiology.	IVI							
CS	5560	Knowledge Discovery and Management								
CS	5566	Introduction to Bioinformatics		M	М					
CS	5567	Machine Learning for Data Scientists/Bioinformatics	М	Μ						
CS	5XXX	IOT and Cognitive Robotics	М	Μ						
CS	5XXX	AI for Cybersecuirty		М						
ECE	484	Digital Image Processing	D	М						
ECE	5582	Computer Vision		М	М					
ECE	430	Microelectronics	D							
ECE	5532	Biomedical Instrumentation	М							
ECE	5316	Artificial Neural and Adaptive Systems	М	М						
ECE	5590	Supervised Learning, Machine Learning	М	М						
ECE	401/5590	Nanoelectromagnatics and Plasmonics	M	M						
ECE	5590	Mathematical Physiology	M	M						
ECE	5590	Low-Power Implantable Electronics for Biomedical	M		М					
FCF	EEOO	Riomedical Sensing Devices	N.4		64					
ECE	5590		IVI NA	N 4	IVI					
	5590		IVI	IVI						
EUE	5590	VLSI for Prostnetics	IVI		IVI					
ECE	5590	Artificial Organs	M		М					
BIO-SCI	5760	Physiology of Mineralized Oral Tissues	М							
BIO-SCI	5710	Genetics and Biochemistry of Cranial Facial Biology	M							
-	1	1		-						

COURSE

DEPT	NO.	COURSE NAME
ME	401	Biomedical Device Design
ME	401	Imaging to Modeling
ME	401	Advanced Topics in Heat Transfer
ME	401	Advanced Topics in Fluid Mechanics
ME	401	Additive Manufacturing
ME	401	Robotics and Unmanned Systems
ME	401	Robotic System Identification
ME	401	Advanced Dynamics and Modeling
ME	401	Biomaterials
ME	401	Multiphase Flow
ME	401	Turbulent Flow
ME	401	Applied Computational Fluid Dynamics
ME	401	Fracture and Fatigue
ME	401	Material Selection
ME	401T	Turbomachines
ME	411	Introduction to Biomechanics
ME	412	Biodynamics
ME	413	Experimental Biomechanics of Human Motion
ME	415	Feedback Control Systems
ME	424	Non-Metallic Engineering Materials
ME	425	Failure Analysis
ME	426	Introduction to Manufacturing Management
ME	433	Advanced Thermodynamics
ME	440	Heating and Air Conditioning
ME	444	Composite Materials
ME	451	Powerplant Design
ME	454	Power Generation Systems
ME	457	Mechatronic System Design
ME	458	Modern Control Systems
ME	467	Fuel Cells and Renewable Energy Systems
ME	484	Vibration Analysis
ME	486	Applied Finite Element Analysis
ME	493	Intermediate Dynamics
ME		

(1)

NEW PROGRAM PRO FORMA

UNIVERSITY OF MISSOURI - Kansas City

PROFORMA: MS Biomedical Engineering

Projection as of 10/21/2020

			Prep	ared by: J	Jeff Ro	SS			Ap	proved by:	S. I	Lindenbaum						
	Academic Level:	GRADUATE	<	Select														
	Degree:	MA/MS	<	Select														
	Unit	SCE	<5	Select														
	PROGRAM:	002		Year 0	Y	ear 1		Year 2		Year 3		Year 4		Year 5		Year 6		Year 7
				F21	F	Y22		FY23		FY24		FY25		FY26		FY27		FY28
(2)	Enrollment Projections																	
	Head Count Students - new incoming					8		16		19		29		47		56		56
	Head Count Students - transfers within campus					-		-		-		-		-		-		-
	Student Credit Hours					120		238		281		441		707		836		836
(3)	Tuition Rate/Credit Hour (See RIM Tuition & Fees Tal	b)			\$	440.64	\$	449.45	\$	458.44	\$	467.61	\$	476.96	\$	486.50	\$	496.23
(0)	Fee Rate/Credit Hour				\$	93.84	\$	95.72	\$	97.63	\$	99.58	\$	101.58	\$	103.61	\$	105.68
(4)	Tuition Discount Rate (%)			-		21.5%		21.5%		21.5%		21.5%		21.5%		21.5%		21.5%
															1			
(5)	Revenue Projections				-		**	******	****	***CALCULATE	D (CELLS ******	****	*****	_			
	Tuition			-		52,877		106,898		128,682		206,406		337,260		406,546		414,676
	Supplemental & Other Fees			-		11,261		22,765		27,405		43,957		71,824		86,579		88,311
	Scholarship Allowances			-		(13,790)	_	(27,878)		(33,559)		(53,828)	-	(87,953)	<u> </u>	(106,022)		(108,142)
	Net Tuition and Fees			-		50,348		101,786		122,528		196,535		321,131	-	387,103		394,845
				60		\$E0 249		\$101 796		\$100 E00	_	\$406 E2E	-	\$224 424	-	\$297 402		\$204 94E
				ŞU		\$ 30,340		\$101,700		\$122,528	-	\$196,535	-	\$321,131	-	\$307,103		\$394,04 5
	Recurring State Support																	
	TOTAL REVENUE			\$0		\$50,348		\$101,786		\$122,528		\$196,535		\$321,131		\$387,103		\$394,845
(6)	Expenditure Projections																	
	Faculty Salaries (inc. Adjuncts)		\$	-	\$	-	\$	-	\$	7,004	\$	7,144	\$	7,287	\$	7,433	\$	7,581
	Technical Salaries																	
	Support Salaries		\$	3,000	\$	3,060	\$	3,121	\$	3,184	\$	3,247	\$	3,312	\$	3,378	\$	3,446
	Total Salaries		\$	3 000	s	3 060	\$	3 121	\$	10 188	s	10 391	\$	10 599	\$	10 811	\$	11 027
	Benefits		\$	1 308	ŝ	1 334	\$	1,361	ŝ	1 924	ŝ	1 963	\$	2 002	\$	2 042	ŝ	2 083
	Subtotal Salaries and Benefits		\$	4,308	ŝ	4.394	\$	4,482	\$	12,112	ŝ	12.354	\$	12.601	\$	12,853	ŝ	13,110
	Operating Expense		Ŷ	1,000	Ŷ	1,001	Ť	1, 102	Ŷ	12,112	Ť	12,001	Ť	12,001	Ţ.	12,000	Ŷ	10,110
	Computing Expenses		\$	-	S	1.020	\$	1.040	\$	1.061	S	1.082	\$	1,104	\$	1,126	\$	1,149
	NonCapital Maintenance & Repair		\$	-	\$	-	\$	-	\$	-	\$	-	\$	-	\$	-	\$	-
	Noncapital Equipment		\$		\$	5,100	\$	5,202	\$	5,306	\$	5,412	\$	5,520	\$	5,631	\$	5,743
	Supplies		\$	-	\$	1,020	\$	1,040	\$	1,061	\$	1,082	\$	1,104	\$	1,126	\$	1,149
	Professional & Consulting		\$		\$	-	\$	-	\$	-	\$		\$	-	\$	-	\$	-
	Travel & Training		\$		\$	-	\$	-	\$	-	\$	-	\$	-	\$	-	\$	-
	Misc. Expenses		\$	5,000	\$	5,100	\$	2,601	\$	2,653	\$	2,706	\$	2,760	\$	2,815	\$	2,872
	Subtotal Operating Expense			5,000		\$12,240		\$9,884		\$10,081		\$10,283		\$10,489		\$10,699		\$10,913
(7)	One-time Expenditures (Startup Costs)																	
	Course Development		\$	-														
	Start-up																	
(8)	Additional Space Costs																	
	Subtotal One-time Expense		\$	-		\$0		\$0		\$0		\$0		\$0		\$0		\$0
	•																	
	TOTAL EXPENDITURES			\$9,308		\$16,634		\$14,366		\$22,193		\$22,637		\$23,090		\$23,552		\$24,023
	DIRECT MARGIN			(\$9,308)		\$33,714		\$87,419		\$100,335		\$173,897		\$298,041		\$363,551		\$370,822
	CUMULATIVE DIRECT MARGIN			(\$9,308)		\$24,405		\$111.825		\$212,160		\$386.057		\$684.098		\$1.047.650		\$1,418,472
				(+=,===)		+= .,		¥,===	_	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			<u> </u>	*** ., ** *	_	.,,		.,
	Subtract:																	
(9)	Revenue from Transfers within Campus				\$	-	\$	-	\$	-	\$	-	\$	-	\$	-	\$	-
									_		_		_		_			
	NET MARGIN TO THE CAMPUS			(\$9,308)		\$33,714		\$87,419		\$100,335		\$173,897		\$298,041	i	\$363,551	_	\$370,822
	CUMULATIVE NET MARGIN TO THE CAMPUS			(\$9,308)		\$24,405		\$111,825		\$212,160		\$386,057		\$684,098	_	\$1,047,650		\$1,418,472
				_	•	1.00.		10.007	•	10 1	•	10.15	•	01.057	-	00.04-	•	
(10)	Campus Overhead Allocation (\$40/SCH)		\$	-	\$	4,994	\$	10,096	\$	12,153	\$	19,494	\$	31,852	\$	38,396	\$	39,164
															_			
				(\$0 309)		\$28 720		\$77 300		\$99 192		\$154 404		\$266 120		\$325 155		\$331 659
				(43,500)		w10,720		<i>\$11,323</i>		<i>400,102</i>		9104,404		¥200,109		<i>4</i> 525,155		4001,000
	AFTER CAMPUS OVERHEAD			(\$9,308)		\$19,411		\$96,735		\$184.916		\$339.320		\$605,509		\$930.664		\$1,262,323

(11) Assumptions:

Key Assumpt

Program begins in Fall 2021

 Tuition (See Pro Forma Tuition Assumptions tab) - Retention rate is 85.7% based on 3yr Avg. for Graduate SCE. Assuming gradual growth in enrollment reaching a steady state of about 25 total students Ultion (see Pro Forma Tuition Assumptions tab) - Retention rate is 85.7% based on 3yr Avg, for Graduate SCE. Assuming grap program
Tuition discount rate - BS students who continue on for MS degree receive undergraduate tuition rate (50% of enrollment)
30 SCH to complete course, expected completion in 2 academic years
Supplemental fees assessed to all SCH
Added placeholder for Academic Advisor/administrator stipend in Yr1

Price and expense growth projected at 2% per annum
 Price and expense growth projected at 2% per annum
 Headcount - 1 Adjunct starting in year 3 at \$6,600; all other teaching provided by faculty who are already teaching and have capacity to add students at no incremental cost
 Marketing costs - SCE continuing Ed expected to support marketing grogram with MCM included in existing marketing (mass email; printed pieces). Conservatively, included \$5000 per year for yrs 0-1 to kick off the program and half that rate beginning in yr 2 as a steady run rate.

Source: Labor Insight (Burning Glass Technologies)

Occupation Analysis - Biomedical Engineer

Designs solutions to problems in medicine and biology to improve patient care. Combines engineering with medical and biological knowledge. May develop medical products designed to replace biological functions, such as prosthetic limbs or artificial hearts, or design equipment such as X-rays and surgical tools.

Common job titles: Biomedical Engineer, Supervisory Biomedical Engineer, Clinical Engineer, Senior Biomedical Engineer, Biomechanical Engineer

Active Selections: Kansas City, MO-KS (Metropolitan Statistical Area), Biomedical Engineer









Job Qualifications

No experience data available for this report with your selected filters.

Education Level



Frequency Requested

Certification	Occasionally	Sometimes	Often
American Board for Engineering and Technology (ABET) Accredited	0	0	Θ
Security Clearance	0	0	٥

Top Skills

Specialized Skills

Biomedical Engineering
Mechanical Engineering
Medical Technology
Appointment Setting
Onboarding
Quality Management
Scheduling

Baseline Skills

Research
Planning
English
Communication Skills
Physical Abilities
Multi-Tasking
Verbal / Oral Communication



Skills Explorer

Occupational Skills for Biomedical Engineer



An occupation's Defining skills represent the day-to-day tasks and responsibilities of the job. An employee needs these skills to qualify for and perform successfully in this occupation.

Skill	Skill Type	Occupat ional Skills Categor y	Sala ry Pre miu m	Job Postings Request ing Last 12 months	Projecte d Growth 2 Years	Location Quotient
Biomedical Engineering	Specialized	Defining		5	-3.9%	0.4 💙
Research	Baseline	NA		3	0% 😽	0.6 😽
Planning	Baseline	NA		3	0% 💊	0.9 🗕
English	Baseline	NA		3	0% 💊	2.4 🙈
Mechanical Engineering	Specialized	Defining	~	3	0% 💊	0.7 💙
Medical Technology	Specialized	NA		3	0% 💊	2.8 🙈
Appointment Setting	Specialized	NA		3	0% 💊	3.2 🕱
Onboarding	Specialized	NA		3	0% 😽	4.4 🙈
Communication Skills	Baseline	NA		2	0% 💊	0.3 😽
Physical Abilities	Baseline	NA		2	0% 💊	0.7 💙
Multi-Tasking	Baseline	NA		2	0% 💊	1.5 🔨
Verbal / Oral Communication	Baseline	NA		2	0% 💊	1.5 🔨
Building Effective Relationships	Baseline	NA		2	0% 💊	1.6 🙈
Meeting Deadlines	Baseline	NA		2	0% 😽	2.7 🙈
People Management	Baseline	NA		2	0% 💊	3.9 🔦
Quality Management	Specialized	Necessary		2	0% 💊	0.9 🗕
Scheduling	Specialized	Necessary		2	0% 😽	1.1 💳
Chemistry	Specialized	Necessary		2	0% 💊	1.3 ^
Physics	Specialized	Defining	~	2	0% 😽	1.4 ^
Technical Support	Specialized	Necessary		2	0% 😽	1.2 💻
Technical Writing / Editing	Specialized	Necessary		2	0% 💊	1.4 ^
Budgeting	Specialized	Necessary	~	2	0% 😽	1.3 ^
Customer Contact	Specialized	NA		2	0% 💊	2.1 🙈
Equipment Repair	Specialized	NA		2	0% 💊	2.4 🙈
Repair	Specialized	Defining		1	0% 💊	0.2 😽
Project Management	Specialized	Necessary	~	1	0% 💊	0.3 😽

Data Analysis	Specialized	Necessary	>	1	0% 📏	0.5 举
Patient Safety	Specialized	Necessary		1	0% 😽	0.8 💙
Staff Management	Specialized	NA		1	0% 💊	0.8 💙

Learn more about Occupational Skill Categories

Top Requested Skills for Biomedical Engineer

Skill	Skill Type	Occupational Skills Category	Salary Premium	Job Postings Requesting Last 12 months	Projected Growth ^{2 Years}	Location Quotient
Biomedical Engineering	Specialized	Defining		5	-3.9% 💊	0.4 🗡
Research	Baseline	NA		3		0.6 😽
Planning	Baseline	NA		3		0.9 🗖
English	Baseline	NA		3		2.4 🔦
Mechanical Engineering	Specialized	Defining	~	3		0.7 💙
Medical Technology	Specialized	NA		3		2.8 🔦
Appointment Setting	Specialized	NA		3		3.2 🔦
Onboarding	Specialized	NA		3		4.4 🕿
Communication Skills	Baseline	NA		2		0.3 😽
Physical Abilities	Baseline	NA		2		0.7 💙
Multi-Tasking	Baseline	NA		2		1.5 ^
Verbal / Oral Communication	Baseline	NA		2		1.5 ^
Building Effective Relationships	Baseline	NA		2		1.6 🔦
Meeting Deadlines	Baseline	NA		2		2.7 🔦
People Management	Baseline	NA		2		3.9 🔦
Quality Management	Specialized	Necessary		2		0.9 🗖
Scheduling	Specialized	Necessary		2		1.1 🗖
Chemistry	Specialized	Necessary		2		1.3 ^
Physics	Specialized	Defining	~	2		1.4 ^
Technical Support	Specialized	Necessary		2		1.2 -
Technical Writing / Editing	Specialized	Necessary		2		1.4 ^
Budgeting	Specialized	Necessary	~	2		1.3 ^
Customer Contact	Specialized	NA		2		2.1 🛠
Equipment Repair	Specialized	NA		2		2.4 🙈
Repair	Specialized	Defining		1		0.2 😽
Project Management	Specialized	Necessary	~	1		0.3 😽

Data Analysis	Specialized	Necessary	~	1	0.5 😽
Patient Safety	Specialized	Necessary		1	0.8 💙
Staff Management	Specialized	NA		1	0.8 💙



Employers & Industries

Top Industries



Others

Assistance



Top Locations



State	Job Postings Last 12 months	Median Salary	Time to Fill _{Days}	Location Quotient
Saint Louis City, MO	10	\$75k	45	2.5 🔌
Johnson, KS	2	\$57k	45	0.3 😽
Leavenworth, KS	2	\$96k	45	5.5 🔦
Boone, MO	1	\$60k	45	0.6 😽
Jackson, MO	1	\$77k	45	0.2 💙
Saint Louis, MO	1	\$77k	45	0.1 😽





Related Jobs







Source: Labor Insight (Burning Glass Technologies)

Occupation Analysis - Biomedical Engineer

Designs solutions to problems in medicine and biology to improve patient care. Combines engineering with medical and biological knowledge. May develop medical products designed to replace biological functions, such as prosthetic limbs or artificial hearts, or design equipment such as X-rays and surgical tools.

Common job titles: Biomedical Engineer, Supervisory Biomedical Engineer, Clinical Engineer, Senior Biomedical Engineer, Biomechanical Engineer

Active Selections: KS, MO, Biomedical Engineer

Overview







Job Qualifications Years of Experience

Education Level



Frequency Requested

Certification	Occasionally	Sometimes	Often
American Board for Engineering and Technology (ABET) Accredited	0	Θ	0
Security Clearance	0	\odot	0
Biomedical Equipment Technician (BMET)	Θ	0	0
Driver's License	٥	0	0

Top Skills

Specialized Skills

Biomedical Engineering
Repair
Project Management
Chemistry
Appointment Setting
Customer Contact
Onboarding

Baseline Skills

Planning	
Communication Skills	
Research	
English	
Troubleshooting	
Preventive Maintenance	
Writing	



Skills Explorer

Occupational Skills for Biomedical Engineer



An occupation's Defining skills represent the day-to-day tasks and responsibilities of the job. An employee needs these skills to qualify for and perform successfully in this occupation.

Skill	Skill Type	Occupat ional Skills Categor y	Sala ry Pre miu m	Job Postings Request ing Last 12 months	Projecte d Growth 2 Years	Location Quotient
Biomedical Engineering	Specialized	Defining		14	-3.9%	0.3 😽
Planning	Baseline	NA		11	0% 💊	0.8 💙
Repair	Specialized	Defining		8	0% 💊	0.4 💙
Project Management	Specialized	Necessary	~	7	0% 😽	0.5 😽
Communication Skills	Baseline	NA		6	0% 💊	0.2 😽
Research	Baseline	NA		6	0% 😽	0.3 😽
English	Baseline	NA		6	0% 💊	1.2 🗖
Chemistry	Specialized	Necessary		6	0% 💊	1 🗖
Appointment Setting	Specialized	NA		6	0% 💊	1.5 🔨
Customer Contact	Specialized	NA		5	0% 💊	1.3 ^
Onboarding	Specialized	NA		5	0% 💊	1.8 🙈
Troubleshooting	Baseline	NA		4	0% 💊	0.2 😽
Mechanical Engineering	Specialized	Defining	~	4	0% 😽	0.2 ݢ
Data Analysis	Specialized	Necessary	~	4	0% 💊	0.5 😽
Physics	Specialized	Defining	~	4	0% 💊	0.7 💙
Patient Safety	Specialized	Necessary		4	0% 💊	0.8 🗡
Medical Technology	Specialized	NA		4	0% 😽	0.9 🗕
Preventive Maintenance	Baseline	NA		3	0% 💊	0.3 😽
Writing	Baseline	NA		3	0% 💊	0.3 😽
People Management	Baseline	NA		3	0% 💊	1.4 🔨
Patient Care	Specialized	Necessary		3	0% 💊	0.4 😽
Project Planning and Development Skills	Specialized	NA		3	0% 😽	0.9 🗕
Problem Solving	Baseline	NA		2	0% 💊	0.1 😽
Physical Abilities	Baseline	NA		2	0% 💊	0.2 😽
Multi-Tasking	Baseline	NA		2	0% 💊	0.4 😽
Microsoft Excel	Software and Programmin	NA		2	0% 💊	0.4 💙

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	g					
Verbal / Oral Communication	Baseline	NA		2	0% 💊	0.4 💙
Building Effective Relationships	Baseline	NA		2	0% 💊	0.4 💙
Self-Starter	Baseline	NA		2	0% 💊	0.9 💻
Meeting Deadlines	Baseline	NA		2	0% 💊	0.7 🗡
Quality Management	Specialized	Necessary		2	0% 💊	0.2 💙
Scheduling	Specialized	Necessary		2	0% 💊	0.3 😽
Technical Support	Specialized	Necessary		2	0% 🛰	0.3 😽
Technical Writing / Editing	Specialized	Necessary		2	0% 💊	0.4 😽
Budgeting	Specialized	Necessary	~	2	0% 😽	0.3 😽
Biotechnology	Specialized	NA		2	0% 😽	0.4 😽
Equipment Repair	Specialized	NA		2	0% 💊	0.6 😽
Clinical Research	Specialized	NA	~	2	0% 😽	0.5 🗡
Radiology	Specialized	NA	~	2	0% 😽	0.5 😽
Organizational Skills	Baseline	NA		1	0% 😽	0.1 😽
Time Management	Baseline	NA		1	0% 😽	0.2 😽
Presentation Skills	Baseline	NA		1	0% 💊	0.2 😽
Listening	Baseline	NA		1	0% 💊	1 -
Staff Management	Specialized	NA		1	0% 💊	0.2 😽
Customer Service	Specialized	NA		1	0% 💊	0.2 😽
Medical Imaging	Specialized	Distinguishi ng		1	0% 😽	0.2 😽

Learn more about Occupational Skill Categories

Top Requested Skills for Biomedical Engineer

Skill	Skill Type	Occupational Skills Category	Salary Premium	Job Postings Requesting Last 12 months	Projected Growth 2 Years	Location Quotient
Biomedical Engineering	Specialized	Defining		14	-3.9% 💊	0.3 😽
Planning	Baseline	NA		11		0.8 💙
Repair	Specialized	Defining		8		0.4 😽
Project Management	Specialized	Necessary	~	7		0.5 😽
Communication Skills	Baseline	NA		6		0.2 😽
Research	Baseline	NA		6		0.3 😽
English	Baseline	NA		6		1.2 -
Chemistry	Specialized	Necessary		6		1.0 🗖

Appointment Setting	Specialized	NA		6	1.5 ^
Customer Contact	Specialized	NA		5	1.3 ^
Onboarding	Specialized	NA		5	1.8 🔦
Troubleshooting	Baseline	NA		4	0.2 💙
Mechanical Engineering	Specialized	Defining	~	4	0.2 💙
Data Analysis	Specialized	Necessary	~	4	0.5 💙
Physics	Specialized	Defining	~	4	0.7 🗸
Patient Safety	Specialized	Necessary		4	0.8 🗸
Medical Technology	Specialized	NA		4	0.9 -
Preventive Maintenance	Baseline	NA		3	0.3 😽
Writing	Baseline	NA		3	0.3 😽
People Management	Baseline	NA		3	1.4 ^
Patient Care	Specialized	Necessary		3	0.4 💙
Project Planning and Development Skills	Specialized	NA		3	0.9 -
Problem Solving	Baseline	NA		2	0.1 😽
Physical Abilities	Baseline	NA		2	0.2 😽
Multi-Tasking	Baseline	NA		2	0.4 😽
Microsoft Excel	Software and Programming	NA		2	0.4 😽
Verbal / Oral Communication	Baseline	NA		2	0.4 💙
Building Effective Relationships	Baseline	NA		2	0.4 😽
Self-Starter	Baseline	NA		2	0.9 -
Meeting Deadlines	Baseline	NA		2	0.7 💙
Quality Management	Specialized	Necessary		2	0.2 😽
Scheduling	Specialized	Necessary		2	0.3 😽
Technical Support	Specialized	Necessary		2	0.3 😽
Technical Writing / Editing	Specialized	Necessary		2	0.4 😽
Budgeting	Specialized	Necessary	\checkmark	2	0.3 😽
Biotechnology	Specialized	NA		2	0.4 😽
Equipment Repair	Specialized	NA		2	0.6 😽
Clinical Research	Specialized	NA	~	2	0.5 😽
Radiology	Specialized	NA	~	2	0.5 💙
Organizational Skills	Baseline	NA		1	0.1 😽
Time Management	Baseline	NA		1	0.2 😽

Presentation Skills	Baseline	NA	1	0.2 😽
Listening	Baseline	NA	1	1.0 🗖
Staff Management	Specialized	NA	1	0.2 😽
Customer Service	Specialized	NA	1	0.2 😽
Medical Imaging	Specialized	Distinguishing	1	0.2 😽



November 18, 2021

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Employers & Industries

Top Industries

2digit



Top Employers







Top Locations

View: Demand Salary T	Fime to Fill Location Quotie	ent View By: State	Metro Area (MSA)	County
Scottsbluff NEBRA Cheyenne	SKA Grand Island	Waterloo IOWA Cedar Ra	pids Davenport Chica	ago South Bend
Fort Collins Denver	United States		Peoria	Lafayette INDIANA Bloomington
Pueblo		Kansas City MISSOURI Springfield	Juis	Evansville KENTU
nta Fe ie - Amarillo	O K L A H O M A	Fort Smith	Jonesbo.	Clarksville
EW XICO Lubbock	Dentón Fort Worth Dallas		MISSISSIPPI	Low Average High Very High
State	Job Postings Last 12 months	Median Salary	Time to Fill Days	Location Quotient
Missouri	13	\$77k	N/A	0.3 😽
Kansas	4	\$77k	N/A	0.2





Related Jobs







VALIDATE: EMPLOYMENT POTENTIAL

PROJECT CRITERIA

Validate	Programs
States	Kansas, Missouri
Degree Level	Master's degree
Time Period	10/1/2020 - 9/30/2021
Selected Programs	Bioengineering and Biomedical Engineering (14 0501)
	Droduct Development Engineer Engineering Manager Disposition
Selected Programs of Study	Engineer

HOW MANY JOBS ARE THERE FOR GRADUATES OF THIS PROGRAM?

For your project criteria, there were 523 job postings in the last 12 months.

Compared to:

- 1,104,615 total job postings in your selected location
- 68,357 total job postings requesting a Master's degree in your selected location

The number of jobs is expected to grow over the next 10 years.

GROWTH BY GEOGRAPHY

Geography	Selected Occupations	Total Labor Market	Relative Growth
Kansas, Missouri	2.52 %	3.55 %	Average
Nationwide	-0.93 %	3.70 %	Average


HOW HAS EMPLOYMENT CHANGED FOR CAREER OUTCOMES OF YOUR PROGRAM?

Employment data between years 2020 and 2030 are projected figures.

POSTINGS TRENDS



DETAILS BY OCCUPATION

Occupation Group	Postings	LQ	Employment (2020)	Employment Growth (2019 - 2020)	Projected Employment Growth (2020-2030)
Engineering Managers	496	0.50	3,615	-9.60%	0.70%
Mechanical and Related Engineers	22	0.50	90	-42.30%	-1.10%
Chemical, Biomedical, and Related Engineering	5	0.20	118	-41.30%	10.20%

HOW VERSATILE IS THIS DEGREE FOR MY GRADUATES?

Graduates of this program usually transition into any of the 3 different occupation groups:

Occupations Group	Market Size (postings)	Percentage of Career Outcome demand	
Engineering Managers	496	94.84%	

Mechanical and Related Engineers	22	4.21%
Chemical, Biomedical, and Related Engineering	5	0.96%



WHAT SALARY WILL MY GRADUATES FIND UPON GRADUATION?

The median salary in Kansas and Missouri for graduates of your program is \$104K

This average salary is Above the average living wage for your region of \$31K



Salary numbers are based on Burning Glass models that consider advertised job posting salary, BLS data, and other proprietary and public sources of information.

Occupation Group	0-2 Years	3-5 Years	6+ Years
Chemical, Biomedical, and Related Engineering	NA	NA	NA
Mechanical and Related Engineers	NA	NA	NA
Engineering Managers	\$93K	\$98K	\$111K

WHERE IS DEMAND FOR MY PROGRAM?



TOP LOCATIONS BY POSTING DEMAND

Location	Postings
California	8,905
_	2.040
lexas	2,818
New York	2,156
Massachusatta	1.012
Massachusetts	1,912
Washington	1,510
Florida	1 426
TIOTIUA	1,420

Virginia	1,401
Illinois	1,326
Colorado	1,288
Georgia	1,110

VALIDATE: COMPETITIVE LANDSCAPE

PROJECT CRITERIA

Validate	Programs
States	Kansas Missouri
Degree Level	Master's degree
Time Period	10/1/2020 - 9/30/2021
Selected Programs	Bioengineering and Biomedical Engineering (14.0501)
Career Outcomes mapped to	Product Development Engineer, Engineering Manager, Biomedical
Selected Programs of Study	Engineer

OVERVIEW

	#	% Change (2016-2020)
Degrees Conferred	40	73%
Number of Institutions	3	50%
Average Conferrals by Institution	13	8.33%
Median Conferrals by Institution	10	-16.67%

MARKET SHARE BY PROGRAM



Bioengineering and Biomedical Engineering

Program	Conferrals	Market Share (%)
	(2020)	Warket Share (70)
Bioengineering and Biomedical Engineering	40	100.00%

MARKET SHARE BY INSTITUTION TYPE



Public	20	50.00%
Private	20	50.00%

TOP INSTITUTIONS

Institution	School Type	Market Share (2020)	Market Share Change	Conferrals (2020)	Conferrals Change (2016-2020)
Washington	Drivato		6 5 2 9/	20	
University in St Louis	Private	50.00%	-0.52%	20	55.65%
University of Kansas	Public	25.00%	-18.48%	10	0.00%
Wichita State	Dublic	25.00%	25.00%	10	100 00%
University	PUDIIC	25.00%	25.00%	TÜ	100.00%

TOP PROGRAMS

Program	Market Share	Market Share	Conferrals	Conferrals Change
Fiografii	(2020)	Change	(2020)	(2016-2020)
Bioengineering and	100.00%	0.00%	10	72 010/
Biomedical Engineering	100.00%	0.00%	40	73.91%

Note: Competitive Landscape reports are based on IPEDS data, which are reported in the CIP 2010

taxonomy. As a result, new programs in CIP 2020 will not have completion data until the release of 2020 data in Fall, 2021.

VALIDATE: MARKET ALIGNMENT

PROJECT CRITERIA

Validate	Programs
States	Kansas, Missouri
Degree Level	Master's degree
Time Period	10/1/2020 - 9/30/2021
Selected Programs	Bioengineering and Biomedical Engineering (14.0501)
Career Outcomes mapped to	Product Development Engineer, Engineering Manager, Biomedical
Selected Programs of Study	Engineer

JOB POSTINGS BY ADVERTISED EDUCATION (%)



JOB POSTINGS BY INDUSTRY (%)



Other

JOB POSTINGS BY EXPERIENCE REQUESTED (%)



TOP TITLES

Experience Level: All Experience

Title	Postings	Market Share (%)
Project Engineer	9	2.37%
Senior Project Engineer	9	2.37%
Engineering Manager	8	2.11%
Customer Engineering Manager	7	1.84%
Director Of Engineering	6	1.58%
Plant Engineering Manager	6	1.58%
Senior Director Engineering	6	1.58%
Manager, Engineering	5	1.32%
Director Of Electrical Engineering	4	1.05%
Engineering Manager - Mac Endpoint - Opportunity For Working Remotely	4	1.05%
Manager-Engineering	4	1.05%
Digital Client Engagement Director	3	0.79%
Director Client Engagement	3	0.79%
Director Engineering	3	0.79%
Director Of Engineeering	3	0.79%

TOP EMPLOYERS HIRING

Experience Level: All Experience

Employer	Postings	Market Share (%)
Vmware Incorporated	18	4.74%
Bayer Corporation	11	2.89%
Honeywell	10	2.63%
Hntb	8	2.11%
Humana	8	2.11%
University of Missouri	8	2.11%
Washington University in St. Louis	8	2.11%
Anthem Blue Cross	7	1.84%
Kiewit Corporation	7	1.84%
Molecula	7	1.84%
Ryder System Incorporated	7	1.84%
KPMG	6	1.58%
World Wide Technology	6	1.58%
Jacobs Engineering Group Incorporated	5	1.32%
Mars Incorporated	5	1.32%



School of Computing and Engineering

Office of the Dean

April 23, 2020

Jennifer Lundgren, Ph.D., F.AED Interim Provost University of Missouri – Kansas City 358 Administrative Center 5115 Oak Street Kansas City, MO 64110

Dear Interim Provost Lundgren,

I would like to state my support for the Bachelor of Science and Master of Science in Biomedical Engineering (BSBME & MSBME) degree proposals by UMKC's School of Computing and Engineering.

UMKC's long history of excellence in the health, life, and biological sciences combined with the rapidly growing disciplines in computing and engineering provide a very strong platform to start these new interdisciplinary degrees in biomedical engineering. The BSBME and MSBME degree programs support the University's vision to promote interdisciplinary education and research. In addition, these programs will help to support Chancellor Agrawal's vision of increasing the size of UMKC.

The BSBME and MSBME programs will share common faculty as well as common elective courses. In addition, there is no upfront cost for either program. We would like to start the MSBME program in the fall semester of 2020 and the BSBME program in the fall semester of 2021. We have already identified approximately 20 faculty members from several UMKC academic units to offer the required and technical elective courses for both programs. No new faculty hires will be needed for either program until the fall semester of 2023. New faculty hires will be required in fall 2023 to accommodate the growth in student population, to add expertise for junior and senior undergraduate courses and technical electives for graduate students, and to add focal areas for interdisciplinary research. Biomedical engineering is at the intersection of the health sciences and every traditional engineering program.

These degree programs will enhance our ability to attract high achieving students in the biomedical field. Your support will allow us to serve the needs of students in the Kansas City metropolitan and regional areas who are considering pursuing undergraduate and graduate degrees in biomedical engineering.

Sincerely,

Kevin Truman, Ph.D., F.ASCE Dean, School of Computing and Engineering

Room 534 Flarsheim Hall | 5110 Rockhill Road | Kansas City, MO 64110 o: 816-235-1285 | f: 816-235-5159 | sce@umkc.edu

OPEN -- ASARED

November 30, 2020

Kevin Z. Truman, Ph.D., F.ASCE Dean, School of Computing and Engineering 534 Flarsheim Hall University of Missouri – Kansas City 5110 Rockhill Road Kansas City, MO 64110

Dear Dean Truman,

I would like to state my support for the proposed Bachelor of Science and Master of Science in Biomedical Engineering (BSBME & MSBME) degrees within UMKC's School of Computing and Engineering.

More than 700 medical and allied health students train at the UMKC School of Medicine (SOM). Internationally known for its BA/MD program, our MD program recently doubled in size. On completion of training, these graduates enter the healthcare workforce in the Greater Kansas City community, or pursue specialty training. The potential to recruit qualified BSBME graduates to our programs, would bring additional diversity to the MD, Physician Assistant and Anesthesia Assistant programs.

Clinical training at the SOM is provided to more than 400 residents and fellows at programs at Truman Medical Centers, Inc, Saint Luke's Hospital, Children's Mercy, and eventually at our new rural health campus at Mosaic Life Care in Saint Joseph, Missouri. Dedicated time for scholarly research is required as a component of their training. The proposed biomedical engineering programs offer opportunities for impactful research opportunities that will be sought-after by these physician trainees. Following training, these practitioners and subspecialists begin their careers at other academic institutions across the US. Those who have trained or collaborated with our biomedical engineering programs will add credentials that will increase their potential for recruitment to other respected universities adding prestige to UMKC.

Faculty at the UMKC School of Medicine and the School of Computing and Engineering (SCE) have a consistent history of collaboration. Dr. Gary Sutkin, the Victor and Caroline *Schutte* Chair in *Women's* Health, collaborates with biomedical engineering faculty to study ways to improve safety in the operating room in this highly funded research. A shared endowed professorship (Franklin D. Dickson/Missouri Endowed Associate Professor of Orthopedic Research)) was created between the SOM Department of Orthopedic Surgery and SCE and the Margaret Suzanne Neal/Missouri Endowed Chair in Orthopedic Surgery, has a role in both institutions.

I see these programs having the potential to attract high achieving students and enhance expertise of our undergraduate and graduate level trainees in the School of Medicine as well as those of our research faculty. Expanding our footprint in the biomedical fields in the Kansas City metropolitan and regional areas, will allow us to demonstrate national and global healthcare innovation and leadership.

Sincerely,

Mary Anne Jackson, MD Dean and Professor of Pediatrics



November 25, 2020

Dear Dr. Bloemker,

I am writing on behalf of RBC Medical Innovations to express support for University of Missouri Kansas City's pursuit of Bachelor of Science and Master of Science in Biomedical Engineering degree programs. RBC Medical Innovations' interest of a Biomedical Engineering program lies in our business being in the field of medical technology engineering and our proximity to UMKC. RBC has over 25 years of experience and have supported 7 of the 10 largest medical device companies in the world on a wide range of projects in the field of medical devices. Additionally, RBC Medical Innovations is in Lenexa, Kansas a suburb to Kansas City, Missouri and less than a 30-minute drive to the UMKC campus and UMKC School of Computing and Engineering. In general, we are enthusiastic at the potential for the Kansas City area to grow in its resources, capability, and talent related to medical technology and medical device engineering.

RBC has the capacity to support UMKC's Biomedical Engineering program in the following ways. First, RBC traditionally hires 2-4 full-time "entry level" engineers per year. For entry level positions we consider engineers from a variety of engineering disciplines including Biomedical. RBC has hired in the past UMKC engineering students and have been very pleased with the skillset, competency, and knowledge of UMKC graduates. As a result, we would consider qualified candidates graduating from the Biomedical program from UMKC for our full-time entry level engineering positions in the future. Additionally, internships, research collaborations, and senior design/capstone projects with members of the program would all be considerations assuming the work was mutually beneficial for the student and RBC.

If desired, we are open to continuing dialogues with UMKC as they develop their program to provide additional information for the type of skillsets and experience that we look for in new full-time hires, interns, and research collaborators. If there are other ways we could potentially provide support to the program please do not hesitate to contact us.

Best,

Corbin Reagan, Director of Engineering

RBC Medical Innovations

creagan@rbccorp.com



saintlukeshealthsystem.org



November 30, 2020

Kevin Z. Truman, Ph.D., F.ASCE Dean, School of Computing and Engineering University of Missouri – Kansas City 5110 Rockhill Road Kansas City, MO 64110

Dear Dean Truman,

I would like to state my support for the proposed Bachelor of Science and Master of Science in Biomedical Engineering (BSBME & MSBME) degrees within UMKC's School of Computing and Engineering (SCE). UMKC has a long history of excellence in the health, life, and biological sciences, and I know SCE has continued to grow in enrollments, sponsored research and community engagement.

As one who has worked in the health science/medical space for >20 years and been able to support my cardiac based outcomes research program with continuous extramural funding throughout that time, I am consistently struck by the unrealized potential of our remarkable assets at UMKC. A large component of this unrealized potential is the lack of sufficient faculty to help fully exploit our opportunities.

To address this need, I believe that a very strong platform in interdisciplinary degrees in biomedical engineering through the SCE could be immensely helpful. The proposed BSBME and MSBME programs can support the University's vision to promote interdisciplinary education and research. Specifically, I as well as my colleagues within St. Lukes's Health System need locally based biomedical engineering programs that merges engineering, computer science, biosciences and medicine. We at St. Luke's have numerous ways to interact with these programs, its students, faculty and equipment, through technology transfer, internships, and research. Biodevices, biomaterials and bioinformatics have been projected to be a trillion dollar market in the coming years. This market will be in great need of biomedical engineering professionals. St. Lukes is just now entering the world of 3-D bioprinting. With SCE's recent investments in 3-D bioprinting and its cleanroom for that printing, several units within St. Luke's will be looking to intern, hire and collaborate with the biomedical engineering students and faculty.

Dean Truman has already identified approximately 20 faculty members from several UMKC academic units who can offer the initial courses for both programs and no new faculty hires will be needed until Fall 2023. St. Luke's personnel look forward to being on the advisory committees for further development of the academic and research missions, to help in hiring new faculty and to add focal areas for interdisciplinary research.

Of course, I would be even more supportive of earlier hires so that more faculty could be available to support collaborative research projects and further enhance our extramural funding. I am hopeful that many of the MS students (and Ph.D. students) will be interested in research and I believe that there is ample opportunity for support of this research with the growing data science and biotechnology resources of UMKCs School of Medicine, Children's Mercy, and Saint Luke's Hospitals.

Your support allows UMKC to serve the needs of students in our and region who are considering pursuing undergraduate and graduate degrees in biomedical engineering.

Sincerely,

Joh Sped

John A. Spertus, MD, MPH Lauer/Missouri Endowed Chair and Professor, University of Missouri – Kansas City; Clinical Director of Cardiovascular Outcomes Research, Saint Luke's Mid America Heart Institute

4401 Wornall Road, Kansas City, MO 64111 • Phone: (816) 932-2000 • saintlukeshealthsystem.org



December 1, 2020

30 W. Pershing Road Suite 200 Kansas City, MO 64108 816.221.2121 fax : 816.842.2865 kcadc@thinkKC.com



Kevin Z. Truman, Ph.D., F.ASCE Dean, School of Computing and Engineering 534 Flarsheim Hall University of Missouri – Kansas City 5110 Rockhill Road Kansas City, MO 64110

Dear Dean Truman,

On behalf of the Kansas City Animal Health Corridor (KCAHC), I would like to state my support for the proposed Bachelor of Science and Master of Science in Biomedical Engineering (BSBME & MSBME) degrees within UMKC's School of Computing and Engineering.

The KCAHC stretches from Columbia and St. Joseph, Missouri, to Manhattan, Kansas. Within this area, there are over 300 companies and 20,000 people working in animal health. The companies located in the KCAHC are responsible for 56 percent of total worldwide animal health, diagnostics, and pet food sales and represent the largest concentration of animal health companies and service providers in the world. For more information about the KCAHC, please visit <u>http://kcanimalhealth.thinkkc.com</u>.

Since its founding 15 years ago, the KCAHC's mission has remained the same: Support the growth of existing companies in the KCAHC and create an environment where new companies can grow and thrive. We accomplish this goal through the implementation of strategic priorities that are approved by the Board. Representatives of the KCAHC Board are executives from the major animal health companies in the region and the Dean of the Veterinary College at Kansas State University and the University of Missouri.

The KCAHC offers industry-leading workforce development solutions to complement the benefits of its globally unique animal health industry concentration. In partnership with regional academic institutions, the Corridor ensures that the KCAHC is pipelining skilled talent into the animal health industry today and for many years to come.

The addition of the BSBME & MSBME degree programs will enhance UMKC's ability to attract high achieving students in the biomedical field. This will serve the needs of the biomedical fields in the Kansas City region.

The KCAHC staff commits to working with UMKC faculty and staff to share student resumes with regional animal health employers. Furthermore, the KCAHC staff commits to making necessary industry connections to ensure that the program offerings are successful and continue to meet industry needs.

Should you require additional information regarding the KCAHC's endorsement of this program, please feel free to call or email me.

Sincerely,

Kun young

Kimberly Young President Kansas City Animal Health Corridor young@thinkKC.com M: 816.654.3617





December 2, 2020

Kevin Z. Truman, Ph.D., F.ASCE Dean, School of Computing and Engineering 534 Flarsheim Hall University of Missouri – Kansas City 5110 Rockhill Road Kansas City, MO 64110

Dear Dean Truman,

I would like to express my strong support for the proposed Bachelor of Science and Master of Science in Biomedical Engineering (BSBME & MSBME) degrees within UMKC's School of Computing and Engineering.

As the Chief Research Information Officer at Children's Mercy Kansas City and an adjunct Professor in Pediatrics and Biomedical and Health Informatics at UMKC, I work closely with clinical and technical experts at both organizations. I often witness issues that would benefit from the unique skills of a well-trained biomedical engineer. My other professional experience includes 16 years at Cerner where I was the Vice President of Genomics and Research and led a group of engineers. I am thrilled to learn of the progress that you have made toward establishing much-needed programs in Biomedical Engineering. This is the right time for UMKC to connect your strengths in engineering with those in healthcare and the biological sciences in launching this new program.

Graduates from this program will be in demand as Children's Mercy, Cerner and other local employers seek to hire people who can effectively work in the space between the clinical and technical. In my experience I always prefer to hire people with proven ability to work across these areas, by definition the students completing these programs will have that interdisciplinary background. At Children's Mercy we see data science, 3D printing, advanced visualization, drug delivery and other technical innovation as growth areas. We have just opened a new nine story research building with the design philosophy of 50% wet lab and 50% dry lab. Included in the dry lab areas is a Maker Space to encourage our clinical and scientific faculty to collaborate with technical experts. We also have a new data center, advanced bioinformatics capabilities, world class instrumentation and other resources relevant to biomedical engineering. We face a clear need to recruit staff and faculty as we grow in these areas and have been very successful when recruiting talent already familiar with the community.

As the program progresses, I will advocate for collaborative opportunities for your students to gain practical experience working with us. I will also work with the leadership of the Children's Mercy Research Institute to identify faculty who would be able to serve as guest lecturers and mentors. We have made exciting progress in pediatric data science, augmented reality visualization and other areas of interest to your future students. I would also like to see us serve as a setting in which your students could perform work related to their theses, one of the best ways for our faculty to evaluate prospective hires.

These degree programs will enhance UMKC's ability to attract high achieving students in the biomedical field. This program will serve the needs of the biomedical fields in the Kansas City metropolitan and regional areas as well as the nation and world. Please let me know how I can be supportive of the program as it progresses.

Sincerely,

Mark Hoffman

Mark Hoffman, Ph.D.

Chief Research Information Officer – Children's Mercy Hospital, Children's Research Institute

Assoc. Professor Biomedical and Health Informatics, University of Missouri Kansas City

O: 816-302-1310 M: 816-920-1931, mhoffman@cmh.edu

October 11, 2021

Mauli Agrawal, Ph.D. Chancellor University of Missouri-Kansas City 5100 Rockhill Road Kansas City, MO 64110

Dear Chancellor Agrawal:

I would like to state my support for the Bachelor of Science and Master of Science in Biomedical Engineering (BSBME & MSBME) degree proposals by UMKC's School of Computing and Engineering. UMKC's long history of excellence in the health, life, and biological sciences combined with the rapidly growing disciplines in computing and engineering provide a very strong platform to start these new interdisciplinary degrees in biomedical engineering.

One of the main missions of University Health is to serve as an academic medical center. We are intent on continuing to be a true academic health center and we do this by investing in research and advancing intellectual collaboration whenever possible. We already have research collaborations with many entities, including the UMKC Health Sciences Campus, and would love to expand these collaborations. The BSBME and MSBME degree programs at UMKC will allow our doctors and researchers to collaborate directly with faculty and students to enhance our current therapeutic research studies. These collaborations will also allow us to start new research initiatives in emerging fields such as, drug design and delivery, state-of-the-art orthopedics, bio- and nano- materials, and bone and tissue engineering.

In addition to the research potential, the biomedical engineering programs at UMKC will provide University Health, and the entire Kansas City metropolitan area, with a highly qualified workforce in the biomedical field. With the ever-changing nature of the health sciences field, young and innovative biomedical engineers will have the ability to bring much needed insight

and new technology to this region's hospitals. We, at University Health, need these talented graduates to help us continue to advance in state-of-the-art biomedical solutions that will better serve the patients of our community.

These new biomedical programs at UMKC will provide University Health with a multidisciplinary workforce, research collaborators, and biomedical entrepreneurs, which we need to enhance our academic research and help the Kansas City community. These programs will allow UMKC to serve not only the needs of students in the Kansas City metropolitan area, but ultimately our patients at University Health.

Sincerely. rlie Shields

President and Chief Executive Officer



2401 Gillham Road Kansas City, Missouri 64108 (816) 234-3000

Paul D. Kempinski, MS, FACHE President and Chief Executive Officer Phone: (816) 234-3650 Fax: (816) 842-6107

October 19, 2021

C. Mauli Agrawal, Ph.D. Chancellor University of Missouri-Kansas City 5115 Oak Street Kansas City, MO 64112

Dear Chancellor Agrawal,

I am writing to state my support for the proposed Bachelor and Master of Science degree programs in Biomedical Engineering (BME) at the University of Missouri-Kansas City (UMKC). UMKC has always been well known for its excellence in the health sciences, including medicine, nursing, dentistry, and pharmacy. Partnering UMKC's excellence in health sciences with the more recent growth of the computing and engineering programs at UMKC's School of Computing and Engineering provides a strong foundation to build top Biomedical Engineering programs that capitalize on the strengths at UMKC and partner organizations and serve as an important asset to the Kansas City region, state of Missouri and beyond.

The UMKC BME faculty, undergraduate students, and graduate students will be a tremendous asset to Children's Mercy's research initiatives. Children's Mercy recently opened a new \$200M, 375,000 sq. ft. research facility that supports our pediatric translational research programs. Our researchers welcome the opportunity to include these engineering faculty and students within our research teams. Additionally, we will offer our researchers and doctors as mentors, instructors, adjunct faculty, and partners in those areas where it makes sense, such as biomaterials, biodevices, bio-related augmented and virtual reality, orthopedics, and innovative drug design, production, and delivery.

The main goal at Children's Mercy is to ensure we are leading in cutting-edge research, so our children are receiving the best care and outcomes possible. With the ever-changing nature of the health sciences field, young and innovative biomedical engineers can bring much-needed insight and new technology to this region's hospitals. Through multidisciplinary collaboration, Children's Mercy doctors and researchers coupled with UMKC's faculty, students, and graduates, there is unlimited potential for biomedical innovation. Children's Mercy cannot do this alone and we need biomedical engineers, ranging from undergraduates to Ph.Ds., to supplement our doctors and researchers so we can serve our patients in the best way possible.

I am extremely excited for the opportunities the new BME programs at UMKC will provide to the Kansas City medical community. Not only will we be able to start new research partnerships with the researchers and faculty, but graduates of these programs will provide tremendous growth in the biomedical tech sector in

this region. Having high-level biomedical engineers studying, researching, and practicing right here in our backyard creates endless opportunities for collaboration and innovation in the medical field which will directly impact the level of care we can give our patients at Children's Mercy.

Sincerely,

6

Paul Kempinski, MS, FACHE President and Chief Executive Officer Alice Berry, DDS, and Katharine Berry, MD, Endowed Chair In Executive Leadership

November 24, 2020

Dear Colleagues,

The School of Computing and Engineering at the University of Missouri-Kansas City has developed two synergistic academic program proposals: a Bachelor of Science in Biomedical Engineering (BSBME) and a Master of Science in Biomedical Engineering (MSBME). This letter serves to communicate my *strong* support for these two programs, along with my assessment of their impact on our community, region, and state.

The School of Computing and Engineering (SCE) at UMKC has a history of high-quality academic programs and cutting-edge research. With the collaboration of faculty in our health sciences programs (School of Medicine, School of Dentistry, School of Pharmacy, and School of Nursing and Health Sciences) and our community healthcare partners (e.g., Truman Medical Center, Children's Mercy Hospital, St. Luke's), the SCE is poised for growth and academic innovation. These degree programs will complement outstanding academic and research programs currently offered at UMKC. Our urban location, coupled with strong regional healthcare partnerships differentiate these programs from similar programs offered throughout our University System, although collaboration in coursework and research opportunities with UM Columbia and S&T are expected.

As you can see from the proposal, there is a strong market in the Kansas City metropolitan area, as well as the broader bi-state (MO, KS) region for these programs. Internship and career placement opportunities for students are robust. These programs will strengthen the already solid reputation of SCE, and our health sciences programs, as well as and expand external funding opportunities from federal and industry sources.

I am confident in the ability of SCE to deliver these programs, integrate them with our existing academic and research opportunities within the UM System, as well as our regional healthcare assets, and make a positive impact on our regional and state economies, as well as our national and international reputation in biomedical research.

Best regards,

Jenife D. Julgen

Jennifer D. Lundgren Provost and Executive Vice Chancellor

GOVERNANCE, COMPENSATION AND HUMAN RESOURCES COMMITTEE

Michael Williams (Chair) Julia Brncic Keith Holloway Robin Wenneker

I. Governance, Compensation and Human Resources Committee

The Governance, Compensation and Human Resources Committee ("Committee") will review and recommend policies to enhance quality and effectiveness of the Board as well as compensation, benefits and human resources functions of the University.

II. Governance

1. Scope

In carrying out its responsibilities regarding governance, the Committee has the central authority of ensuring that board members are prepared to exercise their fiduciary duties and assisting the Board to function effectively, efficiently and with integrity.

2. Executive Liaison

The General Counsel of the University, or some other person(s) designated by the President of the University with the concurrence of the Board Chair and the Committee Chair, shall serve as executive liaison to the Committee on governance matters and be responsible for transmitting Committee recommendations related to governance.

3. Responsibilities

In addition to the overall responsibilities of the Committee described above, and in carrying out its responsibilities regarding governance, the Committee shall review and make recommendations on the following matters:

- 1. ensuring that Board members are prepared to carry out their fiduciary duties to the University;
- 2. providing and monitoring a substantive orientation process for all new Board members and a continuous board education program for existing Board members;
- 3. overseeing, or determining with the Board Chair and President, the timing and process of periodic Board self-assessment;
- 4. establishing expectations and monitoring compliance of individual Board members;
- 5. ensuring that the Board adheres to its rules of conduct, including conflict-of-interest and disclosure policies, and that it otherwise maintains the highest levels of integrity in everything it does;
- periodically reviewing the adequacy of the Board's bylaws and other Collected Rules and Regulations adopted by the Board that pertain to its internal operations (all recommendations for bylaws amendment shall first be considered by this Committee);
- 7. identifying best practices in institutional and Board governance;
- 8. monitoring and assessing external influences and relationships with affiliated entities;
- 9. assessing areas of expertise needed in future Board members; and
- 10. those additional matters customarily addressed by the governance committee of a governing board for an institution of higher education.

III. Compensation and Human Resources

1. Scope

In carrying out its responsibilities regarding compensation and human resources, the Committee reviews and makes recommendations to the Board of Curators on strategies and policies relating to compensation, benefits and other human resources functions and associated programs.

2. Executive Liaison

The Vice President and Chief Human Resources Officer of the University, or some other person(s) designated by the President of the University, with the concurrence of the Board Chair and the Committee Chair, shall serve as executive liaison to the Committee on human resources and compensation matters and be responsible for transmitting committee recommendations related to human resources and compensation.

3. Responsibilities

In addition to the overall responsibilities of the Committee described above and in carrying out its responsibilities regarding human resources and compensation, the charge of the Committee shall include reviewing and making recommendations to the Board on the following matters:

- 1. Performance and compensation of individuals reporting directly to the Board:
 - 1. President
 - 2. General Counsel
 - 3. Secretary of the Board of Curators
 - 4. Chief Audit and Compliance Officer, in conjunction with the Audit, Compliance and Ethics Committee
- 2. Pursuant to Section 320.020 of the Collected Rules and Regulations, appointment or change of appointment of the following shall be reported to and approved by the Board before the effective date:
 - 1. Vice Presidents
 - 2. Chancellors
 - 3. Curators Professors
- 3. Intercollegiate Athletics

Pursuant to Section 270.060 of the Collected Rules and Regulations, contracts for Directors of Intercollegiate Athletics and Head Coaches may not exceed five (5) years and shall not include buyout clauses calling for the individual to receive more than the balance of the annual base salary the individual would have earned under the remaining terms of the contract, unless approved by the UM Board of Curators upon the recommendation of the President.

- 4. Benefit, retirement and post retirement plans, including an annual benefits report, as further defined in Section 520.010, Benefit Programs, of the Collected Rules and Regulations.
- 5. Additional employee benefits including the Education Assistance Program for University Employees, CRR 230.070, and Layoff and Transition Assistance, CRR 350.051.
- 6. Labor Union Recognition and matters as further defined in Section 350.020, Labor Union Recognition, of the Collected Rules and Regulations.
- 7. Employment related policies including those related to employee absences, conduct and grievances.
- 8. Provide oversight over the University of Missouri System's diversity, equity and inclusion programs.
- 9. Additional matters customarily addressed by the compensation and human resources committee of a governing board for an institution of higher education.

Approved by the Board of Curators: Feb 4, 2021

Leave Strategy Update

Board of Curators Meeting November 18, 2021



University of Missouri System

Guiding Principles

- 1. Modernize leave programs to make them more market competitive
- 2. Improve effectiveness of leave programs
- 3. Realize cost savings
- 4. Design leave programs that promote work-life balance
- 5. Explore differentiating leave by staff type and industry

Importance of Leave

- Encourages work/life balance
- Supports optimal employee productivity
- Desired benefit in a competitive job market
- Facilitates retention, which reduces turnover costs

Working Group Charge

- Develop leave design recommendations based on guiding principles
- Priorities/areas that should be considered:
 - Paid Time Off (PTO) plan design for eligible employees
 - Short-term disability coverage
 - Family leave benefit
 - Parameters for allowing unpaid time off
 - Eligibility for participating in accruing leave plans
 - Impact to current employees
- Develop a robust implementation and communication plan

Next Steps

- Nov 2021: Working group designs leave program recommendations
- Dec 2021: Recommendations presented to leadership and key stakeholders
- Feb 2022: Share recommendations with Board
- Feb Jun 2022: Vet changes more fully with university community
- Jun 2022: Design recommendations presented to Board for vote

Appendix Reference Slides

University of Missouri System

Current Time-off Programs (in days)

Plan	Tenure	Exempt	Non-Exempt		
Z	< 5 yrs	17	12		
	5-15 yrs	22	17		
CA	>15 yrs	22	22		
VA V	Max Accrual	2x annual rate			
X	All Employees	12			
SIG	Max Accrual	No Max	kimum		
PERSONAL		4]]	
WINTER BREAK		4]	Use or
HOLIDAYS		8]]	IOSE

University of Missouri System

Value of Leave Time

Leave Type	Exempt	Non-Exempt
Vacation	\$25.6M	\$21.4M
Sick	\$8.3M	\$11.9M
Demonal Dava	¢E ONA	ФЕ А МА
Personal Days	φο.υνι	φ 3.4 ΙVI
Holidays	\$11.9M	\$10.6M
Winter Break	\$5.0M	\$2.2M
Admin	\$1.9M	\$1.9M
Other	\$1.0M	\$2.3M

 Hours actually taken times rate of pay

 Overall leave value is approx. 14% of eligible salaries & wages
Sick & Vacation – Cost by Service Band

	Exempt		Non-Exempt		
Values	<5 Years	Over 5 Years	<5 Years	5-15 Years	Over 15 Years
# of Employees	2,660	3,168	6,495	2,360	1,625
Sick Accrued Days	12	12	12	12	12
Avg. Sick Used Days	4	6	6	9	9
Sick Usage Costs	\$2.8M	\$5.5M	\$5.6M	\$3.7M	\$2.6M
Vacation Accrued Days	17	22	12	17	22
Avg. Vacation Used Days	11	19	8	17	22
Vacation Usage Costs	\$7.6M	\$18.0M	\$8.2M	\$6.9M	\$6.3M

University of Missouri System

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University of Missouri System

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Collected Rules and Regulations 350.051 Layoff and Transition Assistance Pay

Executive Summary

Administration is proposing action to adopt the following changes to Section 350.051 of the Collected Rules and Regulations, Layoff and Transition Assistance Pay. Changes are proposed to be effective January 2, 2022.

- Change transition assistance payments from 4 20 weeks to 4 10 weeks.
- Change transition assistance payment maximum from \$50,000 to \$25,000.
- Change continuation of benefit coverage from 3-6 months to 4-10 weeks.

Note: No changes are proposed to the eligibility, minimum required notice period, unemployment, or COBRA insurance.

These changes are being recommended as a result of a review of key policies that drove increased costs during the pandemic. The Transition Assistance Pay policy was identified by all four universities as a practice needing a deeper review. The program as currently designed is costly to the university and provides more benefits than our competitors. Given the tough economic times, it is important for the university to be effective financial stewards of our limited resources.

Background

The purpose of the program is to allow for a smoother transition for employees and the university, when it is determined an employee's position will end through no fault of their own. The program also avoids claims or litigation against the university. The University of Missouri Layoff and Transition Assistance program applies to Regular Administrative, Service and Support employees who have satisfactorily completed their probationary period, and employees on full-time academic staff appointments other than tenured or tenure-track faculty.

Benchmarking

Part of the university's review included researching other AAU public institutions, four-year universities in Missouri, and other contiguous state universities policies and practices. Based on that review, administration found the following:

- Notice Period
 - Most common offering
 - Varies from 14 days up to one year's notice
 - o 30, 60, or 90-days' notice is the most common
 - Notice period varies between academic and staff, with academic generally receiving a better benefit
- Transition assistance or severance pay
 - Less than half offer post-separation payments
- Benefit continuation
 - Less than half offer post-separation extended benefit coverage

- Other
 - Length of notice period and/or post separation benefits typically varies based on the length of service to the institution

Cost

Between fiscal years 2016 and 2020, 774 laid off employees received benefits from the program. The transition assistance pay cost ranged from \$905K to \$3.1M per year and benefits paid ranged from \$430K to \$1M depending on the number of layoffs. Of these years, the total average cost was \$2.1M for an average of 155 employees laid off.

The changes proposed are estimated to reduce the cost of transition assistance pay and benefit related costs by \$500K to \$2M, based on the utilization of the program. This results in a reduction of roughly 44% of transition assistance pay and 75% of benefit related costs.

No. 1

Recommended Action -	Collected Rules and Regulations 350.051; Layoff and Transition
	Assistance Pay

It was recommended by Vice President of Human Resources, Marsha Fischer, endorsed by President Choi, and recommended by the Governance, Compensation and Human Resources Committee, moved by Curator ______ and seconded by Curator ______, that the following action be approved:

action be approved;

Section 350.051 of the University's Collected Rules and Regulations be amended as set forth in the attached document.

Roll call vote of the Committee:	YES	NO
Curator Brncic Curator Holloway Curator Wenneker Curator Williams		
The motion		
Roll call vote of Board of Curators:	YES	NO
Curator Brncic		
Curator Chatman		
Curator Graham		
Curator Graves		
Curator Hoberock		
Curator Holloway		
Curator Layman		
Curator Wenneker		
Curator Williams		
The motion		

350.051 Layoff and Transition Assistance <u>Pay</u>

Bd. Min. 6-21-18.

- A. **Summary**--Conditions may arise that result in the reduction of the university work force, including but not limited to lack of funds, lack of work, or reorganization. This rule addresses principles and benefits involved in layoffs, including eligibility for transition assistance pay, layoff leave of absence and associated benefits. All layoffs are subject to approval by the appropriate campus, hospital or system Office of Human Resources.
- B. **Definition**--Layoff is defined as the cessation of regular employment due to a reduction in force for a period of one year or more.
- C. Eligibility--To be eligible for layoff leave of absence and transition assistance pay, an employee must fall within the positions described below and must satisfactorily complete all other requirements as identified in this rule. <u>This</u> <u>includes the</u>, <u>including</u> completion of the required <u>Layoff and Transition</u> <u>Assistance Agreementagreement</u> by the established due date.
 - 1. **Positions Eligible**--The following types of employees may be eligible for layoff leave of absence with associated benefit coverage and transition assistance pay regardless of the funding source of their salaries, unless they are excluded as stated below.
 - a. Regular Administrative, Service and Support employees who have satisfactorily completed their probationary period; and
 - Employees on full-time academic staff appointments as defined in Section 310.020.A of these Collected Rules and Regulations (including Non-Tenure Track Faculty as defined in Section 310.035 of these Collected Rules and Regulations, full-time unranked non-regular faculty, and other full-time non-regular academic appointments).
 - 2. **Positions Not Eligible**--The following types of employees are not eligible for layoff leave of absence or transition assistance pay. In cases of doubt, the System Chief Human Resources Officer will determine whether an employee falls within categories listed below, after consultation with campus/hospital chief human resources officers and provosts as appropriate.
 - Regular academic staff appointments as defined in Section 310.020.A.1 of these Collected Rules and Regulations (i.e., tenured and tenure-track appointments);
 - b. Adjunct appointments;
 - c. Employees on full-time academic staff appointments who have been given one year or

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more notice of <u>the ending of their</u> <u>appointmentnon-renewal</u>;

- d. Benefit-eligible positions in which a principle purpose of the position is the education, training, or learning of the employee, such as fellows, interns, residents, and post-doctoral positions;
- e. Non-benefit-eligible positions; and
- f. Any other position determined by the System Chief Human Resources Officer not to be eligible because the nature of the appointment is not consistent with the expectation or purposes of layoff benefits.

3. Other Eligibility Requirements--

- a. To be eligible for a layoff leave of absence and transition assistance pay, eligible employees must submit a completed University of Missouri Layoff and Transition Assistance Agreement to the appropriate campus, hospital or system Office of Human Resources within thirty (30) calendar days after written notice of layoff. The content and form of the University of Missouri Layoff and Transition Assistance Agreement will be approved by the System Chief Human Resources Office and the Office of the General Counsel.
- b. If any of the following circumstances occur prior to or during the layoff leave of absence, the employee no longer will be eligible to receive transition assistance payments or layoff leave of absence and associated benefits coverage.

 (1) Failure to submit completed University of Missouri Layoff and Transition Assistance Agreement by the established deadline;
(2) Failure to perform duties in a satisfactory manner after layoff notification through the effective date of the layoff;

(3) Receipt of <u>Long TermLong-Term</u> Disability (LTD) benefits;

(4) Acceptance of a full-time benefit-eligible University of Missouri position;

- (5) Retirement; or
- (6) Death.

D. Layoff Leave of Absence, <u>Transition Assistance Pay</u>, and Benefits Coverage--

 Layoff Leave of Absence Duration - Upon layoff, an eligible employee will be placed on a layoff leave of absence and provided Transition Assistance for a minimum of four (4) weeks up to a maximum of ten (10) weeks as follows: - The length of layoff leave of absence is determined as follows:

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- a. Eligible employees with less than five (5)ten (10) years of continuous regular employment with the University immediately prior to layoff, will be placed on a layoff leave of absence for three (3) monthsfour (4) weeks from the effective date of layoff.
- b. Eligible employees with a minimum of five (5)ten (10) years of continuous regular employment with the University immediately prior to layoff will be placed on a layoff leave of absence for six (6) months from the effective date of layoffof one (1) week for every twenty-four (24) months of continuous benefit-eligible service up to a maximum of ten (10) weeks, or until the point at which the employees transition assistance payments have reach a total of \$25,000 under subsection D.2. below, whichever comes first.
- 2. Transition Assistance Pay An eligible employee will receive transition assistance payments in amounts equal to the employee's regular pay according to the employee's regular pay schedule. The payments will continue until the maximum number of weeks based on the employee's length of service is reached (as identified in subsection D.1.), or until the total amount of the payments reach a limit of \$25,000, whichever comes first.
- 1.2. Continuation of Benefits During the layoff leave of absence, the eligible employee will be eligible to participate in the University's benefit programs (e.g., medical, dental, vision, life, accidental death, and long-term disability) for the duration of the layoff leave of absence (D.1.). The University will continue to pay its portion of the benefit premiums during the layoff leave of absence.
- E. **Transition assistance payment--**Eligible employees who are laid off will receive transition assistance pay. Eligible employees with four years of continuous benefit-eligible employment or less immediately prior to layoff will receive four (4) weeks of pay. Eligible employees with five or more years of continuous benefit-eligible employment immediately prior to layoff will receive one (1) week of pay for each year of continuous benefit-eligible employment immediately prior to layoff will receive one (1) week of pay for each year of continuous benefit-eligible employment immediately prior to layoff up to a maximum of twenty (20) weeks of pay. In no case will the transition assistance pay exceed \$50,000. Transition payments may be paid in accordance with an employee's regular pay schedule or in a lump sum payment at the discretion of the University.
- **F.E. Continuous Employment**--For purposes of calculating continuous employment under this rule, an employee who completes a nine-month academic appointment will be considered to have accrued one year of employment. Consecutive nine-month academic appointments will be considered as continuous employment. Additional summer months of employment by an employee on a nine-month academic appointment will not affect calculation of continuous employment under this rule.

G.F. Seniority--

OPEN – GOVCHR – 1-6

- 1. For employees on full-time academic staff appointments and regular Administrative, Service and Support employees, other than Service and Maintenance personnel subject to a union agreement, seniority consists of continuous employment in the same department. If relative length of employment among employees is equal, the employee with the greatest length of UniversityUniversity employment is the most senior employee.
- For Service and Maintenance employees subject to a union agreement, see Understanding of Policies, Article VIII, and Seniority. The definition of seniority for service and maintenance employees as outlined in the Understanding of Policies is applicable only if the University has a signed agreement with the unions. If no agreement exists, the definition of seniority for regular Administrative, Service and Support employees will apply.
- 3. All things being equal, job security shall be commensurate with an employee's seniority. If the abilities, skills, training, and other relevant qualifications to fill existing positions are considered equivalent among affected employees, the employee with the longest seniority will be retained and the employee with the shortest seniority will be the first to be laid off. The University reserves the right in any given instance, to determine if an employee possesses the relevant qualifications such as ability, training, and skill to fill the position.
- 4. Seniority accrues from the first day of regular employment. Seniority should not impact employment decisions for regular employees until the completion of the probationary period. Employees laid off retain seniority accumulated to the date of layoff, for a period not to exceed six months. An employee who is laid off retains seniority for a period of six months from the effective date of the layoff but does not continue to accrue seniority during the layoff leave of absence. In the event an employee who is notified of a layoff or who has been laid off transfers to another department, the employee continues to maintain seniority in the department where the layoff occurred for a period of six months from the effective date of the layoff or the transfer, whichever occurs first. During a work-related injury or military leave of absence, an employee continues to accrue seniority.
- H.G. **Recall**--The University shall, in its sole discretion, after a reduction in force, determine the occasion and the advisability of recall of part or all of the laid off employees. The University shall consider seniority, ability, and qualifications, as well as the nature of the jobs for which the employees will be recalled.

<u>H.H.</u> Refilling Eliminated Position--

- 1. Positions which are eliminated due to layoff may not be filled for a minimum of one (1) year.
- 2. If special circumstances occur which create good cause for the position to be filled sooner, approval must be granted by contacting the appropriate campus, hospital or system Office of Human Resources.

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- J.I. Service creditCredit and Vesting--The period of leave of absence is excluded in computing length of service under the University of Missouri Retirement, Disability, and Death Benefit Plan; however, the leave of absence does not constitute an interruption of service. A layoff leave of absence does not count toward vesting in the University of Missouri Retirement, Disability and Death Benefit Plan. The period of leave of absence is included in computing service credit under the Employee Retirement Investment Plan, including for the purposes of vesting.
- K.J. Application in the Event of Discontinuance of Programs or Departments of Instruction--In the event that an employee is laid off in connection with the discontinuance of a program or a department under Section 320.150 of these Collected Rules and Regulations, the employee will:
 - 1. Be eligible to receive transition assistance pay if the employee meets all eligibility requirements stated in this rule; and
 - Receive the leave of absence and benefits stated in Section 320.150 and will not receive layoff leave of absence or associated benefit coverage under the terms of this rule, notwithstanding any provision to the contrary.

<u>L.K.</u>Effective date--

- 1. The provisions of this rule will apply with respect to layoffs of eligible employees on full-time academic staff appointments with an effective layoff date of August 30, 2018January 2, 2022 or later.
- 2. The provisions of this rule will apply with respect to layoffs of regular Administrative, Service and Support employees with an effective date of layoff of January 1, 2019 or later.

350.051 Layoff and Transition Assistance Pay

Bd. Min. MM-DD-YY with an effective date of MM-DD-YY.

- A. **Summary**--Conditions may arise that result in the reduction of the university work force, including but not limited to lack of funds, lack of work, or reorganization. This rule addresses principles and benefits involved in layoffs, including eligibility for transition assistance pay, layoff leave of absence and associated benefits. All layoffs are subject to approval by the appropriate campus, hospital or system Office of Human Resources.
- B. **Definition**--Layoff is defined as the cessation of regular employment due to a reduction in force for a period of one year or more.
- C. **Eligibility**--To be eligible for layoff leave of absence and transition assistance pay, an employee must fall within the positions described below and must satisfactorily complete all other requirements as identified in this rule. This includes the completion of the required Layoff and Transition Assistance Agreement by the established due date.
 - 1. **Positions Eligible**--The following types of employees may be eligible for layoff leave of absence with associated benefit coverage and transition assistance pay regardless of the funding source of their salaries, unless they are excluded as stated below.
 - a. Regular Administrative, Service and Support employees who have satisfactorily completed their probationary period; and
 - Employees on full-time academic staff appointments as defined in Section 310.020.A of these Collected Rules and Regulations (including Non-Tenure Track Faculty as defined in Section 310.035 of these Collected Rules and Regulations, full-time unranked non-regular faculty, and other full-time non-regular academic appointments).
 - 2. **Positions Not Eligible**--The following types of employees are not eligible for layoff leave of absence or transition assistance pay. In cases of doubt, the System Chief Human Resources Officer will determine whether an employee falls within categories listed below, after consultation with campus/hospital chief human resources officers and provosts as appropriate.
 - Regular academic staff appointments as defined in Section 310.020.A.1 of these Collected Rules and Regulations (i.e., tenured and tenure-track appointments);
 - b. Adjunct appointments;
 - c. Employees who have been given one year or more notice of the ending of their appointment;

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- d. Benefit-eligible positions in which a principle purpose of the position is the education, training, or learning of the employee, such as fellows, interns, residents, and post-doctoral positions;
- e. Non-benefit-eligible positions; and
- f. Any other position determined by the System Chief Human Resources Officer not to be eligible because the nature of the appointment is not consistent with the expectation or purposes of layoff benefits.

3. Other Eligibility Requirements--

- a. To be eligible for a layoff leave of absence and transition assistance pay, eligible employees must submit a completed University of Missouri Layoff and Transition Assistance Agreement to the appropriate campus, hospital or system Office of Human Resources within thirty (30) calendar days after written notice of layoff. The content and form of the University of Missouri Layoff and Transition Assistance Agreement will be approved by the System Chief Human Resources Office and the Office of the General Counsel.
- b. If any of the following circumstances occur prior to or during the layoff leave of absence, the employee no longer will be eligible to receive transition assistance payments or layoff leave of absence and associated benefits coverage.

 (1) Failure to submit completed University of Missouri Layoff and Transition Assistance Agreement by the established deadline;
(2) Failure to perform duties in a satisfactory manner after layoff notification through the effective date of the layoff;

- (3) Receipt of Long-Term Disability (LTD) benefits;
- (4) Acceptance of a full-time benefit-eligible
- University of Missouri position;
- (5) Retirement; or
- (6) Death.

D. Layoff Leave of Absence, Transition Assistance Pay, and Benefits --

- 1. Layoff Leave of Absence Duration Upon layoff, an eligible employee will be placed on a layoff leave of absence and provided Transition Assistance for a minimum of four (4) weeks up to a maximum of ten (10) weeks as follows:
 - a. Eligible employees with less than ten (10) years of continuous regular employment with the University immediately prior to layoff, will be placed on a layoff leave of absence for four (4) weeks from the effective date of layoff.

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- b. Eligible employees with a minimum of ten (10) years of continuous regular employment with the University immediately prior to layoff will be placed on a layoff leave of absence of one (1) week for every twenty-four (24) months of continuous benefit-eligible service up to a maximum of ten (10) weeks, or until the point at which the employees transition assistance payments have reach a total of \$25,000 under subsection D.2. below, whichever comes first.
- Transition Assistance Pay An eligible employee will receive transition assistance payments in amounts equal to the employee's regular pay according to the employee's regular pay schedule. The payments will continue until the maximum number of weeks based on the employee's length of service is reached (as identified in subsection D.1.), or until the total amount of the payments reach a limit of \$25,000, whichever comes first.
- 2. Continuation of Benefits During the layoff leave of absence, the eligible employee will be eligible to participate in the University's benefit programs (e.g., medical, dental, vision, life, accidental death, and long-term disability) for the duration of the layoff leave of absence (D.1.). The University will continue to pay its portion of the benefit premiums during the layoff leave of absence.
- E. **Continuous Employment**--For purposes of calculating continuous employment under this rule, an employee who completes a nine-month academic appointment will be considered to have accrued one year of employment. Consecutive nine-month academic appointments will be considered as continuous employment. Additional summer months of employment by an employee on a nine-month academic appointment will not affect calculation of continuous employment under this rule.
- F. Seniority--
 - 1. For employees on full-time academic staff appointments and regular Administrative, Service and Support employees, other than Service and Maintenance personnel subject to a union agreement, seniority consists of continuous employment in the same department. If relative length of employment among employees is equal, the employee with the greatest length of university employment is the most senior employee.
 - 2. For Service and Maintenance employees subject to a union agreement, see Understanding of Policies, and Seniority. The definition of seniority for service and maintenance employees as outlined in the Understanding of Policies is applicable only if the University has a signed agreement with the unions. If no agreement exists, the definition of seniority for regular Administrative, Service and Support employees will apply.
 - 3. All things being equal, job security shall be commensurate with an employee's seniority. If the abilities, skills, training, and other relevant qualifications to fill existing positions are considered equivalent among affected employees, the employee

OPEN – GOVCHR – 1-11

with the longest seniority will be retained and the employee with the shortest seniority will be the first to be laid off. The University reserves the right in any given instance, to determine if an employee possesses the relevant qualifications such as ability, training, and skill to fill the position.

- 4. Seniority accrues from the first day of regular employment. Seniority should not impact employment decisions for regular employees until the completion of the probationary period. Employees laid off retain seniority accumulated to the date of layoff, for a period not to exceed six months. An employee who is laid off retains seniority for a period of six months from the effective date of the layoff but does not continue to accrue seniority during the layoff leave of absence. In the event an employee who is notified of a layoff or who has been laid off transfers to another department, the employee continues to maintain seniority in the department where the layoff occurred for a period of six months from the effective date of the layoff or the transfer, whichever occurs first. During a work-related injury or military leave of absence, an employee continues to accrue seniority.
- G. **Recall**--The University shall, in its sole discretion, after a reduction in force, determine the occasion and the advisability of recall of part or all of the laid off employees. The University shall consider seniority, ability, and qualifications, as well as the nature of the jobs for which the employees will be recalled.

H. Refilling Eliminated Position--

- 1. Positions which are eliminated due to layoff may not be filled for a minimum of one (1) year.
- 2. If special circumstances occur which create good cause for the position to be filled sooner, approval must be granted by contacting the appropriate campus, hospital or system Office of Human Resources.
- I. **Service Credit and Vesting**--The period of leave of absence is excluded in computing length of service under the University of Missouri Retirement, Disability, and Death Benefit Plan; however, the leave of absence does not constitute an interruption of service. A layoff leave of absence does not count toward vesting in the University of Missouri Retirement, Disability and Death Benefit Plan. The period of leave of absence is included in computing service credit under the Employee Retirement Investment Plan, including for the purposes of vesting.
- J. Application in the Event of Discontinuance of Programs or Departments of Instruction--In the event that an employee is laid off in connection with the discontinuance of a program or a department under Section 320.150 of these Collected Rules and Regulations, the employee will:
 - 1. Be eligible to receive transition assistance pay if the employee meets all eligibility requirements stated in this rule; and
 - Receive the leave of absence and benefits stated in Section 320.150 and will not receive layoff leave of absence or associated benefit coverage under the terms of this rule, notwithstanding any provision to the contrary.

OPEN – GOVCHR – 1-12

K. Effective date--

1. The provisions of this rule will apply with respect to layoffs of eligible employees with an effective layoff date of January 2, 2022 or later.

Recommended Action – Resolution for Executive Session of the Board of Curators Governance, Compensation and Human Resources Committee Meeting, November 18, 2021

It was moved by ______ and seconded by _____, that there shall be an executive session with a closed record and closed vote of the Board of Curators Governance, Compensation and Human Resources Committee meeting November 18, 2021 for consideration of:

- Section 610.021(1), RSMo, relating to matters identified in that provision, which include legal actions, causes of action or litigation, and confidential or privileged communications with counsel; and
- Section 610.021(2), RSMo, relating to matters identified in that provision, which include leasing, purchase, or sale of real estate; and
- Section 610.021(3), RSMo, relating to matters identified in that provision, which include hiring, firing, disciplining, or promoting of particular employees; and
- Section 610.021(12), RSMo, relating to matters identified in that provision, which include sealed bids and related documents and sealed proposals and related documents or documents related to a negotiated contract; and
- Section 610.021 (13), RSMo, relating to matters identified in that provision, which include individually identifiable personnel records, performance ratings, or records pertaining to employees or applicants for employment.

Roll call vote of the Committee:

YES NO

Curator Brncic Curator Holloway Curator Wenneker Curator Williams

No. 2

The motion ______.

November 18, 2021

OPEN – GOV CHR – 2-1

HEALTH AFFAIRS COMMITTEE

Robin R. Wenneker (Chair) Maurice B. Graham Keith A. Holloway Michael A. Williams Ronald G. Ashworth (non-curator) John R. Phillips (non-curator)

The Health Affairs Committee ("Committee") assists the Board of Curators in overseeing the clinical health care operations of the University and in coordinating those operations in furtherance of the University's teaching, research, and clinical missions.

I. Scope

The Committee provides oversight for the University's clinical health care operations in the areas of:

- Mission, vision, and strategy;
- Governance and operational oversight;
- Quality of care and patient safety;
- Regulatory compliance;
- Financial planning and performance; and
- Coordination of the clinical, teaching, and research missions.
- Specific projects that enable meaningful collaboration among UM universities.

II. Executive Liaison

The Executive Vice Chancellor for Health Affairs of the University of Missouri-Columbia or some other person(s) designated by the President of the University, with the concurrence of the Board Chair and the Committee Chair, shall be the executive liaison to the Committee and responsible for transmitting Committee recommendations.

III. Responsibilities

In addition to the overall responsibilities of the Committee described above and in carrying out its responsibilities regarding clinical health care operations, the charge of the Committee shall include:

- A. Reviewing and making recommendations to the Board regarding:
 - 1. actions that are appropriate or necessary to assist the Board in overseeing clinical health care operations or coordinating the teaching, research, and clinical missions;
 - 2. significant actions related to health care which should require advance notice or approval by the Committee or Board; and
 - 3. other matters referred to it by the Board and University officers.
- B. Requesting, receiving, and reviewing reports and other information from University officers and advisors regarding health care operations, coordination of the teaching, research, and clinical missions, and related matters, including meeting at least quarterly and receiving regular reports from appropriate officers of University of Missouri Health Care, the MU School of Medicine, and the MU Health Chief Compliance Officer.
- C. Additional matters customarily addressed by the health affairs committee of a governing board for an institution of higher education.

IV. Committee Membership and Quorum Requirements

The Committee's membership may include non-Curator members in addition to Curator members. Subject to approval of the Board, the Board Chair shall determine the number of Curator and non-Curator members to appoint to the Committee and shall select individuals to serve as members of the Committee; provided that, the number of non-Curator members on the Committee shall not exceed the number of Curator members on the Committee, unless the Committee temporarily has more non-Curator members than Curator members because a Curator member of the Committee has resigned from the Board or the Committee. Non-Curator members may resign their Committee membership by providing written notice to the Board Chair. Non-Curator members of the Committee serve at the pleasure of the Board and may be removed by the Board Chair at any time, subject to approval of the Board.

A quorum for the transaction of any and all business of the Committee shall exist when:

- 1. Both a majority of all Curator members of the Committee and a majority of all members of the Committee are participating for Committee meetings which are held in conjunction with meetings of the Board; or
- 2. Both all Curator members of the Committee and a majority of all members of the Committee are participating for Committee meetings which are not held in conjunction with meetings of the Board; or
- 3. Both a majority of all Curator members of the Committee and a majority of all members of the Committee are participating for Committee meetings which are held solely for the purpose of reviewing and overseeing compliance matters.

Approved by the Board of Curators: Feb 4, 2021

EXECUTIVE VICE CHANCELLOR REPORT

There are no materials for this information item.

OPEN – HEALTH AFF – INFO 1-1

UNIVERSITY OF MISSOURI – ST. LOUIS CAMPUS HIGHLIGHTS

There are no materials for this information item.

OPEN – GB VIII A – INFO 1-1

STRATEGIC THEME DISCUSSION – ACHIEVING RESEARCH EXCELLENCE

There are no materials for this information item.

OPEN – GB IX A – INFO 1-1

Recommended Action - COVID-19 Government Contractor Protocols for University Employees

It was recommended and endorsed by President Choi, moved by Curator _______, that:

the Resolution regarding COVID-19 Government Contractor Protocols for University Employees be approved as attached.

Roll call vote:

YES NO

Curator Brncic Curator Chatman Curator Graham Curator Graves Curator Hoberock Curator Holloway Curator Layman Curator Wenneker Curator Williams

The motion ______.

RESOLUTION: COVID-19 GOVERNMENT CONTRACTOR PROTOCOLS FOR UNIVERSITY EMPLOYEES

WHEREAS, the University of Missouri System universities hold many federal contracts that fund hundreds of millions of dollars of research and other activities that are critical to our academic mission and service to Missourians. These contracts also support jobs and programs that contribute substantially to our state's economy. They include:

- Providing medical care to veterans;
- Developing radioisotopes for cancer drugs;
- Research projects that support national defense for the Army, Navy, and the National Geospatial-Intelligence Agency;
- Extensive research that brings agricultural advances in support of one of Missouri's primary industries; and

WHEREAS, in recent weeks, the federal government has issued <u>Executive Order 14042</u> and other <u>Federal guidance</u> which direct federal contractors, such as the University, to follow vaccination and mask protocols for University faculty, staff, and student employees, with some exemptions (the "Federal Mandate"). Under the Federal Mandate, the following individuals are "Covered Employees" subject to the mandate:

- Individuals who work directly on government contracts (even if they work remotely);
- Individuals who work "in connection" with a government contract, such as individuals working in supporting departments;
- Individuals who work at the same location or who may come in contact with individuals in the two categories above unless the University can "affirmatively determine" that the "covered employee" will have no interaction with a non-covered employee, including in common areas such as lobbies, stairwells, parking garages, etc.; and

WHEREAS, the Federal Mandate includes important exceptions for medical or religious reasons; and

WHEREAS, on October 28, 2021, Missouri Governor Mike Parson issued <u>Executive Order 21-10</u> regarding the federal vaccine mandates. Among other things, it requires cooperation with the Attorney General of the State of Missouri in his litigation regarding the federal vaccine mandate; prohibits compelling any individual to receive a COVID-19 vaccine pursuant to the federal vaccine mandate where such individual objects by reason of sincerely held religious belief or medical reasons; and prohibits penalizing an individual or business for non-compliance with any federally imposed vaccine mandate or requirements where non-compliance is the result of an individual's sincerely held religious belief or for medical reasons ("Governor's Executive Order"); and

WHEREAS, attorneys general from 21 states, including Missouri Attorney General Eric Schmitt, submitted a <u>letter</u> to President Biden objecting to the Federal Mandate's broad provisions that leave government contractors "little choice but to require their entire workforce be vaccinated." Attorney General Schmitt co-leads a 10-state coalition that filed a lawsuit over the issue on October 29 alleging, among other things, that the Federal Mandate "ensures that almost any

employee of an organization with a federal contract is a 'covered contractor employee' subject to the contractor vaccine mandate"; and

WHEREAS, it is in the best interest of the University, its students, faculty and staff, and the citizens of the State of Missouri for the University's federal contracts to remain in place while complying with the Federal Mandate and the Governor's Executive Order.

NOW, THEREFORE, BE IT RESOLVED that,

The University will comply with the Federal Mandate and the Governor's Executive Order as follows:

All University employees will comply with vaccine and masking requirements of the Federal Mandate, but they will not be compelled to comply, or penalized for not complying, with the Federal Mandate if they demonstrate:

- A. A sincerely held religious belief;
- B. Medical reasons; or
- C. Based on the nature of their work, work location and lack of interactions with Covered Employees, the University determines that the Federal Mandate does not apply to them.

The University will not require employees to comply with the Federal Mandate in the event that withdrawal, modification, injunction, or invalidation of the Federal Mandate makes it inapplicable to them in whole or in part.

The President of the University may issue appropriate policies to carry out the terms and intent of this Resolution after giving adequate notice to the Board for review and comment.

Recommended Action - Election of Board of Curators Chair, 2022

Upon the motion of Curator ______, Curator ______ was nominated to serve as Chair of the Board of Curators for the term January 1, 2022 through December 31, 2022. The nomination was seconded by Curator _____.

The motion ______.

November 18, 2021

OPEN – GB IX B –2-1

No. 3

Recommended Action - Election of Board of Curators Vice Chair, 2022

Upon the motion of Curator ______, Curator ______ was nominated to serve as Vice Chair of the Board of Curators for the term January 1, 2022 through December 31, 2022. The nomination was seconded by Curator _____.

The motion ______.

November 18, 2021

OPEN – GB IX B – 3-1

GOOD AND WELFARE OF THE BOARD

There are no materials for this information item.

OPEN – GB IX C – INFO 1-1

No. 1

Recommended Action – Resolution for Executive Session of the Board of Curators Meeting November 18, 2021

It was moved by Curator ______ and seconded by Curator ______, that there shall be an executive session with a closed record and closed vote of the Board of Curators meeting November 18, 2021 for consideration of:

- Section 610.021(1), RSMo, relating to matters identified in that provision, which include legal actions, causes of action or litigation, and confidential or privileged communications with counsel; and
- Section 610.021(2), RSMo, relating to matters identified in that provision, which include leasing, purchase, or sale of real estate; and
- Section 610.021(3), RSMo, relating to matters identified in that provision, which include hiring, firing, disciplining, or promoting of particular employees; and
- Section 610.021(12), RSMo, relating to matters identified in that provision, which include sealed bids and related documents and sealed proposals and related documents or documents related to a negotiated contract; and
- Section 610.021 (13), RSMo, relating to matters identified in that provision, which include individually identifiable personnel records, performance ratings, or records pertaining to employees or applicants for employment.

Roll call vote of the Board:	YES	NO
Curator Brncic		
Curator Chatman		
Curator Graham		
Curator Graves		
Curator Hoberock		
Curator Holloway		
Curator Layman		
Curator Wenneker		
Curator Williams		
The motion		