

# BIOLOGY, B.S.

## Program Description

The Biology major at La Salle University is dedicated to the Lasallian tradition of excellence in teaching. We are committed to developing the full intellectual, personal, and social potential of our students in an environment of mutual respect and cooperation.

La Salle's Biology major serves qualified students interested in pursuing further education and careers in the life sciences, health professions, and science education. In addition, we provide for non-science majors a variety of foundation level courses that explore biological issues of interest and concern to the general public.

La Salle has a long and proud tradition of training undergraduates for admission to health profession schools. We believe it important to provide these undergraduates with courses that emphasize the general principles of the life sciences and that address a diverse range of current scientific issues. We are equally committed to preparing students for graduate work in the life sciences, for careers in scientific/clinical technology, or for careers in science education by providing them with broadly-based theoretical and laboratory training. We feel the development of critical thinking skills and the establishment of a firm understanding of the foundational principles of the life sciences are the best preparation for more specialized professional and graduate training.

We believe the academic experience should provide an opportunity for mutual advancement and sharing of excitement for science through supportive yet challenging dialogue among faculty and students.

## Why Take This Major?

The Biology program fosters a deep understanding of foundational knowledge in the life sciences and encourages students to apply this understanding in laboratory research projects that develop critical thinking skills and scientific reasoning. This training allows students to pursue a broad range of opportunities related to the life sciences including medical or graduate school and careers in the health professions, scientific/clinical technology, or science education.

## Degree Earned

Bachelor of Science (B.S.)

## Required for Graduation

- Courses
  - Major: 15
- Credits
  - Major: Minimum of 60
  - Total: 120 to 126 depending on Biology electives chosen
- GPA
  - Major: 2.0
  - Cumulative: 2.0

## Student Learning Outcomes

- Locate, recognize, evaluate and apply foundational knowledge in biology in an accurate and effective manner.
- Apply scientific and quantitative reasoning to explore, analyze and question biological phenomena.

- Use the tools and technologies of modern biology appropriately to collect data and address scientific hypotheses.
- Communicate scientific information effectively both orally and in writing.

## Progress Chart

### Level One - Core Courses

12 courses and 2 modules required.

### Major Requirements

*Major requirements include 4 Level Two ILO requirements, fulfilled through the major.*

Students must complete **15** courses in this major program.

Code	Title	Credits
<b>Level One - Core Courses</b>		
<i>Universal Required Courses</i>		
Students must complete the following 4 courses.		
ILO 8.1: Written Communication ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )		
ENG 110	College Writing I: Persuasion	3
ILO 5.1: Information Literacy ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )		
ENG 210	College Writing II: Research	3
ILO 1.1: Understanding Diverse Perspectives ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )		
FYS 130	First-Year Academic Seminar <sup>1</sup>	3
ILO 2.1: Reflective Thinking and Valuing ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )		
REL 100	Religion Matters	3
<i>Elective Core Courses</i>		
Students must complete 1 course in each of the following 4 ILOs.		
ILO 3.1a: Scientific Reasoning ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )		
BIO 204	Antibiotic Discovery	4
ILO 3.1b: Quantitative Reasoning ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )		
MTH 120	Calculus I	4
ILO 6.1: Technological Competency ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )		
Choose course within ILO ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )		
3		
ILO 8.1a/12.1: Oral Communication/Collaborative Engagement ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )		
Choose course within ILO ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )		
3		
<i>Distinct Discipline Core Courses</i>		
Students must complete 1 course in each of the following 4 ILOs. Each course must be from a different discipline. (A "discipline" is represented by the 3- or 4-letter prefix attached to each course.)		
ILO 4.1: Critical Analysis and Reasoning ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )		
Choose course within ILO ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )		
4		

ILO 9.1: Creative and Artistic Expression ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )	
Choose course within ILO ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )	3
ILO 10.1: Ethical Understanding and Reasoning ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )	
Choose course within ILO ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )	3
ILO 11.1: Cultural and Global Awareness and Sensitivity ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )	
Choose course within ILO ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )	3
<b>Universal Required Modules</b>	
Students must complete the following 2 non-credit modules. <sup>2</sup>	
ILO 7.1a ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )	
Health Literacy Module	
ILO 7.1b ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )	
Financial Literacy Module	
<b>Major Requirements</b>	
<i>Level Two</i>	
Students must complete 1 course/learning experience in each of the 4 commitments.	
ILO 2.2: Broader Identity (Capstone Course/Experience) ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )	
Select one of the following:	3-4
BIO 480 Biological Research	
BIO 453 Molecular Capstone Research	
BIO 454 Systems Capstone Research	
Select one ILO from 3.2a, 3.2b, 4.2, 5.2, 6.2, 7.2a, or 7.2b: Expanded Literacies ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )	
BIO 412 Biochemistry (ILO 3.2a)	4
ILO 8.2b: Effective Expression (Writing-Intensive Course) ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )	
BIO 413 Molecular Biology (8.2b)	4
Select one ILO from 10.2, 11.2, or 12.2: Active Responsibility ( <a href="https://catalog.lasalle.edu/undergraduate/ilo/">https://catalog.lasalle.edu/undergraduate/ilo/</a> )	
BIO 230 BIO 230-Integrated Biology II: Populations and Systems (ILO 12.2)	4
<b>All Other Required Courses</b>	
BIO 210 Integrated Biology I- Molecules and Cells	4
BIO 230 BIO 230-Integrated Biology II: Populations and Systems	4
BIO 250 Phage Genomics	4
BIO 320 Biostatistics	3
BIO 412 Biochemistry	4
BIO 413 Molecular Biology	4
Select one of the following:	3-4
BIO 480 Biological Research	
BIO 453 Molecular Capstone Research	
BIO 454 Systems Capstone Research	
Select four additional BIO courses at the 300/400 level	12-16
Select one of the following:	4-8
CHM 161 Chemistry of The Life Sciences	

CHM 111 & CHM 112	General Chemistry I and General Chemistry II	
CHM 262 or CHM 201	Organic Chemistry for The Life Sciences or Organic Chemistry I	3
MTH 120	Calculus I	4
<b>Free Electives</b>		
In addition to the requirements listed above, students must take enough courses to the fulfill graduation credit requirements for their School and major.		
<b>Total Credits</b>		<b>103-113</b>

1

NOTE. The following students use Level 2 Capstone Experience in Major instead of FYS 130 First-Year Academic Seminar: Honors, BUSCA, Core-to-Core, Transfer, and Non-Traditional/Evening.

2

The Modules are **not** required for Transfer Students, Core-to-Core Students, or BUSCA Students. BUSCA students are required to take modules if/when they pursue a bachelor's degree.

## Recommended Course Sequence

Course	Title	Credits
<b>First Year</b>		
<b>First Semester</b>		
BIO 204	Antibiotic Discovery	4
CHM 111	General Chemistry I	4
<b>Credits</b>		<b>8</b>
<b>Second Semester</b>		
BIO 210	Integrated Biology I- Molecules and Cells	4
CHM 112	General Chemistry II	4
<b>Credits</b>		<b>8</b>
<b>Second Year</b>		
<b>First Semester</b>		
BIO 230	BIO 230-Integrated Biology II: Populations and Systems	4
CHM 201	Organic Chemistry I	4
MTH 119 or MTH 120	Precalculus or Calculus I	4
<b>Credits</b>		<b>12</b>
<b>Second Semester</b>		
BIO 250	Phage Genomics	4
BIO 412	Biochemistry	4
MTH 120	Calculus I	4
<b>Credits</b>		<b>12</b>
<b>Third Year</b>		
<b>First Semester</b>		
BIO 413	Molecular Biology	4
BIO Elective		4
<b>Credits</b>		<b>8</b>
<b>Second Semester</b>		
BIO Elective		4
BIO Elective		4
<b>Credits</b>		<b>8</b>
<b>Fourth Year</b>		
<b>First Semester</b>		
BIO Elective or Capstone		4
BIO Elective		4
<b>Credits</b>		<b>8</b>

Second Semester	
BIO Elective or Capstone	4
Credits	4
Total Credits	68

This is a "typical" schedule. Career path may determine Chemistry course sequence.

## Minors

- Biology, Minor (<https://catalog.lasalle.edu/undergraduate/arts-sciences/natural-sciences/biology-bs/biology-minor/>)
- Translational Science, Minor (<https://catalog.lasalle.edu/undergraduate/arts-sciences/natural-sciences/biology-bs/translational-science-minor/>)

### Course Descriptions

## Biology

### BIO 157 Life Science: An Environmental Approach

This foundation biology course for non-majors places emphasis on the unifying concepts of ecology. It is intended to demonstrate interconnections between the life and physical sciences, provide opportunity for in-depth exploration of environmental issues, and establish a relevance to students' lives. Topics will include human influence on patterns and products of change in living systems, energy matter and organization, and human interaction and interdependence with other living systems.

### BIO 158 Life Science: A Human Approach

This foundation biology course for non-majors places emphasis on the unifying concepts of human biology. It is intended to demonstrate interconnections between the life and physical sciences, provide opportunity for in-depth exploration of life, and establish a relevance to students' lives. Topics will include: maintaining dynamic equilibrium in humans, human reproduction and inheritance, and human growth and differentiation.

### BIO 161 Anatomy and Physiology

This basic course in the structure and functioning of the human body places emphasis on the interrelationships of the major organ systems. It is intended for Allied Health students. Three hours of lecture, two hours of laboratory; two terms. Prerequisite(s): BIO 161 is a prerequisite for BIO 162.

### BIO 162 Anatomy and Physiology

This basic course in the structure and functioning of the human body places emphasis on the interrelationships of the major organ systems. It is intended for Allied Health students. Three hours of lecture, two hours of laboratory; two terms. Prerequisite(s): BIO 161 is a prerequisite for BIO 162.

### BIO 163 Clinical Microbiology

Topics of this course include structure, growth, and identification of medically important microorganisms; role of specific pathogens in the etiology of human disease; immunology; chemotherapeutic and antibiotic control of infectious diseases. It is intended for Allied Health students. Three hours lecture, two hours laboratory.

### BIO 164 Essentials of Anat & Physio

This is a Web-based course designed to present the essentials of human anatomy and physiology. The cell as the fundamental unit of life is discussed and examined, including structure and metabolism. The organization of cells into tissues, tissues into organs, and organs into systems is thoroughly explored, and the integumentary, skeletal, muscular, and nervous systems are focal points of study. The course examines in depth the structure and function of five organ systems: (1) endocrine system, (2) blood and cardiovascular system, (3) lymphatic and immune system, (4) respiratory system, and (5) digestive system. The course emphasizes structure and function relationships as well as the interaction among the organ systems. There will be an array of lecture and laboratory exercises involving the use of computerized data acquisition and analyses.

### BIO 164P Essentials of Anat & Physio

### BIO 170 Special Topics

### BIO 171 Special Topics

### BIO 204 Antibiotic Discovery

In this course, students will engage in an authentic research project and gain experience in the process of scientific inquiry, including hypothesis generation and testing, data interpretation and analysis, communication of information, and common techniques for microbial culture and characterization. Students enrolled in the course will be part of a national crowdsourcing initiative to discover new antibiotics produced by soil bacteria. The collective effort of students addresses a critical global health crisis, the decreasing supply of effective antibiotics and increasing microbial resistance. 6 hour CURE course.

### BIO 205 Scientific Discovery: Phage Hunting I

This course is designed to teach students how to do scientific research. It is the first semester of a year-long research-based project lab course in which students will participate in a nation-wide program in collaboration with undergraduates at other colleges. Students will isolate and characterize novel bacteriophages (viruses that infect bacteria) from the environment using modern molecular biology techniques. (Cross-listed as ISBT 103)

### BIO 210 Integrated Biology I- Molecules and Cells

This course provides an introduction to five core concepts in biology (Information, Evolution, Cells, Homeostasis, and Emergent Properties) through an active learning, inquiry-based examination of molecules and cells. Critical thinking and quantitative reasoning are applied to authentic data to construct foundational knowledge. By engaging in the process of science, students will gain proficiency in core scientific competencies. 6 hour CURE course. Restriction(s): Students must be eligible for Math 113 or Math 120 and Chem 111 Prerequisite(s): High school or college chemistry.

### BIO 230 BIO 230-Integrated Biology II: Populations and Systems

This course provides an introduction to five core concepts in biology (Information, Evolution, Cells, Homeostasis, and Emergent Properties) through an active learning, inquiry-based examination of biological problems spanning from cells to ecosystems. Data analysis and synthesis are applied to authentic data to construct foundational knowledge. By engaging in the process of science, students will gain proficiency in core scientific competencies. Three hours lecture; three hours laboratory. Prerequisite(s): A final grade of C- or higher in BIO 210

**BIO 231 Regulatory Affairs**

This course, as part of the Quality Science Education curriculum developed by Pathway for Patient Health, will give students an understanding of the role of regulators with an overview of regulations as stated in the U.S. Code of Federal Regulations (CFR), EudraLex Directives and Annexes, and Emerging Market regulations for the life science industries. The faculty will demonstrate the relationship between regulatory requirements and legal accountability while introducing fundamental concepts in the regulations related to clinical trial development, management, ethics, data integrity, data security, privacy, change control, and validation. Topics such as the role of guidance documents and industry standards will be reviewed, and case studies utilized to support the program. The "why" of the regulations will support the student's ability to enter the life science industry with an understanding of how to optimize patient health and business success by mobilizing enterprise-wide quality effectiveness through innovative system and critical thinking grounded in science, data, stakeholder awareness and regulatory intelligence.

**BIO 241 Product Dev & Validation**

In this course, students will be exposed to the major design processes that are critical to life science product, process and specification development. Topics to be covered include: cradle to grave product and process development, prototype builds, scalability, design of experiments, variability, control, specification development and validation methodology. Instructors will explore how rigorous human factor engineering studies and clinical trials provide essential inputs into the product development process. The students will be introduced to concepts such as gap analysis, risk assessment, master plan, process characterization, installation qualification, operational qualification, measurement system analysis, repeatability and reproducibility (data collection/analysis), performance qualification/validation. In a world of innovative technology, it is critical that the students gain an understanding of computer system and software validation to ensure the quality of data generation, data storage, and digital processes used in manufacturing and products with digital components using technical and practical aspects expected in the regulated life science industries. Prerequisite(s): BIO 231

**BIO 250 Phage Genomics**

This is the second semester ("Phage 2") of a year-long research-based project lab course in which students will participate in a nationwide program in collaboration with undergraduates at other colleges. Students will describe the basic genome structure. This will involve mastering the strategies and computer programs required to predict where genes are located in the genome and annotating the function of those genes. These results will be presented for peer-review and will likely result in a scientific publication for the student. Prerequisite(s): BIO 210 or ISBT 103

**BIO 251 Risk Failure Analysis**

Although risk and failure analysis is currently taught at many universities, this course will dive into the nuances of the life science industries related to the specific regulations that apply to consumer health products. Through the use of historical risk analysis techniques, such as FMEA, Fault Tree, and 5 Why's, students will be able to analyze a holistic set of data (in-production, across product lines, across equipment, human variability, on-market, on-stability, validation studies, change control, etc.) that will lead to scientifically justified investigations supported by evidence, and the identification of effective corrective and preventative actions (CAPA). Prerequisite(s): BIO 241

**BIO 270 Special Topics****BIO 271 Risk and Failure Analysis**

This Pathways developed course introduces students to the investigation processes and writing scientifically justified conclusions linked to true root cause. Prerequisite(s): BIO 231

**BIO 272 Special Topics****BIO 276 Special Topics****BIO 301 Comparative Vertebrate Anatomy**

This course examines the comparative systemic anatomy of the vertebrate classes, hypotheses of origin, and radiation of the phylum Chordata. Laboratory dissections of representative Chordates from amphioxus to mammal. Two hours lecture; four hours laboratory. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

**BIO 303 Microbiology**

This course addresses the structure, growth, identification, and control of microorganisms of major medical, environmental, and industrial importance; molecular control and genetics of bacteria and viruses; immunology; microbial pathogenesis; and epidemiology of infectious diseases of humans. 6 hour CURE course. Prerequisite(s): C- or higher grade in BIO 230 is required in order to advance to 300/400-level BIO courses.

**BIO 305 Mammalian Physiology**

This lecture-laboratory course examines the metabolic processes and associated physiochemical phenomena of mammals. Current physiological hypotheses of the nervous, endocrine, respiratory, cardiovascular, and digestive systems, as well as special senses, will be studied. Three hours lecture; three hours laboratory. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

**BIO 306 Neurobiology**

This course involves a lecture-laboratory study of the nervous system, including principles of membrane biophysics, cellular neurophysiology, systems neurophysiology, and neuroanatomy. Two hours lecture; two hours laboratory.

**BIO 308 Meths In Bio Rsrch****BIO 310 Genetics**

This course is an introduction to genetics at the molecular, cytological, and organismal level. Included are the thorough coverage of Mendelian and other basic transmission genetics phenomena in the light of our knowledge of DNA and cell structure and function; mutation and mutagenesis; and an introduction to recombinant DNA. Three hours lecture; three hours laboratory Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

**BIO 311 Bioinformatics**

This course examines current biological problems and explores and develops bioinformatic solutions to these issues. Each topic includes a definition of the problem, a review of the basic biological concepts involved, an introduction to the computational techniques used to address the problem along with a utilization of existing web-based tools and software solutions often employed by professionals in the field of bioinformatics. Biological topics include those such as antibiotic resistance, genetic disease, and genome sequencing.

BIO 312 Radiobiology

BIO 315 Plant Physiology

BIO 316 Plant Anatomy

BIO 317 Invertebrate Zoology

Topics of this course involve life processes, phylogenetic advances, and basic classification of the major pre-chordate phyla with emphasis on their evolution and ecology. Three hours lecture, two hours laboratory. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

BIO 318 Evolution

This course involves a presentation and analysis of the evidence for the evolution of life. Major topics include the origin of life and cellular organelles as well as the development of the diversity of life present today. Heavy emphasis will be placed on the ideas of Charles Darwin as expanded and modified by evidence from modern population genetics, cytogenetics, and molecular biology. Three hours lecture. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

BIO 319 The Plant Kingdom

Topics of this course involve functional anatomy, phylogeny, and basic systematics of non-vascular and vascular plants. Two hours lecture, two hours laboratory. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

BIO 320 Biostatistics

Introduction to statistical analysis and probability for students in the biological sciences. Topics include summary statistics, graphical display of data, likelihood, experimental design, binomial and Gaussian probability, hypothesis testing, t-tests, analysis of variance, correlation, linear regression, and chi-square analyses. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

BIO 330 Life Science Innovation

This course is open to students interested in learning how to commercialize new technologies. Teams of science and business students will work with inventor-scientists at the Wistar Institute—as well as with external partners such as venture capitalists, intellectual property lawyers, and biotechnology entrepreneurs—to develop proposals on the scientific merit and commercial feasibility of life science research projects. Students should have either a scientific or business background to enroll in this course. (Cross-listed as MGT 330 and ISBT 330) Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

BIO 350 Co-op Education I

BIO 371 Special Topics

BIO 379 Special Topics

BIO 400 Marine Biology

This course offers a contemporary view of the dynamics establishing community structure in pelagic, estuarine, mangrove tidepool, coral reef, hydrothermal vent, and intertidal ecosystems. Structural, functional, behavioral, and adaptive modifications of marine organisms will be examined. Three hours lecture; field trip(s) typically included. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

BIO 401 Taxonomy Of Seed Plants

BIO 402 Cell Biology

This course examines the physical properties, chemical structure, and metabolism of simple and specialized cells, as well as recent advances in the techniques of cell culture and investigation. Two hours lecture; two hours laboratory. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

BIO 403 Principles of Ecology

This course addresses the basic concepts of ecology and a broad introduction to overall biosphere functioning. Major topics include energy flows; nutrient cycles; environmental conditions and their importance; plants and animals at the individual, population, and community level; and the overall functioning and development of the major terrestrial and aquatic ecosystems. Three hours lecture. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

BIO 404 Field Ecology

This course involves field and laboratory projects/research at La Salle's Penllyn Biostation and other sites. Six hours laboratory and field work. Prerequisite(s): BIO 403 or permission of instructor

BIO 405 Histology

This course focuses on an examination of the minute and ultra structure of mammalian primary tissues together with their functional relationships in the formation of major organ systems; histological basis of function is stressed. Three hours lecture; three hours laboratory. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

BIO 406 Developmental Biology

This course focuses on the molecular and genetic analysis of development and differentiation. Some descriptive morphogenesis is considered. Two hours lecture; two hours laboratory. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

BIO 412 Biochemistry

The course demonstrates the principles of basic biochemistry while focusing on the interrelationships between those biochemical pathways that provide energy and those that provide the basic molecular species for synthesis. Topics include bioenergetics, low molecular weight biosynthesis, enzyme function and kinetics, and metabolic control. Three hours lecture, three hours laboratory. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

BIO 413 Molecular Biology

This is a survey course that will examine the basic concepts of molecular biology. Topics include mechanisms and regulation of DNA replication, transcription, and translation, recombinant DNA technology, molecular aspects of gene interaction and recombination, cellular transformation, and the molecular biology of the nervous and immune systems. The laboratory focuses on utilizing the basic techniques currently employed in molecular biology (molecular cloning, ELISA, genetic recombination, gel electrophoresis, etc.) Three hours lecture; three hours laboratory. Prerequisite(s): BIO 412

**BIO 418 Molecular Biology**

**BIO 419 Molecular Biology Lab**

**BIO 420 Genomics**

The Genomics course will be a hybrid lecture and hands-on computer course. This course will focus on the topic of genome organization and the bioinformatic tools that are used to study genomes. We will investigate the genome structure of viral, microbial, and eukaryotic genomes and the different databases used to store and access this data. DNA sequence analysis using the BLAST algorithm and multiple sequence alignments will be studied. Identifying genes and genomic elements using different computational tools will be performed.

Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

**BIO 422 Virology**

This is a survey course designed to be an introduction to the history and diversity of viruses on Earth. The lectures and topics in class will focus primarily on viruses that cause human disease, but will also include important viruses of other organism. While this class is primarily about the molecular biology of viruses, it will cover clinical symptoms and epidemiology too. This course will also focus on recent scientific literature of important disease-causing viruses. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

**BIO 427 Immunology**

This is a survey course designed to be an introduction to the immune system of humans and other mammals. We will cover the development and physiology of specialized immune system cells, tissues and organs; we will also learn about these structures protect against harmful agents and pathogens. While this course is centered around a textbook, primary literature will feature heavily, both in instructor and student led presentations. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

**BIO 430 The Biology of Cancer**

The cellular and molecular mechanisms driving cancer's hallmark phenotypes will be explored. These include proliferative signaling, evading growth suppressors, resisting cell death, enabling replicative immortality, inducing angiogenesis, activating invasion and metastasis, reprogramming of energy metabolism and evading immune destruction. Within these conceptual frameworks, primary scientific literature will be examined and clinical implications of the research evaluated. Students will choose a specific area of interest, allowing them to develop an in-depth understanding of the current "state-of-the-art" in a field of research. Students will gain an informed understanding of the inherent challenges cancer presents and assess the prospects of treating and ultimately curing the disease. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

**BIO 435 Systems Biology**

This course is an introduction to topics of systems biology. Topics covered will include cellular and population levels of systems biology with an emphasis on modeling biochemical systems, gene expression, and evolutionary systems.

**BIO 440 Biology Senior Seminar**

**BIO 444 Research in BIO I**

This course provides the student with an opportunity to do research with a faculty member. The student and the faculty member agree on the research project before the student registers for the course.

**BIO 445 Research in BIO II**

This course is a continuation of the 444 research course. It provides the student with an opportunity to continue to conduct research with a faculty member.

**BIO 453 Molecular Capstone Research**

Students will perform laboratory-based, original research in an area of molecular and cell biology. Specific topics and research project will vary and will depend on the faculty member's expertise and student interests. The project will culminate in a formal presentation of results and conclusions both orally and in written form.

**BIO 454 Systems Capstone Research**

Students will perform laboratory-based, original research in an area of systems biology. Specific topics and research project will vary and will depend on the faculty member's expertise and student interests. The project will culminate in a formal presentation of results and conclusions both orally and in written form.

**BIO 460 Cooperative Education/Internship**

This is normally a full-time, paid employment at a cooperating institution/company to provide on-the-job training (part-time positions may qualify). It involves appropriate job-related learning assignments under faculty supervision. Position must be approved by Department Chair. Consult the Associate Director for Experiential Education in Career Services before registering or for further information. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

**BIO 461 Internship II**

**BIO 470 Special Topics in Biology**

Periodically, a course will be offered that deals in detail with a topic of interest in current biological research. Students may be asked to write library research paper(s) and present a seminar. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

**BIO 471 Special Topics**

**BIO 472 Neurobiology**

This course involves a lecture-laboratory study of the nervous system, including principles of membrane biophysics, cellular neurophysiology, systems neurophysiology, and neuroanatomy. Three hours lecture; three hours laboratory. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

**BIO 473 Special Topics**

**BIO 474 Special Topics**

**BIO 480 Biological Research**

This research is for election by qualified students contemplating advanced studies. It is intended to provide actual research experience under staff supervision. Students are required to present a seminar on their work and to prepare a poster. Hours to be arranged. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

**BIO 481 Biological Research**

This research is for election by qualified students contemplating advanced studies. It is intended to provide actual research experience under staff supervision. Students are required to present a seminar on their work and to prepare a poster. Hours to be arranged. Prerequisite(s): A final grade of C- or higher in BIO 230 is required in order to advance to 300/400-level BIO courses.

BIO 488 Special Topics

BIO 499 Grant Writing Practicum

A guided exploration of the process of biological research. Discussion topics include hypothesis generation, experimental design and statistics, methods of data presentation, and current advances and research in biology. Students will prepare a NSF grant proposal designed to address a hypothesis about biological phenomenon.

## **Program Contact Information**

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