

## BIOLOGY

Kathie Towler, Regents Science 260  
507-786-3100  
towler2@stolaf.edu  
wp.stolaf.edu/biology

From the molecules that are the building blocks of life to the complex interactions between living organisms and their environments, biology continues to fascinate the human mind. The Biology Department offers a diverse array of courses and experiences that present fundamental biological principles and processes within the context of being informed, responsible, and compassionate citizens. It provides a broad range of learning opportunities through its course offerings, laboratories, independent study/research, internships, and study abroad and away programs at sites including The Bahamas, Central and South America, and Australia. Woven into all learning opportunities are hands-on experiences with modern equipment that stimulate critical and independent thinking.

For science majors, the Biology Department offers an exciting slate of challenging and rewarding courses. For the less science-oriented student, it seeks to stimulate natural curiosity about how our bodies work and how humans interact with their surroundings by providing several courses designed primarily for non-science majors. These courses, which satisfy the Natural Science requirement of the OLE Core curriculum, focus on current biological issues and general interest topics in biology.

### Overview of the Major

The ever-broadening nature of biology requires diversely trained and inquisitive biologists. The biology major has the dual mission of introducing students to the information and technological tools of various disciplines of biology while instilling the confidence to critically assess a biological phenomenon and to design and carry out an appropriate research program. To that end, the biology major provides the necessary content and instrument training while students practice the art of scientific inquiry. Opportunities for interdisciplinary work abound. Biology majors are encouraged to participate in research with faculty, study abroad and away programs in biology, departmental seminars, and social activities.

### Intended Learning Outcomes for the Major

### Special Programs

Research opportunities and other independent study are central to the teaching mission of the Biology Department. Full-credit course opportunities include independent study (BIO 298), independent research (BIO 297 or BIO 398), and directed undergraduate research (BIO 396). BIO 291 is a 0.25 credit opportunity for a journal club or other exploratory course offered at student request and the professor's discretion. BIO 375 is a 0.25 credit course option for students completing a research project or piloting a new project. BIO 297 is independent research that can be taken for 0.25, 0.5 or 1 credit. Each summer, many biology faculty participate in CURI summer research in which paid positions offer excellent opportunities for students in lab, field, and computer-based research.

The Biology Department offers many opportunities for study abroad and away. The semester-long program, Environmental Science in

Australia (usually offered alternating spring semesters), is of particular interest to biology students. Other semester/summer programs are available through affiliated institutions or programs (e.g., ACM Oak Ridge Science Semester, ACM Tropical Field Research, Coe College Wilderness Field Station, Denmark's International Studies Program). In addition, each January term several study abroad or away biology courses are offered; see courses marked "study away" or "study abroad" in the course list below. Students interested in study abroad or away biology courses should consult biology faculty or the Smith Center for Global Engagement.

Several concentrations are offered that closely relate to the Biology Department: biomolecular science, environmental studies, mathematical biology, neuroscience, and statistics. Students interested in these concentrations should consult the descriptions in this catalog or the program director.

## Requirements

### Requirements for the Major

All students majoring in biology complete eight biology courses and a year of chemistry: either CHEM 122 and CHEM 126; or CHEM 125 and CHEM 126. Note that CHEM 126 has a prerequisite of completion of one calculus course.

Code	Title	Credits
<b>Biology courses (explained in more detail below this table)</b>		
Foundation course		1.00
At least one course from each of four core categories		4.00
At least one level III biology course		1.00
Two elective courses		2.00
<b>Chemistry</b>		
Select one of the following sequences (CHEM 126 requires completion of a calculus course):		2.00
CHEM 122 & CHEM 126	Introductory Chemistry and Energies and Rates of Chemical Reactions	
CHEM 125 & CHEM 126	Structural Chemistry and Equilibrium and Energies and Rates of Chemical Reactions	
<b>Total Credits</b>		<b>10</b>

### Foundation Course

The biology major begins with BIO 150. This course explores the evolutionary and genetic foundations of life's biodiversity, and establishes the laboratory and scientific communication skills upon which subsequent courses build. AP or IB credit does not provide the equivalent of this foundation course; students with AP or IB credit instead receive one 100-level elective credit in the major. Students planning to major in biology should take this foundation course first; students who decide to switch to a biology major should take this foundation course at the time of deciding their major.

### Core Categories

Students must take one course from each of the four core categories listed below. While the categories below are listed in order of biological level of organization, students may take their upper-level biology

courses in any order providing that prerequisites are met. Please consult the course descriptions to see the prerequisites for each course.

1. **Genetics.** Genetics examines relationships between genotype and phenotype in prokaryotic and eukaryotic organisms from classical and molecular perspectives. Through a course in this category, students will explore gene structure, inheritance, and expression. Through genetics, students discover the ways in which the field of genetics is interdisciplinary, research-based, and relevant to the world today. Course: BIO 233
2. **Cell Biology.** Cells are the basic units of life, and understanding the structure and function of cells, and how they are studied, is central to understanding modern biology. Through a course in this category, students will obtain a comprehensive overview of cellular structure and function, for example cellular compartments, macromolecular structures, and life processes such as energy and material flux, cell division, and control mechanisms. Course: BIO 227
3. **Comparative Organismal Biology.** Courses in this category study life at the tissue, organ system, and individual levels of organization. Students will broaden their knowledge of a group of organisms (e.g., plants) or of a universal biological phenomenon (e.g., reproduction). Courses in this category approach the content through comparisons across multiple taxa. Courses: BIO 242, BIO 247, BIO 248, BIO 251, BIO 252, BIO 266, BIO 275, or participation in the Environmental Science in Australia semester (but this program cannot count for both the Comparative Organismal and the Ecology core requirements)
4. **Ecology.** Ecology is the study of the interactions between organisms and their environments. These interactions are studied at levels of biological organization from individuals to populations, communities, ecosystems, landscapes, and the entire biosphere. Through ecology, students can better understand interconnections in the natural world, and become more aware of their role in sustaining the biodiversity and ecosystem services that benefit all life on earth. Courses: BIO 261 or participation in the Environmental Science in Australia semester (but this program cannot count for both the Comparative Organismal and the Ecology core requirements)

## Level III Biology Course

Every biology major takes at least one level III course in the department. Our level III course offerings vary greatly in topic and in type of student work, yet they all share aspects such that each student has an opportunity to experience sophisticated, independent, iterative work in biology. Students in a directed research course will practice sophistication in experimental design and practice, independence in their investigation, and iterative troubleshooting. Students in a non-laboratory investigative course will practice sophistication in evaluating the primary literature, as well as independence in assembling and synthesizing ideas from that literature. Not all level III biology courses meet this requirement. Specifically, courses numbered above BIO 393 and any BIO 300-level courses worth less than a full credit cannot fulfill the Level III requirement. Sometimes Level III topics courses in other departments like Environmental Studies can count as the Level III biology course. Students should consult catalog descriptions for each level III course to learn about the topic, type of student work, and prerequisites.

## Elective Courses

Students complete their biology major with two elective courses. Any full credit (1.00) biology course can count as an elective with the following exceptions:

- Only one independent study (BIO 298) and one independent research (BIO 396 or BIO 398) can count toward the major.
- Internships (BIO 294 or BIO 394) do not count toward the major. BIO 294 and BIO 394 can only be taken P/N.
- Independent Research taken as BIO 297 does not count toward the major and can only be taken P/N.

In addition to courses designated as biology, the St. Olaf courses in the table below can count as biology electives:

Code	Title	Credits
CHEM 379	Biochemistry I	1.00
NEURO 239	Cellular and Molecular Neuroscience	1.00
PSYCH 238	Biopsychology	1.00
ENVST 281	Topics in Environmental Studies (when topic includes appropriate biology content)	1.00

## General Considerations for the Major

- No more than two level I biology courses, including BIO 150, and AP or IB credit may count toward the major.
- Of the six courses counting toward the major that must be graded C or above, at least four must be at level II or III.
- Students wishing to count for the major a course taken abroad or at another institution must consult with the chair for approval before taking the course.
- While programs leading to graduate work are planned on an individual basis, many programs require students to have completed two or more quantitative courses (mathematics, statistics, or computer science), two courses in physics, and at least four courses in chemistry. Students intending to enter graduate or professional school are encouraged to consult with the biology faculty to plan a course of study appropriate for the postgraduate program.
- Students pursuing a secondary school science education teaching license with a life science specialty should consider completing the biology major including BIO 123 or BIO 243 as one of their electives. Additional courses are required as specified by the Education Department. Interested students should consult Emily Mohl (mohl@stolaf.edu).
- All of the level II and III courses in biology have prerequisites. Please consult the course descriptions for this information.

*\*By completing this major, the student also satisfies the OLE Core Writing in the Major requirement.*

## Courses

### **BIO 121: *Biological Science: Issues in Biology***

This course explores contemporary biological issues related to health and the environment, with the goal of fostering informed citizens prepared for current biological debates. Students learn the relevant biological principles in lecture and lab followed by appropriate lab or field research. Specific topics vary from year to year and may include emerging diseases, cardiovascular health, genetics, specific groups of organisms, behavior, and environmental dynamics. Students attend lectures plus one two-hour laboratory per week. Offered periodically.

### **BIO 123: *Human Biology***

This course focuses on the wondrous actions of the human body. Students learn how several vital body functions occur subconsciously, such as the rhythmic beating of the heart or the digestion of nutrients after a meal. Topics include how the brain works, how muscles contract, and how kidneys produce urine, and the remarkable biology associated with reproduction. Students use this understanding to elucidate diseases such as diabetes and hypertension. Students attend lectures plus one two-hour laboratory per week. Offered annually.

### **BIO 124: *The Biology of Women***

Issues of women's biology including views of the evolving female and biological determinism are examined. Core material covers anatomy, development, the biological basis of gender, reproduction, sexual response, the menstrual cycle and aging, and aspects of women's health such as eating disorders, cancers, and hormonal treatments. Students participate in significant amounts of group work and oral presentation. The course is open to both men and women. Offered during January term.

### **BIO 131: *Field Paleontology in Florida (study away)***

This course explores the natural history of our planet through the fossil record. Students learn from professional paleontologists and museum curators about how fossils are used in scientific research prior to embarking on a 10-day vertebrate fossil expedition in central Florida. The students then curate, catalog, and interpret their data, using a large museum reference collection. Open only to sophomores, juniors, and seniors. Offered periodically in January Term. Apply through Smith Center for Global Engagement.

### **BIO 135: *Thinking and Doing Biology***

Why do biologists do what they do? How is biology actually done? Students investigate the reasons biological science is done the way it is today. Includes laboratory component. Students have the opportunity to design and perform their own experiments while learning the process of scientific investigation. Designed primarily for non-majors. Offered during January Term.

### **BIO 140: *Explorations in Microbiology***

This course explores the science of microbiology and the impact of microorganisms (bacteria, viruses, fungi, protozoa, and prions) on human affairs and daily life. Topics include microbial diversity, cell structure and function, growth and metabolism, genetics, control of microbial growth, host-pathogen interactions, immunology, infectious disease, and applied microbiology. Each topic provides a basis for discussion of current issues where microorganisms play a role. Students attend lectures plus one two-hour laboratory per week. Offered annually during Spring semester.

### **BIO 143: *Human Anatomy and Physiology: Cells and Tissues***

The study of the anatomy and physiology of the human body is founded on a thorough understanding of the structure and function of cells and tissues. Students attend lectures plus one three-hour laboratory per week. This course may not be taken after completion of CH/BI 227 or BIO 227. Offered in the fall semester.

### **BIO 150: *Evolutionary Foundations of Biodiversity***

This course is the gateway for the biology major, guiding students as they develop the context, skills, and modern framework on which to continue their study of biology. Students explore the history, evolution, and diversity of life in the context of genetics and comparative genomics. The laboratory emphasizes question-asking, problem-solving, and exploring biodiversity, and students have multiple opportunities to practice and communicate their science. Students attend lectures plus one 3-hour laboratory/discussion per week. Offered each semester.

### **BIO 227: *Cell Biology***

This course provides a comprehensive overview of cellular structure and function including cellular compartments, macromolecular structures, and life processes such as energy and material flux, cell division, and control mechanisms. Students learn current and/or historical evidence and methodology (e.g., microscopy, isolation procedures, and probes). Students attend lectures plus one three-hour laboratory per week. Laboratory experiences provide opportunities for qualitative and quantitative observations of cellular structure and function. Students place their work in the context of current research through examination of relevant literature and formal presentations. Offered each semester. Counts toward "cell biology" core category.

**Prerequisites:** CHEM 122, or CHEM 125, or CH/BI 125; BIO 150 is strongly preferred.

### **BIO 231: *Microbiology***

Microbiology examines the morphology, composition, metabolism, and genetics of microorganisms with emphasis on bacteria and viruses. Students examine the dynamic impact of microbes on humans, the immune response, and the role of microbes in the environment. Students attend lectures plus one three-hour laboratory per week. Offered annually during Fall semester.

**Prerequisites:** BIO 143 or BIO 150, and one chemistry course.

### **BIO 233: *Intermediate Genetics***

Genetics examines relationships between genotype and phenotype in prokaryotic and eukaryotic organisms from classical and molecular perspectives. Lectures in this core course cover ideas and technologies contributing to understanding mechanisms of gene transmission and regulation. Laboratories utilize model organisms to investigate classical and molecular modes of inheritance. Students attend lectures plus one three-hour laboratory per week. Offered each semester. Counts as "genetics" core category.

**Prerequisites:** BIO 150; and CHEM 125 or CHEM 122 or CH/BI 125.

### **BIO 242: *Vertebrate Biology***

Students focus on the natural history of Upper Midwest vertebrates and phylogenetic, morphological, and functional relationships of these animals. Laboratories include identification, and morphology. During field trips, students document bird migrations, amphibian chorusing, and other animal activities. Independent projects explore topics ranging from blue bird nesting behavior to thermal conductivity and insulation in animals. Students attend lectures plus one three-hour laboratory per week. Offered annually. Counts as "comparative organismal biology" core category.

**Prerequisites:** BIO 150.

**BIO 243: Human Anatomy and Physiology: Organs and Organ Systems**

Students journey toward greater understanding of the human body through an integrated study of the structure of the body (anatomy) and how organs such as the brain, heart, and kidney perform their remarkable functions (physiology). The course is designed primarily for students intending careers in the health sciences. Students attend lectures plus one three-hour laboratory per week. Offered each semester.

**Prerequisite:** BIO 143, or BIO 150 and BIO 227 or CH/BI 227.

**BIO 247: Animal Physiology**

How do animals do what they need to do to survive in all sorts of environments? Why are others able to exist in only very particular conditions? These are the sorts of questions students explore as they navigate the basic systems that provide circulation, ventilation, movement, digestion, and waste removal. Students look at how these processes are coordinated by the nervous and endocrine systems and how they vary across the animal kingdom to help organisms survive in dry, hot deserts, in dark, deep oceans, and places in between. Students attend lectures plus one three-hour laboratory per week. In laboratory, they conduct quantitative physiological measurements to assess functions such as temperature control, respiration rates, and salt and water balance. Counts as "comparative organismal biology" core category. Offered periodically.

**Prerequisites:** BIO 150; BIO 227 or CH/BI 227 recommended.

**BIO 248: Invertebrate Biology**

This course traces the path of invertebrate evolution from single-celled protozoans to the most primitive chordates. Emphasis is placed upon major breakthroughs in design that enable organisms to exploit new ecological habitats. Laboratories are designed to introduce students to the major invertebrate groups via observation of living animals and through dissection. Students attend lectures plus one three-hour laboratory per week. Counts as "comparative organismal biology" core category. Also counts toward neuroscience concentration.

**Prerequisites:** BIO 150.

**BIO 251: Plant Physiology**

This course begins with an in-depth look at a plant cell and its physiology, followed by a discussion of whole plant physiology as it relates to cellular functions. Students attend lectures plus one three-hour laboratory per week. Counts as "comparative organismal biology" core category.

**Prerequisites:** BIO 150; and CHEM 122 or CHEM 125; and CHEM 126; BIO 227 or CH/BI 227 recommended.

**BIO 252: Plant Evolution and Systematics**

Plants are a diverse and important group of organisms. This course considers their evolution, emphasizing the morphology and anatomy of flowering plants. Students learn about basic techniques of data collection and analysis to investigate plant evolution: identifying plants, dissecting and staining plant structures, and using computer-based taxonomic statistics programs. Students attend lectures plus one three-hour laboratory per week. Offered periodically. Counts as "comparative organismal biology" core category.

**Prerequisites:** BIO 150.

**BIO 253: Water in Morocco: Precious, Precarious, and Problematic (study abroad)**

Students examine water from a scientific perspective -- chemical, physiological, ecological -- and delve into the historical, political, economic, and social implications in Morocco -- a country of diverse cultures and biotic zones from two oceans, mountain ranges, and the driest of dry deserts. Students learn through readings, lectures, student presentations, and field trips. This class is suitable for any student with sophomore standing. Bio 150 OR ENVST 137 highly recommended. Offered periodically during January term. Apply through Smith Center for Global Engagement.

**BIO 261: Ecological Principles**

Ecology focuses on the study of the interrelationships that determine the distribution and abundance of organisms. This core course examines organism-environment interactions and the study of populations, communities and ecosystems. Consideration is given to use of ecological studies in ecosystem management. Students attend lectures plus one three-hour laboratory per week. Offered each semester. Counts as "ecology" core category.

**Prerequisite:** BIO 150.

**BIO 272: Evolutionary Medicine**

The field of evolutionary medicine represents the intersection of evolution and medicine. Students use evolutionary biology to understand, prevent, and treat disease; in turn, they use biomedical data to advance evolutionary biology understanding. Some topics in this field are a mismatch between our evolved bodies and modern environments, evolutionary perspectives on cancer, and individual vs. public health. Students explore the material through large and small group discussions of readings, and short lectures interspersed with activities. Offered periodically.

**Prerequisites:** BIO 150 and at least one 200-level BIO or CH/BI course.

**BIO 275: Biology of Reproduction**

The ability to reproduce is one of the key features of a living organism. Studying the biology of reproduction requires a synthesis of information and concepts from a wide range of fields within biology. This course addresses reproduction at the genetic, organismal, and population levels. Laboratory work adds a valuable investigative component to the course, and social/psychological issues are addressed throughout. Students attend lectures plus one three-hour laboratory per week. Offered periodically. Counts as "comparative organismal biology" core category. Also counts toward gender and sexuality studies major and concentration if approved by petition.

**Prerequisites:** BIO 150 or permission of instructor.

**BIO 287: Island Biology in the Bahamas (study abroad)**

Intensive study of the biology that created the Bahamas and that now constitutes the living structure of these islands. Staying at the Gerace Research Center on San Salvador Island provides access to a diversity of marine and terrestrial habitats including coral reefs, seagrass beds, mangrove forests, hypersaline ponds, limestone caverns, and the "blue-holes" that connect inland waterways to the sea. Offered periodically during January term. Apply through Smith Center for Global Engagement.

**Prerequisite:** BIO 150 or permission of instructor.



**BIO 288: Equatorial Biology (study abroad)**

This course offers intensive field-biology experiences within three equatorial New World environments: the Amazon rainforest, the Andes cloud forests, and the Galapagos Islands. Students compare the rich biodiversity, the adaptations and natural history of species, and the influence of human impact on these areas. Preparation for class requires readings from texts and primary literature concerning ecological and environmental issues specific to each of these regions. Based in Quito, the three field expeditions alternate with home-based rest days allowing for reflective writing in journals, assimilation, and discussion. Offered periodically during January term. Apply through Smith Center for Global Engagement.

**Prerequisite:** BIO 150 or permission of instructor.

**BIO 289: Marine Ecology Research in Jamaica (study abroad)**

Students gain meaningful research experience studying aquatic ecosystems. The course begins on campus as students develop field and analytical skills that they will apply to their research. Staying at the Discovery Bay Marine Lab in Jamaica provides access to unique coral reef, intertidal, freshwater, and waterfall habitats where students conduct independent research projects. The course concludes on campus for data analysis and interpretation. Offered periodically during January term.

**Prerequisite:** BIO 150 or permission of instructor.

**BIO 290: Medical Terminology (0.25 credit)**

This course provides the framework for understanding medical language and terminology used by healthcare professionals, and helps students learn common medical terms essential for safe patient care and effective communication between interprofessional healthcare teams. This course is intended for students preparing for graduate studies in nursing, physician assistant, occupational therapy, physical therapy and other allied health areas, and is not recommended for nursing majors or for students preparing to apply for admission into a school of medicine, dentistry or podiatry. Offered annually in the spring semester. Does not count toward biology major.

**Prerequisites:** BIO 143 and BIO 243.

**BIO 291: Topics in Biological Research (0.25)**

For science majors, learning to read the primary literature and other professional sources is an important transition from classroom learning to post-graduate endeavors. Students read, present, and discuss scientific literature in a field selected by participating faculty. The goal is to garner sufficient expertise to allow critical analysis of the particular field. May be repeated if topic is different. Does not count toward biology major.

**Prerequisite:** permission of the instructor.

**BIO 292: Topics in Biology**

Students study topics in biology. Topics vary from year to year at the discretion of the department. Class work depends on the topics and instructor, but is consistent with the amount and level of work in other 200-level biology courses. May be repeated if topics are different. Counts as an elective toward biology major. May count toward other majors or concentrations if approved by the chair of that major/concentration. Offered periodically each term.

**Prerequisites:** vary.

**BIO 294: Academic Internship**

Internships are designed to provide career-testing opportunities. Students interested in an internship should consult with the Piper Center for Vocation and Career, enlist a faculty supervisor, and complete an internship application. Internships do not count toward the biology major requirements.

**BIO 297: Independent Research (0.25, 0.50, 1.00)**

Independent research is offered for students dedicated to an independent research experience. Emphasis is placed on the iterative process of experimentation and analysis. Students interested in independent research may enroll in BIO 297 or BIO 398. Each course requires a faculty supervisor, who makes the decision as to which course is appropriate. Pass/No Pass. Offered each semester and during January Term. Does not count toward biology major requirements.

**Prerequisite:** approval of instructor.

**BIO 298: Independent Study**

Independent study allows students to study in an area not covered in the regular biology course offerings. The student undertakes substantial independent study in a defined biological field, meets regularly with faculty supervisor, and prepares some form of presentation of the material learned. The student must obtain permission of supervisor and complete an independent study form available from the Registrar's Office or its website.

**BIO 299: Human Gross Anatomy (0.25)**

Human gross anatomy students participate in the dissection of both a female and a male cadaver, preparing cadavers for use in the Human Anatomy and Physiology course, BIO 243. In addition, students serve as TAs for one lab section of BIO 243, conduct guided showings of the cadavers for approved courses such as Biology of Women and Human Biology, and participate in the annual Human Anatomy Chapel service. Does not count toward biology major. Application required. P/N only. Offered annually during the fall semester.

**Prerequisite:** BIO 243.

**BIO 306: Directed Undergraduate Research with Writing**

This course provides a comprehensive research opportunity, including an introduction to relevant background material, technical instruction, identification of a meaningful project, data collection and analysis, and writing. The topic is determined by the faculty member in charge of the course and may relate to their research interests. This course meets the Writing in the Major requirements for Biology majors. Offered based on department decision. May be offered as a 1.00 credit course or .50 credit course.

**Prerequisite:** determined by instructor.

**BIO 308: Independent Research with Writing**

Independent research is offered for students dedicated to an in-depth research experience. In conjunction with a faculty supervisor, a student conceives and performs a research project leading to the production of a major piece of work such as a research paper or poster presentation. This course meets the Writing in the Major requirements for Biology majors. Independent research requires permission of a supervisor and completion of an independent research form available at the Registrar's Office or its website.

**Prerequisite:** determined by instructor.

**BIO 315: Principles of Bioinformatics**

This course introduces computer programming to biologists and allows for the creative application of this skill to an array of biological questions, with an emphasis on advanced genetics topics. From mining large genetic sequence databases to simulating population dynamics, we explore how computational tools are becoming essential to the study of a broad range of biological systems. Students participate in a semester-long project that allows them to sequence and publish their own DNA and analyze their evolutionary history. Students attend lectures plus one three-hour laboratory per week. Also counts toward biomolecular science and mathematical biology concentrations.

**Prerequisite:** BIO 233.

**BIO 324: Evolutionary Genetics**

In this seminar course, students explore new advances and applications at the intersection of evolution and genetics. Short lectures and in-class activities provide students with the necessary background to analyze primary scientific articles, and small group discussions provide a forum for student-led discourse and critique of these articles. Each student undertakes a literature research project on a topic of their choice; this semester-long project includes regular faculty consultation and peer review. Also counts toward biomolecular science concentration.

**Prerequisite:** BIO 233 or permission of the instructor.

**BIO 364: Molecular Biology**

In this seminar course, students explore molecular biology topics or techniques and their applications. Short lectures and in-class activities provide students with the necessary background to analyze primary scientific articles, and small group discussions provide a forum for student-led discourse and critique of these articles. Each student undertakes a literature research project on a topic of their choice; this semester-long project includes regular faculty consultation and peer review.

**Prerequisite:** BIO 233.

**BIO 365: Molecular Cloning**

In this research-based lab course, students learn molecular cloning technique theory and methods. With a faculty member, students design and conduct a cloning project relevant to the faculty member's ongoing research. Students interpret their data and make connections to relevant scientific literature and present their findings in lab meetings and a final poster presentation. Students also consider and articulate how the skills developed through this course impact their future careers as scientists.

**Prerequisite:** BIO 233.

**BIO 371: Field Ecology**

This course focuses on learning modern field and laboratory methods to test ecological hypotheses. Students work on group and individual projects to collect and analyze data and give oral and written presentations on projects. Class periods focus on discussion of primary literature and project results. Class trips include visits to local natural areas. Students attend lecture/discussion plus one four-hour laboratory per week. Also counts toward environmental studies major (natural science emphasis) and mathematical biology concentration.

**Prerequisite:** BIO 261.

**BIO 372: Developmental Biology**

The last decade has unveiled the mechanism by which a single cell gives rise to an embryo rich in pattern and cellular diversity. This course traces the use of surgical, genetic, and molecular techniques as they have uncovered the developmental blueprints encoding the universal body plan fundamental to all metazoan life. Students attend lectures plus one three-hour laboratory per week. Offered periodically during Spring semester.

**Prerequisite:** BIO 233.

**BIO 375: Advanced Supplemental Research (0.25)**

Students work on special projects during one afternoon of laboratory per week. Each student must have the sponsorship of a faculty member. This course does not count toward the biology major. P/N only. Offered each semester. May be repeated if topic is different.

**BIO 382: Immunology**

Immunology focuses on the structure, development, and function of the immune system. The course explores the molecular and cellular basis of the immune responses. The application of immunological principles to allergy, autoimmunity, AIDS, transplantation, and cancer are included. Students attend lectures plus one three-hour laboratory per week. Offered annually during fall semester.

**Prerequisites:** BIO 227 and BIO 233.

**BIO 383: Evolutionary Biology**

The idea of evolution forms the foundation for all modern biological thought. This course examines the processes of evolution in detail (selection, genetic drift, mutation, migration) and studies the methods by which biologists reconstruct the history of life on the planet. Advanced topics are explored through reading and discussion of journal articles. The social and historical context of evolutionary theory is discussed. Students attend lectures plus one three-hour laboratory per week. Also counts toward biomolecular science and mathematical biology concentrations.

**Prerequisite:** BIO 233.

**BIO 385: The Neuron**

From tiny ion channels to the basis for learning, neuroscience is a rapidly developing area. Using texts, reviews, and current literature, students examine in depth the fundamental unit of the nervous system, the neuron. The goals are to understand how neurons accomplish their unique functions: electrical signaling, synaptic transmission, and directed growth and remodeling. Also counts toward neuroscience concentration.

**Prerequisites:** BIO 227 or CH/BIO 227 and progress toward a major in any of the natural sciences.

**BIO 386: Animal Behavior**

This course approaches the study of animal behavior from the blended viewpoints of evolutionary behavioral ecology and comparative psychology. Mechanisms of learning, cognition and development, as well as aggression, territoriality, and mating are examined at the organismic and cellular level. A deeper understanding of the neural and environmental determinants of behavior in a wide variety of species helps students better understand themselves and their place in nature. Laboratory work reinforces class material. Students attend lectures plus one three-hour laboratory per week. Also counts toward neuroscience concentration.

**Prerequisite:** BIO 150.

**BIO 387: Neuroethology**

Neuroethology is the study of how nervous systems generate natural behaviors in animals. The nervous system connects an animal with its environment, determining how an animal perceives, learns, and reacts to stimuli. This course explores the neural mechanisms underlying diverse behaviors - such as escape reflexes, locomotion, and communication - in a wide range of invertebrate and vertebrate species and based on an evolutionary framework. Lecture concepts are explored through laboratory experimentation and different forms of scientific communication. Students attend lectures plus one three-hour laboratory per week. Offered in alternate years with BIO 386 (Animal Behavior).

**Prerequisite:** MATH 120 or equivalent and one of the following: BIO 233, BIO 247, BIO 266, NEURO 239, or PSYCH 238 or permission of instructor.

**BIO 391: Selected Topics**

Specific topics announced prior to each term are based on student interests and available staff. Class work includes comprehensive review of literature on the specific topic. Class meetings present topics in discussion format. May be repeated if topic is different. Also counts toward environmental studies major (all emphases) and concentration when taught with environmental science focus and approved by chair.

**Prerequisites:** vary.

**BIO 392: Laboratory Topics**

Specific topics announced prior to each term are based on student interests and available staff. Class meetings focus on laboratory and/or field methods and student work involves analysis and interpretation of data that reflects on the relevant literature. May be repeated if topic is different. May count toward environmental studies major (all emphases) and concentration when taught with environmental science focus and approved by chair.

**BIO 394: Academic Internship**

Biology 394 is for students who have completed one internship (BIO 294) and wish to complete a second internship. Students interested in an internship should consult with the Piper Center for Vocation and Career, locate a faculty supervisor, and complete an internship form. Internships do not count toward the biology major requirements.

**BIO 395: Biomedical Innovation Scholars Program**

Teams of science, engineering, nursing, and economics students research the potential for commercialization of a novel medical technology. Students gain experience with medical procedures, market research, the FDA approval process, financial analysis, the health insurance industry, business ethics, intellectual property law, and human subjects research ethics. At the end of this practicum, students write a business plan and deliver a professional presentation of their recommendations to staff at the partner company, investment group, or medical organization. Offered annually during January Term. Does not count toward biology major.

**Prerequisite:** permission of instructor.

**BIO 396: Directed Undergraduate Research**

This course provides a comprehensive research opportunity, including an introduction to relevant background material, technical instruction, identification of a meaningful project, and data collection and analysis. The topic is determined by the faculty member in charge of the course and may relate to his/her research interests. This course does NOT meet the level III biology requirement for the biology major because it does not fulfill the Writing in the Major requirement. However, it can count as an elective for the biology major. Offered based on department decision. May be offered as a 1.00 credit course or .50 credit course.

**Prerequisite:** determined by individual instructor.

**BIO 398: Independent Research**

Independent research is offered for students dedicated to an in-depth research experience. In conjunction with a faculty supervisor, a student conceives and performs a research project. Students develop skills reading, evaluating, and synthesizing scientific literature, making decisions about experimental design and implementation, and collecting and analyzing data. This course does not meet the level III biology requirement for the biology major because it does not fulfill the Writing in the Major requirement. However, it can count as an elective for the biology major. Independent research requires permission of a supervisor and completion of an independent research form available at the Registrar's Office or its website.

**BI/ES 226: Conservation Biology**

Conservation biology focuses on the study of biological diversity. Students examine why people should be concerned about the number and types of species on earth, what factors threaten the survival of species, and how people can conserve them. Using principles of ecology and evolution, with input from other disciplines, students gain a better understanding of the impact of humans on biodiversity and the importance of responsible environmental decision-making. Offered annually.

**Prerequisite:** One natural science course.

**BI/ES 228: Environmental Health**

Human health is affected by the biological environment, a teeming world of parasites and diseases, and the physical environment -- the water, air, and landscapes that we inhabit. Human interactions with the environment have changed rapidly, as human populations grow, travel increases, and ecosystems are altered. This course touches upon traditional environmental topics such as air and water quality and integrates newer public health challenges such as emerging diseases and food-borne illnesses. Offered periodically.

**Prerequisite:** an introductory science course.

**BI/ES 286: Tropical Ecology and Sustainable Land Use in Costa Rica (study abroad)**

This course offers students the opportunity to study first-hand the most diverse ecosystems on earth. In this intensive field-oriented course students explore lowland rainforest, montane forest, dry forest, and coastal and agricultural ecosystems through projects and field trips. Students read and discuss texts and primary literature specific to ecology, evolution, conservation, and agricultural practices of each area, and keep reflective journals. Offered during January Term in alternate years. Apply through Smith Center for Global Engagement.

**Prerequisite:** one science course.

## Plan of Study

### Biology Major - Plan of Study

This is a sample plan that meets the prescribed requirements for the biology major at St. Olaf. This tool is meant as a guide and does not replace working closely with the student's academic advisor.

An overview of general options for planning the biology major may be found here.

Course	Title	Credits
<b>First Year</b>		
<b>Fall Semester</b>		
FYS 120 or WRIT 120	First-Year Seminar (or Conversation Program) or Writing and Rhetoric	1.00
BIO 150	Evolutionary Foundations of Biodiversity	1.00
CHEM 122 or CHEM 125	Introductory Chemistry (depending on placement) or Structural Chemistry and Equilibrium	1.00
World Language		1.00
<b>Credits</b>		<b>4</b>
<b>Spring Semester</b>		
WRIT 120 or FYS 120	Writing and Rhetoric (or Conversation Program) or First-Year Seminar	1.00
CHEM 126	Energies and Rates of Chemical Reactions	1.00
MATH 119 or MATH 120	Introduction to Calculus or Calculus I	1.00
World Language		1.00
<b>Credits</b>		<b>4</b>

**Sophomore Year**

**Fall Semester**

BIO 150	Evolutionary Foundations of Biodiversity (if not previously taken in first year)	1.00
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**Credits** 1

**Spring Semester**

BIO 233	Intermediate Genetics (genetics core category course)	1.00
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**Credits** 1

**Junior Year**

**Fall Semester**

BIO 227	Cell Biology (cell biology core course)	1.00
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**Credits** 1

**Spring Semester**

Comparative Organismal Biology Elective Course (see the Requirements tab for approved courses)	1.00
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Biology Elective Course	1.00
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**Credits** 2

**Senior Year**

**Fall Semester**

BIO 261	Ecological Principles (ecology core category course)	1.00
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BIO 300-Level Elective Course	1.00
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**Credits** 2

**Spring Semester**

Biology Elective Course	1.00
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**Credits** 1

**Total Credits** 16

**Note - Junior Year/Senior Year:** Students should consider pursuing research opportunities within the biology department and consider studying off campus as some biology requirements can be satisfied in study abroad or study away programs.

Students must successfully complete the equivalent of 35 St. Olaf credits through a combination of full-credit and fractional-credit courses to earn the Bachelor of Arts.

Visit the Biology department webpage for more information.

Faculty

**Chair, 2025-2026**

**Steven A. Freedberg**

Professor of Biology  
evolutionary biology; computer simulation modeling; bioinformatics

**Diane K. Angell**

Associate Professor of Practice in Biology  
conservation biology; ecology; evolutionary biology

**Lisa M. Bowers**

Associate Professor of Biology  
microbiology; genetics; molecular biology; synthetic biology

**Eric Cole**

Professor of Biology  
developmental biology; invertebrate zoology; cell biology

**Steven Cole**

Instructor of Biology

**Kevin M. Crisp** (on sabbatical 2025-26)

Professor of Biology; Health Professions Committee Chair  
electrophysiology; computational neuroscience; microglia

**Jay A. Demas**

Associate Professor of Physics and Biology  
neuronal biophysics; sensory circuits; retinal neurophysiology

**Sara E. Fruehling**

Associate Professor of Practice in Biology  
microbiology; virology; genetics

**Jacob Grossman**

Assistant Professor of Biology and Environmental Studies

**Kim A. Kandl**

Paul and Mildred Hardy Distinguished Professor of Biology  
cell biology; molecular biology; genetics

**Norman Lee**

Associate Professor of Biology

**Laura L. Listenberger**

Professor of Biology and Chemistry  
lipid biochemistry; cell and molecular biology

**Takashi Maie**

Assistant Professor of Biology

**William (Will) Matchett**

Visiting Assistant Professor of Biology

**Emily K. Mohl**

Associate Professor of Biology and Education  
evolutionary ecology; plant-insect interactions; science education

**Ranjan Muthukrishnan**

Assistant Professor of Biology

**Darin Oenning**

Adjunct Instructor of Biology

**Sean Peterson**

Visiting Assistant Professor of Biology

**Beth Pettitt**

Associate Professor of Practice in Biology  
behavioral ecology; animal communication; wildlife field research

**Jean C. Porterfield**

Associate Professor of Biology  
evolutionary biology; molecular ecology; gene expression analysis

**Claire Riggs**

Assistant Professor of Biology

**Lynn Schofield**

Visiting Instructor of Biology

**Charles E. Umbanhowar** (on sabbatical 2025-26)

Professor of Biology and Environmental Studies; Director of Natural Lands  
prairie ecology; botany; paleoecology; fire ecology; biogeochemistry