

BIOLOGICAL SCIENCES

http://www.pacific.edu/college/biology
Phone: (209) 946-2181
Location: Biology Building, South Campus
Craig Vierra, Co-Chair
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Degrees Offered

Bachelor of Arts

Bachelor of Science

Master of Science (see Graduate Catalog for information)

Majors Offered

Biological Sciences (BA, BS, MS)

Biological Sciences with Departmental Honors (BS)

Biological Sciences for Teaching Credential Candidates (BS)

Minors Offered

Biological Sciences

Career Opportunities

The program of studies is sufficiently flexible to prepare students to pursue careers in cell and molecular biology, botany, microbiology, physiology or zoology as graduate students. Programs in the department also prepare students for professional fields such as dentistry, medicine, pharmacy, medical technology, nursing or physical therapy. No matter what career objective, the student is exposed to the major areas of the biological sciences, and thus may make an intelligent choice of specialization in post-baccalaureate study.

Preparation for admission to the undergraduate program should include high school work in algebra, geometry, trigonometry, biology, chemistry and physics.

Experiential Learning Opportunities

Many students participate in undergraduate research (BIOL 197). Over a period of one or more semesters these students closely interact with faculty on research projects and get hands-on experience with modern research instruments. Stipends are available to selected undergraduates for summer research. Awardees are given the title of Hornage Undergraduate Research Fellow. Students also are encouraged to participate in Co-op/Internship experiences at dental offices, medical clinics, Micke Grove Zoo and other work areas.

Major Field Competence, Sustainability

Demonstrate mastery of general content knowledge from several sub-disciplines, including evolution, ecology, genetics, and molecular biology.

Major Field Competence, Critical & Creative Thinking

Describe science as a way of knowing, including the role of the scientific method and hypothesis-driven research and discovery in the development of scientific knowledge.

Critical Thinking

Critically evaluate new knowledge, information, and claims in the discipline.

Major Field Competence, Critical & Creative Thinking; Ethical Reasoning

Demonstrate laboratory skills and integrate knowledge and skills to formulate relevant questions and design appropriate experiments to advance knowledge in the discipline.

Integrate knowledge of the discipline with broader knowledge gained through a liberal arts education to analyze the potential societal implications of new knowledge in the discipline.

Communication Skills

Demonstrate oral and written communication skills necessary to work effectively in the profession or to succeed in further study.

Collaboration & Leadership; Intercultural & Global Perspectives

Demonstrate collaborative and intercultural skills necessary to work effectively in the profession or to succeed in further study.

Bachelor of Arts Major in Biological Sciences

Students must complete a minimum of 124 units with a Pacific cumulative and major/program grade point average of 2.0 in order to earn the bachelor of arts degree with a major in biological sciences.

I. General Education Requirements

Minimum 42 units and 12 courses that include:

PACS 001	What is a Good Society	4
PACS 002	Topical Seminar on a Good Society	4
PACS 003	What is an Ethical Life?	3

Note: 1) Pacific Seminars cannot be taken for Pass/No Credit. 2) Transfer students with 28 or more transfer units complete 2 additional General Education elective courses from below in place of taking PACS 001 and PACS 002.

One course from each subdivision below:

Social and Behavioral Sciences

IA. Individual and Intersonal Behavior

IB. U.S. Studies

IC. Global Studies

Arts and Humanities

IIA. Language and Literature

IIB. Worldviews and Ethics

IIC. Visual and Performing Arts

Natural Sciences and Mathematics *

IIIA. Natural Sciences

IIIB. Mathematics and Formal Logic

IIIC. Science, Technology and Society

or a second IIIA Natural Sciences course

Note: 1) No more than 2 courses from a single discipline may be applied to meet the requirements of the general education program. 2) * Fulfilled by courses required in the major.

II. Diversity Requirement

Students must complete one diversity course (3-4 units)

Note: 1) Transfer students with 28 units or more transfer units prior to fall 2011 are encouraged but not required to complete a designated course prior to graduation. **2)** Courses may be used also to meet general education and/or major/minor requirements.

III. College of the Pacific BA Requirement

Students must take one year of college instruction or equivalent training in a language other than English.

Note: 1) Transfer students with sophomore standing are exempt from this requirement.

IV. Fundamental Skills

Students must demonstrate competence in:

Writing

Quantitative analysis

V. Breadth Requirement

Students must complete 64 units outside the primary discipline of the first major, regardless of the department who offers the course(s) in that discipline. (This includes general education courses, transfer courses, CPCE/EXTN units, internships, etc.)

VI. Major Requirements

Minimum 66 units that include:

BIOL 051	Principles of Biology	5
BIOL 061	Principles of Biology	5
BIOL 101	Genetics	5
BIOL 175	Ecology	5
BIOL Electives (4 additional courses above BIOL 061, excluding BIOL 089, BIOL 093, BIOL 191. 3 courses must include a laboratory component)		16
CHEM 025	General Chemistry	5
CHEM 027	General Chemistry	5
Select one of the following groups:		10
Group A		
PHYS 023	General Physics I	
PHYS 025	General Physics II	
Group B		
PHYS 053	Principles of Physics I	
PHYS 055	Principles of Physics II	
Math Electives - Select one of the following:		4
MATH 033	Elements of Calculus	
MATH 037	Introduction to Statistics and Probability	
MATH 041	Pre-calculus	
MATH 045	Introduction to Finite Mathematics and Calculus	
MATH 051	Calculus I	
MATH 053	Calculus II	
Electives: 2 additional courses in Biological Sciences, Chemistry, or Geosciences *		8
Total Hours		68

- * 1. One of these electives must include a lab.
- 2. Biology electives above BIOL 061 excluding BIOL 089, BIOL 093 and BIOL 191.
- 3. Chemistry electives above CHEM 121, excluding CHEM 191 and CHEM 197.
- 4. GESC 191 and GESC 197 do not count towards these electives.

Bachelor of Science Major in Biological Sciences

Students must complete a minimum of 124 units with a Pacific cumulative and major/program grade point average of 2.0 in order to earn the bachelor of science degree with a major in biological sciences.

I. General Education Requirements

Minimum 42 units and 12 courses that include:

PACS 001	What is a Good Society	4
PACS 002	Topical Seminar on a Good Society	4
PACS 003	What is an Ethical Life?	3

Note: 1) Pacific Seminars cannot be taken for Pass/No Credit. **2)** Transfer students with 28 or more transfer units complete 2 additional General Education elective courses from below in place of taking PACS 001 and PACS 002.

One course from each subdivision below:

Social and Behavioral Sciences

IA. Individual and Interpersonal Behavior

IB. U.S. Studies

IC. Global Studies

Arts and Humanities

IIA. Language and Literature

IIB. Worldviews and Ethics

IIC. Visual and Performing Arts

Natural Sciences and Mathematics *

IIIA. Natural Sciences

IIIB. Mathematics and Formal Logic

IIIC. Science, Technology and Society

or a second IIIA Natural Sciences course

Note: 1) No more than 2 courses from a single discipline may be applied to meet the requirements of the general education program. **2)** * Fulfilled by courses required in the major.

II. Diversity Requirement

Students must complete one diversity course (3-4 units)

Note: 1) Transfer students with 28 units or more transfer units prior to fall 2011 are encouraged but not required to complete a designated course prior to graduation. **2)** Courses may be used also to meet general education and/or major/minor requirements.

III. Fundamental Skills

Students must demonstrate competence in:

Writing

Quantitative analysis

IV. Breadth Requirement

Students must complete 64 units outside the primary discipline of the first major, regardless of the department who offers the course(s) in that discipline. (This includes general education courses, transfer courses, CPCE/EXTN units, internships, etc.)

V. Major Requirements

Students must complete a minimum of 76 units that include:

BIOL 051	Principles of Biology	5
BIOL 061	Principles of Biology	5
BIOL 101	Genetics	5
BIOL 175	Ecology	5
BIOL Electives (6 additional courses above BIOL 061 excluding BIOL 089 and BIOL 093. Two of the BIOL elective courses must include a laboratory component) *		24-27
CHEM 025	General Chemistry	5
CHEM 027	General Chemistry	5
CHEM 121	Organic Chemistry	5
CHEM 123	Organic Chemistry	5
Select one of the following groups:		10
Group A		
PHYS 023	General Physics I	
PHYS 025	General Physics II	
Group B		
PHYS 053	Principles of Physics I	
PHYS 055	Principles of Physics II	
MATH Electives - Select one of the following:		4
MATH 033	Elements of Calculus	
MATH 037	Introduction to Statistics and Probability	
MATH 041	Pre-calculus	
MATH 045	Introduction to Finite Mathematics and Calculus	
MATH 051	Calculus I	
MATH 053	Calculus II	

Total Hours 78-81

- * 1. 4 units of BIOL 191 or BIOL 197 may count as electives.
2. Students do not receive credit for both BIOL 071 and BIOL 111, nor do students receive credit for both BIOL 081 and BIOL 111.

Bachelor of Science Major in Biological Sciences with Departmental Honors

Students must complete a minimum of 124 units with a Pacific cumulative and major/program grade point average of 3.7 in order to earn the bachelor of science degree with a major in biological sciences with departmental honors.

I. General Education Requirements

Minimum 42 units and 12 courses that include:

PACS 001	What is a Good Society	4
PACS 002	Topical Seminar on a Good Society	4
PACS 003	What is an Ethical Life?	3

Note: 1) Pacific Seminars cannot be taken for Pass/No Credit. **2)** Transfer students with 28 or more transfer units complete 2

additional General Education elective courses from below in place of taking PACS 001 and PACS 002.

One course from each subdivision below:

Social and Behavioral Sciences

IA. Individual and Interpersonal Behavior

IB. U.S. Studies

IC. Global Studies

Arts and Humanities

IIA. Language and Literature

IIB. Worldviews and Ethics

IIC. Visual and Performing Arts

Natural Sciences and Mathematics *

IIIA. Natural Sciences

IIIB. Mathematics and Formal Logic

IIIC. Science, Technology and Society

or a second IIIA Natural Sciences course

Note: 1) No more than 2 courses from a single discipline may be applied to meet the requirements of the general education program. **2)** * Fulfilled by courses required in the major.

II. Diversity Requirement

Students must complete one diversity course (3-4 units)

Note: 1) Transfer students with 28 units or more transfer units prior to fall 2011 are encouraged but not required to complete a designated course prior to graduation. **2)** Courses may be used also to meet general education and/or major/minor requirements.

III. Fundamental Skills

Students must demonstrate competence in:

Writing

Quantitative analysis

IV. Breadth Requirement

Students must complete 64 units outside the primary discipline of the first major, regardless of the department who offers the course(s) in that discipline. (This includes general education courses, transfer courses, CPCE/EXTN units, internships, etc.)

V. Major Requirements

Students must complete a minimum of 76 units that include:

BIOL 051	Principles of Biology	5
BIOL 061	Principles of Biology	5
BIOL 101	Genetics	5
BIOL 175	Ecology	5
BIOL 197	Undergraduate Research *	1-4
BIOL Electives (6 additional courses above BIOL 061 excluding BIOL 089 and BIOL 093. Four courses must include a laboratory component) **		24-27
CHEM 025	General Chemistry	5
CHEM 027	General Chemistry	5
CHEM 121	Organic Chemistry	5
CHEM 123	Organic Chemistry	5
Select one of the following groups:		10
Group A		

PHYS 023	General Physics I	
PHYS 025	General Physics II	
Group B		
PHYS 053	Principles of Physics I	
PHYS 055	Principles of Physics II	
MATH Electives - Select one of the following:		4
MATH 033	Elements of Calculus	
MATH 037	Introduction to Statistics and Probability	
MATH 041	Pre-calculus	
MATH 045	Introduction to Finite Mathematics and Calculus	
MATH 051	Calculus I	
MATH 053	Calculus II	

Total Hours 79-85

- * 1. Complete a minimum of two semesters of BIOL 197.
- 2. Communicate results from a minimum of two semesters of BIOL 197 in a meeting poster, oral presentation or peer-reviewed publication.
- ** 1. 4 units of BIOL 191 or BIOL 197 may count as electives.
- 2. Students do not receive credit for both BIOL 071 and BIOL 111, nor do students receive credit for both BIOL 081 and BIOL 111.

Bachelor of Science Major in Biological Sciences for Teaching Credential Candidates

Students must complete a minimum of 124 units with a Pacific cumulative and major/program grade point average of 2.0 in order to earn the bachelor of science degree with a major biological sciences for Teaching Credential Candidates.

I. General Education Requirements

Minimum 42 units and 12 courses that include:

PACS 001	What is a Good Society	4
PACS 002	Topical Seminar on a Good Society	4
PACS 003	What is an Ethical Life?	3

Note: 1) Pacific Seminars cannot be taken for Pass/No Credit. 2) Transfer students with 28 or more transfer units complete 2 additional General Education elective courses from below in place of taking PACS 001 and PACS 002.

One course from each subdivision below:

Social and Behavioral Sciences

IA. Individual and Interpersonal Behavior	
IB. U.S. Studies	
IC. Global Studies	

Arts and Humanities

IIA. Language and Literature	
IIB. Worldviews and Ethics	
IIC. Visual and Performing Arts	

Natural Sciences and Mathematics *

IIIA. Natural Sciences	
IIIB. Mathematics and Formal Logic	
IIIC. Science, Technology and Society	
or a second IIIA Natural Sciences course	

II. Diversity Requirement

Students must complete one diversity course (3-4 units)

Note: 1) Transfer students with 28 units or more transfer units prior to fall 2011 are encouraged but not required to complete a designated course prior to graduation. 2) Courses may be used also to meet general education and/or major/minor requirements.

III. Fundamental Skills

Students must demonstrate competence in:

Writing

Quantitative analysis

IV. Breadth Requirement

Students must complete 64 units outside the primary discipline of the first major, regardless of the department who offers the course(s) in that discipline. (This includes general education courses, transfer courses, CPCE/EXTN units, internships, etc.)

V. Major Requirements

Minimum 82 units that include:

BIOL 051	Principles of Biology	5
BIOL 061	Principles of Biology	5
BIOL 101	Genetics	5
BIOL 153	Cell Biology	4
BIOL 175	Ecology	5
BIOL 179	Evolution	4
CHEM 025	General Chemistry	5
CHEM 027	General Chemistry	5
CHEM 121	Organic Chemistry	5
CHEM 123	Organic Chemistry	5
PHYS 023	General Physics I	5
PHYS 025	General Physics II	5
PHYS 041	Astronomy	4
MATH Electives (2 courses from MATH 033 or above)		8
Students must complete one Anatomy course from the following:		4-5
BIOL 071	Human Anatomy	
BIOL 162	Comparative Vertebrate Anatomy	
BIOL 165	Embryology and Development	
Students must complete one Physiology course from the following:		4-5
BIOL 081	Human Physiology	
BIOL 134	Comparative Physiology	
One Botany course from the following:		4
BIOL 079	California Flora	
BIOL 130	Plant Kingdom	
One Zoology course from the following: *		4
BIOL 072	Vertebrate Biology	
BIOL 074	Biology of Insects	
BIOL 077	Marine Birds and Mammals	
BIOL 185	Comparative Animal Behavior	
GESC 051	Dynamic Planet	4
GESC 053	Earth and Life Through Time	4

- * 1. One course in statistics is recommended.
- 2. Credit is not given for both MATH 033 and MATH 051.
- 3. MATH 051 is a prerequisite for MATH 053.
- 4. PHYS 023 and PHYS 053 have specific math prerequisites that must be met.

Minor in Biological Sciences

Students must complete a minimum of 22 units and 5 courses with a Pacific minor grade point average of 2.0 in order to earn a minor in biological sciences.

Minor Requirements:

BIOL 051	Principles of Biology	5
BIOL 061	Principles of Biology	5
BIOL Electives (See Note below)		12

Note: 1) 3 courses above BIOL 061 excluding, BIOL 089, BIOL 093, BIOL 191, and BIOL 197. 2) 3 of the 5 courses must be taken at Pacific.

Biological Sciences Courses

BIOL 011. Human Anatomy and Physiology. 4 Units.

A lecture and laboratory introduction to the structure and function of the various systems of the human body is the focus. This class is intended primarily for non-science majors; not open to biology majors. (GE3A)

BIOL 035. Environment: Concepts and Issues. 4 Units.

Principles of ecology as they bear on world environmental problems are introduced with an emphasis on biological aspects of world problems and on the interrelationships between culture and environment. Global dimension of population, resources, food, energy and environmental impact are considered. Course does not count toward a biology major. (ENST, GE3C)

BIOL 041. Introduction to Biology. 4 Units.

A lecture and laboratory introduce the concepts of biology. Physical structure, physiology, nutrition, reproduction, growth and behavior are examined from the perspective of adaptation and interaction with the environment. Human, animal and plant systems are covered. Recommended for non-majors. Course does not count toward a biology major. (ENST, GE3A)

BIOL 051. Principles of Biology. 5 Units.

A lecture and laboratory introduction to evolutionary biology and ecology. Preparation for continued studies in biological science. (ENST, GE3A)

BIOL 061. Principles of Biology. 5 Units.

This course is a lecture and laboratory introduction to cellular and molecular biology, cellular energetics, biochemistry, genetics and evolution. Preparation for continued studies in biological science. (ENST, GE3A)

BIOL 071. Human Anatomy. 5 Units.

This course is a study of the structure of the organ systems of humans. In addition to lecture, one three-hour laboratory per week is required. Credit will not be given if a student has taken BIOL 111. Prerequisites: BIOL 051 and BIOL 061.

BIOL 072. Vertebrate Biology. 4 Units.

Taxonomy, life history, ecology and evolutionary history of vertebrates are emphasized. Prerequisites: BIOL 051 and BIOL 061. (ENST)

BIOL 074. Biology of Insects. 4 Units.

A lecture and laboratory introduce a broad study of the structure and function of over 700,000 different species. It includes a study of their morphogenesis, reproduction, behavior and relation to humans. The laboratory work includes at least three field trips on Saturdays in addition to the preparation of 50-75 classified insects. Both anatomy and physiology of insects is covered in the two weekly laboratories. (ENST)

BIOL 076. Marine Biology. 4 Units.

General concepts of community ecology, taxonomy and phylogeny, anatomical and physiological adaptations of marine organisms, and their interaction with the physical environment are the main focus. The class emphasizes natural history and identification of marine organisms of the Central California intertidal and sub-tidal environment. Prerequisites: BIOL 051 and BIOL 061. (ENST, GE3A)

BIOL 077. Marine Birds and Mammals. 4 Units.

Ecology, behavior, economic importance and conservation of cetaceans, pinnipeds, otters, sirenians, seabirds and shorebirds are introduced. Physical and biological oceanography are considered as they relate to distribution and abundance of marine birds and mammals. This course is open to non-majors as well as majors. Junior standing. (ENST)

BIOL 079. California Flora. 4 Units.

Identification and classification of flowering plants, gymnosperms, ferns and fern allies as represented in Northern Calif. are studied. (ENST, GE3A)

BIOL 081. Human Physiology. 5 Units.

This course is a lecture- and laboratory-based review of the functions of the major organ systems of vertebrates with emphasis on the human body. Lab exercises demonstrate basic physiological processes in the human body and emphasize techniques of instrumental data acquisition and data presentation. Credit will not be given if a student has taken BIOL 111. Prerequisites: BIOL 061; CHEM 023, CHEM 025. Recommended: one semester of genetics.

BIOL 087. Internship. 1-4 Units.

BIOL 087A. Internship. 1-4 Units.

BIOL 089. Lab Assistant in Biology. 1-4 Units.

Students attend organizational meetings during which laboratory material is discussed and then students assist in the laboratory answering student questions, doing dissections, etc. Attendance at class lectures is recommended and students are expected to take lecture and laboratory examinations. Usually one laboratory meeting per week will earn two units credit; two laboratory meetings per week will earn four units credit. Grading is Pass/no credit only.

BIOL 093. Special Topics. 3 or 4 Units.

BIOL 101. Genetics. 5 Units.

Emphasis of study is heritable variations and their relation to structure, behavior and function of genetic material. This basic course is for students concentrating on biological sciences, medical sciences and liberal arts. In addition to lecture, one-three hour laboratory per week is required. Prerequisites: BIOL 051 and BIOL 061. Recommended: Sophomore standing.

BIOL 111. Anatomy and Physiology. 4 Units.

This lecture and laboratory course covers the structure and function of the major physiological systems of the human body, and it is intended primarily for students in the Dental Hygiene program. Students taking BIOL 111 do not receive credit for either BIOL 071 or BIOL 081. Prerequisites: BIOL 051 and BIOL 061.

BIOL 122. Principles of Immunology. 4 Units.

The fundamental properties of antigens and antibodies are covered with an emphasis on the theories of antibody production, tolerance, transplantation immunity, autoimmunity and tumor immunology. Prerequisites: BIOL 101 and CHEM 121.

BIOL 124. Cancer Biology. 4 Units.

The course examines the morphological and molecular events that accompany the changes of a normal mammalian cell into a cancer cell, with an emphasis on the major pathways that affect cell growth and division, cell communication, cell death and metastasis. Prerequisite: BIOL 101.

BIOL 126. Neurobiology. 4 Units.

This course focuses on the molecular and cell biology of neuronal function and development, and how neurons work together to retrieve and process information and respond accordingly, with thorough discussions of sensory and motor systems and a brief review of more complex brain functions, such as emotions, speech and language, and memory. Prerequisites: BIOL 051 and BIOL 061.

BIOL 128. Histology. 4 Units.

A study of the tissues which comprise the organs of the body is the focus. This course is limited to human tissues. Thin sections of organs will be studied and their structure related to function. Credit only given once for BIOL 128 or BIOL 129. Prerequisites: BIOL 051 and BIOL 061.

BIOL 129. Histology Online. 3 Units.

This is a non-lab, online version of BIOL 128. Credit is only given once for BIOL 128 or BIOL 129. Prerequisites: BIOL 051 and BIOL 061. Recommended: BIOL 101.

BIOL 130. Plant Kingdom. 4 Units.

Through lectures, laboratories and field trips, students are introduced to the morphology, reproduction biology and environmental requirements of all major groups of plants. Included are material bearing on the evolutionary relationships within and between each major group. Individual projects are required. Prerequisites: BIOL 051 and BIOL 061. (ENST)

BIOL 134. Comparative Physiology. 4 Units.

This course is a detailed review of organ function in diverse groups of organisms. Emphasis is on physiological adaptation to the environment. Prerequisites: BIOL 051 and BIOL 061.

BIOL 145. Microbiology. 5 Units.

The biology of microorganisms is studied with emphasis on viruses, bacteria, fungi and protozoa. In addition to lecture, one three-hour laboratory per week is required. Prerequisites: BIOL 051, BIOL 061; CHEM 025, CHEM 027.

BIOL 146. Industrial Microbiology. 4 Units.

An in-depth knowledge of the industrial applications of microorganisms. The course uses an understanding of microbial physiology and genetics to illustrate how these organisms are utilized to create commercial products ranging from medicines to food products. Prerequisite: BIOL 145.

BIOL 147. Medical Microbiology. 4 Units.

Medical microbiology covers a survey of microorganisms implicated in human disease; emphasis on characteristics and properties of microorganisms, chiefly bacteria and fungi which are responsible for pathogenesis. Laboratory includes methods of isolation, characterization, and identification of bacteria and fungi responsible for human disease. Prerequisites: BIOL 145 and CHEM 121 with a C- or higher or permission of instructor.

BIOL 151. Parasitology. 4 Units.

Principles of parasitism as well as biology of animal parasites with special emphasis on the protozoa, platyhelminths, nematodes, acanthocephala and arthropods are studied. Techniques of recovery of parasites from various vertebrate hosts are introduced including staining, mounting and identification. Prerequisites: BIOL 051, BIOL 061, BIOL 101. (ENST)

BIOL 153. Cell Biology. 4 Units.

Cell Biology studies cell structure and function with emphasis on the dynamic nature of the cellular environment and the methodologies of cell biology. The experimental basis of our present understanding of the cell is also stressed. Prerequisites: BIOL 051, BIOL 061, BIOL 101, CHEM 025 and CHEM 027. Recommended: Organic chemistry.

BIOL 155. Biological Electron Microscopy. 4 Units.

The process and techniques involved in examining biological specimens with the transmission electron microscope will be covered in detail. When competence in specimen processing is achieved, each student performs an original experiment as a term project. Prerequisites: BIOL 051, BIOL 061, CHEM 025, CHEM 027. Recommended: BIOL 101.

BIOL 157. Topics in Biomedical Research. 4 Units.

Basic research in the areas of cell biology, biochemistry, molecular biology and physiology are examined in their applications to current problems in medicine. Topics covered include genetic engineering, gene therapy, transplants and cloning. Prerequisites: BIOL 051, BIOL 061, BIOL 101; CHEM 121.

BIOL 158. Computerized Data Acquisition. 4 Units.

This lecture and laboratory course introduces students to experimental design and protocol. Students are trained in the programming and use of the computer data acquisition program LabVIEW, then apply the program to an intensive, team-based research project studying amphibian reproductive behavior. The class ends with a symposium-style presentation of each team's experiments and results. Prerequisites: BIOL 051 and BIOL 061.

BIOL 159. Molecular Biological Techniques. 4 Units.

This advanced laboratory course in the methods of molecular biology, has an emphasis on modern techniques and their application in the laboratory. Topics covered include gene cloning, protein expression systems, nucleic acid isolation and purification, and basic methods of bioinformatics. Prerequisites: BIOL 101 and CHEM 121 with a "C-" or higher.

BIOL 162. Comparative Vertebrate Anatomy. 5 Units.

The evolution of vertebrate organ systems as revealed by comparative morphology are emphasized. Prerequisites: BIOL 051 and BIOL 061. Recommended: BIOL 101.

BIOL 165. Embryology and Development. 4 Units.

This laboratory course focuses on the events that occur as a single-celled embryo develops into an adult organism. Developmental processes are studied at the descriptive and mechanistic levels, leading to an understanding of how and why complex structures are produced. Major emphases is placed on animal embryology (both vertebrate and invertebrate) leading to the production to tissues, organs and organ systems. Later developmental processes also are studied, as well as sex determination. Additional topics include cancer and evolution as seen in the context of development. Prerequisites: BIOL 051, BIOL 061, BIOL 101.

BIOL 169. Elements of Biochemistry. 4 Units.

The field of biochemistry is the focus in this non-lab course that is designed as a preparation for students who will attend a Pharmacy or Dental School. Topics include nucleic acid and protein structure and synthesis, intermediary metabolism, enzyme action, and synthesis and degradation of important biological molecules. The relationship of biochemistry, nutrition, and human disease is discussed. This course does not count for the Biochemistry major. Prerequisites: BIOL 051, BIOL 061, BIOL 101, CHEM 123 with a "C-" or higher.

BIOL 171. Methods in Field Biology. 4 Units.

A course focused on methods of biological investigation with emphasis on modern field sampling techniques and instrumentation. Students are trained in experimental design and quantitative data analysis used to address a range of biological questions. Prerequisites: BIOL 051 and BIOL 061 with a "D" or better. (ENST)

BIOL 175. Ecology. 5 Units.

The structure and dynamics of populations, biotic communities and ecosystems, is emphasized with particular focus upon relationships of organisms to their environments. Prerequisites: BIOL 051 and BIOL 061. (ENST)

BIOL 176. Ecology and Conservation Biology. 4 Units.

The principles of ecology are introduced with attention to consider threats and disruptions to ecological systems from the level of local populations through ecosystems, landscapes, and global processes. Ecological principles are used to help understand these systems, to make predictions for the future or for other systems, and to evaluate possible solutions. The class considers the importance of economic and demographic forces in causing conservation problems and in shaping conservation strategies, and students practice planning conservation areas. Prerequisite: BIOL 051. (ENST)

BIOL 177. Natural Medicines. 4 Units.

A lab course that surveys drugs found in nature, in particular their history, uses, and mode of action, and is designed as a preparation for students who will attend a Pharmacy or Dental School. Topics include history of medicine, survey of natural compounds relevant to pharmacology, and survey of naturally-derived drugs used to treat cancer, heart disease, and neurological disorders. Prerequisites: BIOL 051, BIOL 061, BIOL 101, CHEM 123 with a "C-" or higher.

BIOL 179. Evolution. 4 Units.

Lectures and readings on the mechanisms of evolutionary change in organisms are the focus. Prerequisites: BIOL 051 and BIOL 061. Recommended: BIOL 101.

BIOL 182. Medical Endocrinology. 4 Units.

This lecture and laboratory course presents the fundamentals and current topics in human endocrinology. The subject is examined from a medical and clinical perspective, including "virtual" patients. Prerequisites: BIOL 051, BIOL 061, BIOL 101; CHEM 025 and CHEM 027. Recommended: BIOL 071 and BIOL 081.

BIOL 185. Comparative Animal Behavior. 4 Units.

The ecology and evolution of animal behavior are discussed. Laboratory involves a quantitative study of animal behavior at Micke Grove Zoo. Prerequisites: BIOL 051 and BIOL 061. Junior standing in Biological Sciences or Psychology.

BIOL 186. Hormones and Behavior. 4 Units.

This lecture/discussion course focuses on the bidirectional interactions between an animal's behaviors and its endocrine system. Topics include: overview of the vertebrate endocrine system, courtship and sex behaviors, parenting behavior, pheromonal communication, aggression and other social behaviors, learning and memory, hunger, stress, and biological rhythms. Prerequisites: BIOL 051, BIOL 061, BIOL 101.

BIOL 191. Independent Study. 2-4 Units.**BIOL 197. Undergraduate Research. 1-4 Units.**