BIOLOGY

at Arcadia University

Global Perspectives…Personal Attention…Real-World Integrative Learning Experiences

Faculty

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Degree and Certificates

Bachelor of Arts in Biology
Allied Health
Biological Basis of Behavior
Biomedical
Conservation
Forensics
Molecular

Post-Baccalaureate Certificate in the Health Professions

Post-Baccalaureate Certificate in the Sciences

Option
Secondary Education Certification
3+2 in Biology (B.A.) and Environmental Education (M.A.Ed.)
3+2 in Biology (B.A.) and Forensic Science (M.S.F.S.)
3+D.P.T. in Biology (B.A.) and Physical Therapy (D.P.T.)

Minor
Biology

Related Fields of Study
Scientific Illustration

Related Graduate Fields of Study at Arcadia
Forensic Science
Physician Assistant
Physical Therapy
Genetic Counseling
Public Health

Pathways to Study Abroad in Biology

Biology majors are encouraged to spend a semester studying abroad. Many exciting opportunities are available. Sophomore year and fall semester of the junior year are the most convenient times for students to study abroad. Fall semester of the senior year also is possible.

Since 1997, Biology majors have taken a range of Biology courses toward major requirements in Great Britain, Australia, New Zealand, and other countries. In addition, students have completed Undergraduate Curriculum requirements while studying abroad.

Students also have the opportunity to complete internships or independent research projects at a number of internationally recognized institutions such as the London Zoo and the Academy of Natural Sciences of Philadelphia.

Visit the University's website for Pathways to Study Abroad (www.arcadia.edu/pathways) for more information about suggested course sequences and locations. Arcadia has more than 122 programs around the world.

Since it is important that students plan ahead for study abroad, they should consult with their advisers as soon as possible and make their intentions known to their academic advisers, the Department Chair, and the Associate Dean of International Affairs.

About the Bachelor of Arts in Biology

- Preparation for graduate school
- Preparation for careers in medicine, teaching, industry, research
- Opportunities to conduct research and co-publish results with faculty

- Internships and co-ops
- Ability to develop an individual academic plan with faculty adviser
- Opportunities to study abroad at some of the top universities in the world

Majoring in Biology provides an understanding of modern biological principles and the groundwork for careers in medicine, dentistry, physical therapy, veterinary medicine, conservation, scientific and medical research, secondary school teaching, graduate study, or applied biology positions in government or industry.

Undergraduate students are encouraged to undertake research and co-publish results with the assistance of faculty members who have well-established reputations in their fields. Students also may do internships or co-ops with some of the best-known and most-respected pharmaceutical companies and research institutions located in this region.

Bachelor of Arts in Biology

The Bachelor of Arts in Biology prepares students in the major areas of the life sciences as well as in the cognate areas of Chemistry, Mathematics and/or Physics.

Faculty advisers work closely with each student to plan a series of required and elective courses based on individual interests and career goals.

A core of basic science courses includes general biology, evolution and population biology, research methods, comparative anatomy and physiology, genetics, and plant biology or ecology. A range of electives covers animal behavior, biochemistry, developmental biology, human genetics and development, microbiology, cell biology, histology, immunobiology, molecular biology, neurobiology, and conservation biology.

Laboratory sections generally have smaller enrollments than lecture and thus are especially good for interaction and integrative, collaborative and inquiry-based learning.

It is the policy of the Biology Department that General Biology I and II must be taken in the Biology Department at Arcadia or transferred in from an accredited four- or two-year college. Credits earned through an Advanced Placement Exam or International Baccalaureate do not substitute for General Biology I or II.

Study of Biology can be combined with another field, such as Chemistry, Art, Communications or Business.

The Bachelor of Arts in Biology has the greatest degree of overlap with the Pre-Physical Therapy program requirements and the Pre-Physician Assistant program requirements of any major in the University. (See assured admission requirements for these programs.)

3+2 M.A.Ed. in Environmental Education Program with a B.A. in Biology

This is an accelerated program for students interested in a foundation in the biological sciences leading toward a career in environmental education and related fields. In five years, students earn both the Bachelor of Arts (B.A.) in Biology and the Master of Arts in Education (M.A.Ed.) with a concentration in Environmental Education.

This program focuses on issues of global as well as local environmental education; therefore, students electing this program are strongly encouraged to take a semester abroad. Students in this program also can work toward a Pennsylvania teaching credential.

Interested students register as Biology majors and will complete the bachelor's degree in four years and begin taking graduate-level courses during the senior year. Upon entry to Arcadia, students must notify their advisers as to their interest in this program and its options to ensure they take the required sequence of courses. Students must apply for the 3+2 program midway through the junior year and, because this is an accelerated program, must have at least a 3.0 GPA at that time. In the summer of the junior year, students start taking graduate courses leading toward the master's degree.

Students who do not meet eligibility requirements of this accelerated program or who want more flexibility in their undergraduate program may take both degrees, the B.A. in Biology and the M.A.Ed. in Environmental Education, in the normal sequence.

See the catalog section on Environmental Education for degree requirements.

3+D.P.T. Doctor of Physical Therapy (D.P.T.) with a B.A. in Biology

This is an accelerated program for students interested in earning a B.A. in Biology and a D.P.T. In their fourth year, students in the 3+3 program begin their studies in the D.P.T. program. Two undergraduate-level courses, BI 475 and BI 476 (Biomedical Foundations I and II), are taken in this fourth year and are only available to students in the 3+3 program. These courses are equivalent to PT 675 and 676 taken by the other D.P.T. students.

Students must apply for admission into the 3+3 program directly from high school. Highly selective admissions criteria will be used to select academically talented students capable of handling the accelerated schedule. Matriculated students will not be accepted into the 3 + 3 program. Students who do not meet eligibility requirements of this accelerated program or who want more flexibility in their undergraduate program may follow the 4+3 program leading to the B.A. in Biology and the D.P.T. Please refer to the Pre-Physical Therapy link in the Undergraduate Catalog.

3+2 Master of Science in Forensic Science (M.S.F.S.) with a B.A. in Biology

Forensic science is the application of science to the purposes of law. It is highly interdisciplinary by nature and has become a vital part of the judicial and regulatory system in America. Practicing forensic scientists, law enforcement personnel, and criminal justice professionals all recognize the growing need for highly qualified specialists who can execute established and appropriate techniques in the collection, preservation, analysis, and presentation of forensic evidence.

This program provides an accelerated pathway through the Undergraduate Curriculum into Arcadia's master's degree program in Forensic Science. During the first three years of study, a student takes prerequisite biology coursework and Undergraduate Curriculum requirements. In the fourth year of study, the student completes the Senior Seminar and Capstone requirements for the undergraduate degree and begins graduate coursework, which is completed in the fifth year. In five years, students earn both the Bachelor of Arts (B.A.) in Biology and the Master of Science in Forensic Science (M.S.F.S.).

Interested students must apply for admission to this accelerated program when they apply for admission to Arcadia University. Currently enrolled undergraduates at Arcadia University may not apply for this program. Students who do not meet eligibility requirements of this accelerated program or who want more flexibility in their undergraduate program may take both degrees, the B.A. in Biology and the M.S.F.S., in the normal sequence.

See the catalog section on Forensic Science for additional information.

Minor in Biology

The minor in Biology provides students who have a major interest in another science, business, or humanities with the opportunity to explore the field of biology for their own satisfaction or application to a career goal.

Requirements for the B.A. in Biology

(62 credits as listed below, plus Undergraduate Curriculum requirements and electives to total 128 credits)

Core Curriculum

1. Nine courses in Biology

BI	101, 102	General Biology I, II
BI	201	Evolution and Population Biology
BI	204	Genetics
BI	211	Comparative Anatomy and Physiology
BI	222	Plant Biology
	or BI 329 Ecology	
BI	242	Biological Research Methods
BI	290	Junior Seminar in Biology (2 credits)
BI	490	Senior Seminar in Biology (4 credits)

2. Two courses in Chemistry

CH	101, 102	Modern Chemical Concepts I, II

or CH 111,112 Conceptual Chemistry I, II

3. Two cognate courses in Mathematics (MA 110 or higher), or Chemistry (CH 201 or higher), or Physics (PH 201, 202, 211, or 212)

4. Three additional Biology electives at the 300 level. (For some career goals, additional electives may be necessary.)

5. Students who want certain career paths can choose to specialize in one of the following concentrations. (For some career goals, additional coursework may be required.)

6. Practical experience in the form of a BI 370-level Internship or BI 389-level Independent Research is encouraged.

Recommendations for concentrations

Allied Health Concentration

1. Cognate courses
   PH 201, 202 Fundamental Concepts of Physics I, II

2. Biology electives chosen to fulfill interests and career goals

Biological Basis of Behavior Concentration

1. Cognate courses
   PY 111 Introduction to Psychology
   PY 221, 222 Psychology as a Natural Science

2. Biology electives
   BI 332 Animal Behavior
   BI 335 Neurobiology
   A third biology elective chosen in consultation with the adviser

3. Additional recommendation
   MA 141 Elementary Statistics

Biomedical Concentration

1. Cognate courses
   PH 201, 202 Fundamental Concepts of Physics I, II
   or CH 201, 202 Organic Chemistry I, II: Structure, Mechanisms and Reactions

2. Biology electives chosen to fulfill interests and career goals

3. Additional recommendations:
   Students entering biomedical graduate programs should complete both CH 201, CH 202 and PH 201, PH 202.

Conservation Biology Concentration

1. Cognate courses
   MA 141 Elementary Statistics
   CH 201 Organic Chemistry I

2. Biology electives
   BI 333 Molecular Biology
   BI 329 Ecology
   BI 330 Conservation Biology

3. Additional recommendations
   PS 225 Politics of the Developing World
   FA 208 Photography I
   EC 330 Natural Resource Economics

Forensics Concentration

1. Cognate courses
   CH 201, 202 Organic Chemistry I, II: Structure, Mechanisms and Reactions

2. Biology electives
   BI 325 Cell Biology
   BI 340 Biochemistry
   BI 333 Molecular Biology

3. Additional recommendations
   BI 327 Histology
   CH 203 Equilibrium and Analysis

Molecular Biology Concentration

1. Cognate courses
   CH 201, 202 Organic Chemistry I, II: Structure, Mechanisms and Reactions

2. Biology electives
   BI 325 Cell Biology
   BI 323 Microbiology
   BI 333 Molecular Biology

3. Additional recommendations
   PH 201, 202 Fundamental Concepts of Physics I, II

Requirements for the Minor in Biology

(28 credits as listed below)

Students who want to minor in Biology should consult a departmental adviser.

1. Five courses in Biology

BI	101, 102	General Biology I, II
BI	201	Evolution and Population Biology
or BI	204	Genetics
BI	211	Comparative Anatomy and Physiology
BI	222	Plant Biology
	or BI 329	Ecology

2 At least two additional Biology electives at the 300 level to be selected with permission of the Biology adviser

Requirements for Secondary Certification in Biology

Biology majors seeking certification for secondary teaching in biology must notify their advisers and the Coordinator of Science Education. State certification requirements are very specific, so the earlier students plan for this option, the easier it is to develop appropriate programs.

Completion of the requirements for the major in Biology, which must include the following courses:

1. Cognate courses

CH	201	Organic Chemistry I: Structure, Mechanisms and Reactions
PH	201	Fundamental Concepts of Physics I

2. Biology electives

BI	325	Cell Biology
BI	333	Molecular Biology
BI	329	Ecology

3. Additional recommendations for certification with approval of the Education Department
Two Math courses (MA 110 or higher)

PH	223	Essentials of Physical Geology
	or ES 505	Earth Science

Biology Courses (BI)

101
General Biology I
(4 credits; Fall)

This course is an Introduction to the science of living organisms, with emphasis on molecular and cellular aspects of energy processing, cell reproduction and genetics. Three class hours and three laboratory hours weekly.

102
General Biology II
(4 credits; Spring)

This course is an introduction to the science of living organisms, with an overview of kingdoms with emphasis on structure and function of plants and animals and consideration of population biology and ecology. Three class hours and three laboratory hours weekly.
Prerequisites: BI 101; or written permission of the instructor and Department Chair.

201
Evolution and Population Biology
(4 credits; Fall, Spring)

This course is a study of how evolutionary changes contribute to the diversity of life. Includes an overview of the history of evolutionary theories as well as the use of modern molecular techniques, traditional population biology, and genetics to examine the evolutionary history of life. The course also focuses on the role of natural and artificial selection, sexual selection, kin selection, and social behavior on the development of specific adaptations. Three class hours weekly.
Prerequisite: BI 101 and 102; or written permission of the instructor and Department Chair.

204
Genetics
(4 credits; Fall, Spring)

This course is a study of the classical and modern views of the nature of the gene, its transmission and its function. It includes microbial and population genetics. Three class hours and three laboratory hours weekly.
Prerequisites: BI 101 and 102; or written permission of the instructor and Department Chair.

205
Human Anatomy
(4 credits; Spring)

This course is a study of the structure of the human body at cellular, tissue, organ and system levels. Laboratory exercises include appropriate observations and dissections to illustrate each

system being studied. Three class hours and three laboratory hours weekly.
Prerequisites: BI 101 and 102; or written permission of the instructor and Department Chair .

206
Human Physiology
(4 credits; Fall)

This course is a study of the functioning systems of the human organism. It emphasizes mechanisms governing the function of each tissue type as part of the whole organ, and it examines various systems in the laboratory using a variety of experimental techniques. Three class hours and three laboratory hours weekly.
Prerequisites: BI 101 and 102; or written permission of the instructor and Department Chair.

211
Comparative Anatomy and Physiology
(4 credits; Spring)

In this comparative study of the structure and function of vertebrate and invertebrate organisms, lecture emphasizes evolutionary adaptation leading to solutions of environmental challenges. Laboratory exercises include observation and dissection of representative animal examples to highlight structural adaptations that determine function. Three class hours and three laboratory hours weekly. This course must be completed prior to enrollment in BI 490.
Prerequisites: BI 101 and 102; or written permission of the instructor and Department Chair .

222
Plant Biology
(4 credits; Fall)

This survey of the plant kingdom including algae, bryophytes, ferns, gymnosperms and angiosperms emphasizes evolutionary relationships. It explores structural and functional adaptations to life on land among higher plants: plant anatomy, growth patterns, physiology of photosynthesis, growth responses to environmental stimuli and hormonal controls. Three class hours and three laboratory hours weekly. Some field trips.
Prerequisites: BI 101 and 102; or permission of the instructor.

242
Biological Research Methods
(4 credits; Fall, Spring)

This course is a study of the range of modern scientific methods used in experimentation, with a focus on the use of primary scientific literature to examine scientific design, limitations of experimental methods and analysis of results. Selected laboratory exercises introduce students to various techniques used in modern biological experimentation and research writing skills. Three class hours and three laboratory hours weekly.
Prerequisites: BI 101 and 102; or written permission of the instructor and Department Chair.

290
Junior Seminar in Biology
(2 credits; Fall, Spring)

This seminar examines original literature on selected topics. Students complete database searches, readings of primary literature, oral presentations, an overview of career options, and a career preparation assignment designed to meet individual goals. Students participate in weekly two-hour seminar. This course typically is taken in spring of junior year; the fall section is primarily for students who will be studying abroad in spring.
Prerequisites: At least two 200-level Biology courses and junior standing in Biology; or written permission of the instructor and Department Chair.

317
Developmental Biology
(4 credits; Offered occasionally)

This course is a study of the basic processes of differentiation and morphogenesis in plants and animals. It includes consideration of basic underlying genetic mechanisms. Three class hours and three laboratory hours weekly.
Prerequisites: BI 204, and 242; or written permission of the instructor and Department Chair.

321
Human Genetics and Development
(4 credits; Spring; Offered in alternate years)

This course is a study of human heredity and embryological development with emphasis on underlying molecular and cellular mechanisms, with consideration of current advances in understanding the human genome, gene expression in development, and major human genetic and developmental syndromes. Three class hours and special projects (no laboratory).
Prerequisite: BI 204 and 242; or written permission of the instructor and Department Chair .

323
Microbiology
(4 credits; Spring)

This course is a study of microorganisms in their structure, function and relationship to their environment, both physical and human;

immunology; genetic engineering. Three class hours and three laboratory hours weekly.
Prerequisites: BI 204 and 242; or written permission of the instructor and Department Chair .

325
Cell Biology
(4 credits; Fall)

This course is a study of cell structure and function at the molecular level: enzymes, membranes, respiration, photosynthesis, protein targeting, intracellular trafficking, information transfer and storage. The laboratory emphasizes modern biochemical and molecular technique. Three class hours and three laboratory hours weekly.
Prerequisites: BI 204 and 242, CH 101, 102 (may be taken concurrently); or written permission of the instructor and Department Chair .

327
Histology
(4 credits; Summer, Fall)

This course is a biomedical study of the structure and functions of mammalian cells, tissues and organs at the microscopic level. Laboratory session involves an extensive microscopic analysis and identification of the cells, tissues and organs. Three class hours and three laboratory hours weekly.
Prerequisites: BI 242; or written permission of the instructor and Department Chair .

329
Ecology
(4 credits; Fall)

This course is a study of factors that affect the distribution and abundance of organisms on the planet, including evolution, natural selection, competition, predation, population regulation and ecosystem dynamics. Three class hours and three laboratory hours weekly. Field trips.
Prerequisites: BI 242; or written permission of the instructor and Department Chair .

330
Conservation Biology
(4 credits; Spring)

Conservation biology is an emerging field of biology that documents the loss of worldwide biodiversity, seeks to understand the genetic and ecological characteristics of declining populations, and devises strategies to prevent further losses. Topics explored include conservation ethics, taxonomic definitions, global patterns of biodiversity, genetic diversity within species, demographic processes, species interactions, extinctions and invasions, habitat fragmentation, conservation reserves and ecological restoration. Lecture, weekly discussion of primary literature, and field trips.
Prerequisites: BI 242; or written permission of the instructor and Department Chair .

331
Aquatic Biology
(4 credits; Fall)

This course examines the structure and ecology of freshwater ecosystems. Students study lentic (standing water) communities, from small mosquito breeding sites up to the world's largest lakes, lotic (running water), from headwater streams up to our largest rivers, and estuaries, where fresh and saltwater mix. Students further study the political, social and economic aspects of aquatic resources management. This course is geared toward upper-level Biology majors (juniors and seniors), and instruction follows a standard lecture approach augmented with frequent outdoor lectures on Arcadia's campus and numerous field trips to local water bodies where students measure both physical and biological parameters of the site to be analyzed in the laboratory.
Prerequisites: BI BI 242 or written permission of the instructor and Department Chair .

332
Animal Behavior
(4 credits; Spring)

This is an upper-level course focused on animal behavior from an evolutionary perspective. The course explores how animals process and respond to environmental stimuli, including treatments of physiology, learning, memory, hormonal behavior, fixed action patterns, communication, and the ontogeny of behavior. In addition, this course examines the ecology of behavior, stressing the links between environmental factors, behavior, and resultant patterns of organismal distribution and abundance, including discussions of group formation, territoriality, dispersion, colonial breeding, and reproductive ecology. During the last part of the course, topics such as sexual selection, mating system evolution, parental care, kin selection, eusocial behavior, and human sociobiology are addressed. Laboratory work emphasizes hypothesis testing and the development of an independent project.
Prerequisites: BI 201, and 242; or written permission of the instructor and Department Chair.

333
Molecular Biology
(4 credits; Spring)

This study of the molecular structure and functioning of the gene includes in-depth investigation of current areas of molecular research in biological fields such as medicine,

development, population biology, and evolution. Laboratory involves techniques of molecular biology including DNA purification and analysis, cloning, and the polymerase chain reaction. Three class hours and three laboratory hours weekly.
Prerequisites: BI204 and 242, CH101, 102; or written permission of the instructor and Department Chair .

335
Neurobiology
(4 credits; Fall)

A study at the molecular, cellular, and systems level to examine the mechanisms through which the nervous system mediates behavior, this course emphasizes current and historical experimental evidence used to define the underlying principles of the nervous system. Discussions of nervous system disorders and treatments are integrated throughout the course. Topics include development, physiology, pharmacology and neuroanatomy. The laboratory sessions involve a range of models, fixed specimens, computer simulations; invertebrate, vertebrate and human experiments to examine nervous system structure and function. Three class hours and three laboratory hours weekly.
Prerequisites: BI 242, CH 101, 102; or written permission of the instructor and Department Chair .

337
Immunobiology
(4 credits; Spring)

This course is a study of the cellular and molecular components involved in specific and nonspecific immune responses and regulation. In-depth discussion of experimental evidence is used to establish our present interpretations of immune mechanisms. Topics include hematopoiesis, lymphocyte maturation and activation, somatic recombination, isotype switching, hypersensitivity, transplantation, autoimmunity, AIDS and immunological techniques. Oral presentations and critical analyses of research articles are included. Three class hours weekly and special projects (no laboratory).
Prerequisites: BI 204 and 242,CH 101, 102; or written permission of the instructor and Department Chair . BI325 is recommended.

338
Bioinformatics
(Also listed as CS338)

(4 credits; Fall)

This introductory course in Bioinformatics is focused on genomics and concepts related to gene structure and function. Students gain knowledge in the utilization of genome databases/browsers and bioinformatic tools employed for gene model prediction (annotation), and use those tools to annotate sequences from various eukaryotic genomes. Students are given instruction on algorithm design based on pattern-matching and gain hands-on experience in the use of algorithms to help predict gene models and to test those models for accuracy within the context of the programming language Perl. Collaboration between students trained in different disciplines (math, computer science, biology) is encouraged in order to address issues in genomics and to reflect the interdisciplinary nature of the field.
Prerequisites:BI101, 102, and 242 or CS201/202 or written permission of the instructor and Department Chair .

340
Biochemistry
(4 credits; Fall)

This course introduces students to the basic concepts in biochemistry through lecture and problem sets. A biomedical perspective is used throughout. Students learn the basic principles governing the structure and function of biochemical systems.
Prerequisites: BI 242, CH 101, 102; or written permission of the instructor and Department Chair . CH201, 202 are recommended.

360
Topics in Biology
(4 credits)

This course is an In-depth exploration of a selected topic in the biological sciences. Topics are determined by instructor. Current research and methodology are emphasized.
Prerequisite: Written permission of the instructor.

370
Internship in Biology
(4 credits; Fall, Spring)

This internship in a supervised professional setting involves a significant biological research component for a minimum of eight hours per week. It includes meetings with other interns and the instructor to analyze and discuss the work experience. It requires a journal or laboratory notebook, a written report, and a student evaluation of the internship. It is usually not acceptable as an elective in place of a 300-level course.
Prerequisites: Junior or senior standing in Biology and written permission of the major adviser and Chair. Interested students must submit a written proposal for an internship before registering for the course. Students also must carry at least 8 additional credits at Arcadia University while enrolled in the internship, unless regularly attending on a part-time basis.

380
Faculty Sponsored Research
(2 credits; fall, spring, summer)

This course is a 2-credit laboratory or field research experience that can be taken repeatedly for elective credit with approval of the sponsoring professor and Department Chair. Students read and synthesize literature relevant to their research project and develop a research proposal under the guidance of their faculty research adviser. They then carry out this research project, analyze the data, and write a final research report. Because of the highly specialized nature of this course, students must obtain written approval by the faculty research adviser in order to register for the course, and students must register for the course at least one month prior to the first day of classes. This course cannot be counted as one of the 300-level Biology classes required of all Biology majors.
Prerequisite: BI 242 or permission of the instructor.

389
Independent Study
Independent, faculty-supervised laboratory or library research project is conducted at on- or off-campus facilities and summarized in a paper of appropriate length, style and format. Not usually acceptable as an elective in place of a 300-level course.
Prerequisites: Four courses in Biology, junior or senior standing in Biology, approval of the Department and a written proposal.

490
Senior Seminar in Biology
(4 credits; Spring)

This Capstone course involves the completion of a faculty-supervised laboratory, field or library research project in Biology, including a paper in appropriate style and format; participation in a weekly two-hour seminar; and formal presentation and defense of a poster.
Prerequisites: BI 201, 204, 211, 242, 290 and senior standing in Biology, with a GPA of 2.00 or higher in the major.