SCHOOL OF BIOLOGICAL SCIENCES

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Dean:
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Graduate Programs Officer:
Karen Bame

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Aaron Reed

Director, Student Services and Advising:
Tammy Welchert

Interim Head, Division of Cell Biology and Biophysics:
Marilyn Yoder

Interim Head, Division of Molecular Biology and Biochemistry:
Tony Persechini

History and Description
The School of Biological Sciences was established (originally as the School of Basic Life Sciences) in 1985. The School's vision is "to better the quality of life through excellence in education and research." This vision is realized through the provision of quality education at the undergraduate and graduate levels, the expansion of knowledge through scientific research, and the application of scientific information for the advancement of human welfare. The School has been designated as an eminence program by the curators of the University of Missouri, and as such is a unit targeted for expansion and development.

Research by faculty, as well as graduate and undergraduate students, is focused on cellular and molecular aspects of modern biology, with emphases in molecular genetics, cell biology and structural biology. Advances in these areas will provide fundamental knowledge for biotechnology, molecular medicine, environmental remediation and computational biology. Students are encouraged to gain hands-on research experience, involving them in the process of creating knowledge and equipping them to shape the future.

Quality curriculum combined with research-active faculty and state-of-the-art equipment, provide students with an outstanding opportunity to expand critical thinking and problem solving skills while developing an in-depth understanding of the molecular, cellular, and genetic foundations of biological sciences.

Laboratories
The School of Biological Sciences has modern, well-equipped laboratories organized into the following divisions:

Division of Cell Biology and Biophysics
This division houses the laboratories of anatomy, biophysics, developmental biology, cell biology, microbiology, neurobiology, structural biology and virology.

Division of Molecular Biology and Biochemistry
This division houses the laboratories of biochemistry, genetics, genetic engineering, membrane biochemistry, molecular biology, macromolecular structure, neurophysiology and cellular and molecular physiology.
Organizations and Activities

A campus wide biological sciences seminar program is organized and administered by the school. Throughout the year, weekly advanced research seminars are held, featuring presentations by nationally recognized visiting scientists and campus faculty.

The School of Biological Sciences has both graduate and undergraduate student organizations that meet periodically for scientific discussions and social events.

Faculty

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

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Undergraduate

Undergraduate Degrees:

- Bachelor of Science in Biology (http://catalog.umkc.edu/colleges-schools/biological-sciences/bachelor-of-science-biology)
- Bachelor of Science in Biology, Biomedical Sciences Emphasis (http://catalog.umkc.edu/colleges-schools/biological-sciences/bachelor-of-science-biomedical-sciences-emphasis)
- Bachelor of Science in Biology, Bioinformatics Emphasis (http://catalog.umkc.edu/colleges-schools/biological-sciences/bioinformatics-emphasis)
- Bachelor of Science in Biology, Biotechnology Emphasis (http://catalog.umkc.edu/colleges-schools/biological-sciences/biotechnology-emphasis)
- Bachelor of Science in Biology, Cellular and Molecular Basis of Health and Disease Emphasis (http://catalog.umkc.edu/colleges-schools/biological-sciences/cellular-molecular-basis-of-health-and-disease-emphasis)
- Bachelor of Science in Biology, Clinical Laboratory Science Emphasis (http://catalog.umkc.edu/colleges-schools/biological-sciences/bachelor-of-science-clinical-laboratory-sciences-emphasis)
- Bachelor of Science in Biology, Pre-Dentistry Concentration (http://catalog.umkc.edu/colleges-schools/biological-sciences/pre-dentistry-concentration)
- Bachelor of Arts in Biology (http://catalog.umkc.edu/colleges-schools/biological-sciences/bachelor-of-arts-biology)
- Bachelor of Arts in Biology, combined BA/MD dual degree (http://catalog.umkc.edu/colleges-schools/biological-sciences/requirements-for-bachelor-of-arts-biology-for-combined-ba-md-dual-degree-program)
- Biology Honors Program (http://catalog.umkc.edu/colleges-schools/biological-sciences/honors-program)
- Minor in Biology (http://catalog.umkc.edu/colleges-schools/biological-sciences/requirements-for-minor-biology)
- Elective Courses for the Non-Biology Major (http://catalog.umkc.edu/colleges-schools/biological-sciences/elective-courses-for-non-biology-major)

Courses taught by the School of Biological 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.

Students interested in pursuing undergraduate degree programs offered by the School of Biological Sciences are admitted through the UMKC Office of Admissions (http://www.umkc.edu/admissions). Transfer students should contact the University admissions office and the School of Biological Sciences for information about transfer admissions and evaluation of transfer coursework. Transfer admission eligibility includes an overall grade-point average of at least 2.0 for all college-level coursework attempted at previous institutions, an overall GPA of at least 2.0 in courses used to fulfill School of Biological Sciences major requirements, and a University of Missouri Biology GPA of at least 2.0.
General Information About Undergraduate Programs

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 schools and dental schools and incorporates intermediate and upper-level biology courses specifically recommended by medical/dental school admissions officers. Those who wish to follow the pre-med track have the option to pursue the bachelor of science in biology with the cellular and molecular basis of health and disease emphasis, or apply in Spring of their Sophomore year for admission to the competitive biomedical sciences emphasis. Students pursuing admission to dental school may earn a bachelor of science in biology while completing coursework in the a pre-dentistry concentration. Those who are interested in a career as a clinical laboratory scientist/medical technologist may choose to pursue the bachelor of science in biology with the clinical laboratory science emphasis.

Undergraduate Advising

The School of Biological Sciences' team of well-trained academic advisors assists undergraduate students in developing individual plans of study. As teaching faculty, the advisors are uniquely qualified to help students understand and address course selection and professional development issues. Students will find the School of Biological Sciences Undergraduate Programs Handbook, which contains the latest information about degree requirements, academic rules, and related matters, on Blackboard under Biological Sciences Advising. Information on time management, reading and note-taking skills, communicating with professors, and taking exams can also be found on the Biological Sciences Advising site in Blackboard. To facilitate progress toward the student’s degree, and to ensure that courses selected provide an appropriate academic program, students are required to participate in advising each semester before registering for classes.

Students enrolled in double majors or degree programs are advised by both academic units. The primary academic unit generally has the major advising responsibility. However, for issues pertaining specifically to a biology degree, an advisor at the School of Biological Sciences must be consulted.

Students are responsible for becoming familiar with all academic regulations of the campus as outlined in the catalog and in other University documents, including the SBS Undergraduate Programs Handbook.

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

The School of Biological 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 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 they host informational meetings/workshops about aspects of planning for a health professions career, provide information on admission exam preparation, assist in the application process and in developing a personal statement, and help the student work with Career Services to compile a letter of recommendation file. 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 (http://catalog.umkc.edu/pre-medicine-pre-health-home-page) for other information.

Graduate

Graduate Degrees:

- Master of Arts in Biology (http://catalog.umkc.edu/colleges-schools/biological-sciences/master-of-arts-biology)
- Doctor of Philosophy Study (http://catalog.umkc.edu/colleges-schools/biological-sciences/doctor-of-philosophy-study)

The School of Biological 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 and 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

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.

Graduate 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 (http://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.
• 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.

Requirements for Retention
General requirements for retention of graduate students are described in the Graduate Academic Regulations and 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 102L Biology and Living 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.

Prerequisites: BIOLOGY 102.

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 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 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.


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 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.

Prerequisites: BIOLOGY 108, Biology major, Consent of Instructor.

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.


BIOLOGY 203 Essential Cell Biology Credits: 3
Foundations of cellular functions. Serves as a bridge between biochemistry and cell and organ physiology for dental students. Applications of fundamental principles to the physiology and pathology of the oral tissues will be stressed.

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, BIOLOGY 109, CHEM 212R.

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, BIOLOGY 109 (or BIOLOGY 102).

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.

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

BIOLOGY 305 Marine and Freshwater Biology Credits: 3
Introduction to the study of marine ecology, deep-sea biology, oceanic nektan, 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 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: LS-BIOC 341.
Co-requisites: BIOLOGY 409.

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 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 109, BIOLOGY 202, CHEM 212R.

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.
Prerequisites: BIOLOGY 202, BIOLOGY 328.

Co-requisites: CHEM 212R.

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.
Prerequisites: BIOLOGY 202, CHEM 212R.

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: LS-PHYS 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 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.
Prerequisites: BIOLOGY 108, and BIOLOGY 109, and BIOLOGY 109L.

BIOLOGY 344 Bioorganic Structure and Biomolecular Function Credits: 3
An introduction to chemical and physical properties of complex biological macromolecules and their functions in living cells. Nomenclature, functional groups, reactions and stereochemistry are among the topics to be emphasized.
Prerequisites: BIOLOGY 109, CHEM 320, CHEM 322R.

BIOLOGY 346 Plant Biology Credits: 3
An integrated 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.

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 385 Special Topics Credits: 1-3
In depth exploration of a topic in biology

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.
Prerequisites: LS-PHYS 316.

BIOLOGY 427 Plant Physiology Credits: 3
A study of the biochemical and physical processes involved in plant function at the molecular and cellular level and the mechanisms by which plants respond to environmental challenges.
Prerequisites: BIOLOGY 202, BIOLOGY 206, LS-BIOC 341.

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: LS-BIOC 341 (or LS-PHYS 316).

BIOLOGY 485 Special Topics Credits: 1-3
In depth exploration of a topic in biology

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.
Prerequisites: Advisor Consent, BIOLOGY 108, BIOLOGY 109, BIOLOGY 202, BIOLOGY 206, CHEM 320 (or CHEM 322R), RooWriter.

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.
Prerequisites: 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 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: LS-BIOC 341, 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: LS-PHYS 316 (or equivalent).

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: LS-PHYS 316 (or equivalent).

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
BIOLOGY D285 Special Topics Credits: 1-3
In depth exploration of a topic in biology

Life Sciences Courses

LIFE-SCI 201 Healthcare Professions Seminar 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. 
Prerequisites: BIOLOGY 108, BIOLOGY 109, CHEM 212R.

LIFE-SCI 202 Exploring Healthcare Professions Credit: 1
Students will gain an understanding of the role and scope of practice of health professionals, patient privacy, professionalism, and a deeper appreciation of what it means to be a patient through facilitated shadowing experiences. 
Prerequisites: BIOLOGY 202, BIOLOGY 206, CHEM 322R.

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. 
Prerequisites: BIOLOGY 202, BIOLOGY 206.

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. 
Prerequisites: LIFE-SCI 310.

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. 
Prerequisites: LIFE-SCI 320.

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. 
Prerequisites: LIFE-SCI 330.

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: BIOLOGY 108, BIOLOGY 109, CHEM 212R, 3.0 Science GPA.

LIFE-SCI 401 Biophysical Principles Credits: 3
Fundamental biophysical concepts and their application to the study of biological molecules, particularly macromolecules and supramolecular structures. Includes discussion of thermodynamics, kinetics, and spectroscopy. 
Prerequisites: LS-BIOC 341, MATH 210, PHYSICS 210 (or PHYSICS 240).

LIFE-SCI 438 Molecular Recognition in Cellular Biology Credits: 2
Studies the latest development leading to an increased understanding of cellular biology processes when the experimental tools of structural biology analysis and molecular genetics are applied. 
Prerequisites: BIOLOGY 108, BIOLOGY 109, BIOLOGY 202, BIOLOGY 206, LS-BIOC 341.

LIFE-SCI 490WI 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. 
Prerequisites: RooWriter.

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: Completion of Biology degree core requirements, minimum GPA of 3.0.
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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.
LIFE-SCI 497P Directed Studies - Biotechnology Credits: 1-3
Individual or small group study of topics in the area of biotechnology including classroom 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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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 499 may not exceed 4 credit hours toward biology course degree requirements.

**Prerequisites:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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.

**Prerequisites:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.

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:** Completion of Biology degree core requirements, minimum GPA of 3.0.
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: Completion of Biology degree core requirements, minimum GPA of 3.0.

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.

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: Completion of Biology degree core requirements, minimum GPA of 3.0.

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.
Prerequisites: RooWriter.

Life Sciences - Anatomy Courses
LS-ANATO 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).

LS-ANATO 218L Introductory Anatomy Laboratory Credits: 2
Laboratory investigation of cells, tissues, and organs with special emphasis on their interrelationship in vertebrates.
Co-requisites: LS-ANATO 218.

LS-ANATO 219 Functional Anatomy I Credits: 3
An introduction to the functional anatomy of vertebrates with emphasis on organs, organ systems and tissues.

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.

Life Sciences - Biochemistry Courses
LS-BIOC 304 Biochemistry and Nutrition Credits: 4
The chemistry of the structures and processes of the human body in their normal condition with special consideration of the chemical aspects of disease of the oral structure. A presentation of the basic principles of nutrition.

LS-BIOC 3120 Biochemistry and Nutrition Credits: 3
The fundamentals of biochemistry and the nutritional implications as they relate to source and utilization of essential nutrients.

LS-BIOC 3240 Applied Nutrition Credits: 3
Students will discuss life cycle nutrition as it relates to preventive dentistry and total health. Nutritional factors from infancy to old age are discussed, including diet and nutrition for special patients such as expectant mothers, diabetics, patients with heart disease, fracture patients, institutionalized patients, etc. Students will provide nutritional counseling to healthy patients and special patients within the framework of the course. Principles will be utilized in later clinical courses and practicums.

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.
Prerequisites: 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.
Prerequisites: BIOLOGY 202, BIOLOGY 206, CHEM 320 (or CHEM 322R), LS-BIOC 341.

LS-BIOC 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: LS-BIOC 341.

LS-BIOC 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: LS-BIOC 341.
LS-BIOC 365 Human Biochemistry I Credits: 3
The basic principles of human biochemistry for pharmacy students presented in a two-term integrated unit. Topics will include the chemistry and mechanisms involved in biosynthesis, degradations and utilization of the major constituents of living systems and the biochemistry of specialized tissues, hormones, nutrition and regulation. Restricted to students in the School of Pharmacy.
Prerequisites: CHEM 320 (or CHEM 322R).

LS-BIOC 366 Human Biochemistry II Credits: 3
The basic principles of human biochemistry for pharmacy students and other undergraduates presented in a two-term integrated unit. Topics will include 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: LS-BIOC 365, School of Pharmacy Student.

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.
Prerequisites: Admission into the UMKC Pharm.D. program.

LS-BIOC 425 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: LS-BIOC 341

LS-BIOC 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.

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 Gradute 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.

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.

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.
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.


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.


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.


LS-CBB 5599 Thesis Research in Cell Biology and Biophysics Credits: 1-12
Research and thesis preparation for M.S. degree candidates.


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.


LS-CBB 5690 Analytical Methods in Cell Biology and Biophysics Credits: 1-4
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 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.


**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.


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: 3
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.

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.

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.

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.

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.

LS-MBB 5599 Thesis Research in Molecular Biology and Biochemistry Credits: 1-12
Research and dissertation preparation for M.S. degree candidates.

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.

LS-MBB 5690 Analytical Methods in Molecular Biology and Biochemistry Credits: 1-4
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 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.

Life Sciences - Microbiology Courses
LS-MCRB 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.

LS-MCRB 113 Introductory Microbiology Credits: 3
An introduction to microbiology with emphasis on infection and the basis of immunity. For non-majors only; does not count toward Biology degree requirements.

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.
Prerequisites: LS-MCRB 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.
Prerequisites: CHEM 211, LS-ANATO 219.

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.
Prerequisites: LS-MCRB 121.

LS-MCRB 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.

LS-MCRB 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.
Prerequisites: LS-MCRB 313.

LS-MCRB 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.
Prerequisites: LS-MCRB 313.

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.

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 viruses as model systems to study mammalian cells.
Prerequisites: BIOLOGY 202, BIOLOGY 206.

LS-MCRB 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: LS-MCRB 313L (or LS-BIOC 365), LS-MCRB 121 (or LS-MCRB 313).

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 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.

LS-PHYS 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 208, LS-BIOC 341.

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.
Prerequisites: BIOLOGY 202, CHEM 320.

LS-PHYS 400 Pharmacy Physiology II Credits: 3
LSPHYS 400 is a continuation into the study of integrated human physiology. Topics covered include the cardiovascular, respiratory, renal, digestive and reproductive systems.
Prerequisites: LS-PHYS 399.
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.

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