BIOLOGY (BIOL)

BIOL300. INTRODUCTION TO QUANTITATIVE BIOLOGY I. 3.0 Semester Hrs.
This 3-credit course is designed as an introductory course for Quantitative Biosciences and Engineering (QBE) majors, providing them with the foundational skills needed to be a biologist, bioengineer, or medical doctor in the 21st century. Since biological data and questions are becoming more quantitative and more precise in nature, so must our approaches to our analysis. Accordingly, this course will explore the basics of how to access and analyze existing various types biological data across a wide range of biological scales including sequencing data at the molecular scale, microscopy data at the cellular and organismal scale, and tabular data at the ecological scale. From this data, students will learn to conduct fundamental data analysis and produce appropriate visualizations to illustrate their interpretations of the key results. Prerequisite: CBEN120, CSCI101. Co-requisite: MATH201, MATH225.

BIOL301. INTRODUCTION TO QUANTITATIVE BIOLOGY II. 3.0 Semester Hrs.
This course will extend the applications of quantitative biology, building from the foundation in biological data analysis established in BIOL300. Students will learn how to model biological systems both mathematically and computationally and ultimately compare model predictions to experimental data. Mathematical modeling will involve developing and solving differential equations to describe biological processes. Computational modeling will involve writing Python code to simulate various biological processes to gain insights into their behavior. Lastly, as a boarder type of modeling, students will explore biological sequences and genomes to develop both phylogenetic and metabolic models of organisms. Prerequisite: BIOL300.

BIOL399. INDEPENDENT STUDY. 1-6 Semester Hr.
(I, II) Individual research or special problem projects supervised by a faculty member, also, when a student and instructor agree on a subject matter, content, and credit hours. Prerequisite: ?Independent Study? form must be completed and submitted to the Registrar. Variable credit; 1 to 6 credit hours. Repeatable for credit.

BIOL415. QUANTITATIVE BIOSCIENCES AND ENGINEERING FIELD SESSION. 3.0 Semester Hrs.
In this course students will apply all they have learned in QBE courses to date to tackle large projects that have important societal, environmental, energy, and health impacts. Projects will include hands-on collection and analysis of field samples and modern molecular biology and biochemistry laboratory work. Students will need to use their molecular biology, biochemistry, experimental, data analysis, and computational skills to succeed in this course, which will ultimately prepare students for the next steps in their QBE and professional careers. Prerequisite: BIOL301, CHGN431.

BIOL498. SPECIAL TOPICS IN BIOLOGY. 6.0 Semester Hrs.
(I, II, S) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once, but no more than twice for the same course content. Variable credit: 0 to 6 credit hours. Repeatable for credit under different titles.

BIOL500. CELL BIOLOGY AND BIOCHEMISTRY. 4.0 Semester Hrs.
This course will provide students with deep biological insight as well as hands-on experience of studying a biological question at the level of the cell, including gene expression and localization of proteins in eukaryotic cells, to the level of the protein, from molecular biology of the gene to characterization of posttranslational modifications, and protein purification and biochemical and biophysical characterization of protein structure and dynamics. These fundamental properties will be linked to protein activity and function. The emphasis of this course is on quantitative biology. Wherever appropriate, advanced concepts of protein chemistry and physics will be integrated into the delivery of the basic concepts. the course includes a 3 credit hour lecture section and a 1 credit hour lab section.

BIOL501. ADVANCED BIOCHEMISTRY. 3.0 Semester Hrs.
Advanced study of the major molecules of biochemistry: amino acids, proteins, enzymes, nucleic acids, lipids, and saccharides- their structure, chemistry, biological function, biosynthesis, and interaction. Stresses bioenergetics and the cell as a biological unit of organization. Advanced discussion of the intertwining of molecular genetics, biomolecule synthesis, and metabolic cycles. Prerequisites: CHGN428 or BIOL500.

BIOL510. BIOINFORMATICS. 3.0 Semester Hrs.
Bioinformatics is a blend of multiple areas of study including biology, data science, mathematics and computer science. The field focuses on extracting new information from massive quantities of biological data and requires that scientists know the tools and methods for capturing, processing and analyzing large data sets. Bioinformatics scientists are tasked with performing high-throughput, next-generation sequencing. They analyze DNA sequence alignment to find mutations and anomalies and understand the impact on cellular processes. The bioinformatician uses software to analyze protein structure and its impact on cell function. Learning how to design experiments and perform advanced statistical analysis is essential for anyone interested in this field, which is main goal of this course. Prerequisite: CSCI102.

BIOL520. SYSTEMS BIOLOGY. 3.0 Semester Hrs.
This course provides students an introduction to the emerging field of systems biology. It will consist of lectures, group discussion sessions, and problem-solving sessions and/or computational labs. Students will learn strategies and tools to interrogate biological systems using mathematical modeling. Topics of the course will come from typical aspects of biomathematical modeling including, but not limited to: the choice of a modeling framework from various approaches; the design of interaction diagrams; the identification of variables and processes; the design of systems models; standard methods of parameter estimation; the analysis of steady states, stability, sensitivity; numerical evaluations of transients; phase-plane analysis; simulation of representative biological scenarios. All theoretical concepts are exemplified with applications.

BIOL590. QUANTITATIVE BIOSCIENCES & ENGINEERING GRADUATE SEMINAR. 1.0 Semester Hr.
(I,II) The Quantitative Biosciences and Engineering (QBE) Graduate Seminar provides a forum for QBE graduate students to participate in seminars given by QBE professionals, develop an enhanced understanding of the breadth of quantitative bioscience disciplines, and present their research projects. Grade is based on attendance over the semester. Full-time graduate students must enroll in the Graduate Seminar course every semester that they are enrolled at Mines. Repeatable; maximum 2 credits granted towards MS degree requirements and 4 credits maximum granted towards PhD Requirements.

BIOL598. SPECIAL TOPICS. 6.0 Semester Hrs.
(I, II, S) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once, but no more than twice for the same course content.. Variable credit: 0 to 6 credit hours. Repeatable for credit under different titles.

BIOL599. INDEPENDENT STUDY. 0.5-6 Semester Hr.
(I, II, S) Individual research or special problem projects supervised by a faculty member, also, when a student and instructor agree on a subject matter, content, and credit hours. Prerequisite: "Independent Study" form must be completed and submitted to the Registrar. Variable credit: 0.5 to 6 credit hours. Repeatable for credit under different topics/experience and maximums vary by department. Contact the Department for credit limits toward the degree.

BIOL707. GRADUATE THESIS / DISSERTATION RESEARCH CREDIT. 1-15 Semester Hr.
(I, II, S) Research credit hours required for completion of a Masters-level thesis or Doctoral dissertation. Research must be carried out under the direct supervision of the student's faculty advisor. Variable class and semester hours. Repeatable for credit.