

# Biology

## 4 Majors, 1 Minor

School of Arts and Sciences

Bachelor of Arts

Bachelor of Science

Department of Biology/Chemistry

## Faculty

Bruce W. Baldwin, Chair

Michael A. Buratovich

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## About the discipline

The biology major gives its students information about, experience with, and insights into the fascinating topic of life. Functions of organisms and their parts, interactions of organisms with their environments and mechanisms for continued survival are all considered by biology courses.

## Career opportunities

Students with the biology major have several fulfilling options for future careers. Some students desire pre-professional training in preparation for advanced study in human medicine, nursing, dentistry, physical therapy, veterinary medicine and other medical professions. Biology majors who wish to teach in secondary public, private, or charter schools desire a broad biology background. Some biology majors intend to continue their education in graduate school, possibly to find careers in research, wildlife management, resource management or as college professors. Another option chosen by majors has been to enter a biology-related career directly after receiving a degree. Examples of this option are careers in environmental fields and medical laboratories.

## Program strengths and emphases

The biology major has many distinctions. Among them are the following:

- individualized attention from concerned faculty

- Christian life perspective
- research or honors projects
- wide breadth of offerings
- hands-on laboratory and field work
- specialized pre-medical advising
- optional study of special topics

In addition to offering a high-quality, diverse academic program, the department tries to develop an appreciation for life and the moral integrity to use knowledge wisely. This will enable the student to improve the quality of life for each individual, as well as to improve the quality of the earth's environment.

## Requirements

**The 30-hour Bachelor of Arts *biology major* requires:**

- |         |                             |
|---------|-----------------------------|
| BIO 111 | Introductory Biology I (4)  |
| BIO 112 | Introductory Biology II (4) |
| BIO 170 | Freshman Seminar (1)        |
| BIO 480 | Senior Seminar (2)          |

At least one course taken from four of the following five groups:

### *Group I Cellular Biology:*

- |         |                            |
|---------|----------------------------|
| BIO 305 | Principles of Genetics (4) |
| BIO 352 | Microbiology (4)           |
| BIO 365 | Pharmacology               |
| BIO 401 | Cell Biology (3)           |
| BIO 406 | Molecular Genetics (4)     |
| BIO 458 | Human Development (4)      |
| BIO 472 | Biological Chemistry (5)   |

### *Group II Anatomy and Physiology:*

- |         |                                  |
|---------|----------------------------------|
| BIO 263 | Human Anatomy and Physiology (4) |
| BIO 404 | Human Physiology (4)             |

### *Group III Ecology:*

- |         |                           |
|---------|---------------------------|
| BIO 281 | Environmental Science (4) |
| BIO 362 | Principles of Ecology (4) |

### *Group IV Botany:*

- |         |                                      |
|---------|--------------------------------------|
| BIO 330 | Plant Organismal Biology (4)         |
| BIO 345 | Plant Cellular and Molecular Bio (4) |

### *Group V Zoology:*

- |         |                          |
|---------|--------------------------|
| BIO 206 | Genes and Speciation (3) |
| BIO 242 | Vertebrate Zoology (4)   |
| BIO 321 | Parasitology (4)         |

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## Required Support Courses:

- CHE 101 Introductory Chemistry (4) OR
- CHE 111 General Chemistry I (4)
- CHE 201 Organic Chemistry (5)
- HES 351 Statistics (3)

## **The 30-hour Bachelor of Arts *biology-graduate school major* requires:**

Students desiring to attend graduate school in any of the biological sciences are strongly urged to take the asterisked (\*) courses. Doing so will increase the likelihood of admission to and success in graduate school.

- BIO 111 Introductory Biology I (4)
- BIO 112 Introductory Biology II (4)
- BIO 170 Freshman Seminar (1)
- BIO 480 Senior Seminar (2)

One course taken from four of the following five groups:

### *Group I Cellular Biology:*

- BIO 305 Principles of Genetics\*(4)
- BIO 352 Microbiology\* (4)
- BIO 401 Cell Biology\* (3)
- BIO 406 Molecular Genetics\* (4)
- BIO 472 Biological Chemistry I\* (5)
- BIO 473 Biological Chemistry II\* (4)

### *Group II Anatomy and Physiology:*

- BIO 263 Human Anatomy and Physiology (4)
- BIO 404 Human Physiology (4)

### *Group III Ecology:*

- BIO 281 Environmental Science (4)
- BIO 362 Principles of Ecology (4)

### *Group IV Botany:*

- BIO 330 Plant Organismal Biology (4)
- BIO 345 Plant Cellular and Molecular Bio (4)

### *Group V Zoology:*

- BIO 206 Genes and Speciation (3)
- BIO 242 Vertebrate Zoology (4)
- BIO 321 Parasitology (4)

## Required support courses:

- CHE 111 General Chemistry (4)
- CHE 112 General Chemistry II (4)

- CHE 201 Organic Chemistry I (5)
- CHE 202 Organic Chemistry II (4)
- CPS 206 Geographic Information Systems (4)
- HES 351 Statistics (3)

Strongly recommended: BIO 490 Biology research experience.

Note: Individual graduate schools may require physics or other additional courses. Consult admissions websites at graduate schools for specific requirements.

## **The 30-hour Bachelor of Arts *biology health careers major* requires:**

- BIO 111 Introductory Biology I (4)
- BIO 112 Introductory Biology II (4)
- BIO 170 Freshman Seminar (1)
- BIO 480 Senior Seminar (2)

One course taken from four of the following five groups:

### *Group I Cellular Biology:*

- BIO 305 Principles of Genetics\* (4)
- BIO 352 Microbiology\* (4)
- BIO 401 Cell Biology\* (3)
- BIO 406 Molecular Genetics\* (4)
- BIO 458 Human Development\* (4)
- BIO 472 Biological Chemistry I\* (5)
- BIO 473 Biological Chemistry II\* (4)

### *Group II Anatomy and Physiology:*

- BIO 263 Human Anatomy and Physiology\* (4)
- BIO 404 Human Physiology\* (4)

### *Group III Ecology:*

- BIO 281 Environmental Science (4)
- BIO 362 Principles of Ecology (4)

### *Group IV Botany:*

- BIO 330 Plant Organismal Biology (4)
- BIO 345 Plant Cellular and Molecular Bio (4)

### *Group V Zoology:*

- BIO 206 Genes and Speciation (3)
- BIO 242 Vertebrate Zoology (4)
- BIO 321 Parasitology (4)

## Required support courses:

- CHE 111 General Chemistry (4)
- CHE 112 General Chemistry II (4)

CHE 201 Organic Chemistry I (5)  
 CHE 202 Organic Chemistry II (4)  
 CPS 150 Introduction to Computers (3) OR  
 CPS 206 Geographic Information Systems (4)  
 HES 351 Statistics (3)  
 PHY 201 General Physics I (4)  
 PHY 202 General Physics II (4)  
 PSY 100 Introduction to Psychology (4)

**Note:** The asterisked (\*) courses are strongly recommended because of either being required by medical schools or important for success on the Medical College Admission Test (MCAT). Those intending to participate in the program should coordinate their schedule with the pre-medical advisor (regardless of their major).

**The 35-hour Bachelor of Arts *biology secondary education major* requires:**

(All courses must have a grade of 2.67 (B-) or better)

BIO 111 Introductory Biology I (4)  
 BIO 112 Introductory Biology II (4)  
 BIO 206 Genes and Speciation (3)  
 BIO 263 Human Anatomy & Physiology (4)  
 BIO 305 Principles of Genetics (4)  
 BIO 352 Microbiology (4)  
 BIO 362 Principles of Ecology (4)  
 BIO 480 Senior Seminar (2)

Choose one of the following:

BIO 242 Vertebrate Zoology (4)  
 BIO 330 Plant Organismal Biology (4)  
 BIO 345 Plant Cellular and Molecular Bio (4)  
 BIO 321 Parasitology (4)

BIO Electives to total 35 credit hours

Required support courses:

CHE 101 Introductory Chemistry (4) OR  
 CHE 111 General Chemistry I (4)  
 CHE 112 General Chemistry II (4)  
 CHE 201 Organic Chemistry (5)  
 HES 351 Statistics (3)

Strongly recommended:

PHY 102 Conceptual Physics (4)

**The 22-hour *biology minor* requires:**

(All courses must have a grade of B- or better.)

BIO 111 Introductory Biology I (4)

BIO 112 Introductory Biology II (4)  
 BIO 263 Human Anatomy & Physiology (4)  
 BIO 305 Principles of Genetics (4)  
 BIO 362 Principles of Ecology (4)  
 BIO 480 Senior Seminar (2)

Support courses:

CHE 101 Introductory Chemistry (4) OR  
 CHE 111 General Chemistry I (4)

**The 41-hour Bachelor of Science *Biology- Health Careers Major* requires:**

BIO 111 Introductory Biology I (4)  
 BIO 112 Introductory Biology II (4)  
 BIO 170 Freshman Seminar (1)  
 BIO 305 Genetics (4)  
 BIO 352 Microbiology (4)  
 BIO 404 Human Physiology (4)  
 BIO 472 Biochemistry (4)  
 BIO 480 Senior Seminar (2)

Choose one of the following:

BIO 385 Practicum (4)  
 BIO 460 Research (4)  
 BIO 490 Honors Research (4)

Choose ten credit hours from the following

BIO 263 Human Anatomy and Physiology(4)  
 BIO 321 Parasitology (4)  
 BIO 330 Plant Organismal Biology(4)  
 BIO 345 Plant Cellular and Molecular Biology (4)  
 BIO 365 Pharmacology (3)  
 BIO 401 Cell Biology (3)  
 BIO 406 Molecular Genetics (4)  
 BIO 458 Human Development (4)  
 BIO 473 Biological Chemistry (4)

Required support courses;

CHE 111 General Chemistry(4)  
 CHE 112 Inorganic Chemistry(4)  
 CHE 201 Organic Chemistry I (5)  
 CHE 202 Organic Chemistry II (4)  
 CPS150 Introduction to Computers (3) OR  
 CPS206 Geographical Information Systems(4)  
 HES 351 Statistics(3)  
 PHY 201 and PHY202 General Physics I& II(8)  
 OR  
 PHY 211 and PHY212 Modern University  
 Physics I & II(8)

**The 38-Hour Bachelor of Science *Biology Grad School Prep Major* requires:**

BIO 111 Introductory Biology I (4)

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BIO 112 Introductory Biology II (4)  
BIO 170 Freshman Seminar (1)  
BIO 480 Senior Seminar (2)

Choose one of the following:

BIO 385 Practicum (4-8)  
BIO 460 Research (4)  
BIO 490 Honors Research (4)

Choose at least 15 hours from the following:

BIO 206 Genes and Speciation (3)  
BIO 263 Human Anatomy and Physiology(4)  
BIO 281 Environmental Science (4)  
BIO 305 Principles of Genetics (4)  
BIO 321 Parasitology(4)  
BIO 330 Plant Organismal Biology (4)  
BIO 342 Vertebrate Zoology(4)  
BIO 345 Plant Cellular and Molecular Biology(4)  
BIO 352 Microbiology(4)  
BIO 362 Principles of Ecology(4)  
BIO 401 Cell Biology (3)  
BIO 404 Human Physiology(4)  
BIO 406 Molecular Genetics(4)  
BIO 472 Biological Chemistry I (5)  
BIO 473 Biological Chemistry II (4)

Required Support Courses:

CHE 111 General Chemistry (4)  
CHE 112 Inorganic Chemistry (4)  
CHE 201 Organic Chemistry I(4)  
CHE 202 Organic Chemistry II (4)  
CPS 150 Introduction to Computers (3) OR  
CPS 206 Geographic Information Systems(4)  
HES 351 Statistics (3)

Students interested in pursuing graduate studies in the biomolecular sciences or physiological sciences would take the following courses:

MTH 201 Calculus I (4)  
OR MTH 222 Applied Calculus (4)  
PHY 201 Physics I (4)  
OR PHY 211 Modern University Physics I  
PHY 202 Physics II(4)  
OR PHY212 Modern University Physics II (4)

**Note:** Students preparing for specific graduate study in **physical therapy** must work closely with their academic advisor to complete the pre-physical therapy course sequence recommended by the faculty.

**Note: Pre-Veterinary:** Veterinary school academic requirements are very similar to those of medical or dental schools, but vary enough that the student should check the entrance requirements of each potential school to which he or she may apply. Students are expected to have non-curricular experience with veterinary medicine as a part of the undergraduate years. Students intending to apply to MSU Veterinary School will have to take an online Animal Nutrition course in addition to the other pre-vet courses from SAU. A strong GPA and a high score on a standardized test (GRE) are both essential.

**Other considerations:**

- Many upper level courses are offered on an every-other-year basis.
- Be aware of schedules for major events like the Medical College Admission Test and the Michigan Department of Education Subject Area Test if certifying to teach.
- Biology majors are required to pass a departmental examination before graduation.

**Notes for general education:** Lab courses included in the major meet the general education science requirement for biology majors and minors.

**Notes for students certifying to teach:** The biology major and minor is available for secondary certification only. The biology faculty are as concerned with non-academic qualities as biology concepts. With this concern, the faculty will be monitoring and reporting on character, attitude, and behavioral qualities during a student's education at Spring Arbor University. This information will have a direct impact on recommendation of a student for admission to the teacher education program and for admission to student teaching.

All biology education students are required to pass the State of Michigan Subject Area Test in Biology prior to being certified. In order to help Spring Arbor University students pass this requirement, every biology major or minor will be required to pass the Spring Arbor University biology comprehensive test prior to departmental approval for student teaching. The Spring Arbor University biology test may be taken at any time with one week notice to the biology department secretary. Results will be returned to the

student within one week of taking the test. The Spring Arbor University biology test may be taken as many times as needed to pass.

## Course descriptions:

### **BIO 100 Principles of Biology (4)**

Introduces the non-biology major to the entire field of biology. The student gains insight into basic concepts and facts of biology, the methods by which this information is gained and the issues that arise with the development and use of these facts and concepts. Laboratory work reinforces lecture. Does not count toward major or minor. Includes lab. (Offered in fall.)

### **BIO 111 Introductory Biology I (4)**

A survey of organismal biology, anatomy, physiology, energetics, cell structure, phylogeny, ecology and environmental biology. Includes lab. (Offered in fall.)

### **BIO 112 Introductory Biology II (4)**

A survey of the cellular, molecular, and genetic bases of life. Includes lab. (Offered in spring.)

### **BIO 140 Stimulating Science Seminar (1)**

Exploration of the vast and incredible realms of science and technology in a seminar format using discussions, demonstrations, presentations, performances, and writing. Students will be exposed to diverse, illuminating scientific and technological topics of historical, contemporary, and/or futuristic natures. This course will emphasize the wonder, majesty, and potential of God's Creation with links between scientific pursuits and Christian principles and ideals. Grades S/U (Offered in spring).

### **BIO 170 Freshman Seminar in Biology (1)**

Introduction to the possible vocations available to those with a biology major. This course will also emphasize the courses that candidates must take during their college years in order to be successful in their chosen field of interest and the sacrifices that are needed to secure a place in the field of choice. Guest speakers and seminars are the main way we will investigate these options. (Offered in fall.)

### **BIO 200 Biological Basis of Health Concerns (2)**

Students will learn the biological basis for common health concerns. Topics to be covered include: heart attack and stroke (the circulatory system), cancer (cell structure, function and division), AIDS and allergies (the immune system), Alzheimer's Disease and alcoholism (brain structure and function), diabetes (food, nutrition, and metabolism), arthritis and osteoporosis (skeletal system), childbirth and fetal development. Includes lab. Content

is from BIO263. Students may not take both BIO200 and BIO263 (Offered in Weekend College only.)

### **BIO 206 Genes and Speciation (3)**

Introduction to evolutionary biology. Basic population genetics and discussions of how selection, migration, mutation and genetic drift affect Hardy-Weinberg equilibria. Detailed examination of speciation and the history of life on Earth. Discussions of Christian responses to the origins debate. (Offered in fall of odd academic years.)

### **BIO 234 Pathophysiology of Nursing (3) See Nursing**

### **BIO 236 Pharmacology for Nursing (3) See Nursing section**

### **BIO 262 Genetics for Nursing(3) See Nursing section**

### **BIO 263 Human Anatomy and Physiology (4)**

The structures, functions and conditions necessary for the normal activities of the human body. Health and illness related to normal structures and functions. *Prerequisite:* *BIO 111*. Includes lab. (Offered in spring.)

### **BIO 264 Anatomy & Physiology I (3) See Nursing section**

### **BIO 265 Anatomy & Physiology II (3) See Nursing section**

### **BIO 281 Environmental Science (4)**

Current global and local environmental problems and concerns are examined. Scientific bases of problems and possible solutions are included. Topics include atmospheric pollution, population, energy, solid waste, toxic waste, water and others. A Biblical stewardship approach is integrated with course context. Includes lab. (Offered in spring.)

### **BIO 305 Principles of Genetics (4)**

Introduction to the underlying concepts in genetics. Includes a detailed study of Mendelian inheritance patterns in a variety of organisms; an introduction to human genetic diseases; the genetic control of development; the genetics of populations; and evolution. Includes lab. *Prerequisites:* *BIO 111 or 112*. (Offered in fall.)

### **BIO 321 Parasitology (4)**

Structure, life history and effects on the host of various parasitic animals. Laboratory examination and demonstration of hosts and parasites. *Prerequisite:* *BIO 111*. Includes lab. (Offered spring of even academic years)

### **BIO 330 Plant Organismal Biology (4)**

Studies of photosynthetic life, particularly plants, at the organismal level, including how mankind and

society have been, are, and will be dependent upon photosynthetic organisms, the recognition, classification, and geographic distribution of plants, and the ecological impact and roles of photosynthetic life. Classes and lab sessions are supplemented with field studies. *Prerequisites: BIO 111, BIO 112.* (Offered interim or odd academic years)

### **BIO 342 Vertebrate Zoology (4)**

Lecture, laboratory and field work in collection, identification, distribution and environmental relationship of Michigan vertebrates. Includes comparative anatomy and physiology. Includes lab. Required long weekend field trip includes some strenuous activities. *Prerequisite: BIO 111.* (Offered spring of odd academic years).

### **BIO 345 Plant Cellular and Molecular Biology (4)**

Introduction to and application of the theories, concepts, and techniques of cellular and molecular biology directed towards the study of photosynthetic life. This course integrates discussion and analyses of basic and applied biological research techniques, biotechnological systems, phytoremediation efforts, and medical and pharmaceutical applications involving photosynthetic organisms, particularly plants. Includes Lab. *Prerequisites: BIO 111, BIO 112, CHE 111 or instructor's permission, Junior standing or instructor's permission* (Offered in fall of odd academic years).

### **BIO 352 Microbiology (4)**

A comprehensive study of microorganisms including: importance, diversity, metabolism, growth, control, genetics, host-microbe interaction, immunity and disease. Laboratory work supplements lecture and affords practice in identification, cultivation, and observation of microorganism. *Prerequisites: BIO 111 and 112, CHE 101 or 111, or permission of the instructor.* Includes lab. (Offered in spring.)

### **BIO 362 Principles of Ecology (4)**

A study of the components and interrelationships of the components of ecosystems. Topics include biotic-abiotic interaction, biotic-biotic interactions, species diversity, population ecology, species distribution, biogeochemistry, ecological change and community ecosystem patterns and distribution. *Prerequisite: BIO 111 or 112.* Includes lab. (Offered in fall of even academic years.)

### **BIO 365 Introduction to Pharmacology (3)**

Introduction to pharmacodynamics, pharmacokinetics and basic dosing theory. Survey of anti-hypertensives, lipid-lowering drugs, pharmacology re: coronary artery disease and angina pectoralis, diuretics, asthma management, anti-inflammatory drugs, sympathomimetic drugs and management of diabetes mellitus. Case studies, readings and class discussion. Medical terminology appropriate to

the preceding topics. *Prerequisites: BIO 111 or equivalent, and CHE 101 or 111 equivalent, Junior standing.* Also listed as HES 365. (Offered in spring.)

### **BIO 370 Special Topics in Biology (1-3)**

Investigation of varying specialized topics in biology. Examples of topics: immunology, natural selection, microbial genetics, and virology.

### **BIO 401 Cell Biology (3)**

Advanced topics in cellular biology in which we study the structure in relation to the function of subcellular organelles of eukaryotic cells. Includes a survey of the current pertinent scientific literature. *Prerequisite: BIO 111, BIO 112 and CHE 112.* (Offered in fall of odd academic years.)

### **BIO 404 Human Physiology (4)**

A study of the function of organ systems as they relate to the survival of the human organism in its environment. Systems to be studied include the digestive, circulatory, respiratory, sensory and endocrine systems, plus specialized topics. Includes lab. *Prerequisites: BIO 111 or 263 and junior standing.* (Offered in fall of even academic years and spring of odd academic years).

### **BIO 406 Molecular Genetics (4)**

The course covers the molecular understanding of the gene. Topics include: gene structure and expression, structure and replication of DNA, organization of the prokaryotic and eukaryotic genome, role of genes in development including the generation of immune diversity, and the role of oncogenes in cancer. Includes lab. *Prerequisite: BIO 305 and junior standing.* (Offered in spring of odd academic years.)

### **BIO 458 Human Development (4)**

Introduction to developmental biology using human embryology and development as a model. This class will cover such topics as fertilization, cleavage, compaction, gastrulation, primary and embryonic fields, limb development, neurulation, the development of mesodermal derivatives, germ cell development and human stem cells. *Prerequisite: BIO 111 and junior standing.* Includes lab. (Offered in spring of even academic years.)

### **BIO 472 Biological Chemistry I (5)**

Introduction to the chemistry of life. Topics include: structure and function of lipids and membranes; amino acids and proteins; sugars and polysaccharides; mechanisms of enzyme action; carbohydrate metabolism; oxidative phosphorylation and photosynthesis; lipid metabolism. *Prerequisite: CHE 201.* Includes lab. Also listed as CHE 472. (Offered in fall of even academic years.)

**BIO 473 Biological Chemistry II (4)**

Continuation of BIO 472. Topics include: amino acid metabolism; hormonal regulation of metabolism; nucleotide metabolism; nucleic acid structure and function; DNA replication, transcription and translation; gene regulation; blood biochemistry; and hormone mechanism of action.

*Prerequisite:* BIO 472. Includes lab. Also listed as CHE 473. (Offered in spring of even academic years.)

**BIO 480 Senior Seminar (2)**

Advanced studies in selected biological topics. Course design relates the concepts of biology to contemporary, historical, technological, societal, and ethical issues. Lectures, current journal readings, library research, student presentations, and discussion aid in developing inquiry techniques and critical thinking. (Offered in spring.)