

BIOLOGY

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Biologists seek to understand the living world in all of its complexity through scientific methods of inquiry. The Department of Biology is made up of a group of committed faculty with expertise in diverse fields and sub-disciplines. Our curriculum provides majors with opportunities to explore the full breadth of biological organization and provides experiential learning opportunities that enhance students' understanding of content and techniques, as well as the strengths and limitations of scientific methods of inquiry.

The Biology curriculum is designed to give students a strong background in fundamental concepts of biology at the cellular, organismal, and population levels as well as the tools for understanding and carrying out biological research. Student-generated investigations are built into the structure of courses throughout the Biology curriculum beginning in the Gateway courses and continuing through Independent Study. Students collaborate and communicate with peers and faculty as they progress through their courses and Independent Study. These opportunities develop students' oral and written communication skills as well as their capacity for self-education and problem-solving. These abilities, combined with a liberal arts education, are essential for remaining competitive in the rapidly developing life sciences.

Through its curriculum, the Biology Department seeks to develop students who:

- comprehend foundational and unifying biological principles and their implications;
- retain the knowledge essential to a broad understanding of Biology;
- are familiar with scientific methods of inquiry and the philosophy of science, including methodologies for distilling biological information;
- are able to design and conduct an independent scientific investigation;
- can use scientific information to make reasoned decisions and critically evaluate the work of others;
- are able to communicate scientific information effectively;
- show evidence that they understand how knowledge changes; and
- are motivated to think, study and learn independently.

Major in Biology

Consists of fourteen courses:

- CHEM 11200
- One of the following courses: MATH 10700, MATH 11100, CHEM 21100, PHYS 10700, or PHYS 11100
- BIOL 11100

- BIOL 20100
- BIOL 20200
- BIOL 20300
- Five elective 300-level Biology courses with at least three of them having laboratory components and at least one course from each of the two major subdivisions of biology
- Junior Independent Study: BIOL 40100
- Senior Independent Study: BIOL 45100
- Senior Independent Study: BIOL 45200

Minor in Biology

Consists of six courses:

- BIOL 11100
- BIOL 20100
- BIOL 20200
- Three elective 300-level Biology courses, one of which must have a laboratory component. BIOL 20300 does not count as an elective toward the Biology minor.

Special Notes

- **The Breadth Requirement:** The Department of Biology feels that Biology majors should appreciate and understand a range of topics studied in the field of biology. Students are introduced to a diversity of biological topics in our Gateway course sequence (BIOL 20100 and 20200) and then develop additional depth in each subdivision by completing at least one course from each of the two major subdivisions, as organized below. Students are strongly recommended to complete the breadth requirement before beginning BIOL 45100 so that they can incorporate a range of biological concepts and tools into their Independent Study thesis project.

Molecular and Cellular Biology

IDPT 20013. Bioinformatics
 BIOL 30500. Cell Physiology
 BIOL 30600. Genes and Genomes
 BIOL 30700. Development
 BIOL 33500. Microbiology
 BIOL 36600. Immunology
 BIOL 38000. Cellular Neuroscience
 BCMB 30300. Techniques in BCMB
 BCMB 33100. Principles of Biochemistry
 BCMB 33200. Biochemistry of Metabolism
 BCMB 33300. Chemical Biology

Ecology, Evolution, and Organismal Biology

BIOL 31100. Natural History of Vertebrates
 BIOL 32300. Natural History of Invertebrates
 BIOL 34000. Field Botany
 BIOL 34400. Comparative Animal Physiology
 BIOL 35000. Population and Community Ecology
 BIOL 35200. Animal Behavior
 BIOL 35600. Conservation Biology
 BIOL 37700. Behavioral Endocrinology

- BIOL 36000 - *Evolution* synthesizes the major organizational levels in biology for a deeper understanding of this essential biological principle. Thus, BIOL 36000 is not applicable to either subdivision but does count for credit towards the major or minor.
- The Foundations course, BIOL 11100, must be taken as the first course by all Biology majors (unless the student has received advanced placement credit). The Gateway courses (BIOL 20100, 20200) may be taken in either order but should be completed by the end of the sophomore year and must be completed before enrolling in Junior Independent Study. One or both of the Gateway courses is a prerequisite to each upper-level course, although a student may be admitted to an upper-level course by permission of the instructor without having completed the prerequisite, when justifiable.

- BIOL 20300 (Research Skills for Life Scientists) should be taken by prospective Biology majors in the fall of their sophomore year. BIOL 11100 and at least one of the Gateway courses (BIOL 20100 and BIOL 20200) must be taken prior to enrolling in BIOL 20300; the second Gateway course should then be taken concurrently. BIOL 20300 must be completed before enrolling in Junior Independent Study.
- CHEM 11200 must be taken before or with BIOL 20100 and is a prerequisite to several 300-level Biology courses; it should therefore be completed in the first year. Students should complete as many Biology courses as possible, but *at minimum one* 300-level course, before beginning Junior Independent Study.
- BIOL 40100 must be completed before the student enrolls in BIOL 45100, and is normally taken in the second semester of the junior year. Students planning a semester off campus should consult with a Biology adviser early in the planning stage. Off-campus study is best scheduled for the spring of the sophomore year or the fall of the junior year.
- Course sequence suggestions for majors:

First Year:	BIOL 11100, 20100 or 20200 CHEM 11100, 11200
Sophomore Year:	BIOL 20100 and 20300 One or two 300-level electives
Junior Year:	BIOL 40100 Two 300-level electives
Senior Year:	BIOL 45100, 45200 One or two 300-level electives

- The Biochemistry and Molecular Biology courses (BCMB 30300, 33100, 33200, 33300) count toward the Biology major and minor and are considered Biology courses for purposes of determining departmental honors. BIOL 10000 and 40000 courses do not count toward the major or minor, nor do they apply to Honors calculations.
- Biology majors contemplating graduate or professional school are strongly encouraged to take a full year of Organic Chemistry (CHEM 21100, 21200), a full year of general physics (PHYS 10700, 10800 or 11100, 11200), AND at least one course in calculus.
- **Laboratory Grade Policy:** Biology courses with a laboratory will receive one grade that reflects performance in the classroom and laboratory components; the relative weight of the two components will be stated in each course syllabus. Because the Registrar requires a grade for both the course and the laboratory, the course grade and the laboratory grade recorded on student transcripts will be identical.
- **Advanced Placement:** Students receiving a score of 5 on the Advanced Placement Examination in Biology will receive credit for *Foundations of Biology* (BIOL 11100). With a score of 4 on the Biology AP exam a student can receive one course credit in BIOL 10000 *Topics in Biology*, or upon successful completion of the Biology Placement exam may receive one course credit for *Foundations of Biology* (BIOL 11100). Advanced placement credit cannot be substituted for any

other Biology courses than those specified above. To receive appropriate Biology credit for AP scores, please contact the Chairperson of the Biology department. The advanced placement policy of the College is explained in the section on *Admissions*.

- **Off-Campus Study:** Off-campus study can be a valuable and enriching part of the college curriculum, and we encourage our students to consider off-campus study as a means of augmenting and enhancing their study of biology. Students who would like to include this in their program of study are encouraged to talk with a departmental faculty member early in their first year, and to think about scheduling choices that would make this possible. Biology courses taken at other institutions may count toward the major for up to two 300-level courses. Students should discuss their proposed course electives with the department chair prior to their study-abroad experience (or prior to enrolling in courses at other institutions), to determine whether the courses are equivalent to Wooster courses, and whether they will count toward the major.
- **Non-Science Majors:** Biological information has become increasingly important as citizens face crucial decisions on such issues as the environment, emerging diseases, genetic engineering, and our aging population as well as debate ethical questions rooted in science. To gain an appreciation of how biologists approach and understand life processes, non-science majors may enroll in either *Topics in Biology* (BIOL 10000) or *Foundations of Biology* (BIOL 11100). *Topics in Biology* (BIOL 10000) courses address specific topical issues in applied biology on a rotating basis (see catalogue description). *Foundations of Biology* (BIOL 11100) is intended as an entry course for students considering a major in one of the Biological Sciences, and focuses on a serious study of the conceptual underpinnings of genetics and evolution as they relate to the field of biology. For students interested in a more extensive laboratory experience, BIOL 20100 or 20200 would be appropriate after first completing BIOL 11100.
- A maximum of fifteen courses (including BCMB 30300, 33100, 33200 and 33300) from the Department of Biology may count toward the College's thirty-two course graduation requirement.
- Students are not permitted to count any courses taken for S/NC credit towards the major or minor.
- A student must earn a grade of C- or higher for a course to count toward the major or minor.

BIOLOGY COURSES

BIOLOGY FOR THE NON-SCIENCE MAJOR

BIOL 10000-10009. TOPICS IN BIOLOGY (some sections cross-listed with: **Communication, Environmental Studies, Neuroscience**)

The course focuses on a selected topic in biology in order to demonstrate fundamental principles of biology and/or how biology influences human society. The precise nature of the topic will vary from year to year, but in general will focus on a clearly defined topic in biology, often with some discussion of how the topic intersects with human society. Topics taught in the past have included the following: human inheritance, disease, tropical biology, neuroscience, human ecology, animal behavior, and insect biology. All sections of the course are suitable for non-science majors and will feature discussion and lecture formats. (1.0 course credits) *Annually*. [MNS]

BIOLOGY FOR THE SCIENCE MAJOR

BIOL11100. FOUNDATIONS OF BIOLOGY (**Biochemistry and Molecular Biology, Environmental Studies, Neuroscience**)

This introductory course focuses on concepts considered central to understanding biology, including the nature

of science, inheritance, gene expression, descent with modification and evolution by natural selection. This course is designed to provide potential biology majors with the fundamental concepts required for the study of biology. The course serves as a prerequisite for all biology courses numbered higher than 20000. Three class hours weekly. The course is also open to non-majors. (1.0 course credits) Annually, Fall and Spring. [MNS]

BIOL 20100. GATEWAY TO MOLECULAR AND CELLULAR BIOLOGY (Biochemistry and Molecular Biology, Neuroscience)

This course serves as an introduction to the major concepts in the fields of molecular and cellular biology. Topics include cellular structure, biochemistry, metabolism, biosynthesis, photosynthesis, cell division and growth, and molecular genetics. In laboratory, students will learn specific laboratory techniques and will gain experience interpreting and communicating experimental results. This course is a pre-requisite for many upper level biology courses and must be completed with a C- or better before enrolling in BIOL 40100. (1.25 course credits) Prerequisite: C- or better in BIOL 11100 and previous or concurrent registration in CHEM 11200. Annually, Fall and Spring. [Q, MNS]

BIOL 20200. GATEWAY TO ECOLOGY, EVOLUTION, AND ORGANISMAL BIOLOGY (Environmental Studies)

An introduction to the major concepts in the fields of ecology, evolution, behavior and physiology. These biological disciplines are approached from the population and individual levels of biological organization. Through lecture, laboratory, in-class exercises and readings, this course focuses on individual organisms, and on their behavior, interactions, evolution, and conservation. This course is a pre-requisite for many upper level biology courses and must be completed with a C- or better before enrolling in BIOL 40100. Three class hours and one laboratory period weekly. (1.25 course credits) Prerequisite: C- or better in BIOL 11100. Annually, Fall and Spring. [W+, Q, MNS]

BIOL 20300. RESEARCH SKILLS FOR LIFE SCIENTISTS

This course is an introduction to experimental design, data analysis and other important research skills in the life sciences. In addition to sound statistical and experimental practice, emphasis will also be placed on other important skills for life scientists such as how to find and read the literature and how to communicate scientific information effectively. Covered topics also include descriptive statistics, probability theory and many of the commonly used parametric and non-parametric statistical tests. A final group project will allow students to apply what they've learned by designing, carrying out, analyzing and interpreting data from an original research project of their design. Prerequisites: C- or better in BIOL 11100 and in either BIOL 20100 or BIOL 20200. Concurrent registration in the other Gateway course or permission of the instructor. Annually, Fall.

BIOL 30500. CELL PHYSIOLOGY (Biochemistry and Molecular Biology, Neuroscience)

This course focuses on the cellular and molecular basis for complex physiological processes such as aging, disease pathologies, tissue formation and maintenance, and intracellular communication. Specific concepts covered include, signal transduction, membrane biology, cell division, maintaining cellular organization, and motility. The laboratory will include student-led investigations, using model organisms to explore complex cellular processes. Three hours of lectures and one laboratory/discussion section a week. (1.25 course credits) Prerequisite: C- or better in BIOL 20100 and CHEM 11200 or permission of the instructor. Annually, Fall and Spring. [W+]

BIOL 30600. GENES AND GENOMES (Biochemistry and Molecular Biology, Neuroscience)

Genetic analysis has been transformed by the ability to investigate not only single genes, but also complete genomes. This course examines the structure, function, and variation of genes and genomes and provides an introduction to the fundamental methodologies for the modern analysis of genes and genomes. Three classroom meetings and one laboratory/recitation period weekly. (1.25 course credits) Prerequisite: C- or better in BIOL 20100 and CHEM 11200 or permission of instructor. Annually, Fall and Spring.

BIOL 30700. DEVELOPMENT (Biochemistry and Molecular Biology, Neuroscience)

Throughout this course we will investigate the current understanding of the genetic, molecular, and cell biological basis of multicellular organismal development. Emphasis is placed on critically analyzing historical and current experimental approaches from many different model systems with particular reference to the processes of cell differentiation, body plan formation, morphogenesis, and organogenesis. Three lectures weekly. (1.0 course units) Prerequisite: C- or better in CHEM 11200 and BIOL 20100 or permission of instructor. Annually, Fall.

BIOL 31100. NATURAL HISTORY OF THE VERTEBRATES

This course covers the major lineages of extinct and extant vertebrates. Emphasis in lecture is on ecology, behavior, conservation and the evolutionary history of each clade. The laboratory component has two foci: field based

experiences (accommodated through numerous field trips) and identification. Students will learn to identify many common vertebrates of Ohio by sight and sound. Three classroom meetings and one laboratory period weekly. One and one-fourth course credits. (1.25 course credits) Prerequisite: C- or better in BIOL 20200 or permission of instructor. Annually. Spring.

BIOL 32300. NATURAL HISTORY OF THE INVERTEBRATES

This course is about the worlds of invertebrates and how these animals interact with their natural environment, with a focus on a subset of these species found in Northeast Ohio. We will study invertebrates in both terrestrial and aquatic habitats and explore the mechanisms they use to overcome the challenges of survival and reproduction. We will learn about the value and process of natural history studies, including requisite skills such as observation, collection, identification, literature searches, posing and answering interesting questions, and communicating science effectively. Two meetings weekly (6 hours) that are combined classroom, lab, and field studies. (1.25 course credits). Prerequisite: C- or better in BIOL 20200 or permission of instructor. Alternate years. Fall. Not offered 2016-2017.

BIOL 33500. MICROBIOLOGY (Biochemistry and Molecular Biology)

Study of the morphology, classification, physiology, biochemistry, and genetics of bacteria and viruses, and resistance to diseases caused by these organisms. The laboratory provides training in current technology using bacteria and viruses. Three classroom meetings and two laboratory periods. Recommended: Organic Chemistry. (1.25 course credits) Prerequisite: C- or better in CHEM 11200 and BIOL 20100 or permission of instructor. Annually. Spring.

BIOL 34000. FIELD BOTANY AND SYSTEMATICS

Introduction to the principles of field botany and plant systematics. Topics covered include floral and vegetative morphology, plant family characteristics, the use of keys, and basic collecting techniques. We will discuss current methods of biological systematics, traits useful for making phylogenetic inferences, and the evolutionary history of vascular plant groups, especially angiosperms. Topics will include floral biology and pollination, hybridization and speciation, molecular phylogenetics, ethnobotany, and biogeography. Three classroom meetings and one laboratory weekly. (1.25 course credits) Prerequisite: C- or better in BIOL 20200. Alternate years. Spring. Not offered 2016-2017.

BIOL 34400. COMPARATIVE ANIMAL PHYSIOLOGY (Neuroscience)

A detailed study of selected aspects of the physiological ecology of vertebrates and invertebrates, with emphasis on circulatory systems, respiratory systems, energetics, thermoregulation, salt and water balance, and chemical regulation. The laboratory component emphasizes techniques in organismal physiology and experimental design. Three classroom meetings and one lab meeting weekly. (1.25 course credits) Prerequisite: C- or better in BIOL 20100 and 20200 and in CHEM 11200 or permission of instructor. Annually. Spring.

BIOL 35000. POPULATION AND COMMUNITY ECOLOGY (Environmental Studies)

A study of ecological principles as they apply to populations, communities, and ecosystems. These principles inform us about patterns and processes of the natural world and can provide us with insights into many of the environmental issues facing us today and in the future. Topics include population growth, competition, predation, community structure, nutrient cycling, and species diversity. Laboratory exercises emphasize experimental design and techniques used to investigate ecological questions. Two classroom meetings and one laboratory weekly. (1.25 course credits) Prerequisite: C- or better in BIOL 20200 or permission of the instructor. Annually. Fall.

BIOL 35200. ANIMAL BEHAVIOR (Environmental Studies, Neuroscience)

Why do animals behave the way they do? In this course, we will study this question from a variety of angles including: development, mechanistic causes, functional significance, and evolution. We will draw examples from a wide taxonomic spectrum of animals. The laboratory-field period of the course will emphasize how to address animal behavior questions by involving students in studies in which they learn techniques and tools used for observation, experimental design, conducting experiments, and analyzing and presenting results. Two combined lecture-lab meetings weekly. (1.25 course credits) Prerequisite: C- or better in BIOL 20200, or permission of the instructor. Annually. Spring.

BIOL 35600. CONSERVATION BIOLOGY (Environmental Studies)

This course examines the theory, methods, and tools by which biologists attempt to understand and to protect biological habitats and their attendant natural populations of organisms. Topics included demographic and genetic conservation, invasive species, fragmentation and habitat loss, design of nature reserves, management for conservation, and sustainable development within a conservation context. We also examine economic,

social, and political pressures that influence conservation decision-making. Laboratory exercises include computer simulations, field trips, and group projects. Normally two classroom meetings and one three-hour laboratory weekly (1.25 course credits), though may be offered without a laboratory in some years (1.0 course credits). *Prerequisite: C- or better in BIOL 20200 or permission of the instructor. Annually. Spring.*

BIOL 36000. EVOLUTION (Geology)

This course provides an in-depth introduction to evolutionary theory using both molecular and organismal approaches. Topics include: natural and sexual selection, population genetics, speciation, phylogenetics, and adaptation. The history of evolutionary thought and its place in human tradition will also receive emphasis. Three classroom meetings weekly. (1.0 course credits) *Prerequisite: C- or better in BIOL 20100 and 20200 or GEOL 25000 and BIOL 20200 or permission of instructor. Annually. Fall. Not offered 2016-2017.*

BIOL 36600. IMMUNOLOGY

This course will investigate concepts in immunology from a physiological and molecular perspective. Topics to be covered include the lymphatic system and the lymphoid organs, immune cell development and function, antibody structure and function, specific and nonspecific response to infections, allergy, hypersensitivity and other immunological disorders, transplantation immunology, vaccination, and immunological applications in biotechnology. Laboratory exercises will focus on basic immunological techniques such as antibody-antigen interactions, antibody production, and cellular response to infection. Recommended: Organic Chemistry. (1.25 course credits) *Prerequisite: C- or better in CHEM 11200 and BIOL 20100 or permission of instructor. Annually. Fall.*

BIOL 37700. BEHAVIORAL ENDOCRINOLOGY (Neuroscience)

A study of the interrelationships of the endocrine system and behavior of animals. Topics include reproduction, parental behavior, aggression, biological rhythms, mood, and stress. Special emphasis will be placed on endocrine and neuroendocrine mechanisms of behavior. Laboratory exercises include an introduction to endocrine techniques, experimental investigations of hormones and behavior, and comparative anatomy of the endocrine system. Three hours of lecture and three hours of laboratory weekly. (1.25 course credits) *Prerequisite: C- or better in BIOL 20100 and BIOL 20200 and in CHEM 11200, or permission of instructor. Annually. Fall.*

BIOL 38000. CELLULAR NEUROSCIENCE (Biochemistry and Molecular Biology, Neuroscience)

This course focuses on cellular and molecular aspects of nervous system function. Topics include functional implications and the physiological basis of neuronal impulse conduction and synaptic neurotransmission, nervous system development, neuronal plasticity, and the cellular and molecular basis of addiction. Three lecture periods and one laboratory period weekly. Recommended: one upper-level Biology course or PSYC 32300. (1.25 course credits) *Prerequisite: C- or better in BIOL 20100 and in CHEM 11200, or permission of instructor. Annually. Fall or Spring.*

BIOL 39900-39904. SPECIAL TOPICS IN BIOLOGY

A seminar for advanced students in the life sciences to further explore topics in biology, such as Biological Rhythms, Plant-Animal Interactions, and Biogeography. *Prerequisites: determined by the course instructor. (variable credit partial credit offerings may not count towards the major) Offered as appropriate.*

BCMB 30300. TECHNIQUES IN BIOCHEMISTRY AND MOLECULAR BIOLOGY

BCMB 33100. PRINCIPLES OF BIOCHEMISTRY

BCMB 33200. BIOCHEMISTRY OF METABOLISM

BCMB 33300. CHEMICAL BIOLOGY

IDPT 20013. BIOINFORMATICS

BIOL 40000. TUTORIAL

Evaluation of the student's accomplishment will be based on a contract with the supervising professor. Normally, laboratory exercises constitute at least one-quarter of the tutorial. Students will apply to the departmental chair for this option. This course does not count toward a major or minor in Biology. (0.5 - 1.0 course credits) *Prerequisite: The approval of both the supervising faculty member and the chairperson is required prior to registration.*

BIOL 40100. INDEPENDENT STUDY

One weekly meeting with the student's adviser will focus on project design and exploration of the literature related to the proposed I.S. thesis. A second classroom meeting weekly will support these activities in a collaborative environment. A written I.S. thesis proposal is due at the end of the semester. *Prerequisite: A grade of C- or better in BIOL 11100, 20100, 20200, 20300, and one 300-level Biology course. Annually.*

BIOL 41000. INTERNSHIP

A structured, usually off-campus experience, in which a student extends classroom knowledge to a work position within a community, business, or governmental organization. Student interns work and learn under the joint guidance of a host organization supervisor and a College of Wooster mentor. The student must arrange the internship in advance through the appropriate department or program. No more than six internships, and a maximum of four Wooster course credits, will count toward graduation. The form for registering for an internship and the Internship Learning Plan are available in the office of the Registrar. Students are required to attend Life Sciences Seminar series throughout the semester. (0.25-4 course credits) S/NC course. Prerequisite: The approval of a College of Wooster mentor, department chair, the faculty adviser, and the Associate Dean for Experiential Learning is required. Annually.

BIOL 45100. SENIOR INDEPENDENT STUDY – SEMESTER ONE

The thesis in Biology is based on a laboratory or field investigation in which data are collected and analyzed in comparison with the literature related to the project. A student should devote the same amount of time to the research and the subsequent thesis in BIOL 45100 and 45200 as that required for two major laboratory courses. The work is ordinarily done in two terms during the academic year. Research may be conducted in the summer. Data may be collected off campus if suitable supervision can be arranged. Normally, a student will have one research adviser. Students are required to attend Life Sciences Seminar series throughout the semester. Prerequisite: BIOL 40100.

BIOL 45200. SENIOR INDEPENDENT STUDY – SEMESTER TWO

The research adviser, together with a second professor, reads the thesis and conducts an oral examination of the student on the field of research. The evaluation of the thesis will be determined by these two readers in consultation with the department as a whole. Students are required to attend Life Sciences Seminar series throughout the semester. Prerequisite: BIOL 45100.

LIFE SCIENCES SEMINAR SERIES

The seminar series provides group experiences in oral communication and criticism. In addition to student presentations, guest speakers and departmental and interdepartmental staff present their recent research activities. All students pursuing thesis research or enrolled in Independent Study courses are required to attend the weekly departmental seminar. Biology majors are urged to attend these seminars in anticipation of thesis research and as a means of broadening their perspectives.