

Biology

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Biology courses deal with the science of living organisms in their various forms. The curriculum emphasizes the integration of all levels from molecular to ecological, with evolution as a unifying theme, and requires all seniors to complete a research thesis. The department serves students who expect to work in a biological field or related profession such as medicine, as well as those who elect biology as part of a general education (see www.whitman.edu/biology).

A student who enters Whitman without any prior college-level preparation in biology will have to complete 50 credits, including courses in chemistry, mathematics and statistics, and biology, to fulfill the requirements for the biology major.

Learning Goals: Upon graduation,

- **Students will understand core biological concepts including:**
 - evolution (the process creating the diversity of life-forms and the phylogenetic relationships among major groups)
 - structure and function (the basic units of biological structures that control the functions of living things)
 - information flow, exchange and storage (the influence of genetics on the control of the development of phenotypes)
 - pathways and transformations of energy and matter (the ways in which chemical transformation pathways and the laws of thermodynamics govern biological systems)
 - the nature of complex systems.
- Students will be capable of understanding, interpreting, and critically evaluating scientific information presented in multiple forms (e.g., numeric, graphical, written)
- Students will be capable of conducting a structured scientific inquiry and thoroughly communicating scientific biological knowledge.

Distribution: Courses completed in biology apply to the science and quantitative analysis (selected courses) distribution areas.

Total credit requirements for a Biology major: A student who enters Whitman College with no prior experience in Biology will need to complete a total of 50 credits (33 credits in Biology and/or BBMB; 11 credits in Chemistry; 6 credits in Mathematics and Statistics).

The Biology major:

- 33 credits in Biology, 50 credits total
- Required Courses in Biology
 - Biology 111, 112, 205, 206, 499
 - Three credits of Biology/BBMB 490 or 498 (thesis or honors thesis)
 - Four credits from each of the three categories of upper-level courses
 - Molecular/Cell Biology
 - Organismal Biology
 - Ecology/Evolution
 - Additional courses in biology and/or BBMB numbered 200 or above to reach minimum 33 credits
- Required supporting science courses

- Chemistry 125, 126, 135, 136, or 140
- Chemistry 245
- Demonstrated mastery of either two semesters of college calculus (Mathematics 124 or 125 and 126) or one semester each of college calculus and statistics (Mathematics 128 or 247, Economics 227, Psychology 210, Sociology 208)
- Other notes
 - If interested in graduate school
 - A year of physics with labs
 - A full year of organic chemistry
 - A year of foreign language
 - Statistics
 - Computer competency
 - Biology 256 does not count toward the major
 - No P-D-F of Biology or BBMB courses, or other courses that count towards the major after the major is declared.
- Senior Requirements
 - Biology or BBMB 490 or 498 (thesis or honors thesis), and 499
 - One hour oral exam
 - Passing score on the senior written exam
 - Biology Major Field Test (MFT)-not required for the academic year 2023-2024.
 - Score 70th percentile or above
- Honors
 - Students do not apply for admission to candidacy for honors
 - Students must submit a proposal for their thesis or project
 - Must be submitted within the first six weeks of the two-semester period in which student is eligible
 - Accumulated at least 87 credits
 - Completed two semesters of residency at Whitman.
 - Cumulative GPA of at least 3.300 on all credits earned at Whitman College
 - Major GPA of at least 3.500
 - Complete a written thesis or research project prepared exclusively for the satisfaction of this program
 - Earn a grade of at least A- on the honors thesis or project and the honors thesis course
 - Pass the senior assessment with distinction
 - Chair of the department will notify the Registrar of students attaining Honors no later than the beginning of week 12 of the semester.
 - An acceptable digital copy of the Honors Thesis must be submitted to Penrose Library no later than Reading Day

The Biology minor:

- 16 Credits
- Required Courses
 - Biology 111 and 112
 - Eight credits numbered 200 or above in Biology or BBMB (except Biology 256)
- Other notes
 - No P-D-F courses

The Biology+French combined major:

- Students shall complete all of the requirements of a Biology major

- A total of 20 additional credits, comprised as follows:
- At least 16 credits taught in French at the 200 level or above, or equivalent.
- Up to 8 credits may be comprised of any combination of the following:
 - Up to 4 credits from approved courses taught in English
 - Up to 8 credits transferred from Off-Campus Studies or another institution. Any university-level course taught entirely in French may count toward this requirement regardless of topic.
 - Up to 4 credits “double-dipped” with approved courses counting toward another major or minor program
 - Up to 4 transfer credits from AP/IB exams
- Students must attain B2 or Advanced Low level on a recognized language proficiency assessment (DELF, ACTFL, etc.).
- Students must complete two or more of the following integrative components with the primary major:
 - A thesis topic that explicitly incorporates a significant portion of French/ Francophone content, broadly understood. The thesis project is also expected to be sufficiently biological to satisfy Biol-490 requirements.
 - An independent study in Biology conducted substantially in French. If done during the academic year, this option may also be awarded 1 or 2 Special Projects credits (Biology 481 or 482) which can be applied towards the Biology general elective requirements.
 - A grade of B or higher in a Biology course taught in French (normally only an option through Off-Campus Studies)
 - A research experience or internship related to Biology, conducted in French
 - An oral presentation of the senior project (or equivalent) in French, for a general public
 - Portfolio + reflective essay in French
- Students must complete the senior self-evaluation survey about their combined major experience.
- Honors in Biology+French will be determined according to the criteria of the Biology major.

The Biology-Geology combined major:

- 66-70 total credits
 - 23-26 credits in biology
 - 26-29 credits in geology
 - 14-18 credits in other departments
- Required biology courses:
 - Biology 111, 112, 205
 - Four credits from the Organismal Biology category
 - Four credits from the Ecology/Evolution category
 - At least four additional credits in Biology and/or BBMB courses numbered 200 and above
 - Three credits of Biology 490 or 498 (or three credits of Geology 480, 490, or 498)
- Required geology courses:
 - Introductory geology (Geology 110 and 111, or 120 and 121, or 125 and 126)
 - Geology 227, 270, 350, and 358
 - Either Geology 312 or 368
 - Either Geology 301, 321, or 405
 - Three credits of Geology 480, 490, or 498 (or three credits of Biology 490 or 498)
 - During senior year: Geology 470
- Required supporting science courses:
 - Either Chemistry 125, 126, 135, and 136, or Chemistry 140
 - Chemistry 245
 - Mathematics 124 or 125

- Mathematics 126 or a statistics course (Mathematics 128 or 247, Economics 227, Psychology 210, or Sociology 208)
- Notes on courses:
 - No courses for the major may be taken P-D-F.
 - Two semesters of Physics and field experience are strongly recommended.
- Senior requirements:
 - Geology 470
 - Senior assessment:
 - Comprehensive written exams in both geology and biology;
 - One-hour oral exam by biology and geology faculty
- Honors
 - Students do not apply for admission to candidacy for honors
 - If thesis is in Geology students must submit a proposal for their thesis or project
 - Must be submitted within the first six weeks of the two-semester period in which student is eligible
 - Accumulated at least 87 credits
 - Completed two semesters of residency at Whitman.
 - Cumulative GPA of at least 3.300 on all credits earned at Whitman College
 - Major GPA of at least 3.500
 - Complete a written thesis or research project prepared exclusively for the satisfaction of this program (either Geology or Biology)
 - Earn a grade of at least A- on the honors thesis
 - Pass the senior assessment with distinction
 - Chairs of the departments will notify the Registrar of students attaining Honors no later than the beginning of week 12 of the semester.
 - An acceptable digital copy of the Honors Thesis must be submitted to Penrose Library no later than Reading Day

The Biochemistry, Biophysics, and Molecular Biology (BBMB) major: See BBMB under the *Courses and Programs* section in the catalog for a description of the courses and major offered at the interface of biology, chemistry, and physics.

The Biology-Environmental Studies combined major: The requirements are fully described in the *Environmental Studies* section of the catalog.

Upper-Level Course Categories

Molecular/Cell Biology: Biology 250 *Introduction to Computational Biology*, 260 *Microbiology*, 303 *Cell Biology*, 304 *Cell Biology Laboratory*, 305 *Cellular Physiology and Signaling*, 306 *Cellular Physiology and Signaling Lab*, 317 *Genetic Engineering*, 319 *Developmental Biology Seminar*, 320 *Neurobiology*, 329 *Developmental Biology*, 331 *Synthetic Cell Biology*, 342 *Gene Discovery & Functional Genomics*, BBMB 325 *Biochemistry*, 326 *Molecular Biology*, 335 *Biochemistry Laboratory*, 336 *Molecular Biology Laboratory*, 337 *Techniques in Biochemistry and Biophysics*, and BBMB 340 *Immunology*.

Organismal Biology: Biology 221 *Human Anatomy and Physiology I*, 222 *Human Anatomy and Physiology II*, 224 *Animal Development: Determination vs. Plasticity*, 227 *Introduction to Nutrition Science & Metabolism*, 253 *Plant Physiology*, 310 *Physiology*, 315 *Comparative Vertebrate Anatomy*, 319 *Developmental Biology Seminar*, 323 *Neurophysiology*, 328 *Evolutionary Developmental Biology*, 330 *Pathophysiology*, and 338 *Evolutionary Developmental Biology Lab*.

Ecology/Evolution: Biology 212 *Natural History of the Inland Northwest*, 215 *Plant Ecology*, 218 *Symbiosis*, 220 *Grassland Ecology Lab*, 225 *Ornithology Lab*, 229 *Plant Identification*, 277 *Ecology*, 287 *Ecology Lab*, 288 *Plants and Peoples*, 316 *Transformations in Vertebrate Evolution*, 327 *Biology of Amphibians and Reptiles*, 337 *Biology of Amphibians and Reptiles Lab*, and 350 *Evolutionary Biology*.

Some Special Topics courses may be applied to the above categories. Any Special Topics courses applied to the above will be noted in the course descriptions.

110 Evolution for Everyone

Not offered 2023-24

3 credits

Evolution is a word that seems to attract curiosity and controversy wherever it goes. In this non-majors biology class we will talk about what evolution is and isn't, and how evolutionary theory can be used or misused in a variety of social and scientific contexts. Topics may include the evolutionary responses of organisms to climate change; the evolution of our food; how principles of evolution inform medicine; and how misapplication of evolutionary concepts has been used to support racist and sexist ideas in the United States. Work will include readings, class discussion, individual and group projects, lecture, and homework assignments.

111 Biological Principles

Fall, Spring

Fall: Moss; Spring: Cooley

4 credits

The general principles common to all life. Topics are: chemical basis of life and cellular metabolism, cell and tissue structure and function, mitosis and meiosis, information storage and retrieval, and life support mechanisms. Although designed as an introduction to the major, nonmajor students are welcome. Laboratories will consist of exercises illustrating the principles covered in lecture. Three hours of lecture and one three-hour laboratory per week. *Prerequisites:* Chemistry 125 and 135; or Chemistry 140. *Pre- or corequisites:* Chemistry 126 and 136 (unless Chemistry 140 previously completed). *Lab fee:* maximum \$30.

112 The Biological World

Spring

H. Dobson, K. Jackson, Morgan

4 credits

A survey of the major groups of prokaryotic and eukaryotic organisms. The evolutionary history of living organisms is traced from the most simple prokaryotes to the highly complex plants and animals. Parallel trends and adaptations are discussed in addition to the unique features of each group. Laboratories consist of the examination of the structure and characteristics of the major groups. It is recommended that students take Biology 111 or an equivalent course prior to this course. Three lectures and one three-hour laboratory per week. *Prerequisites:* Chemistry 125 and 135; or Chemistry 140 or consent of instructor. *Pre- or corequisites:* Chemistry 126 and 136 (unless Chemistry 140 previously completed) or consent of instructor. *Lab fee:* maximum \$30.

115 Natural History and Ecology

Spring

Parker

4 credits

This course emphasizes applying basic ecological and evolutionary principles to inferring processes responsible for biological patterns students observe in the field. The core of the class is weekly trips in the region between the Columbia River and the Blue Mountains. On these trips students gain familiarity with common plants and animals of the region as part of the process of developing and applying skills observing biological patterns. Students learn to interpret these patterns in light of biological concepts learned in class. Two one-hour lectures and one five-hour field trip per week. Designed for nonscience majors with special applicability for environmental studies majors. Field trips begin at 11 a.m. and extend through the lunch hour and into the afternoon. Offered in alternate years.

121 History and Ethnobiology of the Silk Roads

Not offered 2023-24

2 credits

This interdisciplinary and interdivisional course will provide an integrative exploration into the history and ethnobiology of peoples along various branches of the trading routes across Asia known as the silk roads, with an emphasis on China prior to 1400. Topics will include why certain goods and technologies were traded; agricultural, social, and religious impacts of trading; biological features of items traded or moved along the silk roads, such as foods, beverages, fibers, animals, and diseases. See Asian and Middle Eastern Studies 221 for an optional, supplemental field course that will be offered when funding permits. *Corequisite:* History 121.

122 Plant Biology
Not offered 2023-24

2 credits

This course provides a basic introduction to the biology of plants, and is designed for non-biology majors. It examines plant structure, physiology, reproduction, and ecology, including evolutionary adaptations to different environments. Two lectures per week. *Optional corequisite:* Biology 129.

125 Genes and Genetic Engineering
Not offered 2023-24

2 credits

Designed for non-science majors. An introduction to principles of genetics related to medicine, agriculture and biotechnology. The class will focus on selected genetics-related topics of current social, environmental or economic importance, and will include student-led investigations into benefits and controversies of those topics and related applications.

126 Biology for Behavioral Scientists: It's in our DNA?
Not offered 2023-24

4 credits

Behavior and mental life are framed by genetics, profoundly shaped by the circumstances of our development, and implemented by chemical signaling. This course is intended as a compact introduction to biological principles that complement exploration of topics like gender, nature vs. nurture, and sociality from cognitive or cultural perspectives. Topics will include genes and genomes, what it means--in operational terms-- for a cell to be alive, how information is encoded into molecular signals, how a complex animal develops from a single cell (i.e., fertilized egg), and the interactions between DNA and environment in producing complex behavior. The course offers a way for students without a previous background in biology to 1) encounter the analytical tools of current biology; 2) analyze and interpret biological data; 3) apply these basic biological principles to problems in the social and behavioral sciences. This course is not intended for students planning to major, minor, or attend graduate school in the life sciences, and does not substitute for Biology 111.

127 Nutrition
Not offered 2023-24

3 credits

An introduction to the science of nutrition with focus on how the foods we eat promote health or contribute to disease risk. We will examine the nutrients and their food sources, metabolism, and physiologic functions in order to be able to make more informed decisions on food choices. We will also consider the social, economic, and political factors that contribute to malnutrition, food (in)security and sustainability, and dietary guidelines. Students will actively participate with weekly journals, dietary and nutrition label analyses, and discussion of case studies. This course can be taken by students who have not taken any other biology course and by students requiring nutrition for entry into health professions programs.

129 Plant Identification Lab
Not offered 2023-24

1 credit

In this field-oriented laboratory, students will explore aspects of body form and growth that characterize different plant groups, acquire basic skills for plant identification, and learn to recognize on sight the most common plant families in the western United States. At least one lab will be substituted by a field trip, and all students will be required to make a plant collection. This lab course is designed for non-majors, and meets concurrently with Biology 229. One three-hour laboratory per week. *Corequisite:* Biology 122. *Lab fee:* maximum \$30.

130 Conservation Biology
Fall

Hutchison

4 credits

An introduction to the dynamic and interdisciplinary world of biological conservation. Fundamental principles from genetics, evolution, and ecology will be discussed and then applied to problems including extinction, species preservation, habitat restoration, refuge design and management, and human population growth and its myriad impacts on our environment. Three one-hour lectures and one three-hour laboratory per week. Designed for nonscience majors with special applicability for environmental studies majors. *Lab fee:* maximum \$30.

140 The Human Genome

Not offered 2023-24

2 credits

Our genome is literally what makes us human. But what exactly is our genome? How does it dictate (or not dictate) aspects of our development and health? How can we all share "the human genome", yet each be a biologically unique individual? In this class, which is intended for non-Biology majors, we will discuss what's in the genome and how it functions as the information our cells use to build a human being. Using genomics and genetics as a starting point, we'll use readings, discussion, and group projects to explore topics such as heritable diseases, stem cells, cancer, epigenetics, ancestry tests, and aspects of genome evolution.

171, 172 Special Topics in Biology for Nonscience Majors

1-4 credits

Lectures (possibly with laboratories) on topics in biology not generally covered by other nonmajor courses in the department. Examples of topics include field biology and evolution. The topic and course credit will be designated prior to registration for the semester in which a special topic for nonscience majors is offered. Any current offerings follow.

171 ST: Campus landscape: a living laboratory

Spring

H. Dobson and A. Molitor

2 credits

This course gives students the opportunity to learn about landscapes holistically from biological, physical, and social constructs. Students will learn to look more closely at landscapes around them and identify elements of ecological systems, physical structures, and historical contexts. More specifically, emphasis will be placed on the biodiversity and ecology of eastern Washington's natural landscapes. Students are required to engage in landscape projects that will aid in increasing sustainability, inclusion, education, and outreach within our campus grounds. This course consists of one lecture and one lab per week. Distribution area: none.

177 Ecology of the American West

Not offered 2023-24

4 credits

This course will explore the adaptations and relationships of organisms to their abiotic and biotic environments, with focus on the varied ecosystems of the Hells Canyon region of northeastern Oregon and the high desert ecosystems of northern New Mexico. Students will come to understand the forces impacting, and the impact of, individual organisms as they exist over time and space, as parts of higher levels of ecological constructs including the population, community, and ecosystem. A significant proportion of the class will be spent in the field quantifying vegetative associations and a selection of the fauna inhabiting those associations. The course is team-taught sequentially over two intensive, two-week periods. Laboratory sessions consist primarily of fauna and flora identification, ecological monitoring techniques including vegetative plot monitoring, dry pitfall monitoring, and avian transect monitoring. Environmental studies majors may substitute this course for Biology 130 or 115, as a foundation course in the sciences, with a lab, to satisfy environmental studies major requirements. *Prerequisites:* required of, and open only to, students accepted to Semester in the West.

205 Genetics

Fall, Spring

Fall: Cooley; Spring: Hutchison and Vernon

3 credits

The principles which underlie the hereditary processes observed in microbes, plants, and animals. Selected topics include structure, organization, function, regulation, and duplication of the genetic material; protein synthesis and its control; mechanisms and patterns of inheritance; population genetics. *Prerequisites:* Biology 111; Chemistry 125 and 126, or Chemistry 140; sophomore status.

206 Genetics Laboratory

Spring

Fall: Cooley; Spring: Vernon

1 credit

Laboratory exercises in molecular and Mendelian genetics. Labs will include DNA isolation, amplification, and characterization, introductions to computer DNA analysis and genomics, and an extended project in Mendelian genetics, involving phenotypic observation and segregation analysis. One three-hour laboratory per week. Prior completion of Biology 205 is recommended, but not required; this lab can be taken after completion of Biology 205 or along with it. Biology 206 cannot count as elective credit for the BBMB major. *Pre- or corequisite:* Biology 205. Lab fee: maximum \$30.

210 When is science reliable?

Fall

Parker

2 credits

Science is widely recognized as an effective process for developing reliable understanding of the natural world, but science is not all equally reliable. In a number of disciplines ranging from ecology and conservation to psychology, nutrition, and medicine, there is growing recognition that certain common but 'questionable' research practices undermine reliability. In this course, students will learn about these 'questionable research practices', the statistical principles that make them 'questionable', and the institutional incentives that have promoted their use. Students will gain experience recognizing unreliable research practices and will critically evaluate scientific claims both in the scientific literature and in the popular press. Further, they will evaluate and debate proposals for practices and policies designed to reduce bias and improve reliability. This course meets once per week for 1 hour and 20 minutes. *Recommended prerequisite:* any statistics course.

212 Natural History of the Inland Northwest

Not offered 2023-24

4 credits

This course will engage biology majors with the plants, animals, and topography of a specific biotic province of our region (e.g., Blue Mountains or Walla Walla Valley) within the larger context of its geology and paleoecological history. The class will emphasize field experiences and interpretation of ecological and evolutionary processes shaping our surroundings with discussion of current environmental issues facing the area. One three-hour class per week, eight six-hour labs, some overnight. Applies to the Ecology/Evolution major requirement. *Prerequisites:* Biology 112; Biology 215 or 277 recommended (or concurrent). *Lab fee:* maximum \$85.

215 Plant Ecology

Not offered 2023-24

3 credits

This course covers the diverse adaptations of plants to their abiotic and biotic environments from ecological and evolutionary perspectives. Lectures will address effects of climatic factors (water, light, temperature) and soils on plant morphology, physiology, growth, and reproduction, and the complex relationships of plants with other forms of life, especially insects. Three hours of lecture per week, plus one field trip during the semester. Applies to the Ecology/Evolution major requirement. Offered in alternate years. *Prerequisites:* Biology 111 and 112.

218 Symbiosis

Fall

Clark

3 credits

Symbiosis, which encompasses the interactions and relationships that organisms have with each other, is a major source of evolutionary and ecological novelty. These interactions can be described as antagonistic, defensive, harmful, communal, opportunistic, beneficial, cooperative, or neutral. Symbiotic interactions often fall into one of three categories: commensalism, mutualism, and parasitism. This course explores these categories and interactions from ecological, physiological, and evolutionary lenses. Methods of instruction include lectures, primary literature seminars (in class and discussion board), and problem-based learning (quizzes, exams, presentations and assignments). Applies to the Ecology/Evolution major requirement. *Prerequisites:* Biology 111 or consent of instructor.

220 Grassland Ecology Lab**Not offered 2023-24****1 credit**

Exploration of grassland and shrubland ecosystems based on field trips and research. Research designed to give students experience in the process of ecological science, including observing patterns to develop questions, searching primary literature, evaluating hypotheses and predictions, initiating experiments and gathering data in the field, processing data, statistical analysis, and presenting results in written and graphical form. Fieldwork will involve various physical demands such as hiking and working off-trail on steep slopes. One three or four hour lab per week. Approximately six times during the semester we will depart at noon rather than 1 pm. One required full-day or overnight field trip. Applies to the Ecology/Evolution major requirement. *Prerequisite:* Biology 112. *Lab fee:* maximum \$30.

221 Human Anatomy and Physiology I**Fall****T. Knight****4 credits**

A survey of the structure and function of the human body that will examine cells, tissues, and the skeletal, muscular, endocrine, and the nervous systems. This course will emphasize both structure and function by integrating anatomical knowledge with principles of physiology from the cellular to the organismal level, including clinical relevance. Lab sessions will include animal dissection, participation of students as subjects (e.g., electromyography), and may incorporate lectures or demonstrations by clinicians/patients. Three lectures and one three-hour laboratory per week. Applies to the Organismal major requirement. *Prerequisite:* Biology 111 or consent of instructor. Lab fee: maximum \$30.

222 Human Anatomy and Physiology II**Spring****T. Knight****4 credits**

A survey of the structure and function of the human body that will examine cardiovascular, respiratory, digestive, urinary, immune, endocrine, and reproductive systems. This course will emphasize both structure and function by integrating anatomical knowledge with principles of physiology from the cellular to the organismal level, including clinical relevance. Lab sessions will include animal dissection, participation of students as subjects (e.g., respirometry), and may incorporate lectures or demonstrations by clinicians/patients. Three lectures and one three-hour laboratory per week. Applies to the Organismal major requirement. *Prerequisite:* Biology 111 or consent of instructor. Biology 221 is not a prerequisite. Lab fee: maximum \$30.

224 Animal Development: Determination vs. Plasticity**Not offered 2023-24****3 credits**

The way an individual animal develops is largely a product of the evolutionary history of its species. Accordingly, fundamental processes of embryonic development are largely genetically pre-programmed. Yet, the trajectory of an individual's development can be altered profoundly by the environment in which development unfolds. This course provides an introduction to basic principles of animal development, showing how the complementary approaches of embryology and molecular analyses have converged to unify the field to address long standing questions of how developmental mechanisms balance a pre-programmed process with environmental influences. Applies to the Organismal major requirement. *Prerequisite:* Biology 111 or consent of instructor.

225 Ornithology Lab**Spring****Parker****1 credit**

An introduction to the study of birds based on field trips, lab activities, and research. Research designed to give students experience in the processes of doing science, including searching primary literature, evaluating hypotheses and predictions, gathering and processing data, statistical analysis, and presenting results in written and graphical form. One three or four hour lab per week. Approximately six times during the semester we will depart at noon rather than 1 pm. One required full-day or overnight field trip. Applies to the Ecology/Evolution major requirement. *Prerequisite:* Biology 112. *Lab fee:* maximum \$30.

227 Introduction to Nutrition Science & Metabolism**Spring****Russo****3 credits**

This course provides an introduction to the science of human nutrition. It will emphasize the ingestion and digestion of food, absorption of nutrients, and the metabolism of macronutrients (proteins, carbohydrates, lipids) and micronutrients (vitamins, minerals). We will explore how the dietary patterns of the foods we eat promote health or contribute to disease risk by examining how nutrient balance or imbalance affect cellular and physiological systems. This course is recommended for students requiring nutrition for entry into health profession programs. Applies to the Organismal category requirement for the Biology major. *Prerequisites:* Biology 111 and Chemistry 126 or 140.

229 Plant Identification Lab**Not offered 2023-24****2 credits**

In this field-oriented laboratory, students will explore aspects of body form and growth that characterize different plant groups, acquire basic skills for plant identification, and learn to recognize on sight the most common plant families in the western United States. At least one lab will be substituted by a field trip, and all students will be required to make a plant collection. This lab course is designed for biology majors, and meets concurrently with Biology 129. One three-hour laboratory per week. Applies to the Ecology/Evolution major requirement.

Prerequisite: Biology 112. *Lab fee:* maximum \$30.

250 Introduction to Computational Biology**Spring****Tien****4 credits**

In biological research and study, there is growing demand for scientists capable of integrating computational and mathematical skills to solve complex problems. In this course, students will learn to think abstractly in their approach to solve historic biological problems through the implementation of algorithms and data structures in an object-oriented programming language (Python). To focus these skills in a biological context, students will utilize software and packages developed for biological research, such as those used to analyze large and/or complex data sets (Biopython). Students will gain the necessary syntactical skills used in computer programming that will translate into any future programming language (e.g. R-programming language). Students' programming assignments will develop their skills through paired-programming. Students will be tested on design, documentation, implementation, test-creation, and debugging. They will demonstrate mastery of the fundamentals of computer science through the completion of a final project. Applies to the Molecular/Cell requirement for the Biology major. *Prerequisite:* Biology 205.

253 Plant Physiology**Not offered 2023-24****4 credits**

Plant physiology is the study of how plants function, internally as well as in relation to their environment. We will investigate how plants use light, water, and minerals to grow and reproduce, at scales ranging from the molecular to the ecological. The course includes both lecture and laboratory components. Applies to the Organismal major requirement. *Prerequisite:* Biology 111. *Lab fee:* maximum \$30.

256 Regional Biology**Fall****Cooley, Parker****1 credit**

Field biology of a region with emphasis on ecology and evolution in a natural history context. Students will keep field notebooks, and their notebook entries must meet minimum standards. Trips will usually be taken over one long weekend (typically Thursday to Sunday). May be repeated for credit for different destinations. This course does not count toward the major requirements in biology or biology combined majors or minor. Graded credit/no credit.

Prerequisites: Biology 111 and 112 and declared biology or biology-environmental studies major or biology minor. *Fee:* maximum \$75.

260 Microbiology**Fall****Tien****4 credits**

Organisms at the micron scale (single-cell organisms) are ubiquitous, fascinating, and mysterious entities that orchestrate biogeochemical cycling, impact the well-being of multicellular organisms, and potentiate transformative biotechnologies. Entire microbial ecosystems thrive within a single droplet of water, persist in the barest landscapes, and survive the harshest environments. This course will explore the physiological mechanisms that microbes have evolved to inhabit almost every habitat on Earth. It will also provide a survey of biology at the microbial level and will outline specific techniques commonly used to identify, study, and harness the power of microbial entities. We will integrate concepts from cell physiology, chemistry, evolution, epidemiology, and biotechnology. Lab work will utilize microscopy, spectrophotometry, and bioinformatic tools to study and manipulate bacteria, fungi, and viruses. Students will learn how to work in a sterile controlled environment, identify bacterial strains, isolate microbes from several environments, and test the metabolic capabilities of isolated microbes. Applies to the Molecular/Cell requirement for the Biology major. *Prerequisite:* Biology 111.

271, 272 Special Topics in Biology
1-4 credits

Any current offerings follow.

271 ST: Mussel Ecology in the Walla Walla Valley

Fall

Maine

2 credits

This course engages major concepts and approaches in modern ecology via immersive field experiences, hands-on sampling, and project-based learning in aquatic habitats. Topics will include population and community ecology, mollusk status and distribution survey design and methods, and touch on themes of disturbance, invasive species, indigenous resource management (First Foods management), and climate change. In this course students will learn to identify freshwater mussels native to the Pacific Northwest and the Walla Walla area, learn about their ecological roles and requirements, and conduct surveys and observations to better understand their ecology, biology, status, and distribution. This course emphasizes fieldwork and hands-on experience. Students will also learn to write field notes, synthesize data, and use basic statistical analysis to evaluate research results. This course is conducted largely outdoors regardless of weather conditions so that ecological phenomena can be examined in real time and real life. Applies to the Ecology/Evolution major requirement. *Prerequisite:* Biology 112. Distribution area: none.

272 ST: Fish Ecology

Spring

Clark

4 credits

Fish Ecology course focuses on the interactions between fishes and their environments. The course broadly covers fish anatomy, physiology, life-history, evolution and ecology in freshwater and marine habitats. Other topics of discussion include adaptations for survival under different environmental constraints, basic fisheries concepts and fish conservation. Methods of instruction include lectures, primary literature seminars, problem-based learning (quizzes, exams, and assignments), and learn by doing (laboratory and student research). Applies to the Ecology/Evolution major requirement. *Prerequisite:* Biology 111. Distribution area: science.

277 Ecology

Fall

Parker

3 credits

The relationships of organisms to one another and to the abiotic environment. We will learn ecological concepts and principles important to populations, evolution, inter-specific interactions, communities, landscapes, energy flow, nutrient cycles, and conservation. Three lectures per week. Applies to the Ecology/Evolution major requirement. *Prerequisites:* Biology 111 and 112.

287 Ecology Lab

Fall

Parker

1 credit

Field research designed to give students experience in the process of ecological science, including observing patterns to develop questions, searching primary literature, evaluating hypotheses and predictions, initiating

experiments and gathering data in the field, processing data, statistical analysis, and presenting results in written and graphical form. Fieldwork will involve various physical demands such as hiking and working off-trail on steep slopes. One three or four hour lab per week. Approximately six times during the semester we will depart at noon rather than 1 pm. Applies to the Ecology/Evolution major requirement. *Prerequisite:* Biology 112. *Lab fee:* maximum \$30.

288 Plants and Peoples

Not offered 2023-24

3 credits

The relationship between plants and human societies, drawing examples from different geographical regions and placing emphasis on plants used for food, medicine, clothing, and shelter. Topics will explore the various uses of plants, implications of altering natural habitats and cultural traditions, origins and histories of cultivated plants, development of agriculture and ecological aspects of its practices, including soil management, pest control, plant breeding, and preservation of genetic diversity. Three lectures per week, plus one optional weekend field trip. Applies to the Ecology/Evolution major requirement. *Prerequisites:* Biology 111 and 112 or consent of instructor. Offered in alternate years.

303 Cell Biology

Not offered 2023-24

3 credits

The cell is the basic unit of organization of all life. Cell biology integrates principles from biochemistry, genetics, chemistry, and physiology to understand cellular processes and their regulation and to relate defects in these processes to human diseases. In this course, we will learn about the inner life of cells: how they function, grow, and die. Upon completion of this course, the student will gain a deeper understanding of 1) cell structure and functions such as gene expression, protein targeting, cell-cell signaling, cell division, and programmed cell death, 2) internal and external regulation of cellular processes, 3) human diseases that result from impaired structures such as neurological disorders, and 4) breakthrough research on diagnosis and treatment of cell diseases such as immunology therapeutics. Applies to the Molecular/Cell major requirement. *Prerequisites:* Biology 205 and Chemistry 245. *Recommended prerequisite:* Biology 112.

304 Cell Biology Laboratory

Not offered 2023-24

1 credit

The laboratory extension of Biology 303, the exercises will illustrate principles of eukaryotic cellular biology, with emphasis on modern instrumentation techniques, particularly protein isolation and cell culture techniques. One three-hour laboratory session per week. Applies to the Molecular/Cell major requirement. *Prerequisite:* Biology 303 or 305. *Recommended prerequisite:* Biology 112. *Co-requisite:* Biology 303 or 305. *Lab fee:* maximum \$30.

305 Cellular Physiology and Signaling

Not offered 2023-24

3 credits

This class will cover the essentials of cell biology and can be used in place of Biology 303 to fulfill the cell biology requirement for biology majors (when taken concurrently with Biology 306) and is suitable as an elective for BBMB majors. In particular, this class will emphasize the role of cellular membranes and signaling machinery in regulating proper cell function. Diversity in cellular signaling will be illustrated through investigation of various strategies used to mediate changes in the physiology of single cells and potentially, the organism. Cell communication is critical to cell survival and adaptation. It is an area of biological study that incorporates biochemistry, cell biology/physiology and membrane biophysics — all of which will be specifically highlighted through literature review and discussion sessions. Three lectures per week. Applies to the Molecular/Cell major requirement. *Prerequisites:* Biology 111 and Chemistry 245 or consent of instructor. *Co-requisites (to fulfill biology major requirements):* Biology 306. *Recommended prerequisite:* Chemistry 246.

306 Cellular Physiology and Signaling Lab

Not offered 2023-24

1 credit

Laboratory exercises in cellular biology will incorporate cell labeling, microscopy, biochemical analysis, and pharmacological manipulation to assess cell physiology (e.g., motility, metabolism, development, and signaling). One three-hour laboratory per week. Applies to the Molecular/Cell major requirement. *Pre- or corequisite:* Biology 305. *Lab fee:* maximum \$30.

310 Physiology

Spring

Staff

4 credits

An advanced-level examination of the biological functions that allow self-maintenance, reproduction, and regulation in various environments. Animals in general will be covered, but we will emphasize mammals and humans. An initial overview examines the principles of traditional organ-systems physiology and how these are increasingly being altered by evolutionary biology, Darwinian medicine, molecular and cellular physiology, and genomics. This overview will be integrated with organismal functions including hormonal and neural regulation, defense, support and movement, excretion and osmotic balance, circulation and transport, respiration, energy balance, and reproduction. We will also discuss several disease models and how they disrupt normal physiology. This course will include three 50-minute lecture periods per week and one 3-hour laboratory section per week. Applies to the Organismal major requirement. *Prerequisites:* Biology 111 and 205, or consent of instructor. *Recommended prerequisite:* Biology 112; 303 and 304 or 305 and 306. *Lab fee:* maximum \$30.

315 Comparative Vertebrate Anatomy

Fall

K. Jackson

4 credits

The structure and function of vertebrates within an evolutionary context. By the end of the course students should have gained a familiarity with the structural diversity of the 60,000 or so living vertebrates and some of their extinct ancestors, a detailed knowledge of the anatomy of a few “representative” vertebrates studied in lab, and an understanding of the major structural trends and innovations in the history of vertebrates. Three lectures and one three-hour laboratory per week. This course is especially recommended for students planning careers in medicine or veterinary medicine or with an interest in evolutionary biology. Applies to the Organismal major requirement. *Prerequisites:* Biology 111 and 112. *Lab fee:* maximum \$30.

316 Transformations in Vertebrate Evolution

Not offered 2023-24

2 credits

This course explores major transformations that vertebrates have undergone in the course of their 500 million year history. For example, how and why did fishes first make the transition to land? How and why did whales (and ichthyosaurs, plesiosaurs, sea turtles and others) make the transition back to water from land? How did flying birds evolve from running dinosaurs? Drawing on the primary literature, from multiple levels of biological organization and integrating research from a range of disciplines (e.g. palaeontology, developmental biology, phylogenetic systematics, ecology), students will explore these and other important transformations in the evolutionary history of vertebrates. Applies to the Ecology/Evolution major requirement. *Prerequisites:* Biology 112 and 205. *Recommended prerequisite:* other 300-level Biology course.

317 Genetic Engineering in the 21st Century

Not offered 2023-24

2 credits

Recent scientific advances such as genome sequencing and CRISPR gene editing have enabled us to “hack” the very building blocks of life in microbes, plants, and animals. Will genetic engineering come to revolutionize the 21st century in the same way that computer engineering did in the 20th century? This advanced seminar course will explore the biological principles underlying genetic engineering technologies and the impact they are having on medicine, agriculture, and the environment. Most readings will come from the primary research literature, and the class will be a mix of presentation and discussion, with overviews and background material given by the instructor. Applies to the Molecular/Cell major requirement and as an elective for BBMB majors. *Prerequisite:* Biology 205.

319 Developmental Biology Seminar

Not offered 2023-24

2 credits

Only 30-50% of all human conceptions survive to birth, due to faults in cellular and molecular regulation of development, but even after birth, developing tissues continue to be vulnerable to insult. This upper level seminar course will focus on embryonic and early postnatal development and developmental disorders due to genetic mutations or environmental conditions. Most readings will come from the primary literature, and the class will be a mix of presentations and discussion, with overviews and background material given by the instructor. Applies to the Molecular/Cell major requirement. *Prerequisites:* Biology 111 and 205.

320 Neurobiology

Not offered 2023-24

4 credits

This course emphasizes the cellular and molecular biology of neurons as a basis for understanding how the nervous system controls behavior. Topics include the structure and function of neurons and glia, synaptic transmission, brain development and regeneration, sensory and motor systems, brain mechanisms of learning and memory, clinical issues, and becoming a neuroscientist. The laboratories will emphasize hands-on experience with techniques used to study the brain in current research including neuroanatomy, neurocytology, neurophysiology, analysis of neuronal gene expression, and observation of living neurons in culture. Three hours of lecture and one three-hour laboratory per week. Applies to the Molecular/Cell major requirement. *Prerequisites:* Biology 111 and 205. *Recommended prerequisite:* Biology 112 and 303 and 304 or 305 and 306. *Lab fee:* maximum \$30.

323 Neurophysiology

Not offered 2023-24

4 credits

This course will introduce students to the multidisciplinary field of neurophysiology from cellular processes to integrated central and peripheral nervous systems functions. The course will examine core principles of neuroanatomy, membrane excitability, neuronal signaling, sensory and motor function, neuroendocrine regulation of integrated organismal physiology (e.g., cardiovascular), and abnormalities that give rise to neurological disorders. Laboratory exercises will emphasize core concepts and methodology, and may incorporate lectures/demonstrations by clinicians/patients and integrative case studies. Three lectures and one three-hour laboratory per week. Applies to the Organismal Biology major requirement and as an elective for BBMB majors. *Prerequisite:* Biology 111. Biology 303 or 305 or BBMB 325 are highly recommended. *Lab fee:* maximum \$30.

327 Biology of Amphibians and Reptiles

Not offered 2023-24

3 credits

Herpetology is the study of amphibians and reptiles. In this course, taxonomy, life history, behavior, physiology, ecology, etc., of frogs, salamander, turtles, lizards, snakes, crocodiles, and others will be presented in the context of the evolutionary history of this diverse assemblage of vertebrates. In the course of the semester, students will prepare an essay on a herpetological topic of their choice. Three lectures per week. Applies to the Ecology/Evolution major requirement. *Prerequisites:* Biology 112, other organismic level courses desirable. *Optional corequisite:* Biology 337.

328 Evolutionary Developmental Biology

Not offered 2023-24

3 credits

Evolution and development are inexorably linked and genetics is the tie that binds them. This interdisciplinary class explores how genetic and developmental mechanisms have evolved to produce biological diversity. Through lectures, class discussions, and activities, and analysis of both classic and cutting-edge scientific papers, we will examine the contributions of all three research areas to the emerging field of “evo-devo”. Three lectures per week. Applies to the Organismal major requirement. *Prerequisite:* Biology 111 and 205. *Optional corequisite:* Biology 338.

329 Developmental Biology

Not offered 2023-24

4 credits

This upper-level course addresses how a complex multicellular organism arises from a single cell, the fertilized egg. The course is framed by questions formulated using classic experiments in experimental embryology and current molecular and cellular approaches that yield new answers to these questions. Emphasis is on how specialized form and pattern develop in animals; ethical and social issues relevant to developmental biology also are discussed. Labs emphasize independent experimentation and current techniques including time-lapse and digital microscopy of living cells and organisms. Three lectures and one three-hour laboratory per week. Applies to the Molecular/Cell major requirement. *Prerequisites:* Biology 111, 205; Chemistry 245. Biology 112, and Biology 303 and 304 or 305 and 306 or BBMB 325 are recommended. *Lab fee:* maximum \$30.

330 Human Physiology

Not offered 2023-24

4 credits

A survey of the functions of the human body using disease states to illustrate key physiological processes. This course will cover in detail the endocrine, nervous, muscular, cardiovascular, respiratory, digestive, renal, and immune systems and will offer an overview of integrative functions such as electrolyte and metabolic regulation. This course will examine a sample of pathological states as a springboard for understanding principles of physiology and use case studies to synthesize and apply knowledge from cellular/tissue processes to integrated organ-systems functions. Foundational principles of physiology will be investigated and emphasized through experimental laboratory work. Lab sessions will also incorporate lectures or demonstrations by clinicians/patients and/or tours of hospital clinics. Applies to the Organismal Biology major requirement and is suitable as an elective for BBMB majors. Given extensive overlap with Biology 310, students may not take both courses for credit. Three lectures and one three-hour laboratory session per week. *Prerequisites:* Biology 111 and Chemistry 245 or consent of instructor. *Lab fee:* maximum \$30.

331 Synthetic Cell Biology

Fall

Moss

4 credits

Synthetic biologists take apart, rebuild, and repurpose parts of a cell in order to program and probe cell behavior. To do this, synthetic biologists utilize approaches from cell biology, engineering, molecular genetics, and biochemistry. This advanced course will survey the questions addressed by synthetic biology research, the molecular approaches utilized, and the implications of this work in the realms of biomedicine and agriculture. A key component of this survey will be the lab, wherein students will engage in a synthetic biology research project. Course-work will include reading and discussion of primary research literature, lectures to provide background information, student-led presentations, scientific writing, and hands-on lab work. The course will consist of 2.5 hours of lecture/discussion and one 3-hour lab per week. Applies to the Molecular/Cell major requirement and as an elective for BBMB majors. Students who received credit for BIOL 374 ST: *Molecular and Synthetic Biology* cannot receive credit for this course. *Prerequisites:* Biology 205 and Chemistry 245. *Lab fee:* maximum \$30.

337 Biology of Amphibians and Reptiles Lab

Not offered 2023-24

1 credit

Labs will focus on study of preserved specimens, and identification of amphibian and reptile species from all over the world. Students also will learn to identify all local species. One three-hour lab per week. Applies to the Ecology/Evolution major requirement. *Corequisite:* Biology 327. *Lab fee:* maximum \$30.

338 Evolutionary Developmental Biology Lab

Not offered 2023-24

1 credit

The Evolutionary Developmental Biology Lab is designed to accompany the associated lecture course (Biology 328). Students will gain hands-on experience in acquiring and analyzing data using a variety of techniques common in the field of “evo devo”, and will then work in small groups to apply these skills to develop and test hypotheses regarding a “mystery” developmental mutant of either the mustard plant *Arabidopsis* or the fruit fly *Drosophila*.

Applies to the Organismal major requirement. *Prerequisite:* Biology 111 and 205. *Optional corequisite:* Biology 328. *Lab fee:* maximum \$30.

342 Gene Discovery and Functional Genomics

Not offered 2023-24

2 credits

An advanced course providing an introduction to how biologists discover genes and determine their roles in diverse biological processes in both plants and animals. Research literature will provide examples of gene identification by forward genetics, molecular methods, transcriptomics, and genomics. We will discuss genome annotation and functional analysis by reverse genetics and other genome-based methods. Class will include reading and discussion of primary research literature, some lecture to provide background information, student presentations, and some hands-on work with genome or gene expression databases. Conceptual familiarity with recombinant DNA techniques, molecular methods, and sequence databases covered in Genetics and Genetics Lab is expected. Applies to the Molecular/Cell major requirement. *Prerequisites:* Biology 205 and 206 or consent of instructor.

350 Evolutionary Biology

Spring

Hutchison

4 credits

Designed for the upper-level biology major, this course emphasizes the importance of evolutionary theory to biology. Using modern examples in population biology, molecular evolution and phylogenetics, students will gain a firm foundation in the mechanisms of evolution, speciation, and extinction, and an appreciation of the applicability of evolutionary principles to current issues in areas such as conservation, medicine, and social behavior. Three lectures and one three-hour lab per week. Applies to the Ecology/Evolution major requirement. *Prerequisites:* Biology 111 and 205. Biology 112 and 277 or 215 are recommended. *Lab fee:* maximum \$30.

371- 374 Special Topics in Biology

1-4 credits

Any current offerings follow.

371 ST: Hormones and Behavior

Fall

Wilson

3 credits

Hormones influence all multicellular organisms and play a major role in modulating how the brain regulates physiology and behavior. We will examine the interactions between the nervous and endocrine systems by investigating how the brain regulates hormone secretion and in turn how hormones influence the brain. The focus of the course encompasses how these processes influence physiology and behavior across vertebrates with special attention to reproduction, appetite, biological rhythms, aggression, and stress responses. The course consists of lectures, activities (e.g., group brainstorming, theoretical design of experiments, data analysis, etc.) and discussion of primary literature. Applies to the neuroscience category requirement for the BBAC major. Applies to the Organismal major requirement. *Prerequisite:* Biology 205. Distribution area: none.

372 ST: Integrative Organismal Biology

Spring

Vernasco

3 credits

Integrative Organismal Biology will focus on how connections between different levels of biological organization relate to organismal function within ecological and evolutionary contexts. This course will dive into the complex interplay between molecular, cellular, physiological, ecological, and evolutionary processes, with a particular emphasis on understanding how these processes shape the structure, function, and behavior of organisms. Examples of topics to be covered include, but are not limited to, behavioral endocrinology, phenotypic plasticity, metabolism and energetics, senescence, and epigenetics. Through a combination of lectures, discussions, and active learning techniques, students gain knowledge about how organisms work and the factors that influence their function. Applies to the Organismal major requirement. *Prerequisite:* Biology 111 and 205. Distribution area: none.

401, 402 Seminar**1-3 credits**

Selected advanced topics in biology. Examples of recently offered topics include bioethics, evolution, and nutrition. Course topic and credit to be designated by instructor. Students will be expected to complete readings, make presentations, and participate in discussions about the selected topics. The topic and course credit will be designated prior to registration for the semester in which a seminar is offered; consult the chair of the department for information. Any current offerings follow.

471, 472 Special Topics**1-5 credits**

Lectures (possibly with laboratories) on advanced topics in biology not generally covered in other courses in the department. Examples of topics offered include plant systematics, invertebrate biology, biology of amphibians and reptiles, entomology, and immunology. The topic and course credit will be designated prior to registration for the semester in which a special topic is offered. Any current offerings follow.

481, 482 Special Projects**Fall, Spring****Staff****1-4 credits**

Selected topics of an experimental or descriptive nature, arranged with individual students who are prepared to undertake semi-independent work. The students will consult with the faculty member most closely associated with the area of interest to determine if the topic is suitable and can be successfully accomplished with the available material and library facilities. This consultation should take place in the semester preceding the anticipated research project. *Prerequisite:* consent of the supervising instructor.

490 Senior Thesis**Fall, Spring****Staff****1-3 credits**

After carrying out a supervised research project involving laboratory experiments, fieldwork, and/or data analysis, senior Biology and Bio- combined majors will write a thesis on the research in accepted scientific style, with guidance from a faculty thesis instructor. Research can take place between sophomore and senior years. Seniors should register for the thesis section supervised by their thesis instructor. Each student is required to give a short seminar presentation of his/her results to the faculty and other students in the major. A total of 3 credits, spread over two semesters, are required for the Biology major. *Prerequisites:* consent of thesis instructor, and senior standing as a Biology, BBMB, or Biology-combined major.

498 Honors Thesis**Fall, Spring****Staff****1-3 credits**

Honors students will finish data collection and write a thesis on the research in accepted scientific style. One or more initial drafts of the thesis will be required before the final version is due in the library. Presentation of results to the staff and other biology majors is required. Students register for Biology 490, but are awarded credits in Biology 498 if honors are earned. Credit cannot be earned simultaneously for Biology 498 and 490. *Prerequisites:* consent of supervising professor, and admission to honors candidacy.

499 Senior Seminar**Spring****H. Dobson****1 credit**

Each student will attend a weekly, one-hour seminar where students present the results of their senior theses. Course is graded credit/no credit. Open only to senior Biology majors.