

# Biology

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The biology program lays a foundation for graduate study in biology, and for training in the professions and technologies based upon the biological sciences. It is the philosophy of the department that as undergraduates, students should be broadly trained; should be knowledgeable in an area of specialization; should understand the process by which scientists ask and pursue the answers to questions; and should be acquainted with ethical principles and issues as they relate to the field of biology.

Both the B.A. and B.S. degrees are awarded in biology.

Bachelor of Science students must complete 36 credits in biology while Bachelor of Arts students must complete 33 credits.

Students begin in the first-year with General Biology (BL 150-153) where cellular, organismal and population biology are introduced. Subsequently, they select one of these three sub-disciplines as an area of concentration. During the sophomore, junior and senior years, they complete Cell Biology, one advanced course with lab in each of the three areas of concentration, and an additional advanced course with lab in their chosen concentration.

Additionally, during the last semester of the junior year and through the senior year, students plan and complete a senior research project under the supervision of individual faculty.

Students are also required to complete one year of General Chemistry, one year of Organic Chemistry, and one year of Physics. B.S. students must complete one year of Calculus while one semester of Calculus is required of students electing the B.A. degree. It is strongly recommended that B.A. students complete a second semester of Calculus, and that all students complete one semester of statistics before their senior year. Further, since questions of an ethical and moral nature often arise in biology and related fields, students are encouraged to include a bioethics course in their curriculum.

General Biology is a prerequisite for all advanced courses and, with the exception of General Biology, only courses above BL 200 may be applied towards the total biology credits required.

In individual circumstances and with permission of the chairperson, a course may be substituted for one of the required courses listed under the cellular, organismal, and population concentrations. Students should work closely with their advisors and are cautioned to give careful and serious consideration to the selection of courses because requirements and recommended courses may differ among professional and graduate schools.

## Biology Learning Objectives:

- To prepare students for a graduate study in biology, training in the health professions and employment based upon the biological sciences.

- To provide students with the skills and knowledge of mathematics, chemistry and physics necessary to form a broad foundation in science.

- To enable students to approach biological questions from the perspective of molecular, cellular, organismal and population biology.

- To enable students to develop and complete an experimentally-based undergraduate research project.

- To bring to consciousness the ethical and moral issues inherent in the field of biology and its technologies.

- To provide opportunities for students to learn the Catholic position on bioethical issues.

## Teacher Preparation

Additional Science Course Requirements for Certification in Biology (7-12): In addition to a major in biology, the certification candidate must satisfy the following special requirements:

PH 106 Physical Geology 3

PH 107 Physical Geology Laboratory 1

See Education Department guidelines to plan core classes and other courses required for certification.

## Requirements for a Bachelor of Arts Degree in Biology

(See Core Curriculum requirements.)

### Major Requirements (61 credits):

BL 150, 152 General Biology I and II 6

BL 151, 153 General Biology Laboratory I and II 2

BL 208 Cell Biology 3

BL 209 Cell Biology Laboratory 1

BL 301 Junior Research Seminar 2

BL 302 Research Project 2

BL 303 Research Thesis 1

CH 101, 102 General Chemistry I and II 6

CH 103, 104 General Chemistry Laboratory I and II 2

CH 221, 222 Organic Chemistry I and II 6

CH 223, 224 Organic Chemistry Laboratory I and II 2

PH 111, 112 General Physics I and II 6

PH 113, 114 General Physics Laboratory I and II 2

MA 109 Calculus I 4

Fulfill the requirements for one area of concentration:

### Cell and Molecular Biology Concentration:

BL 214 Molecular Genetics 3

BL 215 Molecular Genetics Laboratory 1

and

BL 212 Microbiology 3

BL 213 Microbiology Laboratory 1

or

BL 216 Biotechnology 3

BL 217 Biotechnology Laboratory 1

One course with laboratory from each of the organismal and population biology areas. 8

### Organismal Biology Concentration:

BL 220 Comparative Vertebrate Anatomy 3

BL 221 Comparative Vertebrate Anatomy Laboratory 1

or

BL 222 Developmental Biology 3

BL 223 Developmental Biology Laboratory 1

or

BL 228 Wildlife Biology 3

BL 229 Wildlife Biology Laboratory 1

and

BL 224 Mammalian Physiology 3

BL 225 Mammalian Physiology Laboratory 1

One course with laboratory from each of the cellular and population areas. 8

### Population Biology Concentration:

BL 232 Ecology 3

BL 233 Ecology Laboratory 1

or

BL 236 Biology of Environmental Disturbances 3

BL 237 Biology of Environmental Disturbances Laboratory 1

and

BL 234 Evolution and Systematics 3

BL 235 Evolution and Systematics Laboratory 1

One course with laboratory from each of the cellular and organismal areas. 8

**Strongly Recommended:**

BL 260 Biostatistics	3
or	
PY 203 Statistics I	3
and	
TH 280 Catholic Bioethics	3
or	
PL 218 Bioethics	3

**Requirements for a Bachelor of Science Degree in Biology**

(See Core Curriculum requirements.)

**Major Requirements (68 credits):**

BL 150, 152	General Biology I and II	6
BL 151, 153	General Biology Laboratory I and II	2
BL 208	Cell Biology	3
BL 209	Cell Biology Laboratory	1
BL 301	Junior Research Seminar	2
BL 302	Research Project	2
BL 303	Research Thesis	1
CH 101, 102	General Chemistry I and II	6
CH 103, 104	General Chemistry Laboratory I and II	2
CH 221, 222	Organic Chemistry I and II	6
CH 223, 224	Organic Chemistry Laboratory I and II	2
PH 111, 112	General Physics I and II	6
PH 113, 114	General Physics Laboratory I and II	2
MA 109, 110	Calculus I and II	8
Elective Course in Biology		3

*(Any three credit, 200 level biology course, CH251, CH252, BIN218, or BIN219 qualifies as an elective course in biology)*

Fulfill the requirements for one area of concentration:

**Cell and Molecular Biology Concentration:**

BL 214	Molecular Genetics	3
BL 215	Molecular Genetics Laboratory	1
and		
BL 212	Microbiology	3
BL 213	Microbiology Laboratory	1
or		
BL 216	Biotechnology	3
BL 217	Biotechnology Laboratory	1
One course with laboratory from each of the organismal and population biology areas.		8

**Organismal Biology Concentration:**

BL 220	Comparative Vertebrate Anatomy	3
BL 221	Comparative Vertebrate Anatomy Laboratory	1
or		
BL 222	Developmental Biology	3
BL 223	Developmental Biology Laboratory	1
or		
BL 228	Wildlife Biology	3
BL 229	Wildlife Biology Laboratory	1
and		
BL 224	Mammalian Physiology	3
BL 225	Mammalian Physiology Laboratory	1
One course with laboratory from each of the cellular and population areas.		8

**Population Biology Concentration:**

BL 232	Ecology	3
BL 233	Ecology Laboratory	1
or		
BL 236	Biology of Environmental Disturbances	3
BL 237	Biology of Environmental Disturbances Laboratory	1
and		
BL 234	Evolution and Systematics	3
BL 235	Evolution and Systematics Laboratory	1
One course with laboratory from each of the cellular and organismal areas.		8

**Strongly Recommended:**

BL 260 Biostatistics	3
or	
PY 203 Statistics I	3
and	
TH 280 Catholic Bioethics	3
or	
PL 218 Bioethics	3

**Requirements for Minor in Biology (26 credits)**

All students must complete the following courses:

BL 150, 152	General Biology I and II	6
BL 151, 153	General Biology Laboratory I and II	2
CH 101, 102	General Chemistry I and II	6
CH 103, 104	General Chemistry Laboratory I and II	2
Additionally, students must complete 10 credits from the courses listed below. Two lecture-laboratory course combinations, each combination from a different area of concentration, must be included. Students may complete the remaining credits in any concentration.		

**Cell and Molecular Biology Concentration:**

BL 208	Cell Biology	3
BL 209	Cell Laboratory	1
BL 212	Microbiology	3
BL 213	Microbiology Laboratory	1
BL 214	Molecular Genetics	3
BL 215	Molecular Genetics Laboratory	1
BL 216	Biotechnology	3
BL 217	Biotechnology Laboratory	1
BL 242	Histology	2
BL 243	Histology Laboratory	1
BL 248	Environmental Microbiology	3
BL 249	Environmental Microbiology Laboratory	1
BL 250	Medical Microbiology	3
BL 251	Medical Microbiology Lab	1
CH 251	Proteins and Metabolism	3
CH 253	Proteins and Metabolism Laboratory	1
CH 252	Nucleic Acids and Membranes	3
CH 254	Nucleic Acids and Membranes Laboratory	1
BIN 218	Bioinformatics, Genomics, and Proteomics	3
BIN 219	Biomedical Informatics	3

**Organismal Biology Concentration:**

BL 220	Comparative Vertebrate Anatomy	3
BL 221	Comparative Vertebrate Anatomy Laboratory	1
BL 222	Developmental Biology	3
BL 223	Developmental Biology Laboratory	1
BL 224	Mammalian Physiology	3
BL 225	Mammalian Physiology Laboratory	1
BL 228	Wildlife Biology	3
BL 229	Wildlife Biology Laboratory	1
BL 230	Ornithology	3

## Population Biology Concentration:

BL 232	Ecology	3
BL 233	Ecology Laboratory	1
BL 234	Evolution and Systematics	3
BL 235	Evolution and Systematics Laboratory	1
BL 236	Biology of Environmental Disturbances	3
BL 237	Biology of Environmental Disturbances Laboratory	1

## Typical First-Year Schedule

### First Semester (14-15 credits):

BL 150	General Biology I	3
BL 151	General Biology Laboratory I	1
CH 101	General Chemistry I	3
CH 103	General Chemistry Laboratory I	1
EL 102	Language and Rhetoric	3
or		
TH 119	Exploring Religious Meaning	
	Core course (History, Social Science, etc.)	
or	Calculus	3-4

All students must take one course designated as a First-Year Seminar to satisfy a Core Curriculum requirement.

### Second Semester (17-18 credits):

BL 152	General Biology II	3
BL 153	General Biology Laboratory II	1
CH 102	General Chemistry II	3
CH 104	General Chemistry II Laboratory	1
EL 102	Language and Rhetoric	3
or		
TH 119	Exploring Religious Meaning	
	Core course (History, Social Science, etc.)	3
	Core course or Calculus	3-4

## Course Descriptions

Note: BL 150-153 are prerequisites for all courses above the 100 level.

### COURSES INTENDED FOR NON-SCIENCE MAJORS

#### BL 100 Introduction to Biology (Tier 1)

This course provides insight into the organization of living systems at the molecular, cellular, organismal and population levels.

Emphasized are the structural and functional characteristics common to most organisms, organismal diversity, biological evolution, and interactions between organisms and their environment. The laboratory is designed to introduce the process of science and the characteristics of scientific knowledge. Students learn to formulate questions and hypotheses, design simple experiments, interpret results, draw conclusions and present their work in scientific formats. For non-science majors. Tier 1 course, no prerequisite. Four credits.

#### BL 104 Field Biology (Tier 1)

This combined lecture/laboratory course is designed to introduce non-science majors to the study of living organisms through direct observations in streams, pastures, lakes and forests. We will follow examples of ancient and modern field biologists as we develop background knowledge and skills in natural history, field collection methods and modern analysis of field data. Be prepared to work outside during each class, wearing old shoes, hip boots, or a life vest. For non-science majors. Tier 1 course, no prerequisite. Four credits.

#### BL 112 Understanding Biotechnology (Tier 1)

This integrated lecture-laboratory course is focused on the ways in which our understanding of biological systems is applied for practical purposes. The lecture portion addresses the basic biology

and theory behind topics such as genetic engineering of microbes, plants, and animals for agricultural, industrial, and medical purposes; cloning of genes, plants and animals; as well as, DNA analysis in forensic science and medicine. Special consideration is given to the ethical issues raised by the application of these technologies. The laboratory component is designed to reinforce the scientific method while providing hands-on experience with DNA technologies and forensics analyses. For non-science majors. Tier 1 course, no prerequisite. Four credits.

#### BL 113 All About Drugs (Tier 2)

Almost all of us use drugs, whether over-the-counter drugs, prescription drugs, or recreational drugs. Drugs impact our lives, as well as the lives of our family and friends. In this course, the pharmacology of drugs, including their mechanisms of action, side effects, and therapeutic uses will be discussed. The abuse potential of recreational drugs, tolerance and addiction, and the ethical issues surrounding modern drug discovery also will be discussed. The laboratory component is designed to reinforce lecture concepts. For non-science majors. Tier 2 course, any Tier 1 course serves as the prerequisite. Four credits.

#### BL 114 Human Biology and Laboratory (Tier 2)

This course is an overview of the human body's structure, its functionality, and the process of reproduction. We will give some attention to learning about common disease states and the efforts to treat them. Lastly, we will explore topics of specific interest to college students such as the importance of sleep, maintenance of immune function, and the body's ability to cope with stress. Case studies, class discussions, and student presentations will be integrated into lecture and lab periods in addition to experimental and observational study in the laboratory. For non-science majors. Tier 2 course, any Tier 1 course serves as a prerequisite. Four credits.

#### BL 116 Bacteria, Friends or Foes? (Tier 1)

This course will include discussions, lectures, and laboratories to study the tiny creatures that surround us known as microorganisms, particularly bacteria and viruses. The course will study the two-sided relationship between microorganisms and man. Most people think of bacteria and viruses as harmful because they cause disease. On the other hand, these tiny entities have many positive roles in our society including advancing biotechnology, food and beverage production, and roles in the environment including degrading of materials and cycling of nutrients. These and other topics will be discussed. For non-science majors. Tier 1 course, no prerequisite. Four credits.

#### BL 117 Animal Behavior (Tier 2)

This course will introduce students to the study of animal behavior. The course will provide an overview of the mechanisms that animals use to sense and interact with the environment and with each other. There will be extensive examination of the various behaviors that animals have evolved as means for survival in a challenging world. The course will discuss how these behaviors give insight into human behavior and psychology. Additionally, there will be a component of the course that involves the discussion of the sociobiology debate and the ethical issues that accompany the study of animal behavior. For non-science majors. Tier 2 course, any Tier 1 course serves as a prerequisite. Four credits.

#### BL 118 Killer Germs (Tier 2)

This course will include discussions, lectures, and laboratories to study past, present, and potential future diseases caused by microorganisms. The course will focus on the bacterial microorganisms and viruses, how they cause disease, treatments, and their impact on society. Topics will include tuberculosis, HIV/AIDS,

antibiotic-resistance, and other significant topics. For non-science majors. Tier 2 course, any Tier 1 course serves as the prerequisite. Four credits.

### **COURSES INTENDED FOR SCIENCE MAJORS**

#### **BL 150, 152 General Biology I and II**

This year-long course is intended for science majors. The first semester addresses the biology of cells, and animal physiology, development, and taxonomy. The second semester continues with plant biology, classical and molecular genetics, and ecology and evolution. At the conclusion of the course, Biology majors select cell and molecular biology, organismal biology or population biology as an area of concentration for subsequent work. A passing grade in BL 150 is required for BL 152. Three credits each semester.

#### **BL 151, 153 General Biology I and II Laboratory**

This course introduces scientific method, statistics, laboratory techniques, and the use of instruments as students perform experiments that reinforce and expand upon ideas presented in BL 150 and 152. One credit each semester.

#### **BL208 Cell Biology**

This course is an intensive examination of cell ultrastructure and function. Emphasis is placed on the role of specific organelles in cellular processes such as membrane structure, function, biogenesis and recycling; protein structure, assembly, modification and trafficking; energy transduction; intracellular transport; cellular locomotion; cell cycle control and programmed cell death; and, cell to cell communication. Techniques employed in the study of cellular components and processes, including microscopy, are integrated into the course content; as is the relationship of individual cells within the environment of an integrated multicellular organism. Prerequisites BL150-153. Three credits.

#### **BL209 Cell Biology Laboratory**

The laboratory is designed to familiarize students with the general methods used to study the physical nature of cells and their inherent biochemical processes. Experimental techniques performed range from the measurements of cell growth rates to the differential purification and biochemical analysis of subcellular components. The use of fluorescence microscopy to localize specific proteins in situ, using digital image capture and analysis, will be profiled. Throughout the laboratory an emphasis will be placed on the use of digital technologies to facilitate quantitative analysis of biological processes. Prerequisites BL150-153. One credit.

#### **BL 260 Biostatistics**

This course deals centrally with quantitative and statistical methodology in the biological sciences. It includes experimental design and the conventions of generating, analyzing, interpreting and presenting biological data. Three credits.

### **Cell and Molecular Biology**

A study of complex cellular processes and interactions through characterization of the structure and function of their molecular components.

#### **BL 212 Microbiology**

This course will introduce students to microbiology, the study of microorganisms with a focus on bacteria and viruses. The course will include discussions and lectures on the history of microbiology, microbial growth and metabolism, and microbial genetics. The impact of microorganisms in the environment, interactions with other organisms, and microbial diseases, treatments and the human immune response will be studied. Prerequisites BL150-153. Three credits.

#### **BL 213 Microbiology Laboratory**

Students will learn how to properly handle, grow, and identify microorganisms. Students will study microorganisms in the environment including biofilms, the effect of antibiotics on bacteria, identification of food contaminants, and various factors that contribute to changes in microbial growth. The lab will focus on bacteria. Prerequisites BL150-153. One credit.

#### **BL214 Molecular Genetics**

This course focuses on the gene, both in the context of genome structure and organization, and the coordination of individual gene expression. Specific emphasis is placed on the interaction between DNA and protein in relation to the regulation of gene expression, DNA replication, and recombination; the critical role of chromatin structure in gene organization and expression; and the molecular events in transcription, translation, and mutation. Structure and function comparisons are made between prokaryotes and eukaryotes using the bacterium *Escherichia coli*, the simple eukaryote *Saccharomyces cerevisiae* (baker's yeast), and humans, as paradigm organisms. Special attention is given to the techniques employed in molecular genetic analysis, including recombinant DNA methodologies and the relationship between molecular genetics and the fields of bioinformatics and biotechnology. Prerequisites BL150-153. Three credits

#### **BL215 Molecular Genetics Laboratory**

This course is a hands-on engagement of the foundational methodologies used to elucidate, manipulate and quantify gene anatomy and expression. The technologies employed for cloning vector design and construction, molecular cloning, gene transfer, nucleic acid isolation, hybridization analysis, DNA amplification, RT-PCR, DNA sequencing, and, genetic sequence and database analyses are explored theoretically and in practical application. Prerequisites BL150-153. One credit.

#### **BL216 Biotechnology**

This course engages the rapidly developing field of biotechnology through careful dissection of the technologies and their applications. Topics including cell-based and cell-free food and beverage biotechnology, heterologous protein expression in prokaryotic and eukaryotic systems, the design and production of transgenic plants and animals, stem cell technologies, reproductive and therapeutic cloning strategies, somatic and germline gene therapy approaches, vaccine development, DNA forensics, bioremediation, biofuels, and high throughput screening are examined in detail with consideration given to both their potential and realized industrial, medical and environmental applications. Emphasis is placed on the technical considerations unique to each technology, although safety and ethical considerations will also be addressed. Offered in even-numbered years. Prerequisites BL150-153. Three credits

#### **BL217 Biotechnology Laboratory**

This course provides students with significant hands-on experience performing techniques critical to the biotechnology industry. Laboratory exercises involve, food biotechnology, biosensor construction, recombinant protein production and purification in both prokaryotic and eukaryotic systems, plant and animal cell culture, and gene transfer to cultured plant and animal cells. Must be concurrently enrolled in BL216 Biotechnology. Offered in even-numbered years. Prerequisites BL150-153. Three credits.

## Organismal Biology

Study of the structural and physiological characteristics of tissues, organs and organ systems, and their relationships to the organism as a whole.

### BL 220 Comparative Vertebrate Anatomy

This course endeavors to provide a comprehensive comparison of vertebrate structure and function in the major body systems. Animals being discussed range from fish to reptiles, to mammals. Human comparisons are also included with each body system. This course is taken concurrently with Comparative Vertebrate Anatomy Laboratory. Prerequisites BL150-153. Three credits.

### BL 221 Comparative Vertebrate Anatomy Laboratory

The first part of this course is the comparative analysis of vertebrate skeletal structure. Animals under study include sharks, fish, amphibians, reptiles, birds, and mammals. The second part of the course involves an intensive study of mammalian gross anatomy through dissection of a cat. Body systems to be studied include the muscular, digestive, urogenital, reproductive, circulatory, and nervous systems. Prerequisites BL150-153. One credit.

### BL 222 Developmental Biology

This course provides a comprehensive study of both invertebrate and vertebrate embryology with a particular focus on important model organisms. The course will also provide an overview of plant developmental mechanisms. Areas of study include gametogenesis, fertilization, early embryological events and organogenesis. This course will focus on both classical embryological and modern molecular and genetic techniques. In addition, the course incorporates a component that discusses the bioethical issues surrounding important areas in developmental biology such as cloning and stem cell research. Taken concurrently with Developmental Biology Laboratory. Prerequisites BL150-153. Three credits.

### BL 223 Developmental Biology Laboratory

This course serves as a counterpart to the developmental mechanisms discussed in lecture. One portion of the laboratory will focus on learning the anatomy and stages of embryonic development for major model organisms through the study of slides, models and preserved materials. A second portion of the laboratory will focus on experience with embryological techniques and involve the observation and comparison of normal and abnormal development in both invertebrate and vertebrate systems. Prerequisites BL150-153. One credit.

### BL 224 Mammalian Physiology

Detailed study of organ system function with emphasis on humans. The systems studied include neuromuscular, cardiovascular, respiratory, renal, digestive and endocrine. Homeostasis, regulatory mechanisms and the functional relationships between systems are emphasized. Prerequisites BL150-153. Three credits.

### BL 225 Mammalian Physiology Laboratory

Hypothesis-driven laboratory experiments designed to explore organ system function in mammals, including humans. Students work extensively with computers to acquire, process and present data. Prerequisites BL150-153. One credit.

### BL 228 Wildlife Biology

This course combines elements of animal natural history, physiology, and behavior to survey how animals cope with short-term and seasonal changes in their environment. In particular, we will discuss the challenges animals face in maintaining homeostasis during periods of reproduction, migration, hibernation and torpor, resource scarcity, and heightened competition or predation risk.

We will examine strategies used by a variety of vertebrate and invertebrate species. Prerequisites BL150-153. Three credits.

### BL229 Wildlife Biology Laboratory

The objectives for lab and field activities in this course include instruction on animal capture techniques, and the study of animal resource use in relation to habitat and microclimate. Prerequisites BL150-153. One credit.

## Population Biology

Organisms in their relationship to each other and their environment, both historically and presently, form the core of this approach.

### BL 232 Ecology

This is a general course emphasizing physical-chemical-biological relationships. Evolutionary trends are considered. Topics include energy relations, biogeochemistry, population growth, and the structure and function of communities and ecosystems. Prerequisites BL150-153. Three credits.

### BL 233 Ecology Laboratory

Lab and field experiences paralleling Ecology 232 are designed to teach specific techniques of research design, field sampling, and data analysis in terrestrial and freshwater ecosystems. Prerequisites BL150-153. One credit.

### BL 234 Evolution and Systematics

The theory and evidence of the gradual evolution of organisms, and taxonomic relationships of animals and plants. Offered in odd-numbered years. Prerequisites BL150-153. Three credits.

### BL 235 Evolution and Systematics Laboratory

Laboratory experiments, computer simulations, and field trips are designed to study concepts presented in BL 234. Offered in odd-numbered years. Prerequisites BL150-153. One credit.

### BL 236 Biology of Environmental Disturbances

We will explore the biological aspects of many natural and human-caused disturbances by studying the cellular, physiological and ecological responses of organisms to disturbances such as treefalls, logging, pesticides, acid deposition and drought. The course will focus on ecological problems as well as solutions. Offered in even-numbered years. Prerequisites BL150-153. Three credits.

### BL 237 Biology of Environmental Disturbances Laboratory

Laboratory experiments, computer simulations and field work will parallel the topics presented in lecture. Field work will provide data for case studies on disturbances in both terrestrial and freshwater ecosystems. Offered in even-numbered years. Prerequisites BL150-153. One credit.

## Senior Research Program

The Senior Research Program introduces students to all facets of developing and completing a research project. It begins with BL 301 where the student writes a research proposal. He/she is introduced to biological literature searches, critical reading of primary research articles, formulation of biologically significant questions, experimental design and long-range planning. The program continues in BL 302 where the student performs the proposed laboratory work. The student masters, adapts and applies laboratory techniques to the solution of specific biological problems. Additionally, the student experiences the excitement of success and the frustration of setbacks common to all research. The program concludes with BL 303 where the student critically analyzes the data, integrates it with the findings of others and presents the work in a written thesis format. Enrollment in the first phase of the program (BL 301) requires completion of General Biology and at least two upper level biology courses, with concurrent registration in a third. Students with a biology QPA less than 2.0 or with two or more grades below C in upper level biology lecture courses may not register for BL 301.

### BL 301 Junior Research Seminar

Design and plan a research project. Write a research proposal. Two credits.

### BL 302 Research Project

Perform the experimental phase of the research project. Prerequisite: BL 301. Two credits.

### BL 303 Research Thesis

Write the senior research thesis. Prerequisite: BL 302. One credit.

## Electives

### BL 230 Ornithology

For thousands of years people have marveled at the beauty, the diversity, and the abilities of birds, particularly their ability to fly. Feathers are unique to birds, and birds are also known for their migratory behavior, singing ability, and parental care. While this course will cover these topics in depth, we will also examine how the study of birds can generate new insights relating to issues affecting all animals, including the nature of intelligence, communication, evolution, and ecological interactions. Class periods will feature lecture, multimedia demonstrations, and discussion of scientific literature. There will be a significant number of field trips to observe, identify, and capture birds in their native habitats. Prerequisites BL150-153. Three credits.

### BL 242 Histology

A detailed study of the normal tissues of vertebrates from both a morphological and a functional viewpoint. Special emphasis is placed on the characteristics of human tissues. Students must take the laboratory concurrently. Prerequisites BL150-153. Two credits.

### BL 243 Histology Laboratory

Each student gets experience in the preparation of slides as well as identifying tissues under the microscope. Prerequisites BL150-153. One credit.

### BL 248 Environmental Microbiology

A study of a variety of microorganisms that exist in natural environments, including Antarctica, deep-sea hydrothermal vents, Hot Springs in Yellowstone Park, and sedimentary rock. The possibility of microbial life on the moon will be discussed. The involvement of microorganisms in the flow of energy and cycling of materials will be investigated. Special attention will be given to studying the effect of pollutants on natural microbial populations and the effect

of microbiota on environmental contaminants. The application of microbes in the area of bioremediation and bioaugmentation will be presented. May be used to complete a biology minor or counted as an elective for the biology major. Prerequisites BL150-153. Three credits.

### BL 249 Environmental Microbiology Laboratory

Laboratory exercises and field work will be used to introduce students to useful techniques for isolating and examining microorganisms from many different environments, including soil and aquatic environments, and plants and animals. The use of microbes in the area of bioremediation and bioaugmentation will be investigated. May be used to complete a biology minor or counted as an elective for the biology major. Prerequisites BL150-153. One credit.

### BL 250 Medical Microbiology

This course will introduce students to the study of pathogenic (disease causing) microorganisms with a focus on bacteria and viruses. The course will include discussions and lectures and focus on microbial diseases, treatments and prevention, and the human immune response to microorganisms. Prerequisites BL150-153. Three credits.

### BL 251 Medical Microbiology Lab

Students will learn how to properly handle, grow and identify microorganisms. Students will study the effect of antibiotics on bacteria; mutation rates and causes including genetic transfer; and the future of medical microbiology and its importance in the health care setting. The lab will focus on bacteria. Prerequisites BL150-153. One credit.

### BL 310 Teaching Biology

Primarily laboratory instruction which includes lecturing, laboratory preparations and assistance under the supervision of the faculty member in charge of the course. It is not substitute teaching and is intended to provide first-hand experience with the teaching process. Permission of instructor required. One credit.

### BL 333 Special Study

The student will pursue a faculty directed course of study. Permission of Chairperson required. Variable credit. May be repeated.

### BL 350 Independent Research Project

The student will pursue research distinct from the Senior Research Project. Does not fulfill major or minor credit requirements. Variable credit. May be repeated.

### BL 550 Cooperative Education — Biology Internship

Work experience program extending the learning experience beyond the college into the world of work. Students are employed in an area related to their academic endeavor. Academic credits are P/F and are awarded by individual departments according to the extent of the work experience. Students may or may not be paid depending on the site. The purpose of the program is to integrate academic studies and employment activities. Does not fulfill major or minor credit requirements. Variable credit. May be repeated.