

MOLECULAR, CELLULAR AND DEVELOPMENTAL BIOLOGY

The undergraduate program in molecular, cellular and developmental biology (MCDB) is directed toward understanding the molecular and cellular mechanisms that provide the basis for biological structure, growth, evolution, embryonic development and genetic inheritance. Undergraduate majors learn about the scientific method, experimental approaches and groundbreaking discoveries that have made modern molecular and cellular biology such an important force in medicine, agriculture, and the growing biotechnology industry. They also learn about the diverse tools of modern biology, including recombinant DNA, genomic mapping, transgenic organisms, gene targeting, analysis of mutants, biochemical purification, antibody probes, laser manipulation of living cells, light and electron microscopy, and computer modeling. In addition to academic and laboratory classes, MCDB majors have many opportunities to participate in ongoing research in the department.

Learn how living systems operate at the cellular and molecular levels of organization, their assembly and structure, with heavy emphasis on genetic information and regulation, including embryonic development.

Course code for this program is MCDB.

Animal Use Policy

Biology is the science of life, and a major in it must include some hands-on experience with living organisms to be complete. Exercises involving the use of living animals or animal tissues are included, therefore, in MCDB laboratory courses. Majors with objections on moral grounds may arrange to limit their participation in these exercises, although their educational experience is compromised by doing so.

Nonmajors may take MCD biology lecture courses without the accompanying laboratories. Laboratory courses in which living vertebrate animals or tissues are used are identified in the course description section of this catalog. For additional information, please contact the department.

Bachelor's Degree

- Molecular, Cellular and Developmental Biology - Bachelor of Arts (BA) (catalog.colorado.edu/undergraduate/colleges-schools/arts-sciences/programs-study/molecular-cellular-developmental-biology/molecular-cellular-developmental-biology-bachelor-arts-ba/)

Minor

- Molecular, Cellular and Developmental Biology - Minor (catalog.colorado.edu/undergraduate/colleges-schools/arts-sciences/programs-study/molecular-cellular-developmental-biology/molecular-cellular-developmental-biology-minor/)

Faculty

While many faculty teach both undergraduate and graduate students, some instruct students at the undergraduate level only. For more information, contact the faculty member's home department.

Abbott, Lois A.
Senior Instructor Emerita

Anseth, Kristi S. (https://experts.colorado.edu/display/fisid_103471/)
Distinguished Professor; PhD, University of Colorado Boulder

Betterton, Meredith D. (https://experts.colorado.edu/display/fisid_125396/)
Associate Professor; PhD, Harvard University

Blumenthal, Thomas (https://experts.colorado.edu/display/fisid_143346/)
Professor, Visiting Professor; PhD, Johns Hopkins University

Boswell, Robert E. (https://experts.colorado.edu/display/fisid_100196/)
Professor; PhD, University of Colorado Boulder

Cech, Thomas R. (https://experts.colorado.edu/display/fisid_103252/)
Distinguished Professor; PhD, University of California, Berkeley

Chen, Zhe (https://experts.colorado.edu/display/fisid_148754/)
Assistant Research Professor; PhD, University of Colorado Boulder

Copley, Shelley (https://experts.colorado.edu/display/fisid_104067/)
Professor; PhD, Harvard University

DeDecker, Brian S. (https://experts.colorado.edu/display/fisid_143934/)
Senior Instructor; PhD, Yale University

Detweiler, Corrella Scott (https://experts.colorado.edu/display/fisid_128240/)
Associate Professor; PhD, University of California, San Francisco

Donaldson, Zoe Rebecca (https://experts.colorado.edu/display/fisid_157087/)
Assistant Professor; PhD, Emory University

Dowell, Robin D. (https://experts.colorado.edu/display/fisid_147779/)
Associate Professor; DSc, Washington University

Dubin, Mark W.
Professor Emeritus

Espinosa, Joaquin Maximiliano (https://experts.colorado.edu/display/fisid_134378/)
Visiting Associate Professor; PhD, Univ of Buenos Aires (Argentina)

Fillman, Christy L. (https://experts.colorado.edu/display/fisid_145115/)
Senior Instructor; PhD, University of Colorado Boulder

Garcea, Robert L. (https://experts.colorado.edu/display/fisid_146103/)
Professor; MD, University of California, San Francisco

Gold, Lawrence (https://experts.colorado.edu/display/fisid_100581/)
Professor; PhD, University of Connecticut

Guild, Nancy Ann
Professor Attendant Rank; PhD, University of Colorado

Han, Min (https://experts.colorado.edu/display/fisid_105512/)
Professor; PhD, University of California, Los Angeles

Harvey, Pamela Ann (https://experts.colorado.edu/display/fisid_148012/)
Instructor; PhD, Tufts University

Hoenger, Andreas (https://experts.colorado.edu/display/fisid_142883/)
Professor; PhD, Universität Basel (Switzerland)

- Jones, Kevin Robert (https://experts.colorado.edu/display/fisid_102094/)
Associate Professor; PhD, University of California, Berkeley
- Junge, Harald Jobst (https://experts.colorado.edu/display/fisid_148593/)
Assistant Professor; PhD, Philipps-Universität Marburg (Germany)
- Klymkowsky, Michael W. (https://experts.colorado.edu/display/fisid_101226/)
Professor; PhD, California Institute of Technology
- Knight, Jennifer Kirsten (https://experts.colorado.edu/display/fisid_101933/)
Associate Professor; PhD, University of Michigan Ann Arbor
- Kralj, Joel M. (https://experts.colorado.edu/display/fisid_153055/)
Assistant Professor; PhD, Boston University
- Krauter, Kenneth S. (https://experts.colorado.edu/display/fisid_107978/)
Professor; PhD, Yeshiva University
- Kuempel, Peter L.
Professor Emeritus
- Leinwand, Leslie Anne (https://experts.colorado.edu/display/fisid_107104/)
Distinguished Professor, Faculty Director; PhD, Yale University
- Martin, Jennifer Mary (https://experts.colorado.edu/display/fisid_110125/)
Senior Instructor; PhD, University of Washington
- Mastronarde, David N.
Professor Attendant Rank; PhD, University of Colorado
- McConkey, Edwin H.
Professor Emeritus
- McIntosh, J. Richard
Distinguished Professor Emeritus
- Niswander, Lee (https://experts.colorado.edu/display/fisid_160024/)
Chair, Professor; PhD, Case Western Reserve University
- Odorizzi, Charles Gregory (https://experts.colorado.edu/display/fisid_118429/)
Professor; PhD, University of California, San Diego
- Old, William (https://experts.colorado.edu/display/fisid_103039/)
Assistant Professor; PhD, University of Colorado Boulder
- Olwin, Bradley Bruce (https://experts.colorado.edu/display/fisid_109888/)
Professor, Associate Chair; PhD, University of Washington
- Orth, James D. (https://experts.colorado.edu/display/fisid_152017/)
Assistant Research Professor; PhD, Mayo Graduate School of Medicine
- Pace, Norman R.
Distinguished Professor Emeritus
- Park, Soyeon (https://experts.colorado.edu/display/fisid_151944/)
Assistant Professor; PhD, Mayo Graduate School of Medicine
- Parker, Roy Robert (https://experts.colorado.edu/display/fisid_151440/)
Distinguished Professor; PhD, University of California, San Francisco
- Perkins, Thomas T. (https://experts.colorado.edu/display/fisid_124578/)
Associate Professor Adjoint; PhD, Stanford University
- Runner, Meredith
Professor Emeritus
- Sawyer, Sara Lea (https://experts.colorado.edu/display/fisid_155218/)
Associate Professor; PhD, Cornell University
- Shen, Jingshi (https://experts.colorado.edu/display/fisid_146414/)
Associate Professor; PhD, Columbia University
- Singh, Ravinder (https://experts.colorado.edu/display/fisid_112067/)
Associate Professor; PhD, Baylor College of Medicine
- Staelin, L. Andrew
Professor Emeritus
- Stowell, Michael (https://experts.colorado.edu/display/fisid_124136/)
Associate Professor; PhD, California Institute of Technology
- Su, Tin Tin (https://experts.colorado.edu/display/fisid_113847/)
Professor, Chair; PhD, Carnegie Mellon University
- Sueoka, Noboru
Professor Emeritus
- Van Blerkom, Jonathan (https://experts.colorado.edu/display/fisid_100545/)
Research Professor; PhD, University of Colorado Boulder
- Vigers, Alison Jane (https://experts.colorado.edu/display/fisid_142378/)
Instructor; PhD, University of Colorado Denver
- Voeltz, Gia Kaarina (https://experts.colorado.edu/display/fisid_143587/)
Professor; PhD, Yale University
- Weaver, Benjamin
Assistant Professor; PhD, University of Kansas
- Wood, William B. III
Distinguished Professor Emeritus
- Xue, Ding (https://experts.colorado.edu/display/fisid_112336/)
Professor; PhD, Columbia University
- Yarus, Michael J.
Professor Emeritus

Courses

MCDB 1020 (1) Introduction to Molecular, Cellular and Developmental Biology Major

Introduces students to the Molecular and Cellular Biology major. Provides an overview of the major and how it differs from other CU biology programs; how to get involved in clubs, research, and/or internship opportunities; strategies for succeeding in MCDB courses; and career options. This is a first-year colloquium course specifically designed for freshman and other students exploring their educational and career opportunities in our department.

Recommended: New MCDB majors.

Grading Basis: Pass/Fail

MCDB 1030 (3) Introduction to Molecular Biology

Introduces the foundation of molecular, cell, developmental and evolutionary biology in the context of human development and disease. Including how the immune system works to protect us from infections and technologies being developed towards the goal of better health around the world. For nonmajors.

Additional Information: GT Pathways: GT-SC2 -Natural Physicl Sci:Lec Crse w/o Req Lab

Arts Sci Core Curr: Natural Science Sequence

Arts Sci Gen Ed: Distribution-Natural Sciences

MAPS Course: Natural Science

MCDB 1041 (3) Fundamentals of Human Genetics

Covers the basic principles of genetics, human pedigree analysis, and how genetic diseases affect DNA, RNA, and proteins. Considers implications of this research for medicine and society. For nonmajors.

Recommended: Requisite good background in high school chemistry and biology.

Additional Information: GT Pathways: GT-SC2 -Natural Physicl Sci:Lec Crse w/o Req Lab

Arts Sci Core Curr: Natural Science Sequence

Arts Sci Gen Ed: Distribution-Natural Sciences

MAPS Course: Natural Science

MCDB 1043 (1) Exploring Genetics Laboratory

Provides hands-on experience with fundamental genetic principles. Topics include scientific method, experimental design, mitosis, meiosis, classical genetics, molecular genetics, mutagenesis, DNA analysis, and transgenic organisms. Wherever possible, the focus of the lab will be on integrating science process skills with human-relevant experiments to encourage students to learn and apply science skills while seeing the application to humans.

Requisites: Restricted to Biological Sciences (MCDB) non-majors only.

Recommended: Corequisite MCDB 1041.

Additional Information: Arts Sci Core Curr: Natural Science Lab

Arts Sci Gen Ed: Distribution-Natural Sci Lab

Arts Sci Gen Ed: Distribution-Natural Sciences

MAPS Course: Natural Science Lab or Lab/Lec

MCDB 1111 (3) Core Concepts in Biology I: Evolutionary, Molecular and Cell Biology

Web-based, in-class discussion course covering the fundamental properties shaping living systems. Uses evolutionary (including social) and physical-chemical mechanisms to frame molecular, cellular and organismic processes. Interpreting and answering questions scientifically as well as quantitative reasoning skills are stressed. Fulfills the MCDB major's requirement for MCDB 1150.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 1150

Additional Information: Arts Sci Core Curr: Natural Science Sequence

Arts Sci Gen Ed: Distribution-Natural Sciences

MAPS Course: Natural Science

MCDB 1150 (3) Introduction to Cellular and Molecular Biology

Covers biologically important macromolecules and biological processes, together with an introduction to cell structure, function, and physiology. Provides the foundation for advanced MCDB courses to majors, and a rigorous overview of modern biology to non-majors.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 1111

Recommended: Prerequisite high school chemistry and algebra, and recommended corequisite of MCDB 1152.

Additional Information: GT Pathways: GT-SC2 -Natural Physicl Sci:Lec Crse w/o Req Lab

Arts Sci Core Curr: Natural Science Sequence

Arts Sci Gen Ed: Distribution-Natural Sciences

MAPS Course: Natural Science Lab or Lab/Lec

MCDB 1152 (1) Problem Solving Co-Seminar for Introduction to Molecular and Cellular Biology

Uses problem solving and other interactive group work to aid student learning in a corequisite course, MCDB 1150. Students will work in small groups on learning and practicing how to solve difficult conceptual problems, as well as using hands-on activities and concept mapping to help learn content.

Recommended: Corequisite MCDB 1150.

Grading Basis: Pass/Fail

MCDB 1161 (2) From Dirt to DNA: Phage Genomics Laboratory I

Provides laboratory experience working on a bacteriophage genomics research project. Students will study novel bacteriophage they isolate from the environment. Topics covered include phage biology, bacteria and phage culturing and amplification, DNA isolation, restriction digest analysis, agarose gel electrophoresis, and electron microscopy.

Recommended: Prerequisites or corequisites: MCDB 1150 or EBIO 1210.

Grading Basis: Letter Grade

Additional Information: Arts Sci Core Curr: Natural Science Lab

Arts Sci Gen Ed: Distribution-Natural Sci Lab

Arts Sci Gen Ed: Distribution-Natural Sciences

MAPS Course: Natural Science Lab or Lab/Lec

MCDB 1171 (2) Drug Discovery Through Hands-on Screens I

Provides introductory research and laboratory experience. Students will work in teams to screen small molecule libraries for novel antibiotics using the bacterium Salmonella as a model system. Topics covered include the basic biology of the model system, genetics, approaches to screening for new therapeutics, statistical analysis of the data, compound verification and lead compound development.

Recommended: Prerequisite or corequisite MCB 1150 or EBIO 1210.

Grading Basis: Letter Grade

Additional Information: Arts Sci Core Curr: Natural Science Lab

Arts Sci Gen Ed: Distribution-Natural Sci Lab

Arts Sci Gen Ed: Distribution-Natural Sciences

MAPS Course: Natural Science Lab or Lab/Lec

MCDB 1181 (2) Biological Probiotic/Drug Discovery Through Hands-on Screens

Provides introduction to research and laboratory experience. Students will work in teams to screen novel mycobacterial strains for use as probiotics or immunoregulatory/anti-inflammatory drugs using THP-1 cells, a human monocytic cell line. Topics covered include the hygiene or "Old Friends" hypothesis, the human microbiome, approaches to screening for new probiotics of therapeutics and statistical analysis of the data.

Equivalent - Duplicate Degree Credit Not Granted: IPHY 1181

Grading Basis: Letter Grade

MCDB 1234 (1-9) Skills Center: Modular Laboratory of Modern Molecular Biology Skills

Dedicated to teaching students fundamental laboratory skills in modern molecular biology. The skills are updated on a rolling basis in consultation with MCDB faculty and local Pharma/Biotech companies in an effort to provide students with real world skills that can help them transition from a traditional lab course environment to a more independent research environment. Credit hours are determined according to the Colorado Department of Higher Education guidelines such that 12.5 module hours equals one university credit hour. Students can mix and match various skills to receive one or more university credit hours and students who successfully complete a module are given a certificate recognizing their competency.

Repeatable: Repeatable for up to 15.00 total credit hours.

MCDB 2150 (3) Principles of Genetics

Introduces the behavior of genes and chromosomes in eukaryotic and prokaryotic organisms. Covers three areas: transmission genetics, molecular genetics, and population genetics. Attention is given to genetic mapping, recombinant DNA procedures, and gene expression.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 2222

Recommended: Prerequisite MCDB 1150 or EBIO 1210 or CHEN 2810 (minimum grade C-) and recommended corequisite of MCDB 2152.

Additional Information: GT Pathways: GT-SC2 -Natural Physicl Sci:Lec Crse w/o Req Lab

Arts Sci Core Curr: Natural Science Sequence

Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 2152 (1) Problem Solving Co-Seminars for Genetics

Uses problem solving and other interactive group work to aid student learning in MCDB 2150. Students will work in small groups on learning and practicing how to solve difficult conceptual problems, as well as using hands-on activities and concept mapping to help learn content.

Recommended: Corequisite MCDB 2150.

Grading Basis: Pass/Fail

MCDB 2161 (2) From DNA to Genes, Phage Genomics Laboratory II

Provides laboratory experience working on a bacteriophage isolated during the previous semester. Topics include bioinformatics, genome annotation, open reading frame and RNA identification, BLAST analysis, phylogenetics and submission to a genomic database.

Requisites: Requires prerequisite course of MCDB 1161 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 2171 (2) Drug Discovery Through Hands-On Screens 2

Provides introductory research and laboratory experience. Students will work in teams to screen molecule libraries using fruit flies as a model system. Topics covered include the basic biology of the model system, genetics, approaches to screening for new therapeutics, statistical analysis of the data, compound verification and lead compound development.

Recommended: Prerequisite or corequisite MCB 1150 or EBIO 1210.

Grading Basis: Letter Grade

Additional Information: Arts Sci Core Curr: Natural Science Lab

Arts Sci Gen Ed: Distribution-Natural Sci Lab

Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 2200 (3) Introduction to Biophysical Methods: From Brains to Bonds

Provides a practical overview of modern biophysical methods used to study biological systems from whole body imaging methods to methods for investigating single molecules and molecular bonds. The goal of this course is to provide a broad survey of methods available to the modern biologist rather than a complete in-depth treatment of the physics and mathematics of each individual method.

Requisites: Requires prerequisite course of MCDB 1150 or EBIO 1210 (minimum grade C-).

MCDB 2222 (3) Core Concepts in Biology II: Genes, Genetics and Phenotypes

Web-based, in-class discussion course focused on the origins of genetic variation and inheritance, genome dynamics and gene expression and their relationship to phenotype(s). Interpreting, explaining and answering questions scientifically as well as quantitative reasoning are stress.

Course fulfills the departmental requirement for MCDB 2150.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 2150

Requisites: Requires a prerequisite course of MCDB 1111 or MCDB 1150 (minimum grade C-).

Grading Basis: Letter Grade

Additional Information: Arts Sci Core Curr: Natural Science Sequence

Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 2350 (3) Understanding Cancer: Introduction to the disease's biology, medicine, and societal implications

A course for students who want to learn about cancer but have little or no background in biology. It is based on a text that presents relevant science and medicine in a readable and comprehensible way. Classes will be discussion of material from the text with weekly quizzes for feedback. The ethics and economics of cancer treatments will be discussed, along with ways to minimize one's own cancer risk and live with cancer if necessary.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 2840 (1-3) Lower-Division Independent Study

Students with adequate prerequisites should take MCDB 4840.

Repeatable: Repeatable for up to 8.00 total credit hours.

MCDB 3000 (3) Synthetic Biology: Engineering Biomolecular Systems in the Laboratory

Hands-on research experience in engineering biological systems. Students will design biological systems to address relevant medical and environmental problems facing our society. They will learn how to build their molecular designs in the lab using current synthetic biology techniques. Students will also learn how to critically evaluate current research in the field and effectively communicate their own research. Formerly offered as a special topics course.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Requires prerequisite courses of (MCDB 1150 and MCDB 2150) or CHEN 2810 (all minimum grade C).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sci Lab

MCDB 3010 (2) Undergraduate Teaching in Course-Based Undergraduate Research Experiences

To address the need for more advanced and continued participation in course-based research, MCDB 3010 is designed to train students who have taken MCDB 1171 or MCDB 2171 or MCDB 4202 as teaching assistants. The aim is to enhance the students' experience and responsibilities in course-based research and to prepare them for research and mentorship in a departmental or graduate laboratory.

Repeatable: Repeatable for up to 4.00 total credit hours.

Requisites: Requires prerequisite course of MCDB 1171 or MCDB 2171 or MCDB 1161 or MCDB 4202 (minimum grade B).

Grading Basis: Letter Grade

MCDB 3105 (3) Antibiotics: Functions and Failures

Learn about treatments for infectious diseases, how the first antibiotics were discovered, where they come from, how and why they work, and how resistance develops. Understand how antibiotics make modern medicine possible. Explore ways clinicians minimize the spread of resistance to antibiotics. Examine how new antibiotics and other approaches to treating infection are being developed.

Requisites: Requires prerequisite course of MCDB 2150 (minimum grade C).

Grading Basis: Letter Grade

MCDB 3135 (3) Molecular Biology

Examines the central dogma of biology by discussing the most important molecules in cells (DNA, RNA and protein) and how their synthesis (DNA replication, transcription, RNA processing and translation) is regulated. Incorporated into the discussion is how recombinant DNA techniques are used to discover and dissect cellular processes, how to design and interpret experiments, and understanding the limits of experiments to draw conclusions.

Requisites: Requires prerequisite courses of MCDB 2150 or EBIO 2070 and CHEM 1113 or CHEM 1400 or CHEN 1211 (all minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 3140 (2) Cell Biology Laboratory

Provides laboratory experience using microscopy, bioinformatics, DNA isolation, PCR and gel electrophoresis to study cell biology and gene expression in a model organism. Students will learn research skills such as interpreting data and planning experiments.

Recommended: Corequisite MCDB 3135 or MCDB 3145.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sci Lab
Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 3145 (3) Cell Biology

Examines intracellular mechanisms, including transport of ions and small molecules across membranes; protein targeting to organelles; membrane trafficking between organelles; signal transduction; the cytoskeleton; and the cell cycle.

Requisites: Requires prerequisite courses of (MCDB 2150 or EBIO 2070) and (CHEM 1113 or CHEM 1400 or CHEN 1211) (all minimum grade C-).

Recommended: Prerequisite or corequisite MCDB 3140 concurrent with either this class or MCDB 3135.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 3150 (3) Biology of the Cancer Cell

Highlights dimensions of the cancer problem; cancer as a genetic/cellular disease; chemicals, viruses, and radiation as causes of cancer; cancer and diet; cancer epidemiology; cancer risk factors; proto-oncogenes, oncogenes, and cancer suppressor genes; and prevention of cancer.

Recommended: Prerequisite MCDB 2150 or EBIO 2070 (minimum grade C-).

Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence
Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 3160 (3) Infectious Disease

Illustrate how cutting edge tools in genomics can be used to study, monitor and cure disease caused by new and re-emerging human pathogens such as SARS/MERS, Ebola virus, Neisseria meningitides, influenza virus and malaria parasites. Technologies covered will include genome sequencing, annotation, transcriptomics, phylogenetics and genotyping of microbial populations. An integrated approach to this topic will be presented, with these concepts threaded throughout: natural history and evolution of pathogens, molecular biology, immunology, epidemiology, public health and clinical diagnosis. There may be some overlap with material covered in MCDB 1030 and MCDB 4750.

Requisites: Requires prerequisite course of MCDB 2150 or EBIO 2070 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 3171 (2) Advanced Discovery Based Lab - Antibiotics

Provides students an opportunity to expand upon the research they performed in the introductory level course, Drug Discovery Through Hands on Screens I (MCDB 1171). Students will work in teams to validate potential antibiotics against human pathogens. Topics include hit validation, dose response, mechanism of action, applied statistical analysis, and an introduction to the primary literature.

Repeatable: Repeatable for up to 4.00 total credit hours.

Requisites: Requires prerequisite course of MCDB 1171 (minimum grade C-).

Grading Basis: Letter Grade

MCDB 3300 (3) Personalized Medicine - Recent Advances in Diagnostics and Therapeutics

Time for personalized medicine is now. Attempts to learn from and put the patient/person back into the equation because personalized medicine, at its worst, does nothing personal at all. Discusses historical perspective, recent advances in molecular biology and medicine (including OMICS) in regards to diagnostics and therapeutics for selected human diseases, and what the future holds for personalized medicine. Guest lectures (medical experts, patients, family members) will further enrich the course.

Recommended: Prerequisites MCDB 2150 or EBIO 2070.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 3330 (3) Evolution and Creationism

Intensive lecture/discussion course on the interrelationships among science, religion, and social policy. Includes historical and scientific development of evolution theory, social Darwinism/sociobiology, and the public perception of science.

Recommended: Prerequisite MCDB 1150 or EBIO 1210 (minimum grade C-).

Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence
Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 3332 (1) Scientific Ethics

A reading/discussion course on the implications of modern biologically-based technologies, from in vitro fertilization and its variants and issues surrounding these techniques, to genomic testing of embryos and adults, the genetic engineering of organisms, including humans, to issues surrounding communicable diseases and vaccination. Discussion will include a serious consideration of various philosophical and non-scientific perspectives.

Requisites: Requires prerequisite course of MCDB 1150 or EBIO 1210 (minimum grade C). Restricted to students with 57-180 credits (Juniors or Seniors).

Grading Basis: Letter Grade

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 3333 (3) Biomedical Innovations and Discoveries

Discusses how biological inventions and discoveries fuel biomedical innovations, how important techniques in molecular biology have advanced our understanding of cellular processes and contributed to biotechnology revolution and biomedical sciences to benefit our society. Guest lectures from experts in industry and site visits will enhance the course by providing a non-academic perspective, networking opportunities, and unexpected avenues for career paths for our graduates. Department enforced prerequisite: MCDB 2150 or EBIO 2070 or instructor consent.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 3350 (3) Fertility, Sterility, and Early Mammalian Development

Describes the production of germ cells, ovulation, fertilization, reproductive cycles, controls of reproduction, early development of the embryo, methods of contraception, and causes and treatments of sterility. Recommended for students planning careers in the health sciences.

Recommended: Prerequisite MCDB 1150 or EBIO 1210 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 3450 (3) Biological Data Science

The central function of data science is to extract information from complex datasets. Biology is an increasingly large-data endeavor with health care records, genomics datasets, and extensive imaging. This course will develop core data science skills, including statistical analysis, visualization, data management, machine learning, and modeling.

Recommended: Prerequisite MCDB 2150 or EBIO 2070 (minimum grade C-), or exposure to probability theory.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 3501 (3) Structural Methods for Biological Macromolecules

Teaches fundamental knowledge about protein structures, protein interactions and protein folding. Discusses in detail the most common methods on how proteins and macromolecular complexes are studied, such as X-ray crystallography, NMR-spectroscopy and electron microscopy. Offers about 50 percent direct teaching, 40 percent discussion of papers in a journal club style and 10 percent hands-on practicals on software packages relevant to structural biology. Formerly MCDB 4501.

Recommended: Prerequisite MCDB 2150 or EBIO 2070 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 3650 (3) The Brain - From Molecules to Behavior

Examines the molecular basis of the brain's role in thought, action, and consciousness by exploring issues such as relationship of cognition and localized brain function, sensory systems and their role in cognition, learning and memory, and behavioral neurochemistry.

Recommended: Prerequisite MCDB 2150 or EBIO 2070 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 3651 (3) The Brain: Dysfunction to Disease

Misregulation of synaptic function results in abnormal brain function and behavior that is manifested in numerous neurological and psychiatric diseases. Explores the molecular mechanisms responsible for altered synaptic plasticity in neurological diseases such as frontotemporal dementia (FTD), Parkinson's disease, Huntington's disease, Creutzfeldt-Jakob disease, Down syndrome, epilepsy, autism, and Alzheimer's disease.

Recommended: Prerequisites MCDB 3650 or NRSC 2100 (minimum grade C-) or instructor consent required.

Grading Basis: Letter Grade

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 3700 (3) Poisons in Cell Biology and Society

Investigate the inner workings of our cells by studying how poisons disrupt these processes. We will learn how selected poisons affect critical processes inside the cell to cause death or destruction. The scientific aspects of the poison will be discussed in the context of its historical significance or impact on society and popular culture.

Requisites: Requires prerequisite course of MCDB 2150 or EBIO 2070 (all minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 3990 (3) Introduction to Systems Biology for Biologists

Introduces majors with relatively little mathematical experience to the major concepts in systems biology, in the context of key processes (cell growth, division, adaptation, development, and disease). Designed to help students master the necessary mathematical tools involved.

Recommended: Prerequisites MCDB 3135 and MCDB 3145 and MATH 1310 (minimum grade C-).

Grading Basis: Letter Grade

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4100 (1-6) Special Topics

Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

Recommended: Prerequisites MCDB 3135 and MCDB 3145 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4101 (3) Manipulating Genomes-Discovering Gene Functions

Discover novel gene function in vertebrate embryonic development using the latest gene-editing technology, CRISPR-Cas9. Pick your gene of interest and design experiments to mutate the gene, confirm the mutation and characterize the phenotype. Search scientific databases to learn more about the gene and formulate a hypothesis about the gene function. Discuss and present your findings to your peer and faculty.

Recommended: Prerequisites MCDB 3135 and MCDB 3145.

Grading Basis: Letter Grade

MCDB 4105 (3) Function of Cellular and Nuclear, Assemblies, and Machines

Maintaining cellular functions requires a coordinated interaction of all kinds of organelles, assemblies and machines. This course will explore the structure, function, regulation and interactions of cellular organelles, supramolecular assemblies, and molecular machines (motors, ribosomes, polymerases, channels, etc.). Students will be exposed to a set of lectures and prepare specific papers that will be discussed in the group.

Grading Basis: Letter Grade

MCDB 4111 (3) Experimental Design and Research in Cell and Molecular Biology

Learning molecular and cell biology experimental design and approaches through independent research projects. Students, working in pairs, will explore the research process and gain extensive first-hand experience in: hypothesis formation; experimental design; solution preparation and experimental methodology; proposal presentation and defense (oral and written); formal presentation of results and conclusions (oral and written in a publication-style format); the publication process; critical reading and evaluation of primary scientific literature.

Recommended: Prerequisite MCDB 1150 or EBIO 1210 (minimum grade C-) and recommended corequisite of MCDB 3135.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4150 (3) Biology of Aging and Longevity

Through lectures and reading assignments, this capstone course will introduce fascinating cellular and molecular mechanisms underlying aging and longevity based on historical and recent research achievements. We will discuss major aging theories and multiple cellular regulatory systems that prominently affect lifespan. The course will integrate basic concepts from multiple other courses by addressing specific physiological problems in the aging field and present students with the opportunity to learn the reasoning process in cutting-edge biomedical research.

Requisites: Requires prerequisite courses of (MCDB 1150 or EBIO 1210) AND (MCDB 2150 or EBIO 2070) (minimum grade of C-).

Recommended: Prerequisite MCDB 3135 or MCDB 3145 (minimum grade C-).

MCDB 4185 (3) Geomicrobiology

Examines how microbial and chemical processes interact on the Earth's surface today and have shaped the planet throughout its history. Emphasis will be placed on how the life styles and chemical ingenuity of microorganisms drive key biogeochemical processes including weathering and transformations of carbon, oxygen, sulfur, iron and nitrogen. Towards this goal, major geologic and evolutionary events will be examined through the lens of microbial diversity, metabolic energetics, microbe-mineral interactions, and molecular biomarkers.

Equivalent - Duplicate Degree Credit Not Granted: GEOL 5185, ENVS 4185, and GEOL 4185

Requisites: Requires prerequisite courses of CHEM 1113 and CHEM 1114 or CHEM 1400 and CHEM 1401 (minimum grade D-).

Recommended: Prerequisites GEOL 1180 or MCDB 1150 or GEOL 3320 or EBIO 3400 or ENVS 4160 or EVEN 4484.

Grading Basis: Letter Grade

MCDB 4201 (3) From Bench to Bedside: The Role of Science in Medicine

Demonstrates the breadth of research in the life sciences and how such research (not just in medical schools) can lead to medical applications. Lecturers from life sciences, the medical school and biotechnology, discuss drug development and the transfer of research into the clinical arena. Students also prepare a paper and presentation on the development of a commercial drug.

Recommended: Prerequisites MCDB 3135 and MCDB 3145 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4202 (3) The Python Project

Studies how python hearts grow after they consume a meal. Understanding the molecular processes of growth and regression in the python heart could lead to development of therapeutics for heart disease. Students work in groups in the laboratory and generate novel data by using modern molecular biology and bioinformatic techniques to clone and sequence candidate molecules of the python genome. May be repeated once.

Repeatable: Repeatable for up to 6.00 total credit hours.

Recommended: Prerequisites MCDB 3135 and MCDB 3145 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4234 (3) Research Methods

Presents a rigorous and pedagogically coherent introduction into the experimental process used to collect data, formulate hypotheses, and answer scientific questions in general, and biological questions in particular. Includes a detailed consideration of the elements of experimental design, data collection and analysis, and the interpretation of results in the context of effective science teaching. Part of the CU Teach course sequence for teacher certification in science and mathematics.

Requisites: Restricted to Biological Sciences (MCDB) majors or School of Education (EDUC) undergraduate students only.

Recommended: Prerequisites MCDB 3135 and MCDB 3145 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4300 (3) Immunology

Emphasizes cellular and molecular mechanisms by which organisms protect themselves from pathogens and the experimental basis for our understanding of these processes. Discusses development, function, and malfunction of t-cells, b-cells and other components of the immune system, focusing on the human immune system.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5301

Recommended: Prerequisites MCDB 3135 and MCDB 3145 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4310 (3) Microbial Genetics and Physiology

Examines the physiology and genetics of bacteria, Archaea and viruses. Particular emphasis will be on metabolism, regulation of gene expression and protein function, mechanisms of interactions with and manipulation of the environment, and evolution in response to environmental pressures.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5310

Recommended: Prerequisites MCDB 3135 and MCDB 3145 (minimum grade C-) and recommended corequisite of CHEM 4611.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4312 (3) Quantitative Optical Imaging

Explores the fundamentals of optical imaging in biology, especially molecular and cellular biology. Covered topics include an introduction to optics and microscopes, fluorescence microscopy and image analysis, and biological applications. MATLAB will be taught at the beginning of the course and used throughout for image processing. Prior experience with MATLAB (or Python) is highly recommended but not required.

Equivalent - Duplicate Degree Credit Not Granted: BCHM 4312, MCDB 5312 and BCHM 5312

Grading Basis: Letter Grade

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4350 (3) Microbial Diversity and the Biosphere

Provides a molecular phylogeny-based perspective on microbial diversity and the interactions between organisms that result in the biosphere. Provides overview of recent methods and findings in microbial ecology, as well as computer-based workshop in molecular phylogeny. Fulfills MCDB scientific reasoning requirement.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5350

Recommended: Prerequisites MCDB 1150 or EBIO 1210 and CHEM 1133 and EBIO 3400 and/or CHEM 3311 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4361 (3) Evolution and Development

Relates how recent discoveries in the molecular mechanisms of development are shaping our understanding of animal evolution. Reviews basic principles of molecular developmental biology and applies these concepts to critically discuss current research in the field of Evo-Devo (evolution and development). Fulfills MCDB scientific reasoning requirement.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5361

Recommended: Prerequisites MCDB 3135 and MCDB 3145 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4410 (3) Human Molecular Genetics

Studies the human organism as a genetic system, including effect of mutation on protein structure and function, biochemical basis of human genetic disease, polymorphic gene loci, gene mapping and identification, gene cloning and characterization, and impact of human genetics on medicine and society. Fulfills MCDB scientific reasoning requirement.

Recommended: Prerequisite MCDB 3135 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4420 (3) Genetics of Brain and Behavior

Examines the genetic underpinnings of animal behavior, including an examination of behavioral evolution and the use of genes as tools to examine neural architecture. We will cover topics including foraging, social behavior, personality, parental care and fear. We will explore these behaviors at multiple levels, including genomics, population genetics, molecular genetics, epigenetics, endocrinology and neurobiology. Fulfills MCDB scientific reasoning requirement.

Equivalent - Duplicate Degree Credit Not Granted: NRSC 4420

Requisites: Requires prerequisite courses of NRSC 2100 and EBIO 2070 or (MCDB 2150 and (MCDB 1161 or MCDB 1171 or MCDB 1181 or MCDB 2171)) (all minimum grade C).

Grading Basis: Letter Grade

MCDB 4422 (3) Molecular Biology of Free Radicals: Role(s) in Oxidative Stress, Signaling, Disease, Aging

Examines how free radicals are formed in biological systems and their roles in oxidative stress, cell signalling, aging, and disease. Emphasis will be placed on the recent literature. Fulfills MCDB scientific reasoning requirement.

Recommended: Prerequisites MCDB 3135 and MCDB 3145 and CHEM 3311 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4425 (3) Topics in Membrane Biology: Cell Biology, Physiology and Disease

Students will apply their knowledge of basic biology to exploring several of the most exciting topics in biomedicine including protein folding and stress responses, nutrient sensing and balance and signal transduction across membranes. Emphasis will be placed upon human physiology and associated human diseases including Alzheimer's disease, diabetes and cardiovascular disease. Fulfills MCDB scientific reasoning requirement.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5425

Recommended: Prerequisites MCDB 3135 and MCDB 3145 or instructor consent.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4426 (3) Cell Signaling and Developmental Regulation

Introduces several cell signaling processes and their biological functions. Students read and analyze original research articles to learn the thinking processes of scientific research. Writing assignments and oral presentations are required. Fulfills MCDB scientific reasoning requirement.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5426

Recommended: Prerequisites MCDB 3135 and MCDB 3145 and CHEM 4700 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4427 (3) Biology of the Visual System

Explores the neurobiology, cell biology, genetics and developmental biology of the visual system. Discusses neurodegenerative and vascular diseases that lead to blindness. Students read and analyze original research articles to train scientific reasoning. Involves student-organized presentations and classroom discussion. Fulfills MCDB scientific reasoning requirement.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5427

Recommended: Prerequisites MCDB 3135 and MCDB 3145 (minimum grade C-) or instructor consent required.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4428 (3) Regulation of Lifespan

Lectures and literature reading/discussion will introduce students to historical, fascinating and cutting-edge research achievements, as well as the basic genetic/biochemical approaches, towards understanding cellular signaling systems and mechanisms that regulate the aging process and lifespan of animals and humans. Through the combination of presentation, discussion, homework and two exams, students will learn the reasoning process of scientific research in the aging field, become familiar with typical experimental approaches and improve their communication ability.

Requisites: Requires prerequisite course of MCDB 3135 (minimum grade C-).

Grading Basis: Letter Grade

MCDB 4441 (4) Animal Developmental Diversity

Surveys development in a range of vertebrate and invertebrate systems to reconstruct the common bilaterian ancestor, and elucidate the developmental genetic changes underlying animal diversification. Lab focuses on vertebrate embryos and explores key methods in evolutionary developmental biology including in situ hybridization, embryo microinjection, and transgenesis.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5441 and EBIO 4440 and EBIO 5440

Recommended: Prerequisites MCDB 1150 or EBIO 1210 and MCDB 2150 or EBIO 2070 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab

MCDB 4444 (3) Cellular Basis of Disease

Explores the cellular basis of disease. Discusses diseases arising from defects in intracellular targeting, cytoskeletal function, intracellular signaling, genomic instability, gene regulation, cell proliferation, and cell death. Involves student-organized presentations and classroom discussion. Fulfills MCDB scientific reasoning requirement.

Recommended: Prerequisites MCDB 3135 and MCDB 3145 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4471 (3) Mechanisms of Gene Regulation in Eukaryotes

Focuses on manifestations of regulated gene expression. Studies gene regulation at multiple steps, including transcription, RNA processing and translation. Is based on critical analysis of primary research papers. Written assignments and oral presentations are required. Fulfills MCDB scientific reasoning requirement.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5471

Recommended: Prerequisite MCDB 3135 (minimum grade C-) or instructor consent required.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4520 (3) Bioinformatics and Genomics

Computational and experimental methods in bioinformatics and genomics, and how these methods provide insights into protein structure and function, molecular evolution, biological diversity, cell biology and human disease. Topics include database searching, multiple sequence alignment, molecular phylogeny, microarrays, proteomics and pharmacogenomics.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5520

Recommended: Prerequisites MCDB 3135 or CHEM 4700 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4521 (1) Bioinformatics and Genomics Laboratory

Provides experience with, and exposure to, computational and experimental methods in bioinformatics and genomics. Meets once a week. Students are expected to read original research papers, discuss findings, plan and execute data analysis in selected areas.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5521

Grading Basis: Letter Grade

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab

MCDB 4550 (3) Cells, Molecules and Tissues: A Biophysical Approach

Focuses on the biophysics governing the structure/function of enzymes, cells, extracellular matrix and tissue. Synthesizes ideas from molecular biology, physics, and biochemistry, emphasizing how low Reynolds number physics, not Newtonian physics, is relevant to life inside a cell. Fulfills MCDB scientific reasoning requirement.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5550 and PHYS 4550 and PHYS 5550

Recommended: Prerequisites MCDB 3135 and MCDB 3145 and PHYS 2010 and PHYS 2020 and CHEM 1133 and MATH 1300 and/or CHEM 3311 (minimum grade C-) or instructor consent required.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4560 (3) Introduction to Biophysics

Covers an introduction to the physics of living systems. Focuses on how living systems are able to generate order, with both physical principles and biological examples. Covers the development of quantitative models for biological systems, including estimates. Taught from a physics perspective, with biology background introduced as needed.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5560 and PHYS 4560 and PHYS 5560

Requisites: Requires a prerequisite course of PHYS 2210 (minimum grade C-).

Recommended: Prerequisite PHYS 4230.

Grading Basis: Letter Grade

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4615 (3) Biology of Stem Cells

Stem cells have received considerable notice in both the scientific and social arena. Examines the stem cell concept by a critical examination of the primary scientific literature. Topics will include pluripotency and plasticity, environment, technology, self-renewal, transdifferentiation, molecular signature, epigenetic programming and stem cell versus cancer cell. Fulfills MCDB scientific reasoning requirement.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5615

Recommended: Prerequisite MCDB 3135 or MCDB 3145 or instructor consent required.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4621 (3) Genome Databases: Mining and Management

Develops essential skills for performing genomic analyses, with focus on developing practical research tools. Introduces human genome and microbiome projects, Python/Sql scripting, accessing and understanding genomic data, sequence alignment and search, evolutionary models, expression data, biological networks, and macromolecular structure.

Equivalent - Duplicate Degree Credit Not Granted: BCHM 4621, MCDB 5621 and BCHM 5621

Requisites: Requires prerequisite course of BCHM 2700 or BCHM 4700 or CSCI 3104 or MCDB 3500 (minimum grade C-).

Recommended: Prerequisite MCDB 3135 or CSCI 3104 or CHEM 4700 and recommended corequisite of CSCI 2270.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4650 (3) Developmental Biology

Explores the development of invertebrate and vertebrate organisms, emphasizing cellular, molecular and genetic mechanisms. Focuses on conceptual understanding and experimental approaches to topics such as embryology, developmental control of gene expression in eukaryotic cells, mechanisms of differentiation and morphogenesis and developmental genetics.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5651

Requisites: Requires prerequisite courses of MCDB 3135 and MCDB 3145 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4680 (3) Mechanisms of Aging

Studies aging as a developmental process emphasizing genetic, cellular and molecular mechanisms. Fulfills MCDB scientific reasoning requirement.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5680

Recommended: Prerequisites MCDB 3135 and MCDB 3145 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4750 (3) Animal Virology

Encompasses the structure and replication of both lytic and transforming animal viruses. Emphasizes diversity of naturally occurring genomic structures and the resulting strategies of infection as well as the impact of viral epidemics on society. Includes critical analysis of primary research papers. Fulfills MCDB scientific reasoning requirement.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5750

Recommended: Prerequisite MCDB 3135 (minimum grade C-) or instructor consent required.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4777 (3) Molecular Neurobiology

Introduces the functional anatomy of the nervous system and explores current knowledge regarding the molecular and genetic basis of the development and function of the nervous system. Studies recent insights into the molecular basis of neurodegenerative diseases, in the last portion of the course.

Equivalent - Duplicate Degree Credit Not Granted: MCDB 5777

Recommended: Prerequisites MCDB 3135 and MCDB 3145 (minimum grade C-).

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4790 (3) Oocytes, Stem Cells, Organisms: Experiments to Discoveries

Develop critical thinking, scientific reasoning and communication skills by reading and presenting primary research articles and Nobel Prize winning research on patterning, stem cells, cell death, genetic and epigenetic mechanisms that regulate embryonic development. Learn about experimental approaches from a historical and present view, while discussing their ethical implications.

Grading Basis: Letter Grade

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4800 (3) Molecular Evolution: How Natural Selection has Shaped the Molecules of Life

This course explores how Darwin's idea has shaped the structures of DNA, RNA and proteins across the long history of life on earth. Natural selection driving the evolution these macromolecules and subsequent developmental pathways will be fully appreciated as the process that ultimately produced the amazing variety of species on this planet. Looking ahead, our recent efforts to harness the power of evolution in the test tube to develop new therapies will be covered.

Requisites: Requires prerequisite courses of MCDB 3135 and MCDB 3145 (minimum grade C-).

MCDB 4810 (3) Insane in the Membrane: The Biology and Biophysics of the Membrane

Studies the biology and physics of the biomembrane. Topics include structure and mechanism of membrane proteins; membrane biogenesis; membrane protein folding and stability; membrane homeostasis; mechanisms of membrane fusion and fission; lipid trafficking. Fulfills MCDB scientific reasoning requirement.

Recommended: Prerequisite CHEM 4700 (minimum grade C-) or instructor consent required.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4811 (3) Teaching and Learning Biology

Provides an introduction to recent research into student learning on the conceptual foundations of modern biology, together with pedagogical methods associated with effective instruction and its evaluation. Students will be involved in active research into conceptual and practical issues involved in biology education, methods to discover student preconceptions, and the design, testing and evaluation of various instructional interventions.

Equivalent - Duplicate Degree Credit Not Granted: EDUC 6811 and EDUC 4811 and MCDB 5811 and EBIO 4811

Recommended: Prerequisites MCDB 1150 or EBIO 1210 and MCDB 2150 and MCDB 3145.

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

MCDB 4840 (1-6) Upper-Division Independent Study

An independent study contract is required.

Repeatable: Repeatable for up to 8.00 total credit hours.

Recommended: Prerequisite MCDB 2150.

MCDB 4900 (1-3) Public Health Practicum

Offers practical experience in Public Health with direct supervision.

Equivalent - Duplicate Degree Credit Not Granted: EBIO 4900 and IPHY 4900

Repeatable: Repeatable for up to 6.00 total credit hours.

MCDB 4960 (1) Research Communication: Analyzing Data and Effectively Communicating Science for Honors Students

This course is intended for MCDB honors students and to be taken the same semester as their undergraduate thesis defense. The course will teach honors students how to analyze their research data with proper statistics and effectively write their undergraduate honors thesis. Students will also gain experience in presenting their research to an audience with constructive feedback given.

Requisites: Requires prerequisite courses of MCDB 3135 and MCDB 3145 (minimum grade C-).

MCDB 4980 (3) Honors Research

Provides faculty-supervised research for students who have been approved by the departmental honors committee. Normally taken during the semester before completion of the honors thesis.

Recommended: Prerequisite MCDB 4840 or comparable research experience, and minimum GPA of 3.20.

Additional Information: Arts Sciences Honors Course

MCDB 4990 (3) Honors Thesis

Involves the preparation and defense of an honors thesis, based on faculty-supervised original research, including final phases of the research project.

Recommended: Prerequisites MCDB 4840 or MCDB 4980 or comparable research experience, and minimum GPA of 3.3 and approval by the MCDB Honors Committee.

Additional Information: Arts Sciences Honors Course