

BIOLOGICAL SCIENCES

Division of Biological Sciences

Biological Sciences Building

5007 Rockhill Road

<http://sbc.umkc.edu/>

Research facilities and laboratories

Equipment and Core Facilities

Microscope core facility on the ground floor in our building and overseen by the PI houses:

1. Olympus Fluoview 300 confocal laser scanning microscope (CLSM) with DIC optics and four PMT detectors, three for epi-confocal imaging, and one for transmitted-light imaging. Argon 488 nm and He/Ne lasers are installed on the microscope.
2. Nikon upright fluorescence microscope with a GRID confocal imaging device and Metamorph Image acquisition software for real time fluorescence imaging.
3. Nikon inverted fluorescent DIC microscope with APO quality optics, four filter sets, and attached ColorView CCD camera with computer and Analysis software to analyze images.
4. Olympus microscope with a range of objectives and filters attached to a CCD camera linked to a Silicon Graphics O2 loaded with Deltavision software for image acquisition and analysis (deconvolution).

Genomics core facility located on the second floor of the building overseen by a dedicated technician and directed by the PI includes:

- (1) Allegra 25 centrifuge and two tetrad PCR machines for 96-well based applications
- (3) Amersham Storm 860 Imaging System
- (4) Amersham Typhoon 9400 phosphoimager with ImageQuant software

Protein core facility capable of mass spectrometry sample preparation and analysis is directed by Dr. Andrew Keightly and is located on the 4th floor of our building includes:

1. Thermo Finnigan LTQ linear ion trap, equipped with Proxeon nanospray source
2. Voyager DE Pro MALDI MS
3. Eksigent binary nano-LC pump system (1D nanoLC)
4. Eksigent quaternary nano-LC pump system (2D nanoLC)

X-ray crystallographic data are collected at beamlines 22ID and 22BM at the Advanced Photon Source of Argonne National Laboratory. Access to these beamlines is guaranteed for 24 hours on each beamline (three times a year) through our membership to the Southeast Regional Collaborative Access Team (SER-CAT).

Faculty

Rachael Allen; teaching assistant professor of biological sciences; B.S. University of Bristol, M.Sc. University of Bristol, Ph.D. Northern Illinois University.

Tara Allen; teaching professor of biological sciences; B.S. (University of Evansville); Ph.D. (University of Missouri-Columbia).

Marshall Anderson, adjunct professor of biological sciences.

Karen J. Bame^{2,3} graduate programs officer and associate professor of biological sciences; B.A. (University of California-Santa Barbara); Ph.D. (University of California-Los Angeles).

James M. Benevides; teaching professor of biological sciences; B.S. (University of Massachusetts); M.S., Ph.D. (University of Rhode Island).

Grant Bledsoe; teaching assistant professor of biological sciences; B.S. (University of South Carolina-Aiken); Ph.D. (Medical University of South Carolina).

Samuel Bouyain^{2,3}; chair, cell biology and biophysics; associate professor of biological sciences; Diploma of Engineer (École Nationale Supérieure de Chimie de Paris); D.Phil. (University of Oxford).

Stephane Dissel^{2,3}; assistant professor of biological sciences; B.S., M.S. (Universite Louis Pasteur); Ph.D. (University of Leicester).

Leonard L. Dobens, Jr.^{2,3}; director of research and professor of biological sciences; B.S. (Boston College), Ph.D. (Dartmouth College).

Lawrence A. Dreyfus² adjunct professor of biological sciences; B.A. (University of Kansas); M.S. (Michigan State University); Ph.D. (University of Kansas).

Brooke Esquivel, instructor of biological sciences.

Brian Geisbrecht; adjunct professor of biological sciences

Erica Geisbrecht; adjunct professor of biological sciences

Carl Gelhaus; adjunct professor of biological sciences

R. Scott Hawley; adjunct professor of biological sciences; Ph.D. (University of Washington).

Robert Holmes; adjunct professor of biological sciences

Saul M. Honigberg^{2,3}; professor of biological sciences; B.S. (University of Georgia), Ph.D. (Yale University).

Chi-Ming Huang^{2,3}; associate professor of biological sciences; B.S. (National Taiwan University, Taiwan); M.S., Ph.D. (University of California-Los Angeles).

Marisa James; adjunct professor of biological sciences

Tamas Kapros; teaching professor of biological sciences; B.S., Doctor Universitatis in Genetics, Ph.D. (Jozsef Attila University of Sciences, Szeged, Hungary).

J. Andrew Keightley; research associate professor of biological sciences; B.S., Ph.D. (University of New Mexico-Albuquerque).

Margaret Kincaid; teaching associate professor of biological sciences; B.A. (University of Missouri – Columbia); M.S., Ph.D. (University of Missouri – Kansas City).

Loretta Klamm; instructor of biological sciences; B.S. Creighton University, M.S. Creighton University.

Peter Koulen; professor of biological sciences; M.S., Ph.D. (Johnnes Gutenberg University, Germany).

Lee Likins; assistant teaching professor in biological sciences; B.S. (University of West Florida-Pensacola); M.A. (University of Kansas); Ph.D. (University of Missouri – Kansas City).

Lara Mabry; adjunct professor of biological sciences

Jessica Magana, assistant teaching professor of biological sciences.

Hillary McGraw^{2,3}; assistant professor of biological sciences; B.A. (University of Oregon); Ph.D. (University of Washington).

Thomas M. Menees² associate professor of biological sciences; B.S., M.S. (University of California Irvine); Ph.D. (Yale University).

Ryan Mohan^{2,3}; assistant professor of biological sciences; Ph.D. University of Western Ontario.

Michael O'Connor^{2,3}; professor of biological sciences; B.A. (Trinity College Dublin); Ph.D. (National University of Ireland).

Anthony Persechini^{2,3}; chair, molecular biology and biophysics; professor of biological sciences; B.A. (University of New Hampshire), Ph.D. (Carnegie-Mellon University).

Jeffrey L. Price^{2,3}; professor of biological sciences; B.S. (College of William and Mary), Ph.D. (Johns Hopkins University).

Jane Rachel; adjunct professor of biological sciences

Aaron Reed; director of course development and assessment and associate teaching professor of biological sciences; B.S. (Kansas State University); M.S. (University of Memphis); Ph.D. (Kansas State University).

Jon Robertus; adjunct instructor of biological sciences.

Julia Snyder, adjunct professor of biological sciences.

Nicole Stanton-Wilson; Instructor of biological sciences

Karyn Turla; teaching professor of biological sciences; B.S. (Pennsylvania State University); Ph.D. (University of Michigan).

Shizhen Wang^{2,3}; assistant professor of biological sciences; B.S. (InnerMongolia University for Nationalities); M.S. (Nanjing Agricultural University); Ph.D. (Tsinghua University).

Tammy S. Welchert²; director of student affairs and academic advising and associate teaching professor of biological sciences; B.S., M.S. (Southwest Missouri State University); IPh.D. (University of Missouri-Kansas City).

Theodore C. White^{2,3}; dean, Marion Merrell Dow professor in biological sciences; B.S. (Cornell University); Ph.D. (University of Michigan).

Gerald J. Wyckoff^{2,3}; professor of biological sciences; B.S. (Cornell University); Ph.D. (University of Chicago).

Xiaolan Yao^{2,3}; associate professor of biological sciences; B.S., M.S. (Zhengzhou University, China); Ph.D. (Iowa State University).

Yu, Xiao-Qiang(Sean)^{2,3}; professor of biological sciences; Ph.D. (Kansas State University).

¹ Associate or Adjunct Graduate Faculty

² Members of UMKC Graduate Faculty

³ Members of UMKC Doctoral Faculty

EMERITUS

Raymond L. Burich, Gerald M. Carlson, Bibie Chronwall, Alfred F. Esser, Edward P. Gogol, Ana J. Iriarte, Ronald A. MacQuarrie, Marino Martinez-Carrion, Denis Medeiros, Henry M. Miziorko, William T. Morgan, Lynda Plamann, Michael Plamann, G. Sullivan Reed, Garth E. Resch, Ann Smith, George J. Thomas, Jr., Jakob H. Waterborg, Marilyn D. Yoder

Undergraduate Undergraduate Programs

- Minor in Biology (<http://catalog.umkc.edu/colleges-schools/sbc/biology/minor-biology/>)
- Bachelor of Arts in Biology (<http://catalog.umkc.edu/colleges-schools/sbc/biology/bachelor-of-arts-biology/>)
- Bachelor of Science in Biology (<http://catalog.umkc.edu/colleges-schools/sbc/biology/bachelor-of-science-biology/>)
- Bachelor of Science in Biology, Biomedical Sciences Emphasis (<http://catalog.umkc.edu/colleges-schools/sbc/biology/bachelor-of-science-biomedical-sciences/>)
- Bachelor of Science in Biology, Bioinformatics Emphasis (<http://catalog.umkc.edu/colleges-schools/sbc/biology/bachelor-of-science-bioinformatics/>)
- Bachelor of Science in Biology, Biotechnology Emphasis (<http://catalog.umkc.edu/colleges-schools/sbc/biology/bachelor-of-science-biotechnology/>)
- Bachelor of Science in Biology, Cellular and Molecular Basis of Health and Disease Emphasis (<http://catalog.umkc.edu/colleges-schools/sbc/biology/bachelor-of-science-cellular-molecular-basis-of-health-and-disease/>)
- Bachelor of Science in Biology, Clinical Laboratory Science Emphasis (<http://catalog.umkc.edu/colleges-schools/sbc/biology/bachelor-of-science-clinical-laboratory-science/>)
- Bachelor of Science in Biology, Pre-Dentistry Concentration (<http://catalog.umkc.edu/colleges-schools/sbc/biology/bachelor-of-science-biology-pre-dentistry/>)
- Dual Degree: Bachelor of Arts in Biology, combined BA/MD

Courses taught by the School of Biological and Chemical Sciences support academic programs within the schools of Nursing, Dentistry, Medicine, Pharmacy and Education, and departments within the College of Arts and Sciences. An undergraduate minor in biology and a variety of courses that may interest non-biology majors are available to complement other fields of study, or to satisfy general education requirements of other academic units. A background in biology combined with non-science skills creates many career possibilities.

General Information About Undergraduate Programs

Admission Requirements

Other than University of Missouri admission requirements, there are no special prerequisites for beginning either the bachelor of arts or the bachelor of science program. High school biology and a good working knowledge of algebra and arithmetic are desirable for entering the bachelor of science program. It should be noted that much of the bachelor of science program, and the bachelor of arts program, are highly structured in the order which biology and chemistry courses must be taken. It is assumed that transfer students, Associates degree students, and junior college students should have begun the appropriate course sequence in their previous schools. All students are required to consult with a Biological Sciences Undergraduate Advisor before their registration at UMKC.

Career Implications of a Bachelor's Degree in Biology

Our programs prepare students for a variety of career opportunities. Some students choose careers in the pharmaceutical or biotech industries, while others opt for graduate study in areas such as bioinformatics, forensics, or cell biology. In addition, a biology major is an excellent choice for students planning careers in medicine, veterinary medicine, dentistry, optometry, physical therapy, and other health professions. The bachelor of science in biology curriculum fulfills the admissions requirements for most medical and dental schools and incorporates intermediate and upper-level biology courses specifically recommended by medical/dental school admissions officers.

Pre-Medicine, Pre-Dentistry and Pre-Health Professions Academic Advising

The School of Biological and Chemical Sciences' experienced team of advisors is knowledgeable about admission requirements and application processes for health profession programs. It is important for students considering eventual application to medical, dental, or veterinary school or other professional programs to consult early and often with a School of Biological and Chemical Sciences advisor about appropriate course selection and additional preparation.

Advisors assist the student in investigating programs throughout the country and in planning an individualized undergraduate course of study.

In addition the School offers Careers in Healthcare I and II to assist student preparation through the exploration of healthcare options and the professional school application including decisions on where to apply, developing a personal statement, interview skills and letters of recommendation. Each student receives support and encouragement during all phases of the application process. Students are strongly encouraged to take advantage of advisor expertise by discussing their career plans beginning with their first semester at UMKC. Please see the additional catalog section on Pre-Medicine/Pre-Health (<https://catalog.umkc.edu/pre-medicine-pre-health-home-page/>) for other information.

Teacher Certification in Biology

Certification as a middle school (grades 5-9) science or secondary (grades 9-12) biology teacher in Missouri requires that a student complete a teacher preparation program. Once you complete a bachelor's degree in biology, you can apply to the School of Education for the Master of Arts in Teaching program, which prepares you for the teaching profession and teacher certification. A separate application for the Master of Arts in Teaching program is required. For further information about the program, consult the School of Education section of this catalog or contact the Division of Teacher Education and Curriculum Studies at (816) 235-2245.

Honors Program

The School of Biological and Chemical Sciences offers an Honors Program for qualified undergraduate students seeking either the bachelor of arts or the bachelor of science in biology interested in pursuing rigorous preparation for advanced professional training and careers. The program requires high levels of academic achievement as well as an undergraduate research experience and other enrichment activities. The SBC Honors Program is separate and distinct from the UMKC Honors College (<http://honors.umkc.edu/>). For further information about this program, consult the School website or Dr. Aaron Reed, Director for Undergraduate Curriculum at (816) 235-2329.

Prerequisites and Co-requisites

A minimum grade of C- or higher is expected for all prerequisite and co-requisite courses for all students taking courses within the Division of Biology. Additionally, students must be concurrently enrolled in or have previously completed all co-requisite courses. Course prerequisites are set by the Curriculum Committee of the School based on the level at which a course is taught and the assumed background knowledge necessary for successful completion of the course. Lack of prerequisites, therefore, indicates lack of background knowledge necessary for success in the course. Prerequisites for SBC courses are strictly enforced. In exceptional cases, students may receive written consent to waive one or both of these requirements from the Undergraduate Academic Standards Committee by completing and submitting a detailed petition form to the Undergraduate Programs Office and only if approval of the petition is granted.

Elective Courses for the Non-Biology Major

Students in other academic units are encouraged to select courses in the School of Biological and Chemical Sciences to meet their general education requirements and to complement their major area of study. Suggested courses include:

| Code | Title | Credits |
|----------------------------------|-------------------------------|---------|
| BIOLOGY 102 | Biology and Living | 3 |
| BIOLOGY 102L | Biology and Living Laboratory | 1 |
| BIOLOGY 108 | General Biology I | 3 |
| BIOLOGY 109 | General Biology II | 3 |
| BIOLOGY 202 | Cell Biology | 3 |
| BIOLOGY 206 | Genetics | 3 |
| LS-PHYS 217 | Human Physiology | 3 |
| Upper-level Courses ¹ | | |

¹ Upper-level courses for which prerequisites have been satisfied are recommended for those students who wish to gain a strong foundation in biological sciences.

Students enrolling in these biology majors' courses should have a solid background in high school biology and chemistry.

Academic Standing

Academic standing is determined at the end of each semester, fall, spring and summer for each student. Good standing at the university is attained with a University of Missouri (UM) cumulative GPA of 2.0 or higher and with the School of Biological and Chemical Sciences with a UM biology GPA (major's applicable courses) of 2.0 or higher.

Grade Point Average

In general, the UM GPA is calculated by dividing the total grade points earned in courses on any UM campus by the total number of graded semester hours attempted. If a course attempted within UM is repeated, the previous hours and grade point remain in the student's GPA. Courses taken credit/no credit, courses earning grades of S, P, I or AT, and courses transferred from non-University of Missouri institutions are not included in the UM GPA calculations. See appropriate sections below.

In general, the UM biology GPA is calculated by dividing the total grade points earned in majors courses on any UM campus by the total number of graded semester hours attempted. If a course attempted within UM is repeated, the previous hours and grade point remain in the student's GPA. Courses taken credit/no credit, courses earning grades of S, P, I or AT, and courses transferred from non-University of Missouri institutions are not included in the UM GPA calculations. See appropriate sections below.

Request for GPA Adjustments for repeated courses may be initiated by students and submitted by an SBC Academic Adviser after completion of the repeating attempt. A student's academic standing may be revised after the GPA adjustment is made in Pathway. GPA adjustments may be used for a maximum of 15 semester hours. See the UMKC Repeated Courses policy and GPA Readjustment form for more information.

If a student's UM cumulative GPA and/or UM biology GPA falls below the 2.0 minimum the student will no longer be in good standing. Students who fail to maintain good standing will be placed on Academic Warning, Probation, or will be declared Academically Ineligible to continue.

ACADEMIC WARNING

First Time College (FTC) students with a declared major in the SBC will be placed on Academic Warning when their UM cumulative GPA and/or UM biology GPA is between 1.5 and 2.0 at the end of their first semester at UMKC.

A student on Academic Warning will have the same requirements as students on Academic Probation as described below. Students may return to good academic standing by raising their UM cumulative GPA and/or UM biology GPA to the minimum 2.0 required. If the student cannot raise their UM cumulative GPA and/or UM biology GPA to 2.0 or higher after the warning semester, they may be placed on Academic Probation for a maximum of 2 (two) additional semesters. After 1 (one) warning semester and 2 (two) probation semesters, the student must return to good standing or be declared academically ineligible to continue as a student in SBC and/or UMKC.

First Time College (FTC) students with a declared major in the SBC will be placed on Academic Probation when their UM cumulative GPA and/or UM biology GPA is below 1.5 at the end of their first semester at UMKC. See Academic Probation below.

Transfer students and continuing students are not eligible to be placed on Academic Warning.

ACADEMIC PROBATION

Students with a declared major in the SBC will be placed on Academic Probation if their UM cumulative GPA and/or UM biology GPA falls below 2.0. When an SBC student is placed on academic probation as a result of the previous semester grades, the students will be notified prior to the beginning of the next semester through their UMKC email. The student will be required to enter into an Academic Success Contract designed to provide the student with assistance to support a return to good standing. The contract will specify enrollment requirements and keep the advisor and student in close contact throughout the semester to provide additional support. The contract will outline the student's responsibilities while on probation including, but not limited to the following:

1. Return to good standing by raising UM CUM and/or UM BIO GPA above the minimum 2.0. **OR**
2. If the student cannot return to good standing after the contract semester, they may be continued on probation for one additional semester if they earn a grade of **C- or higher in all contracted courses AND** earn a 2.5 (**B- average**) or higher semester/biology GPA during the contracted semester.
3. Participate in additional activities as listed in the contract.

The contract's requirements may be altered **ONLY** in consultation with the student's assigned academic advisor. The requirements of the contract are binding with or without the student signature.

If a student fails to meet the terms of the contract, they may be declared academically ineligible to enroll in future semesters as a student with a declared major in the SBC.

If a student cannot raise their UM cumulative GPA and/or UM biology GPA above 2.0, they may remain on probation one additional semester provided they meet the requirements in #2 above. If a student's UM cumulative and/or UM biology GPA is still below 2.0 after a second semester on probation, they will be declared academically ineligible to continue as a student in SBC. A student may, if eligible (UM cumulative GPA above 2.0), transfer to another academic unit at UMKC.

Students who have been placed on academic probation and have returned to good standing may be placed on academic probation again if their UM cumulative and/or UM biology GPA fall below the minimum 2.0 required.

ACADEMIC INELIGIBILITY

Students on academic probation or warning that do not meet the terms of their Academic Success contract with SBC become academically ineligible to enroll for future semesters as a student with a declared major in the SBC. Students declared academically ineligible will be notified through their UMKC email prior to the start of the next semester. If the student's UM cumulative GPA is above 2.0 the student may continue at UMKC, but will need to meet with an advisor in a different academic unit to discuss options and declare a major other than biology to do so. Students will have until the date given in the email notification to change their major; failure to make these changes by the date indicated will result in cancellation of their registration with any fees paid refunded. Students who have become academically ineligible may re-declare biology as their major after raising their UM cumulative GPA and UM biology GPA above the minimum 2.0 required.

Undergraduate Advising

Roo Advising (<http://catalog.umkc.edu/roo-advising/>)

Roadvising@umkc.edu

816-235-1148

Academic advising for undergraduate students is delivered through Roo Advising. Academic Advising is an integral part of student's university experience and has a significant impact on student success. The goals of Roo Advising are to provide students an exceptional advising experience that is equitable, holistic, personal, and timely. Advisors will assist students with the following:

- Understand degree requirements and have a early plan to graduation
- Navigate UMKC processes, systems, and services
- Explore, clarify and confirm fit with their major and career plans
- Develop clear and personalized academic objectives for short and long-term goals
- Enhance self-efficacy and sense of agency

Our professional academic advisors will assist students in all aspects of their undergraduate educational career.

- Assist students in choosing majors and developing academic plans
- Inform students about general education requirements
- Advise students on class selection and registration
- Offer advise on educational and career goals
- Assist students to connect with support services on campus
- Regularly review academic progress and progression toward degree completion
- Connect students with faculty mentors and UMKC Career Services
- Review academic policies and procedures
- Help student with other related issues or problems of an academic nature

Academic Advising

To facilitate progress toward the student's degree, and to ensure that courses selected support completion of degree requirements, students are required to participate in advising each semester before registering for classes. Academic advising is required for all undergraduate students and is enforced using an advising hold in Pathway. In general, students should schedule an appointment to meet with their assigned academic advisor to discuss their enrollment plan and request their advising hold be released. Once students have a fully approved academic plan, there may be options to have holds released without a requirement for an appointment with certain programs.

Students enrolled in double majors or dual degree programs may be advised by two or more advisors with expertise in the specific programs. The advisor for student's primary degree program will have the major advising responsibility.

Students have many options to meet with their assigned academic advisor. Students are encouraged to schedule an appointment with their assigned advisor to ensure appropriate time is set aside to address student's issues and concerns.

Schedule an appointment

Students can schedule an appointment to meet with their assigned academic advisor on their own through UMKC Connect (<https://umkc.starfishsolutions.com/starfish-ops/support/login.html>). If assistance is required, students can call Roo Advising at 816-235-1148 or send an email to roadvising@umkc.edu.

Walk-in Advising

Walk-In Advising will be available the week prior to and the first week of each term. In addition, walk-in advising is available during regular terms.

- Monday and Tuesday 11am-12:00pm
- Wednesday and Thursday 1:00pm-2:00pm

Advising Office Locations

Roo Advising is delivered across UMKC

- Arts & Cultural Studies-Scofield Hall, Room 9
- Business & Management-Scofield Hall, Room 9
- Human Behavior, Education & Justice-Scofield Hall, Room 9 and School of Education, Suite 129 (for education majors only)
- Natural & Health Sciences-Flarsheim Hall, Suite 510 (including Health Sciences-non nursing tracks and public health)and Health Sciences Building (Health Sciences Campus, 2411 Holmes, Kansas City, MO) Suite 1410 (for Health Sciences nursing tracks and Nursing program only)
- Numbers, Engineering, Technology, & the Cosmos-Flarsheim Hall, Suite 336)

Faculty Mentors

Faculty in student's declared degree programs are a significant and valuable resource for students. As experts in their respective fields they can assist students with their exploration of major and career options. Faculty can assist students to consider elective options tailored to their specific interests and assist students to make connections with professionals in Kansas City, Missouri, the United States, or across the globe. In addition, faculty can help students to make connections with colleagues in graduate or professional schools that may be of interest to students.

Students are responsible for becoming familiar with all academic regulations of the campus as outlined in the catalog and in other University documents.

Graduate Graduate Programs

- Master of Science in Cellular and Molecular Biology (<http://catalog.umkc.edu/colleges-schools/sbc/biology/master-of-arts-biology/>)
 - Emphasis in Bioinformatics (<http://catalog.umkc.edu/colleges-schools/sbc/biology/master-of-arts-biology/>)
- Master of Arts in Biology (<http://catalog.umkc.edu/colleges-schools/sbc/biology/master-of-arts-biology/>)
- Doctor of Philosophy Study (<http://catalog.umkc.edu/colleges-schools/sbc/biology/doctor-of-philosophy-study/>)

The School of Biological and Chemical Sciences offers programs of study leading to a master of science degree in cellular and molecular biology. In addition, a master of arts degree in biology is offered. The school participates in UMKC's Interdisciplinary Ph.D. program in Cell Biology/Biophysics (<http://catalog.umkc.edu/colleges-schools/graduate-studies/cell-biology-biophysics/>) and Molecular Biology/Biochemistry. (<http://catalog.umkc.edu/colleges-schools/graduate-studies/molecular-biology-biochemistry/>)

Graduates with research experience in cell biology and biophysics or molecular biology and biochemistry may enter careers in many areas, including biotechnology, pharmaceuticals, academia or governmental research involving the environment, agriculture, energy, defense or health.

General Information About Graduate Programs

Admission

Admission to the school's graduate programs is competitive and students are encouraged to apply early. Applications are reviewed by an admissions committee that evaluates students on the basis of past performance and evidence of ability to pursue graduate studies successfully. The school admits students to its doctoral and master's degree programs throughout the year; however, early application (by Feb. 15) is advised to receive consideration for assistantships and other financial support.

Information on admission to master's or Ph.D. degree programs may be found at the Graduate Programs Web site at <http://www.umkc.edu/sbs/graduate/>, in the Graduate Academic Regulations and Information (<https://catalog.umkc.edu/general-graduate-academic-regulations-information/>) section of this catalog, by e-mail to sbs-grad@umkc.edu, or by writing to our graduate programs office at the mailing address at the beginning of this section.

Graduate teaching assistantships, graduate research assistantships and fellowships are available through the school and are awarded on a competitive basis. Currently, all fully admitted, full-time doctoral students receive financial support.

To be eligible for admission to the School of Biological Sciences' graduate programs, the applicant must:

- Possess a bachelor's degree in biological sciences or a related field with a minimum of 120 credit hours, or possess an advanced degree in a health sciences field.
- Have an undergraduate GPA of at least 3.0.
- Have sufficient background coursework to undertake graduate studies in biological sciences.

- Have acceptable scores in the Graduate Record Examination aptitude tests. Applicants to the MA Biology program (only) may submit MCAT or DAT scores in place of a GRE score.
- Submit three letters of recommendation from individuals familiar with the student's academic performance and scientific abilities.

Students may be admitted with certain deficiencies, with the stipulation that these can be removed early in the course of study.

Advising

New students will be advised by the principal graduate advisor until they have selected their permanent research advisor. The graduate programs office will contact students in advance of their first semester for information about advising and registration.

Students are responsible for becoming familiar with all academic regulations of the campus as outlined in the catalog and in other University documents.

Requirements for Retention

General requirements for retention of graduate students are described in the Graduate Academic Regulations and Information (<https://catalog.umkc.edu/general-graduate-academic-regulations-information/>) section of this catalog. For all graduate students, a 3.0 (B) GPA is required for satisfactory progress. No F grades are permitted.

Any doctoral student who receives more than one C grade in a basic course will be dropped from the doctoral program.

Any master's student who receives more than two C grades or more than one C and one D grade in graduate courses will be dropped from the program.

Biology Courses

BIOLOGY 102 Biology and Living Credits: 3

Introduction to structural organization and functional processes of living systems. For non-biology majors only. Does not count toward biology degree.

BIOLOGY 102 - MOTR BIOL 100L: Essentials in Biology with Lab



BIOLOGY 102L Biology and Living Laboratory Credit: 1

Exploration of basic biological concepts through laboratory activities requiring data collection and analysis. For non-majors only; does not count toward Biology degree requirements.

Corequisite: BIOLOGY 102 (or prerequisite).

BIOLOGY 102L - MOTR BIOL 100L: Essentials in Biology with Lab



BIOLOGY 108 General Biology I Credits: 3

Fundamental studies in biology emphasizing the unity and diversity of life. Topics include the basic chemistry of biological processes, cell types and organelles, energy harvesting and energy producing pathways, cell and life cycles, genetics, DNA structure, genes, transcription, translation, natural selection, population genetics, speciation, and phylogenetic analysis.

BIOLOGY 108 - MOTR BIOL 150: Biology



BIOLOGY 108L General Biology I Laboratory Credit: 1

Basic laboratory studies in Biology emphasizing the unity and diversity of life. Structure, function, heredity, development, ecology and evolution will be explored.

Co-requisites: BIOLOGY 108.

BIOLOGY 108L - MOTR BIOL 150L: Biology with Lab



BIOLOGY 109 General Biology II Credits: 3

Fundamental studies in biology emphasizing the unity and diversity of life. Topics include prokaryotes, fungi, invertebrate-vertebrate zoology and phylogeny, human evolution, plant structure and development, animal development and physiology, ecology (population and ecosystems).

BIOLOGY 109L General Biology II Laboratory Credit: 1

Basic laboratory studies in Biology emphasizing the unity and diversity of life. Structure, function, heredity, development, regulation of growth and evolution will be explored.

Co-requisites: BIOLOGY 109.

BIOLOGY 112 Microbiology and Living Credits: 3

Lectures and demonstrations concerning the cell structure, genetics and physiology of microorganisms and the role microorganisms play in the world around man with an emphasis on medical and clinical aspects of the significance of various groups of bacteria, viruses fungi and other microorganisms. This course is intended for nursing and other allied health students and for non-biology majors interested in life sciences and does not count toward Biology major requirements.

BIOLOGY 115 First Year Seminar Credit: 1

This course is designed to provide students with the skills necessary to achieve success at the university. The curriculum includes time management, study, reading, note-taking and test-taking strategies, health and wellness, and student support services. Additional emphasis will include career exploration, including professionalism, writing a resume, and developing plan of study for degree completion.

BIOLOGY 122 Human Genetics Credits: 3

This is a non-majors biology course in human genetics designed for those with little classroom training in the sciences. The focus will be on the nature of human genetic variation and how variation shapes and affects our lives. This includes the structure and function of genes and how genes create traits. The discussion will focus on how genes function in human development through sex determination. The inclusion of human genomic sequencing technology and personal genomics will emphasize several issues related to knowledge and privacy.

BIOLOGY 122 - MOTR LIFS 100G: Essentials in Human Biology - Gene

**BIOLOGY 125L Guided Research in Biology Credits: 2**

An introduction to basic principles and methods of scientific research in the biological sciences. Students will engage in experimental design, use of bioinformatic tools, molecular graphics, and specialized tools related to different biology disciplines to characterize a specific gene or cell system under the guidance of a faculty member. Recommended preparation: BIOLOGY 108.

BIOLOGY 199L Methods in Biological Research Credits: 2

The course will provide an introduction to laboratory safety and common research methods used in modern biological research. It is intended for students that wish to gain research experience in the School or a career in research.

Prerequisites: BIOLOGY 108 or BIOLOGY 109.

BIOLOGY 201 Preparing for Careers in Biology Credit: 1

This course will help students prepare for their post-undergraduate future. Topics will include communication, skills identification and marketing, how to find employment or internship opportunities, a review of the application process for graduate education and the role of undergraduate research.

Prerequisites: Sophomore standing (or higher).

BIOLOGY 202 Cell Biology Credits: 3

Basic concepts of cellular and subcellular structure and function, including supramolecular and organelle structure and organization, bioenergetics, cell growth and cellular communication.

Prerequisites: (BIOLOGY 108 (or MOTRBIOL 150L), and CHEM 212R) OR (CHEM 212R, LS-ANATO 219, LS-ANATO 219L, and LS-MCRB 121).

BIOLOGY 206 Genetics Credits: 3

A modern approach integrating molecular and organismal studies of the general genetics of lower and higher organisms. Chromosomal structure and function, gene transmission, heredity, plasticity and population genetics will be discussed.

Prerequisites: BIOLOGY 108 (or MOTRBIOL 150L), BIOLOGY 109 (or MOTRBIOL 150LZ or MOTRBIOL 100LZ), and CHEM 212R or LS-ANATO 219.

BIOLOGY 217L Human Physiology Laboratory Credit: 1

This course is designed to illustrate the important principles of human physiology in a laboratory setting. Using an organ systems approach, the course will feature microscopic work, audio-visual presentations, and student experiments when possible. For non-majors only; does not count toward biology degree requirements.

Prerequisites: LS-PHYS 117.

BIOLOGY 218 Introductory Anatomy Credits: 3

Description and discussion of the cells, organs, organ systems and basic tissues of vertebrates with special emphasis on their interrelationships in functional anatomy.

Prerequisites: BIOLOGY 102 or BIOLOGY 108 or BIOLOGY 109.

Co-requisites: BIOLOGY 218L.

BIOLOGY 218L Introductory Anatomy Laboratory Credits: 2

Laboratory investigation of cells, tissues, and organs with special emphasis on their interrelationship in vertebrates.

Co-requisites: BIOLOGY 218.

BIOLOGY 250 Careers in Biological & Chemical Sciences I Credit: 1

This course will introduce students to a variety of careers in the biological and chemical sciences. Guest speakers will share information including day-to-day activities on the job, educational requirements, career advancement, and necessary interests and abilities.

BIOLOGY 251 Careers in Biological & Chemical Sciences II Credit: 1

This course will help students prepare for their post-undergraduate future. Topics will include communication, skills identification and marketing, how to find employment or internship opportunities, a review of the application process for graduate education and the role of undergraduate research.

BIOLOGY 285 Special Topics Credits: 1-3

In depth exploration of a topic in biology

BIOLOGY 302 General Ecology Credits: 3

Introduction to the study of populations, communities, and ecosystems by examining the interrelationships between living organisms and their environments. The role of natural selection and evolution will also be considered. Prerequisites: BIOLOGY 108 (MOTR 150L), BIOLOGY 109 (MOTR 150LZ), or BIOLOGY 102 (MOTR 100L).

Prerequisites:

BIOLOGY 302L Ecology Laboratory Credits: 2

This course provides laboratory and field experience in ecology. The course will cover topics including statistical analysis and data presentation, terrestrial and aquatic sampling, experimental design and scientific writing.

Co-requisites: BIOLOGY 302.

BIOLOGY 303 Invertebrate Zoology Credits: 3

Taxonomy, evolutionary relationships, behavior, reproduction, morphology and ecology of the invertebrates. Recommended preparation: BIOLOGY 108, BIOLOGY 109, and CHEM 212R.

BIOLOGY 304 Biostatistics 1 Credits: 3

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.

Prerequisites: MATH 110 or STAT 235; or ACT Math sub-score of 28 or higher; or SAT Math sub-score of 660 or higher.

BIOLOGY 305 Marine and Freshwater Biology Credits: 3

Introduction to the study of marine ecology, deep-sea biology, oceanic nekton, inter-tidal ecology, estuaries, mangroves and salt marshes, as well as ecology of rivers, lakes, streams, wetlands and human impact on aquatic habitats.

Prerequisites: BIOLOGY 108, BIOLOGY 109, CHEM 211.

BIOLOGY 306 From Bench to Bedside: Translational Research Credits: 3

This course explores the interplay between basic biological research and bedside clinical practice, delving into the topic "what is translational research?" By engaging with people from the community involved at all levels of translational research, students will gain an appreciation for the civic issues behind medical research, the interdisciplinary nature of research, and the part that Kansas City institutions play in regional life and health sciences.

Prerequisites: BIOLOGY 108 OR BIOLOGY 102.

BIOLOGY 308 Vertebrate Zoology Credits: 3

Taxonomy, evolutionary relationships, behavior, reproduction, morphology and ecology of the vertebrates.

Prerequisites: BIOLOGY 108, BIOLOGY 109, CHEM 212R.

BIOLOGY 312WL Laboratory in Developmental Biology, Genetics and Cell Biology Credits: 3

Experimental studies of genetics and development in selected eukaryotic model organisms with an emphasis on the molecular and cellular mechanism of inheritance.

Prerequisites: BIOLOGY 441.

Co-requisites: BIOLOGY 409.

BIOLOGY 313 Microbiology Credits: 3

Fundamental and applied aspects of microbial structure, metabolism, genetics and diversity. Experimental approaches to studying the microbial world will be emphasized.

Prerequisites: BIOLOGY 202, BIOLOGY 206.

Co-requisites: BIOLOGY 441.

BIOLOGY 313L Laboratory in Microbiology Credits: 3

General microbiological procedures plus advanced work in the areas of microbial physiology and genetics, pathogenic microbiology, virology, applied microbiology and biotechnology.

Co-requisites: BIOLOGY 313, BIOLOGY 441.

BIOLOGY 313WL Laboratory in Microbiology Credits: 3

General microbiological procedures plus advanced work in the areas of microbial physiology and genetics, pathogenic microbiology, virology, applied microbiology, and biotechnology.

Co-requisites: BIOLOGY 313, BIOLOGY 441.

BIOLOGY 314 Entomology Credits: 3

Anatomy, physiology and identification of insects with emphasis on their environmental adaptations.

Prerequisites: BIOLOGY 109 (or LS-ANATO 219).

BIOLOGY 316 Principles of Physiology Credits: 3

Physiological functions and processes of animals at the organ and organ systems levels, including concepts of integrated and homeostatic mechanisms. The relationship between organ function and underlying cellular mechanisms in vertebrates will be emphasized.

Prerequisites: BIOLOGY 202.

BIOLOGY 319 Global Health: New and Emerging Infectious Diseases Credits: 3

This course will discuss infectious diseases that are newly identified, or increasing in prevalence throughout the world. Several aspects of each disease will be discussed, including transmission, symptoms, treatment, prevention, and diagnosis. The course is meant for students interested in a health-related career (medicine, dental, pharmacy, public health), but other students with a basic biology background are welcome.

Prerequisites: BIOLOGY 108, BIOLOGY 109 (or BIOLOGY 102).

BIOLOGY 322 General Parasitology Credits: 3

Parasitic protists, worms and arthropods and the disease states they may induce, will be examined in relationship to human, animal and plants hosts.

Prerequisites: BIOLOGY 109 (or LS-ANATO 219).

BIOLOGY 326 Biological Conservation Credits: 3

Applications of ecology and genetics to the conservation of communities and individual species, including discussion of the Endangered Species Act, extinction processes, and the effects of habitat fragmentation.

Prerequisites: BIOLOGY 108, BIOLOGY 109.

BIOLOGY 327 Biogeography and Biodiversity Credits: 2

Evolutionary and climatological effects on the geographic distribution of organisms, including areas of endemism as well as preservation of biodiversity.

Prerequisites: BIOLOGY 108, BIOLOGY 109.

BIOLOGY 328 Histology Credits: 2

Animal tissues and their specialization in the organism, with major emphasis on higher organisms.

Prerequisites: BIOLOGY 202.

BIOLOGY 328L Laboratory in Histology and Cellular Ultrastructure Credits: 3

Examination of structure/function relationships at the subcellular, cellular and organ levels. Both plants and animals will be examined with emphasis on vertebrates.

Co-requisites: BIOLOGY 328.

BIOLOGY 328WL Laboratory in Histology and Cellular Ultrastructure Credits: 3

Examination of structure/function relationships at the subcellular, cellular and organ levels. Both plants and animals will be examined with emphasis on vertebrates.

Co-requisites: BIOLOGY 328.

BIOLOGY 329 Endocrinology Credits: 3

Study of the physiological functions and controls in human and related mammalian systems, with emphasis on endocrine-directed processes that underlie normal and abnormal metabolic and clinical conditions. The course will be presented in traditional lecture format, and focus on the molecular, chemical, membrane and cellular basis of metabolic homeostatic processes in cells, cytoplasmic compartments and primary organ systems.

Prerequisites: BIOLOGY 202.

Co-requisites: BIOLOGY 316.

BIOLOGY 331 Reproductive Biology Credits: 2

Comprehensive overview of current concepts and knowledge regarding male and female reproductive processes, from gametogenesis through early placentation. Includes structural, developmental, physiological and pathophysiological aspects of reproduction.

BIOLOGY 333 Invasive Species Credits: 3

Students will study the biological traits that contribute to successful invasions, the ecological and economic impacts of invasive species, and the legal and cultural responses to invasions. Students will develop critical analysis and communication skills by analyzing scientific literature, discussing implications, and presenting arguments in written and oral platforms.

Prerequisites: BIOLOGY 108 and BIOLOGY 109; or BIOLOGY 102.

BIOLOGY 338L Comparative Vertebrate Anatomy Laboratory Credits: 3

This class explores anatomical similarities and differences that exist between the major vertebrate groups and relates aspects of anatomy to evolutionary history and function. Students will gain hands-on experience of anatomy through dissection and examination of several model vertebrates. Recommended preparation: BIOLOGY 108, BIOLOGY 109, and BIOLOGY 109L.

BIOLOGY 346 Plant Biology Credits: 3

An integrative study of growth, development, and reproduction of plants, including structure and function of plant tissues and organs, as well as a survey of the recent advances in genetic engineering, plant defense mechanisms, and medical botany and the usefulness of plants to humans.

Co-requisites: BIOLOGY 202.

BIOLOGY 350 Assisting Undergraduate Learning in Biology Credits: 1-3

This course addresses current issues and pedagogy of teaching biology and providing instructional support for designated undergraduate courses in the School of Biological Sciences. Students meet weekly with the course instructor and assist in the classroom, studio, or laboratory.

Prerequisites: BIOLOGY 108, BIOLOGY 109, BIOLOGY 202, BIOLOGY 206.

BIOLOGY 360L Laboratory in Biochemistry and Molecular Biology Credits: 3

Laboratory studies in biochemistry and molecular biology with an emphasis on modern techniques and quantitative relationships.

Prerequisites: BIOLOGY 441.

BIOLOGY 360WL Laboratory in Biochemistry and Molecular Biology Credits: 3

Laboratory studies in biochemistry and molecular Biology with an emphasis on modern techniques and quantitative relationships.

Prerequisites: BIOLOGY 441.

BIOLOGY 385 Special Topics Credits: 3

In depth exploration of a topic in biology. Repeatable toward the major only when the topic changes.

BIOLOGY 397 Experience Based Education Credits: 1-3

This course will allow students to earn credit for experience gained through educational experiences such as service, shadowing, leadership, employment and study abroad.

BIOLOGY 404 Biostatistics 2 Credits: 3

An advanced study of inferential statistics. The course will introduce correlation, linear and categorical regression, and emphasize model selection and multi-model inference. The use of statistical computer software also will be emphasized.

Prerequisites: BIOLOGY 304 or STAT 235.

BIOLOGY 405 Introduction to Evolution Credits: 3

Discussion of the biological processes that produce organic diversity through phyletic change, including variation, mutation, adaptation, population genetics, natural selection, genetic drift, gene flow, and macroevolution.

Prerequisites: BIOLOGY 206.

BIOLOGY 409 Developmental Biology Credits: 3

Principles of development and differentiation of structure during embryology in animals. Molecular, cellular and organismal level concepts and mechanisms will be considered.

Prerequisites: BIOLOGY 202, BIOLOGY 206.

BIOLOGY 415 Pathophysiology Credits: 3

Pathophysiology will focus on the physiological basis of cellular and tissue function, and the consequences of dysregulated metabolic/cellular expression on essential homeostatic processes in cells, cytoplasmic compartments and primary organ systems. Recommended preparation: BIOLOGY 316.

BIOLOGY 430 Molecular Biology and Genetic Engineering Credits: 3

Molecular aspects of gene structure and function, including macromolecular synthesis, gene regulation, genetic transfer and biotechnology will be discussed in prokaryotes and eukaryotes.

Prerequisites: BIOLOGY 202, BIOLOGY 206.

Co-requisites: BIOLOGY 441.

BIOLOGY 435 Immunology Credits: 3

A study of the cellular and humoral aspects of the immune response, with emphasis upon the mechanisms involved and the relationship of this response to disease processes.

Prerequisites: BIOLOGY 441.

BIOLOGY 441 Biochemistry Credits: 3

One semester course covering the properties of organic compounds important to biological systems. Structures, characterization and reactions of common compounds and their relationship to the building blocks of biological systems will be discussed.

Prerequisites: BIOLOGY 202, CHEM 320 (or CHEM 321).

BIOLOGY 442 Neurobiology Credits: 3

Neurobiology will consist of the presentation of theory and data concerning cellular and molecular fundamentals of the nervous system, synaptic mechanisms, sensory-motor systems, and higher-order functions of the nervous system.

Prerequisites: BIOLOGY 441.

BIOLOGY 445 Evolutionary Ecology Credits: 3

This class explores the scientific concepts and methods underpinning modern understanding of evolutionary ecology as it relates to organisms. Students will gain hands-on experience using techniques that are central to quantitative and qualitative studies of organismal evolutionary ecology.

Prerequisites: BIOLOGY 302, BIOLOGY 405.

BIOLOGY 452 Bioinformatics Credits: 3

Study of the acquisition, storage, retrieval, analysis, modeling, and distribution of information in biomolecular databases. Recent developments in genomics and proteomics and how these databases are used in modern biological research will be emphasized.

Co-requisites: BIOLOGY 441.

BIOLOGY 485 Special Topics Credits: 1-3

In depth exploration of a topic in biology. Repeatable toward the major only when the topic changes.

BIOLOGY 498WI Critical Analysis of Biological Issues Credits: 3

Reading and analysis of scientific literature, including original papers, on a topic of broad biological interest. Critical discussion of experimental methods and results. Writing of scientific reviews and a term paper. Taking the MFAT test is a requirement of this course, and the course satisfies the general education synthesis requirement.

Co-requisites: BIOLOGY 441.

BIOLOGY 5501 Proposal Writing Credit: 1

This course addresses how to develop a testable hypothesis, and write a NIH-style proposal to convince the reader of the significance of the proposed studies. Students will write a proposal that will form the basis of their oral comprehensive exam in the Cell Biology and Biophysics (CBB) and Molecular Biology and Biochemistry (MBB) disciplines. The is limited to doctoral students with CBB and MBB coordinating disciplines that have a plan of study filed with the School of Graduate Studies.

BIOLOGY 5510 Gross Anatomy for Nurse Anesthetists Credits: 3

This course will present and examine the anatomic concepts and conditions essential for critical thinking and decision making by the nurse anesthetist. Specifically, the course will provide the foundation upon which patient interventions may be based during the perioperative period.

Prerequisites: Graduate status.

Co-requisites: BIOLOGY 5510L.

BIOLOGY 5510L Gross Anatomy for Nurse Anesthetists Credit: 1

This laboratory course will present and examine the anatomic concepts and conditions essential for critical thinking and decision making by the nurse anesthetist. Specifically, the course will provide the foundation upon which patient intervention may be based during the perioperative period.

Prerequisites: Graduate status.

Co-requisites: BIOLOGY 5510.

BIOLOGY 5511 Professional Development Credit: 1

The purpose of this course is to facilitate a competitive application to professional health programs for student seeking the M.A. in Biology. Students will gain an understanding of the application process, including decisions for where to apply, assessing fit, developing a personal statement, strategies for letters of evaluation, and an execution of a successful interview.

Prerequisites: Admission to the M.A. Biology program, or by instructor consent.

BIOLOGY 5515 Biochemistry Credits: 4

The chemistry and mechanisms involved in biosynthesis, degradation and utilization of the major constituents of living systems and the biochemistry of specialized tissues, hormones, nutrition and regulation.

Prerequisites: Admission to the UMKC MA Biology program.

BIOLOGY 5516 Global Health: New and Emerging Infections Diseases Credits: 3

This course will discuss infectious diseases that are newly identified, or increasing in prevalence throughout the world. Several aspects of each disease will be discussed, including transmission, symptoms, treatment, prevention, and diagnosis. The course is meant for students interested in a health-related career (medicine, dental, pharmacy, public health), but other students with a basic biology background are welcome.

Prerequisites: BA or BS in Biology or related field

BIOLOGY 5517 From Bench to Bedside: Translational Research Credits: 3

This course explores the interplay between basic biological research and bedside clinical practice, delving into the topic "what is translational research?" By engaging with people from the community involved at all levels of translational research, students will gain an appreciation for the civic issues behind medical research, the interdisciplinary nature of research, and the part that Kansas City institutions play in regional life and health sciences. As part of the course, students will produce a "public service announcement" style video that explains a particular aspect of translational research for consumption by people within the broader Kansas City community.

Prerequisites: Must be in a graduate program in the School of Biological Sciences or instructor consent.

BIOLOGY 5518 Graduate Histology Credits: 2

Animal tissues and their specialization in the organism, with major emphasis on higher organisms.

Prerequisites: BA or BS in Biology or Chemistry, or permission of the instructor.

BIOLOGY 5519 Principles of Evolution Credits: 3

Synthesis of the modern concepts of evolution. Discussion of the biological processes that produce organic diversity through phyletic change. Discussed are variation, mutation, population genetics, natural selection and adaptation.

Prerequisites: BIOLOGY 206.

BIOLOGY 5525 Bioinformatics and Data Analysis Credits: 3

Methods and procedures for the storage, retrieval and analysis of information in biomolecular and biological databases. Emphasis will be given to the use of database information in biological research and to recent developments in genomics and proteomics.

Prerequisites: BIOLOGY 441, LS-BIOC 360.

BIOLOGY 5528 Human Genomic Epidemiology Credits: 3

This course is designed for biological researchers and clinicians interested in studying common human diseases using state-of-the-art genomics/genetics epidemiological approaches. The course provides a basic yet comprehensive introduction to key topics in human genome epidemiological research, including basic concepts and methodologies of quantitative/statistical genetics, an introduction to emerging technologies and analytical methods for genomic science, basic study for various types of genomic research approaches, utilization of widely-used software packages for analyses of genomic data, and examples of human genome epidemiology information improving health, and ethical, legal and social issues in the design and conduct of human genome epidemiology studies.

BIOLOGY 5534 Cardiovascular Pulmonary Physiology Credits: 3

Function of the cardiovascular and pulmonary systems at the cellular, tissue, and system levels with particular emphasis on regulation, maintenance of homeostasis and integration with other systems.

Prerequisites: BIOLOGY 316.

BIOLOGY 5539 Mammalian Physiology Credits: 4

Study of the physiological functions and controls in human and related mammalian systems, with emphasis on fundamental processes that underlie normal and abnormal clinical conditions.

Prerequisites: BIOLOGY 316.

BIOLOGY 5540 Pathophysiology Credits: 4

Pathophysiology will focus on the physiological basis of cellular and tissue function, and the consequences of dysregulated metabolic/cellular expression on essential homeostatic processes in cells, cytoplasmic compartments and primary organ systems.

Prerequisites: BIOLOGY 5539.

BIOLOGY 5542 Neurobiology Credits: 3

Neurobiology will consist of the presentation of theory and data concerning cellular and molecular fundamentals of the nervous system, synaptic mechanisms, sensor-motor systems, and higher-order functions of the nervous system.

Prerequisites: LS-BIOC 304.

BIOLOGY 5591 Directed Individual Studies Credits: 1-6

Intensive readings and/or research in an area selected by the graduate student in consultation with the instructor. Not to be identified with thesis research.

BIOLOGY 5592 Master of Arts Topics in Biology Credits: 1-6

Special problems and topics in biology specifically intended to satisfy the project or report requirement for the master of arts degree in biology.

Prerequisites: Nine hours of graduate work in Biology.

BIOLOGY 5593 Master of Science Topics Credits: 1-4

Investigation of problems and topics to satisfy the M.S. topics requirement for the master of science degree in Cellular and Molecular Biology.

Prerequisites: LS-MBB 5561, LS-MBB 5562.

BIOLOGY 5899 Required Graduate Enrollment Credit: 1

Life Sciences Courses

LIFE-SCI 201 Careers in Health I Credit: 1

This course will introduce students to various healthcare professions. Guest speakers will cover topics including day-to-day activities on the job, educational requirements, career advancement, and necessary interests and abilities.

LIFE-SCI 202 Careers in Health II Credit: 1

Students will gain an understanding of the role and scope of practice of health professionals, patient privacy, professionalism, professional school applications and a deeper appreciation of what it means to be a patient through facilitated shadowing experiences.

LIFE-SCI 310 Fundamentals of Medicine I Credits: 2

This course introduces students to various aspects of women's health care. In addition, students will consider the cultural diversity of caring for patients with various medical conditions, and will integrate information from the basic sciences, the, and the social sciences as they learn about health care. Recommended preparation: BIOLOGY 202 and BIOLOGY 206.

Prerequisites: Bachelor of Science, Biomedical Sciences Emphasis Student.

LIFE-SCI 320 Fundamentals of Medicine II Credits: 2

This course introduces students to the aging process and various medical conditions in the elderly. Cultural diversity within aging patient populations will be discussed. Students will experience personal growth and reflection. Recommended preparation: LIFE-SCI 310.

Prerequisites: Bachelor of Science, Biomedical Sciences Emphasis Student.

LIFE-SCI 330 Fundamentals of Medicine III Credits: 2

This course introduces students to various aspects of pediatric health care. Students will become familiar with medical symptoms and clinical findings while integrating knowledge in anatomy, physiology, and pathophysiology of infants, children, and adolescents. Recommended preparation: LIFE-SCI 320.

Prerequisites: Bachelor of Science, Biomedical Sciences Emphasis Student.

LIFE-SCI 340 Fundamentals of Medicine IV Credits: 2

This course introduces students to aspects of adult health care, including bioethics, conflict resolution, informed consent, and human subject research. Presentations on various medical symptoms and clinical findings will be provided to integrate anatomy, physiology, and pathophysiology for learning about acute and chronic medical conditions. Recommended preparation: LIFE-SCI 330.

Prerequisites: Bachelor of Science, Biomedical Sciences Emphasis Student.

LIFE-SCI 399 Introduction to Research Credits: 1-3

Introduction to the theory and practice of research in modern biological sciences. Requires minimum of 3-4 hours per week in the laboratory for each credit hour.

Prerequisites: Departmental consent.

LIFE-SCI 497 Directed Studies—Biological Sciences Credits: 3

Individual or small group study of topics in an area of the biological sciences including class room work, presentation, library work, and writing of term papers or other reports.

Prerequisites: CHEM 320 (or CHEM 322R).

LIFE-SCI 497A Directed Studies-Bioinformatics Credits: 1-3

Individual or small group study of topics in the area of bioinformatics including class room work, presentation, library work, and writing of term papers or other reports. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 courses may not exceed 4 credit hours toward Biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 497B Directed Studies-Genetics Credits: 1-3

Individual or small group study of topics in the area of genetics including class room work, presentation, library work, and writing of term papers or other reports. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 courses may not exceed 4 credit hours toward Biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 497BB Directed Studies: Behavioral Biology Credits: 1-3

Individual or small group study of topics in the area of behavioral biology including class room work, presentation, library work, and writing of term papers or other reports. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 courses may not exceed 4 credit hours toward Biology course degree requirements.

Prerequisites: BIOLOGY 206 and LS-BIOC 441.

LIFE-SCI 497C Directed Studies-Microbiology Credits: 1-3

Individual or small group study of topics in the area of microbiology including class room work, presentation, library work, and writing of term papers or other reports. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 courses may not exceed 4 credit hours toward Biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 497D Directed Studies-Physiology Credits: 1-3

Individual or small group study of topics in the area of physiology including class room work, presentation, library work, and writing of term papers or other reports. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 courses may not exceed 4 credit hours toward Biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 497E Directed Studies - Biochemistry Credits: 1-3

Individual or small group study of topics in the area of biochemistry including class room work, presentation, library work, and writing of term papers or other reports. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 courses may not exceed 4 credit hours toward Biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 497F Directed Studies - Biophysics Credits: 1-3

Individual or small group study of topics in the area of biophysics including class room work, presentation, library work, and writing of term papers or other reports. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 courses may not exceed 4 credit hours toward Biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 497G Directed Studies-Cell Biology Credits: 1-3

Individual or small group study of topics in the area of cell biology including class room work, presentation, library work, and writing of term papers or other reports. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 courses may not exceed 4 credit hours toward Biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 497H Directed Studies - Neuroscience Credits: 1-3

Individual or small group study of topics in the area of neuroscience including class room work, presentation, library work, and writing of term papers or other reports. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 courses may not exceed 4 credit hours toward Biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 497I Directed Studies-Botany Credits: 1-3

Individual or small group study of topics in the area of botany including class room work, presentation, library work, and writing of term papers or other reports. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 courses may not exceed 4 credit hours toward Biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 497J Directed Studies-Zoology Credits: 1-3

Individual or small group study of topics in the area of zoology including class room work, presentation, library work, and writing of term papers or other reports. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 courses may not exceed 4 credit hours toward Biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 497K Directed Studies - Ecology Credits: 1-3

Individual or small group study of topics in the area of ecology including class room work, presentation, library work, and writing of term papers or other reports. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 courses may not exceed 4 credit hours toward Biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 497L Directed Studies - Biological Sciences Credits: 1-3

Individual or small group study of topics in the area of biological sciences including class room work, presentation, library work, and writing of term papers or other reports. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 courses may not exceed 4 credit hours toward Biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 497P Directed Studies - Biotechnology Credits: 1-3

Individual or small group study of topics in the area of biotechnology including class room work, presentation, library work, and writing of term papers or other reports. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 courses may not exceed 4 credit hours toward Biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 497WI Directed Studies—Biological Sciences Credits: 3

Individual or small group study of topics in an area of the biological sciences including class room work, presentation, library work, and writing of term papers or other reports.

Prerequisites: CHEM 320 (or CHEM 322R).

LIFE-SCI 499 Undergraduate Research-Biological Sciences Credits: 3

Independent research, including the writing of research reports in the area of biological sciences.

Prerequisites: CHEM 320 (or CHEM 322R).

LIFE-SCI 499A Undergraduate Research-Bioinformatics Credits: 1-3

Independent research, including the writing of research reports in the area of bioinformatics. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 may not exceed 4 credit hours toward biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 499B Undergraduate Research-Genetics Credits: 1-3

Independent research, including the writing of research reports in the area of genetics. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 may not exceed 4 credit hours toward biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 499C Undergraduate Research-Microbiology Credits: 1-3

Independent research, including the writing of research reports in the area of microbiology. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 may not exceed 4 credit hours toward biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 499D Undergraduate Research-Physiology Credits: 1-3

Independent research, including the writing of research reports in the area of physiology. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 may not exceed 4 credit hours toward biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 499E Undergraduate Research-Biochemistry Credits: 1-3

Independent research, including the writing of research reports in the area of biochemistry. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 may not exceed 4 credit hours toward biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 499F Undergraduate Research- Biophysics Credits: 1-3

Independent research, including the writing of research reports in the area of biophysics. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 may not exceed 4 credit hours toward biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 499G Undergraduate Research-Cell Biology Credits: 1-3

Independent research, including the writing of research reports in the area of cell biology. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 may not exceed 4 credit hours toward biology course degree requirements. Recommended preparation: BIOLOGY 206 and LS-BIOC 441.

Prerequisites: Departmental consent.

LIFE-SCI 499H Undergraduate Research-Neuroscience Credits: 1-3

Independent research, including writing of research reports in the area of neuroscience. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 may not exceed 4 credit hours toward biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 499I Undergraduate Research-Botany Credits: 1-3

Independent research, including the writing of research reports in the area of botany. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 may not exceed 4 credit hours toward biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 499J Undergraduate Research-Zoology Credits: 1-3

Independent research, including the writing of research reports in the area of zoology. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 may not exceed 4 credit hours toward biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 499K Undergraduate Research-Ecology Credits: 1-3

Independent research, including the writing of research reports in the area of ecology. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 may not exceed 4 credit hours toward biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 499L Undergraduate Research-Biological Sciences Credits: 1-3

Independent research, including the writing of research reports in the area of biological sciences. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 may not exceed 4 credit hours toward biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 499M Undergraduate Research-Biological Sciences Honors Credits: 1-3

Independent research, including the writing of research reports in the area of biological sciences.

Prerequisites: Departmental consent.

LIFE-SCI 499P Undergraduate Research-Biotechnology Credits: 1-3

Independent research, including the writing of research reports in the area of biotechnology. Combined credit for LIFE-SCI 497 and LIFE-SCI 499 may not exceed 4 credit hours toward biology course degree requirements.

Prerequisites: Departmental consent.

LIFE-SCI 499WI Undergraduate Research-Biological Sciences Credits: 3

Independent research, including the writing of research reports in the area of biological sciences.

Prerequisites: CHEM 320 (or CHEM 322R).

LIFE-SCI 5899 Required Graduate Enrollment Credit: 1

LIFE-SCI H490WI Honors Senior Seminar Credits: 3

Discussion, writing and specific readings to coordinate with and amplify topics covered in School of Biological Sciences seminars; must include a term paper on a specific topic. Writing Intensive.

Life Sciences - Anatomy Courses

LS-ANATO 219 Functional Anatomy I Credits: 3

An introduction to the functional anatomy of vertebrates with emphasis on organs, organ systems and tissues.

Prerequisites: Pharmacy or Medicine Student.

LS-ANATO 219L Functional Anatomy I Laboratory Credit: 1

An introduction to the functional anatomy of vertebrates with emphasis on organs, organ systems and tissues.

Prerequisites: Pharmacy or Medicine Student.

Life Sciences - Biochemistry Courses

LS-BIOC 341 Basic Biochemistry Credits: 3

One semester course covering the properties of organic compounds important to biological systems. Structures, characterization and reactions of common compounds and their relationship to the building blocks of biological systems will be discussed. Recommended preparation: BIOLOGY 202, CHEM 320 (or CHEM 322R).

LS-BIOC 360 Biochemistry Credits: 3

Introduction to modern biochemistry. Structure and function of biologically important compounds, major biochemical pathways and their regulation in animals, plants and microorganisms, and the molecular and biochemical basis of gene function will be studied. Recommended preparation: BIOLOGY 202, BIOLOGY 206, BIOLOGY 441, CHEM 320 (or CHEM 322R).

LS-BIOC 370 Pharmacy Biochemistry Credits: 4

The chemistry and mechanisms involved in biosynthesis, degradation and utilization of the major constituents of living systems, and the biochemistry of specialized tissues, hormones, nutrition and regulation with a focus on application to clinical pharmacy practice.

Life Sciences - Cell Biology A Courses

LS-CBB 5501 Graduate Biophysical Principles Credits: 3

The focus of this course is on the theoretical principles underlying the biophysical methods used by a wide range of biological chemists. The approaches covered include thermodynamics, chemical kinetics, molecular interactions, transport properties, quantum mechanics, optical spectroscopy, and molecular structural approaches involving nuclear magnetic resonance spectroscopy, X-ray diffraction, and Mass spectrometry.

LS-CBB 5504 Graduate Virology Credits: 3

Survey of the molecular biology of animal, plant, and bacterial viruses. The course will emphasize the molecular mechanisms of virus replication, viral pathogenesis, and the use of virus as model systems to study mammalian cells.

LS-CBB 5505 Molecular and Cellular Neurobiology Credits: 3

The molecular basis of chemical and electrical communication between nerve cells. Topics will include: neurotransmitters, neuropeptides, receptors, channels, second messengers, cytoskeleton, cell adhesion, development, neuronal plasticity and psychopharmacology.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

LS-CBB 5520 Cell and Molecular Biology II Credits: 3

A presentation of the cellular and subcellular organization and function of eukaryotic cells. Discussions will emphasize basic concepts by which structure and functions are integrated.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

LS-CBB 5530 Cell and Molecular Biology I Credits: 3

Molecular aspects of gene structure and function in prokaryotic and eukaryotic organisms and their viruses. Emphasis in genome structure and organization and regulation of gene expression.

Co-requisites: LS-MBB 5561.

LS-CBB 5538 Molecular Recognition in Cellular Biology Credits: 2

Graduate Research Seminar. Studies of the latest development leading to an increased understanding of cellular biology processes when the experimental tools for structure biology analysis and molecular genetics are applied.

Co-requisites: LS-MBB 5561.

LS-CBB 5566 Membrane Biochemistry and Biophysics Credits: 3

Structure and function of biological membranes including architecture, dynamics, models, biochemical compartmentation, energy transduction, transport mechanisms, membrane protein structures, and cell surface receptors.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

LS-CBB 5569 Structural Biology, Methods and Strategies Credits: 3

Analysis of strategies and methodologies such as X-ray crystallography, nuclear magnetic resonance and advanced microscopy procedures including imaging analysis for the study of relationships of higher order macromolecular structures to biological functions.

Prerequisites: LS-MBB 5561, LS-MBB 5562.

LS-CBB 5583 Current Topics in Cell Biology and Biophysics Credits: 1-3

Current topics and recent developments in cell biology and biophysics with emphasis on rapidly developing research areas.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

LS-CBB 5591 Directed Individual Studies in Cell Biology and Biophysics Credits: 1-6

Intensive reading and/or research in an area selected by the graduate student in consultation with the instructor.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

LS-CBB 5596 Advanced Experimental Cell Biology I Credits: 2

Structured laboratory work with individual tutorial sessions designed to familiarize first year Interdisciplinary Ph.D. students with concepts and techniques of modern cell biology research. 1-2 hr/wk tutorial and 15-20 hr/wk of laboratory work.

Co-requisites: LS-MBB 5561.

LS-CBB 5597 Advanced Experimental Cell Biology II Credits: 2

Continuation of LS-CBB 5596.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

LS-CBB 5599 Thesis Research in Cell Biology and Biophysics Credits: 1-12

Research and thesis preparation for M.S. degree candidates.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

LS-CBB 5612 Seminar in Cell Biology and Biophysics Credit: 1

Presentation and discussion of selected areas in cell biology and biophysics. This course may be repeated by doctoral students for a maximum of 3 credit hours.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

LS-CBB 5690 Analytical Methods in Cell Biology and Biophysics Credits: 1-5

A course that emphasizes the development of skills in experimental design, analytical methods and instrumentation as applied to problems of interest to modern cell biology and biophysics, and analysis of results. Can be repeated up to a maximum of eight hours total.

Prerequisites: LS-MBB 5561, LS-MBB 5562.

LS-CBB 5696 Dissertation Development Credits: 1-6

This course is individually directed research leading to the fulfillment of the Comprehensive Exam requirements for the Cell Biology and Biophysics primary discipline. This includes submission of the final, revised version of the NIH-style research proposal to committee members and (ii) successful oral defense of the proposal before the student's research advisory committee. Prerequisites: BIOLOGY 5501.

LS-CBB 5699 Dissertation Research in Cell Biology and Biophysics Credits: 1-12

Research and dissertation preparation for interdisciplinary Ph.D. degree students who have Cell Biology and Biophysics as a discipline.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

Life Sciences - Molecular Biol Courses

LS-MBB 5503 Eukaryotic Molecular Biology Credits: 3

Molecular aspects of gene structure and function in eukaryotic organisms and their viruses. Emphasis on genome structure and organization, gene expression and regulation and the molecular basis of growth and development.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

LS-MBB 5509 Graduate Developmental Biology Credits: 3

Principles of development and differentiation of structure during embryology in animals. Molecular, cellular and organismal level concepts and mechanism will be considered.

LS-MBB 5510 Graduate Biochemistry for Nurse Anesthetists Credit: 1

This course will present the fundamentals of biochemistry necessary for the practice of nurse anesthesia, specifically, the structure and characteristics of biomolecules found in the cell, how molecules are metabolized to generate biochemical energy, and the basic mechanisms to regulate metabolic processes with regard to the nutritional state of the organism. The course is limited to graduate students in the nurse anesthetist program or in other disciplines where a fundamental understanding of biochemistry would be useful.

LS-MBB 5538 Molecular Recognition in Molecular Biology Credits: 2

Graduate Research Seminar. Analysis of the impact of most recent developments in molecular genetics and structural biology as related to fundamental molecular recognition events.

Co-requisites: LS-MBB 5561.

LS-MBB 5561 General Biochemistry I Credits: 4

The first semester of a two-semester sequence in general biochemistry. This course will emphasize the structure of biological molecules, thermodynamics and kinetics of biological reactions, and selected aspects of energy metabolism and metabolic pathways.

Prerequisites: CHEM 322R.

LS-MBB 5562 General Biochemistry II Credits: 3

The second semester of a two-semester sequence in general biochemistry. This course will emphasize selected aspects of the biochemistry of metabolism and macromolecular assemblies. The molecular basis of genetic and metabolic regulation will be discussed.

Prerequisites: LS-MBB 5561.

LS-MBB 5565 Structure And Function Of Proteins Credits: 3

This course will discuss structure-function relationships of proteins. Topics will include: methods of structure-function analysis, catalytic mechanisms, and regulation of enzyme activity.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

LS-MBB 5567 Physical Biochemistry Credits: 3

Application of physical and chemical principles to elucidate structure and function of biochemical systems. The various modes of interactions between biologically important molecules and the specificity of their interaction will be examined through selected literature examples.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

LS-MBB 5569 Current Topics in Molecular Biology and Biochemistry Credits: 1-3

Current topics and recent developments in biochemistry and molecular biology with emphasis on rapidly developing research areas.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

LS-MBB 5591 Directed Individual Studies In Molecular Biology And Biochemistry Credits: 1-6

Intensive readings and/or research in an area selected by the graduate student in consultation with the instructor.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

LS-MBB 5596 Advanced Experimental Molecular Biology I Credits: 2

Structured laboratory work with individual tutorial sessions designed to familiarize first year Interdisciplinary Ph.D. students with concepts and techniques of modern molecular biology research. 1-2 hr/wk tutorial and 15-20 hr/wk of laboratory work.

Co-requisites: LS-MBB 5561.

LS-MBB 5597 Advanced Experimental Molecular Biology II Credits: 2

Continuation of LS-MBB 5596.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

LS-MBB 5599 Thesis Research in Molecular Biology and Biochemistry Credits: 1-12

Research and thesis preparation for M.S. degree candidates.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

LS-MBB 5611 Seminar in Molecular Biology and Biochemistry Credit: 1

Presentation and discussion of selected areas in biochemistry and molecular biology. This course may be repeated by doctoral students for a maximum of 3 credit hours.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

LS-MBB 5690 Analytical Methods in Molecular Biology and Biochemistry Credits: 1-5

A course that emphasizes the development of skills in experimental design, analytical methods and instrumentation as applied to problems of interest to modern molecular biology and biochemistry, and analysis of results. Can be repeated up to a maximum of eight hours total.

Prerequisites: LS-MBB 5561, LS-MBB 5562.

LS-MBB 5696 Dissertation Development Credits: 1-6

This course is individually directed research leading to the fulfillment of the Comprehensive Exam requirements for the Molecular Biology Biochemistry primary discipline. This includes submission of the final, revised version of the NIH-style research proposal to committee members and (ii) successful oral defense of the proposal before the student's research advisory committee.

Prerequisites: BIOLOGY 5501.

LS-MBB 5699 Dissertation Research in Molecular Biology and Biochemistry Credits: 1-12

Research and dissertation preparation for interdisciplinary Ph.D. program students who have Molecular Biology and Biochemistry as a discipline.

Co-requisites: LS-MBB 5561, LS-MBB 5562.

Life Sciences - Microbiology Courses

LS-MCRB 114L Introductory Microbiology Laboratory Credits: 2

Introductory laboratory studies in microbiology and infection to correlate with LS-MCRB 113. For non-majors only; does not count toward biology degree requirements. Recommended preparation: BIOLOGY 112 or LS-MCRB 113.

LS-MCRB 121 Human Biology III (Microbiology) Credits: 3

Basic concepts of microbiology with emphasis on infectious diseases and host defenses. Recommended preparation: CHEM 211.

Prerequisites: LS-ANATO 219 or BIOLOGY 108.

LS-MCRB 121L Human Biology III (Microbiology) Lab Credit: 1

Laboratory exercises demonstrating basic concepts of microbiology with emphasis on infectious diseases and host defenses.

Co-requisites: LS-MCRB 121.

LS-MCRB 4180 Microbiology Credits: 4

Study of infectious diseases, their etiology, symptoms, prevention and treatment. Special emphasis is placed on plaque formation, caries development, periodontal and other oral diseases that relate to dentistry.

Prerequisites: School of Dentistry Student.

LS-MCRB 431 Virology Credits: 3

Survey of the molecular biology of animal, plant, and bacterial viruses. The course will emphasize the molecular mechanisms of virus replication, viral pathogenesis, and the use of virus as model systems to study mammalian cells.

Prerequisites: BIOLOGY 202, BIOLOGY 206.

Co-requisites: BIOLOGY 441.

Life Sciences - Physiology Courses

LS-PHYS 217 Human Physiology Credits: 3

Introduction to body functions presented from an organ systems approach. For non-majors only.

Prerequisites: BIOLOGY 102 (or BIOLOGY 108 or BIOLOGY 109).

LS-PHYS 217 - MOTR LIFS 100P. Essentials in Human Biology - Phys



LS-PHYS 3070 Oral Physiology Credits: 3

Concepts of general physiology will be discussed as they relate to the clinical practice of dental hygiene. Emphasis will be placed on the normal and abnormal physiology of oral structures, including such topics as neurophysiology, muscle function, salivation, and endocrinology.

Prerequisites: Dental Hygiene Student.

LS-PHYS 399 Pharmacy Physiology I Credits: 3

LSPHYS 399 is an introduction to integrated physiology of the human body, beginning with an emphasis on understanding the foundations of physiologic principles followed by an in depth study of the physiology of the nervous, endocrine, and muscle systems. Recommended preparation: BIOLOGY 202 and CHEM 320.

Prerequisites: School of Pharmacy Student.

LS-PHYS 400 Pharmacy Physiology II Credits: 3

LS-PHYS 400 is a continuation into the study of integrated human physiology. Topics covered include the cardiovascular, respiratory, renal, digestive and reproductive systems. Recommended preparation: LS-PHYS 399.

Prerequisites: School of Pharmacy Student.

LS-PHYS 401 Physiology Lecture Credits: 5

An integrated study of normal functions of various organ systems of the human body with special consideration of the physiology of the oral cavity and its related structures.

Prerequisites: School of Dentistry Student.

Medical Technology Courses

MED-TECH 999 Medical Technology Internship Credits: 0-15