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 year-long research project. 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 52 credits to fulfill the requirements for the biology major. Courses completed in this major apply to the science and quantitative analysis (selected courses) distribution areas.

The Biology major: A minimum of 35 credits in biology, including Biology 111, 112, 205, 206; 215 or 277; 309 or 308, 310 or 330, 488, 489; 490 or 498; seven additional credits in biology and/or BBMB courses (to include at least one lab course) numbered 200 or above; Chemistry 125, 126, 135, 136, or Chemistry 140; 245; Mathematics 125, 126. Departmental policy does not allow a P-D-F grade option for biology courses within the major.

The senior assessment consists of oral and written components. Oral component: a one-hour exam administered by a committee of biology faculty. Written component: students must take the biology subject GRE and score in the 30th percentile or above.

The department recommends that students desiring a major program in biology begin with Chemistry 125, 126, 135, 136; or 140; and Biology 111 *Biological Principles*; followed by (in order) Biology 112 *The Biological World*; Chemistry 245 *Organic Chemistry I*; Biology 205 *Genetics*; 206 *Genetics Laboratory*; 215 *Plant Ecology* or 277 *Ecology*; 309 *Cell Biology* or 308 *Cellular Physiology and Signaling*; and 310 *Physiology* or 330 *Pathophysiology*. For those planning to pursue most graduate programs in biology, a year of physics (with labs), additional organic chemistry, a year of foreign language, Mathematics 128, and competency with computers are highly recommended.

The Biology minor: Biology 111, 112, and a minimum of eight additional credits in biology and/or BBMB courses numbered 200 or above. Departmental policy does not allow a P-D-F grade option for biology courses within the minor.

The Biology-Geology combined major: Biology 111, 112, 205; 215 or 277; 310 or 330 (note: Biology 309 is recommended prior to 310 or 330), 488, and at least four additional credits in biology numbered above 200; Geology 110, 120, or 210; 220, 320, 345, 346, 350, 470, and a minimum of one credit in 358; either three credits of Geology 480, 490, or 498 or three credits of Biology 489 and 490 (or 498). Chemistry 125, 126, 135, 136, or Chemistry 140; 245; Mathematics 125, 126. Two semesters of physics and field experience are strongly recommended. Courses completed in this major apply to the science and quantitative analysis (selected courses) distribution areas.

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. Courses completed in this major apply to the science and quantitative analysis (selected courses) distribution areas.

100 Ecology of Birds
4; not offered 2008-09

This is a course on bird ecology and identification designed for the nonscience major. No prior science background is presumed. Through the use of afternoon field trips to local habitats, mounted specimens, computer images, slides, videos, and lectures, the course will introduce the student to bird images and habitats necessary to identify birds of the Pacific Northwest. This knowledge will in turn enable one to identify most bird families found worldwide. Three lectures and

one three-hour lab, or field trip, per week. Offered in alternate years. Distribution area: science with lab.

111 Biological Principles
4, 4 Fall: L. Knight; Spring: Wallace

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 lectures and one three-hour laboratory per week. *Prerequisites:* Chemistry 125 and 135; or 140. *Corequisites:* Chemistry 126 and 136 (unless Chemistry 140 previously completed).

112 The Biological World
4, 4 Dobson and Jackson

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. No prerequisites but prior completion of Biology 111 or the equivalent is recommended. Three lectures and one three-hour laboratory per week.

115 Regional Natural History
x, 4 Parker

The natural history of environments in and around Walla Walla County. Designed for nonscience majors with special applicability for environmental studies majors. The course will emphasize applying basic ecological principles to the interpretation of the processes shaping biological communities. The core of the class will be weekly trips in which we develop and apply skills in observing and interpreting local environments from the Columbia River to the Blue Mountains. Through this process, students will become familiar with common plants, animals, and ecological communities of the region. Two one-hour lectures and one five-hour field trip per week. Field trips begin at 11a.m. and extend through the lunch hour and into the afternoon. *Prerequisites*: none. Distribution area: science with lab.

120 Human Anatomy and Physiology
4; not offered 2008-09

Designed for the nonbiology major. Lectures will focus on the structures and functions of organ systems responsible for maintenance, reproduction and regulation of the human body, including their evolutionary origins and their major malfunctions such as caused by diseases. Laboratories will parallel the lectures to reinforce processes introduced in lecture, will include students as test subject (e.g., measuring temperature, respiration, electrocardiograms, etc.), and may include dissection of preserved animals. Three lecture or discussion hours and one three-hour laboratory per week. May not be taken for credit by those who have completed Biology 310.

122 Plant Biology
3; not offered 2008-09

A field-oriented course, designed for the nonmajor, that provides a basic introduction to the biology of plants, examines their ecological adaptations to different habitats, and discusses current issues. In the laboratories, students will explore aspects of plant form and growth, delve into attributes of plant communities, acquire basic skills for plant identification, and learn to recognize on sight the most common plant families in the western United States. Several labs will be substituted by field trips, and all students will be required to make a plant collection. Two lectures and one three-hour laboratory per week.

125 Genes and Genetic Engineering
2; not offered 2008-09

Designed for the nonbiology major. This class provides an introduction to the principles of genetics, and to how genetics is applied in medicine, agriculture, forensics, and biotechnology. Social, ethical, political, and economic issues related to genetics and genetic engineering will be discussed.

127 Nutrition
3, x Golden

The required nutrients and their food sources, their metabolism and eventual functions and fates in the body will be discussed. Principles applied to specific life stages and circumstances. Current topics in nutrition will be addressed, including eating disorders, global nutrition issues, world hunger, food additives, supplements, pesticide use, factors leading to chronic disease, etc. Students will read current articles and develop analytical skills which enable them to make informed decisions regarding food choices. Designed for nonbiology majors. Three lectures.

130 Conservation Biology
4, x Hutchison

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, human population growth and its myriad impacts on our environment. Three one-hour lectures and one three-hour laboratory per week. *Prerequisites:* none. Designed for nonscience majors with special applicability for environmental studies majors.

171, 172 Special Topics in Biology for Nonscience Majors
1-4

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.

171 SW ST: Ecology of the American West
4, x O'Brien and Arbetan

This course will explore the adaptations and relationships of organisms to their abiotic and biotic environments, with a focus on the varied ecosystems of the Hells Canyon region of northeastern Oregon and the high desert ecosystems of northern New Mexico. Particularly, we hope you will come to understand the forces impacting, and the impact of, individual organisms, as they exist over time and space, and as parts of higher levels of ecological constructs including the population, community, and ecosystem. A significant proportion of this 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 will consist primarily of fauna and flora identification, ecological monitoring techniques including vegetative plot monitoring, dry pitfall monitoring, and avian transect monitoring. Required of, and open only to students accepted to Semester in the West. Environmental studies majors may substitute this course for Biology 130 *Conservation Biology* or Biology 115 *Regional Natural History*, as an interdisciplinary foundation course in the sciences with a lab, for the major. *Prerequisites*: Acceptance into the Semester in the West Program. Distribution area: science with lab.

172 ST: History and Ethnobiology of the Silk Roads

x, 2 **H. Dobson**

The course will be taught by Prof. Dobson (Biology) and complements History 248, taught by Prof. Dott. It will provide an integrative exploration into the history and ethnobiology of peoples along the different branches of the trading routes across Asia known as the silk roads. We will delve into agricultural practices and crops of different peoples and regions and how they were shaped by geography and its associated landscape and climatic variables. Lectures and readings will describe major biological items traded, going into biological features and how they contributed to each item's importance. We will also discuss how movement of items along trade routes influenced the way peoples used them. Items to be covered include, but are not limited to: 1) food crops, e.g., grains ("staffs of life"), legumes, fruits, roots, spices, sugar; 2) animal sources of food, e.g., chickens, goats; 3) beverages, e.g., tea; 4) clothing and shelter, e.g., silk, cotton, wool, flax, bamboo; 5) medicinal plants, e.g. ginseng; 6) disease, e.g. "the plague"; 7) transportation, e.g. horses; 8) religious and decorative items, e.g., plant and animal dyes, lacquer, incense. *Corequisite*: Students must enroll simultaneously for History 248, with the same title and also for 2 credits. Distribution area: science.

178 Fundamentals of Marine Biology

x, 3 **Yancey**

An examination of life in the oceans, from the intertidal to the deep sea, with emphases on adaptations of organisms to major habitat factors and current environmental crises. Three lecture and/or discussion periods per week. Designed for nonbiology majors and may not be taken for credit by those who have completed Biology 278. May be taken concurrently with Biology 179. *Prerequisite*: consent of instructor. Offered in alternate years.

179 Fundamentals of Marine Biology Field Trip

x, 1 **Yancey**

A week-long trip to a coastal location during spring break. Normally the trip will be to the University of Washington Friday Harbor Laboratories on San Juan Island, where we will trawl subtidal habitats on a research ship, investigate intertidal communities at various sites on the island, and conduct observations and experiments in a laboratory. There is a $200 fee for food and lodging on the San Juan trip. However, in some years, other locations may be used, with a higher fee. Designed for nonbiology majors and may not be taken for credit by those who have completed Biology 279. May be taken concurrently with Biology 178. *Prerequisite*: consent of instructor. Offered in alternate years.

205 Genetics

3, 3 **Vernon and Hutchison**

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

x, 1 **Vernon**

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. Biology 206 is not recommended for BBMB majors. *Co-* or *prerequisite:* Biology 205.

212 Natural History of the Inland Northwest 4; not offered 2008-09

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. *Prerequisites*: Bio 112; Bio 215 or 277 recommended (or concurrent).

215 Plant Ecology
4; not offered 2008-09

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. The laboratory will include several research projects and field trips. Three lectures and one three-hour laboratory per week. *Prerequisites:* Biology 111, 112. Offered in alternate years.

228 Biostatistics
3; not offered 2008-09

This course will place a strong emphasis on conceptual understanding of statistical methods and their proper application to research questions in biology. We will cover descriptive, inferential and comparative statistics while highlighting hypothesis testing and appropriate experimental design. Topics will include parametric (normal) and nonparametric analyses of continuous and categorical variables to include t-tests, chi-square tests, correlation analysis, simple linear regression, and analyses of variance. Student achievement will be assessed through case studies, homework problems and exams. *Prerequisite*: junior or senior standing in BBMB, biology or biology-combined majors. May not be offered every year. Distribution area: science or quantitative analysis.

259 Comparative Vertebrate Anatomy
4, x **Jackson**

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. *Prerequisites*: Biology 111, 112.

270 Vertebrate Biology
4; not offered 2008-09

The taxonomy, systematics, evolution, distribution, ecology, migrations, behavior, and reproduction of vertebrates. Three lectures and one three-hour laboratory per week. The laboratories emphasize vertebrate identification with the use of taxonomic keys and afternoon field trips. *Prerequisites:* Biology 111, 112. Offered in alternate years.

277 Ecology
4, x **Parker**

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 one-hour lectures and one three-hour lab per week. Labs primarily involve field studies relevant to major concepts, along with data processing and analysis skills, and presentation of results in written and graphical form. *Prerequisites:* Biology 111, 112.

278 Marine Biology
x, 3 **Yancey**

Life in the oceans from the intertidal to the deep sea, with emphasis on anatomical, physiological, and biochemical adaptions of organisms to major environmental factors. Three lectures per week. *Prerequisites:* Biology 111, 112 and consent of instructor.

279 Marine Biology Lab
x, 1 **Yancey**

A field trip to a coastal location for one week during spring break. Normally, the trip will be to the University of Washington's Friday Harbor marine laboratory on San Juan Island, where we will trawl subtidal habitats on a research ship, investigate intertidal communities at various sites on the island, and conduct observations and experiments in a laboratory. There is a $200 fee for food and housing on the San Juan trip. However, in some years, other locations for the trip may be used, with a higher fee. *Prerequisites:* Biology 111, 112 and consent of instructor.

288 Plants and Peoples
4, x **H. Dobson**

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, weeds, plant breeding, and preservation of wild genetic diversity. Three lectures and one three-hour laboratory per week. *Prerequisites:* Biology 111, 112; or consent of instructor. Offered in alternate years.

308 Cellular Physiology and Signaling
x, 4 **L. Knight**

This course will focus on the fundamentals of cell biology and 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 highlighted through laboratory exercises, literature review and discussion sessions. This class will cover the essentials of cell biology and can be used in place of Biology 309 to fulfill the cell biology requirement for biology majors and is suitable as an elective for BBMB majors. Three lectures and one three-hour laboratory session per week. *Prerequisites*:

Biology 111; Chemistry 246; or consent of instructor.

309 Cell Biology
x, 4 **Golden**

The ultrastructure and function of cells. This course will examine in detail the major cellular processes in eucaryotic cells to include: biological molecules, membranes and cell surfaces, cellular energetics, motility, protein processing and transport, etc. The laboratory exercises will illustrate the principles discussed in lecture and will stress modern instrumentation techniques. Three lectures and one three-hour laboratory session per week. *Prerequisites:* Biology 111, Chemistry 245. Biology 112 is recommended.

310 Physiology
4, x **T. Knight**

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 with emphasis on mammals. An initial overview examines the principles of traditional organ-systems physiology and how these are increasingly being altered by evolutionary biology and 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. Three lectures and one three-hour laboratory per week; the latter will parallel the lecture topics. *Prerequisites:* Biology 111; Chemistry 245; or consent of instructor. Biology 112 and 309 or 308 are recommended.

320 Neurobiology
4, x **Wallace and Withers**

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 lectures and one three-hour laboratory per week. *Prerequisites:* Biology 111 and 205. Biology 112 and 309 or 308 are recommended.

329 Developmental Biology
x, 4 **Withers**

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 are also discussed. Labs emphasize independent experimentation and current techniques including timelapse and digital microscopy of living cells and organisms. Three lectures and one three-hour laboratory per week. *Prerequisites:* Biology 111, 205; Chemistry 245. Biology 112, and Biology 309 or 308 or BBMB 325 are recommended.

330 Pathophysiology
4; not offered 2008-09 **Knight**

A survey of the functions of the human body using disease states to illustrate key physiological processes. This course will examine a sample of pathological states as a springboard for understanding: the basic principles of systems physiology; the cellular/tissue processes that give rise to abnormal function; and, the effectiveness of preventative/therapeutic approaches. This course will cover in detail the cardiovascular, endocrine, neuromuscular, renal, and immune systems and will offer an overview of integrative body functions such as electrolyte and nutritional regulation. Basic principles of physiology will be emphasized through laboratory work. Lab sessions will incorporate guest lectures by clinicians/patients or tours of hospital clinics and simulated clinical data and patient case studies. This course can be used in place of Biology 310 to fulfill the physiology requirement for Biology majors, and is suitable as an elective for BBMB. Three lectures and one three-hour laboratory session per week. *Prerequisites*: Biology 111; Chemistry 245; or consent of instructor. Biology 309 or BBMB 325 are highly recommended.

339 Microbiology and Immunology
4, x **Golden**

Bacteria, viruses, and eukaryotic microbes. Cell structure and chemistry, metabolism, evolution, and ecology will be themes emphasized throughout the course as other topics such as pathogenesis, disease, the immune system, cultivation, taxonomy, and practical applications for microorganisms are discussed. The laboratory will establish sterile techniques and stress the structure and biochemical differentiation of bacterial species. Three lectures and one three-hour laboratory per week. *Prerequisites:* Biology 111 and a year of college chemistry. Biology 112 is recommended.

350 Evolutionary Biology
x, 4 **Hutchison**

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. *Prerequisites:* Biology 111, 205. Biology 112 and 277 or 215 are recommended.

401, 402 Seminar
1-3

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.

402A Seminar: Bioethics
x, 1 **Yancey**

A reading-and-discussion course intended for biology majors. Topics will include the ethical implications of biological research involving genetic engineering, animal experimentation, advances in medical and reproductive technology, human medical experiments, intelligence measurements, environmental degradation, etc. Issues will be analyzed using bioethical principles and actual case studies. Readings will be taken from current science journals and other recent sources. Students will lead most of the discussion sessions. *Prerequisite:* Biology 205.

402B Seminar: Current Issues in Nutrition
x, 2 **Golden**

An upper-level seminar on selected topics related to nutrition. Students should have a solid biology foundation and be familiar with basic nutrient metabolism. Choice of topics will be largely student-driven, but examples might include genetically modified organisms, the merits of various fad diets, food safety, obesity, or any other current topic that is related to nutrition. Students should be prepared to discuss controversies surrounding the issues, including the social, psychological and ethical implications thereof.

471, 472 Special Topics
1-4

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.

472A ST: Biology of Amphibians and Reptiles
x, 4 **Jackson**

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. Labs will focus on study of preserved specimens, and identification of species from all over the world. Students will also learn to identify all local species in preparation for field-based labs in the spring. In the course of the semester, students will prepare an essay on a herpetological topic of their choice. Three lectures and one three-hour lab per week. *Prerequisites*: Biology 112 required, other organismic level courses desirable.

481, 482 Special Projects
1-3, 1-3 **Staff**

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.

488 Research Preparation
1, x **H. Dobson**

This required course prepares biology majors for their senior thesis research project. Students learn of faculty research interests and of research opportunities on- and off-campus. Library and computer literature resources and thesis requirements are covered. Each student must arrange a research project and choose a departmental research adviser by the end of the semester. Grade credit/no credit. Required of all junior biology majors; open to seniors or prospective biology-major sophomores who study abroad fall of their junior year.

489 Senior Research
1, 1 **Staff**

Students develop methodologies and begin data collection in their research projects developed in Biology 488. There will also be several meetings (one per week) with the research adviser to discuss the senior research thesis and senior assessment. *Prerequisites:* Biology 488 (may be taken concurrently by students completing requirements in December*)*, consent of supervising professor, senior standing as a biology major.

490 Senior Thesis and Seminar
2, 2 **Staff**

Continuation of Biology 489. Each student 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 last week of classes. Each student is also required to give a short seminar presentation of his/her results to the faculty and other biology majors. *Prerequisite:* Biology 489 *(may be taken concurrently by students completing requirements in December)* or consent of supervising professor.

498 Honors Thesis and Seminar
3, 3 **Staff**

Continuation of Biology 489 and required of senior honors candidates, who will conduct more extensive research than students in Biology 490. 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. Credit cannot be earned simultaneously for Biology 498 and 490. *Prerequisites:* Biology 489, consent of supervising professor, and admission to honors candidacy.