BIOLOGY

DEPARTMENT OFFICE

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Biology at NMU

The Biology Department offers programs leading to the bachelor of arts, bachelor of science and master of science in biology. The department offers four separate majors: biology, botany, zoology and biology/secondary education. Students with a biology major have the opportunity for further specialization by choosing from one of four concentrations: general biology, ecology, microbiology and physiology. The department also contributes course work to interdisciplinary programs in water science, biochemistry, environmental science, diagnostic genetics and science technologist. The department offers three minor programs of study: biology, human biology and biology education. The offerings complement programs in nursing, health, liberal arts and sciences, physical education, clinical laboratory science, and environmental conservation, among others. The courses emphasize fundamental concepts of biology at the subcellular, organismic and population levels. The laboratory courses provide students with first-hand experience in understanding biological concepts, thus furthering their understanding of life.

Biologists should have a knowledge of organisms at all levels ranging from molecular activities within cells to ecosystem dynamics. For this reason, the biology tracks and the botany and zoology majors are all built around a common core of courses. The remaining courses for the major are selected to satisfy the student's interests and career plans. A strong background in the physical sciences is helpful to a biological career.

Student Organizations

- Pre-Dental Club
- Pre-Medical Club
- Pre-Veterinary Club
- Student Michigan Education Association
- Tri Beta Society
- Wildlife Society

Department Facilities

- greenhouse
- herbarium
- Lake Superior research boat
- Longyear Forest
- molecular biology facilities
- small-animal facility
- zoological collections

Department/Program Policies

Each non-teaching biology major requires a 2.00 GPA to complete the major. Exceptions must be requested via petition to the department's academic programs committee. Students majoring in secondary education biology or minoring in biology education must maintain a grade point average of 2.70 or greater with no grade below a "C" in the professional education sequence, the major and/or minor and required cognates combined.

Students enrolled in biology laboratory courses must pay replacement costs for damaged supplies (e.g., glassware and microscope slides) or equipment (e.g., microscopes) having value in excess of one dollar. Records of assessments for damage are maintained in the department, and students are notified of any costs due no later than the last laboratory meeting.

Recommendation for Students Bound for Graduate School

Students who plan to apply to a professional school or pursue graduate work in biology are strongly advised to take Organic Chemistry I and II (CH 321, 322) and a year of physics.

Many graduate programs in the biological sciences, including the one at Northern Michigan University, require the Graduate Record Examination (GRE) for admission. Students intending to pursue graduate study in the biological sciences should take this examination early in their senior year.

BACHELOR DEGREE PROGRAMS

Liberal Studies: *Complete information on the liberal studies requirements and additional graduation requirements, including the health promotion requirement, is in the "Liberal Studies Program and Graduation Requirements" section of this bulletin (38-44).*

Courses within each major that can be used to satisfy liberal studies requirements are listed with the roman numeral (in brackets) that coincides with the liberal studies division the course falls under.

General Biology Major

This major provides an opportunity for a diversified background in biology, applicable to a wide range of introductory positions of employment in business and industry, hospitals, universities, the military and government at the local, state and federal levels. It also provides excellent preparation for graduate work in biology or related sciences.

Total Credits Required for Degree	**124**
Liberal Studies	**30-40**
Health Promotion	**2**
Required Courses in Major	**44**
BI 111 Introductory Biology: Principles [III]	4
BI 112 Introductory Biology: Diversity [III]	4
BI 210 Principles of Ecology	4
BI 218 Introduction to Cell and Molecular Biology	4
BI 312 Genetics	4
BI 315 Evolution	4
Choose from the following:	4
BI 222 Animal Physiology (4 cr.)	
BI 313 Cell Biology (4 cr.)	
BI 431 Plant Physiology (4 cr.)	
Choose from the following:	4
BI 230 Plant Kingdom (4 cr.)	
BI 430 Plant Anatomy (4 cr.)	
BI 434 Plant Ecology (4 cr.)	
Choose from the following:	*3-4*
BI 221 Comparative Anatomy (4 cr.)	
BI 321 Embryology (4 cr.)	
BI 322 Vertebrate Zoology (4 cr.)	
BI 421 Invertebrate Zoology (4 cr.)	
BI 423 Parasitology (3 cr.)	
BI 424 General Entomology (4 cr.)	
BI 427 Ecological Animal Physiology (4 cr.)	
BI 460 Ichthyology (3 cr.)	
BI 461 Herpetology (3 cr.)	
BI 462 Ornithology (3 cr.)	
BI 465 Aquatic Insects (4 cr.)	
Choose from the following:	5
BI 203 Medical Microbiology (5 cr.)	
BI 303 General Microbiology (5 cr.)	
Biology Electives	**3-4**
Any BI course at the 200 level or above except for BI 206 and BI 305 [III]	
Other Required Courses	**32**
CH 111 General Chemistry I* [III]	5
CH 112 General Chemistry II* [III]	5
Chemistry electives numbered 215 or above	8
CIS 110 Principles of Computer Information Systems [V] *or* CS 120 Computer Science I (4 cr.) [V]	4
PH 201, PH 202 College Physics I and II [III] *or* PH 220, PH 221 Introductory Physics I and II [III]	10

**Transfer students may satisfy this requirement with a minimum of 4 credit hours.*

Biology Major–Ecology Emphasis

This major provides a background for further study or for introductory positions of employment in fish and wildlife management, forestry, environmental science and other natural resource fields. Students interested in a career in wildlife biology should obtain information from the Biology Department on course selection for certification as an associate wildlife biologist by the Wildlife Society.

Total Credits Required for Degree	**124**
Liberal Studies	**30-40**
Health Promotion	**2**
Required Courses in Major	**44**
BI 111 Introductory Biology: Principles [III]	4
BI 112 Introductory Biology: Diversity [III]	4
BI 210 Principles of Ecology	4
BI 218 Introduction to Cell and Molecular Biology	4
Choose from the following	*4-5*
BI 222 Animal Physiology (4 cr.)	
BI 303 General Microbiology (5 cr.)	
BI 313 Cell Biology (4 cr.)	
BI 431 Plant Physiology (4 cr.)	
BI 310 Ecology Theory and Methods	4
BI 312 Genetics	4
BI 315 Evolution	4
Choose from the following:	*3-4*
BI 230 Plant Kingdom (4 cr.)	
BI 322 Vertebrate Zoology (4 cr.)	
BI 410 Ecology of the Great Lakes (4 cr.)	
BI 421 Invertebrate Zoology (4 cr.)	
BI 423 Parasitology (3 cr.)	
Choose from the following:	4
BI 424 General Entomology (4 cr.)	
BI 427 Ecological Animal Physiology (4 cr.)	
BI 434 Plant Ecology (4 cr.)	
BI 460 Ichthyology (3 cr.)	
BI 461 Herpetology (3 cr.)	
BI 462 Ornithology (3 cr.)	

BI 463 Mammalogy (3 cr.)
BI 465 Aquatic Insects (4 cr.)

Choose from the following:	*3*-4
BI 410 Ecology of the Great Lakes (4 cr.)	
BI 411 Limnology (4 cr.)	
BI 441 Fisheries Management (3 cr.)	
BI 442 Wildlife Management (4 cr.)	
Biology Electives	**3-6**
Any BI course at 200 level or above except for BI 206 and BI 305 [III]	
Other Required Courses	**27-29**
CH 111 General Chemistry I* [III]	5
CH 112 General Chemistry II* [III]	5
CH 220 Introductory Organic Chemistry (5 cr.) *or* CH 321 Organic Chemistry I (4 cr.)	4-5
PH 201 College Physics I [III] *or* PH 220 Introductory Physics I [III]	5
Electives	**8-9**
Choose from the following:	
Chemistry electives at the 215 level or above	
PH 202 College Physics II (5 cr.) [III]	
PH 221 Introductory Physics II (5 cr.) [III]	
MA 161 Calculus (5 cr.) [III]	
GC 202 Soils (4 cr.)	
GC 225 Introduction to Maps (2 cr.)	
GC 335 Geographic Information Systems (4 cr.)	
GC 385 Weather and Climate (4 cr.)	
GC 255 Physical Geology (4 cr.) [III]	

**Transfer students may satisfy this requirement with a minimum of 4 semester hours.*

Biology Major–Microbiology Emphasis

This major is appropriate for pre-professional students in pre-medicine, pre-dentistry, and pre-veterinary medicine. It provides a foundation for introductory positions of employment in such fields as pharmaceuticals, manufacturing of biological products, and monitoring of health and environmental standards. It can also serve as a foundation for graduate studies in special areas of microbiology.

Total Credits Required for Degree	**124**
Liberal Studies	**30-40**
Health Promotion	**2**
Required Courses in Major	**44**
BI 111 Introductory Biology: Principles [III]	4
BI 112 Introductory Biology: Diversity [III]	4
BI 210 Principles of Ecology	4
BI 218 Introduction to Cell and Molecular Biology	4
BI 303 General Microbiology	5
BI 312 Genetics	4
BI 315 Evolution	4
Biology Electives	**15**
Choose from the following:	
BI 203 Medical Microbiology (5 cr.)	
BI 222 Animal Physiology (4 cr.)	
BI 313 Cell Biology (4 cr.)	
BI 402 Microbial Ecology (3 cr.)	
BI 404 Virology (3 cr.)	
BI 405 Immunology (3 cr.)	
BI 413 Biochemistry of Development (4 cr.)	
BI 418 Molecular Biology (4 cr.)	
BI 423 Parasitology (3 cr.)	
BI 431 Plant Physiology (4 cr.)	
Other Required Courses	**32**
CH 111 General Chemistry I* [III]	5
CH 112 General Chemistry II* [III]	5
CH 321 Organic Chemistry I	4
CH 322 Organic Chemistry II	4
CH 450 Introductory Biochemistry	4
PH 201, 202 College Physics I and II [III] *or* PH 220, 221 Introductory Physics I and II [III]	10

**Transfer students may satisfy this requirement with a minimum of 4 credit hours.*

Biology Major–Physiology Emphasis

This major is appropriate for pre-professional students in pre-medicine, pre-dentistry, pre-veterinary medicine, pre-optometry and physical therapy. It provides a foundation for introductory positions of employment in such fields as biomedical research, food and drug manufacturing, nutrition and sports physiology. It can also serve as a basis for graduate studies in developmental biology, physiological ecology, embryology and molecular biology.

Total Credits Required for Degree	**124**
Liberal Studies	**30-40**
Health Promotion	**2**
Required Courses in Major	**43-45**
BI 111 Introductory Biology: Principles [III]	4
BI 112 Introductory Biology: Diversity [III]	4
BI 210 Principles of Ecology	4
BI 218 Introduction to Cell and Molecular Biology	4
BI 221 Comparative Anatomy (4 cr.) *or* BI 201 Human Anatomy (3 cr.)	3-4
BI 222 Animal Physiology (4 cr.) *or* BI 202 Human Physiology (5 cr.)	4-5
BI 312 Genetics	4
BI 313 Cell Biology *or* BI 431 Plant Physiology (4 cr.)	4
BI 315 Evolution	4

Biology Electives	**8**
Choose from the following:	
BI 201 Human Anatomy (3 cr.)	
BI 202 Human Physiology (5 cr.)	
BI 203 Medical Microbiology (5 cr.)	
BI 221 Comparative Anatomy (4 cr.)	
BI 222 Animal Physiology (4 cr.)	
BI 225 Physiology of Aging (3 cr.)	
BI 303 General Microbiology (5 cr.)	
BI 313 Cell Biology (4 cr.)	
BI 321 Embryology (4 cr.)	
BI 405 Immunology (3 cr.)	
BI 413 Biochemistry of Development (4 cr.)	
BI 416 Experimental Cytogenetics (2-3 cr.)	
BI 418 Molecular Biology (4 cr.)	
BI 419 Biology of Cancer (4 cr.)	
BI 425 Endocrinology (3 cr.)	
BI 426 Human Histology (4 cr.)	
BI 427 Ecological Animal Physiology (4 cr.)	
BI 431 Plant Physiology (4 cr.)	
Other Required Courses	**32**
CH 111 General Chemistry I* [III]	5
CH 112 General Chemistry II* [III]	5
CH 321-322 Organic Chemistry I and II *or*	8
CH 220 Introductory Organic Chemistry plus 3 additional chemistry credits	
CH 450 Introductory Biochemistry	4
PH 201, PH 202 College Physics I and II [III] *or*	10
PH 220, PH 221 Introductory Physics I and II [III]	

**Transfer students may satisfy this requirement with a minimum of 4 semester hours.*

Botany

This program provides an opportunity for a diversified background in botany applicable to a wide range of introductory positions in business and industry, universities, and government at the local, state and federal levels. It also provides preparation for graduate work in botany or related sciences.

Total Credits Required for Degree	**124**
Liberal Studies	**30-40**
Health Promotion	**2**
Required Courses in Major	**44**
BI 111 Introductory Biology: Principles [III]	4
BI 112 Introductory Biology: Diversity [III]	4
BI 210 Principles of Ecology	4
BI 218 Introduction to Cell and Molecular Biology	4
BI 312 Genetics	4
BI 315 Evolution	4
BI 431 Plant Physiology	4
Biology Electives	**10-12**
Choose from the following:	
BI 230 Plant Kingdom (4 cr.)	
BI 430 Plant Anatomy (4 cr.)	
BI 433 Local Flora (2 cr.)	
BI 434 Plant Ecology (4 cr.)	
Biology Electives	**4-6**
Any BI course above 220 except for BI 305 [III]	
Other Required Courses	**28**
CH 111 General Chemistry I* [III]	5
CH 112 General Chemistry II* [III]	5
Chemistry Electives 200 level or above	8
PH 201, 202 College Physics I and II [III] *or*	10
PH 220, 221 Introductory Physics I and II [III]	

**Transfer students may satisfy this requirement with a minimum of 4 credit hours.*

Secondary Education Biology Major

Successful completion of this major's biology courses and the professional education sequence leads to certification as a secondary school teacher in biology. Students in this program must select an academic minor in another department. A minor in chemistry education is recommended.

Total Credits Required for Degree	**145**
Liberal Studies	**30-40**
Health Promotion	**2**
Required Courses in Major	**40**
BI 111 Introductory Biology: Principles [III]	4
BI 112 Introductory Biology: Diversity [III]	4
BI 210 Principles of Ecology	4
BI 312 Genetics	4
BI 315 Evolution	4
BI 203 Medical Microbiology *or*	5
BI 303 General Microbiology (5 cr.)	
BI 222 Animal Physiology *or*	4
BI 313 Cell Biology (4 cr.) *or*	
BI 431 Plant Physiology (4 cr.)	
Biology Electives	**11**
Chemistry Electives	**18**
CH 111 General Chemistry I [III]	5
CH 112 General Chemistry II [III]	5
Chemistry Electives (200 level and above)	8
Physics Electives	**10**
PH 201 College Physics I [III]	5
PH 202 College Physics II [III]	5
Other Required Courses	**4**
Choose from the following:	
AS 103 Observational and Solar System Astronomy (4 cr.) [III]	
GC 100 Physical Geography (4 cr.) [III]	
GC 225 Introduction to Maps (2 cr.)	
GC 246 Earth Science (4 cr.) [III]	
GC 255 Physical Geology (4 cr.) [III]	
GC 260 Minerals and Rocks (4 cr.)	
GC 390 Oceanography (2 cr.)	
Teaching Minor, minimum	**20-24**
Professional Education	**37**
ED 201 Introduction to Education	2
ED 231 Teaching and Learning in the Secondary Classroom	4

ED 301 Dimensions of American Education	2
ED 319 Teaching of Reading for Secondary Teachers	3
ED 349 Teaching for Diversity, Equity and Social Justice in the Secondary School Community	2
ED 361 Special Education and the General Classroom Teacher	2
ED 483 Educational Media and Technology	2
ED 430 Teaching in the Secondary School	11
ED 450 Seminar in Teaching	1
MSED 340 Fundamental Concepts in Science	4
MSED 350 Methods and Materials in the Teaching of Science Education	4

Zoology Major

This major provides a foundation for introductory positions of employment in museums, zoos, universities, and state and federal agencies involved in fish, wildlife and other natural resource use. It is an appropriate program for pre-medicine, pre-dentistry, and pre-veterinary science students. It also provides a solid background for students who wish to pursue graduate studies in special areas of zoology.

Total Credits Required for Degree	**124**
Liberal Studies	**30-40**
Health Promotion	**2**
Required Courses in Major	**44**
BI 111 Introductory Biology: Principles [III]	4
BI 112 Introductory Biology: Diversity [III]	4
BI 210 Principles of Ecology	4
BI 218 Introduction to Cell and Molecular Biology	4
BI 222 Animal Physiology *or* BI 313 Cell Biology (4 cr.)	4
BI 312 Genetics	4
BI 315 Evolution	4
Choose from the following:	*3*-4
BI 421 Invertebrate Zoology (4 cr.)	
BI 423 Parasitology (3 cr.)	
BI 424 General Entomology (4 cr.)	
BI 465 Aquatic Insects (4 cr.)	
Choose from the following:	*3*-4
BI 322 Vertebrate Zoology (4 cr.)	
BI 460 Ichthyology (3 cr.)	
BI 461 Herpetology (3 cr.)	
BI 462 Ornithology (3 cr.)	
BI 463 Mammalogy (3 cr.)	
Choose from the following:	4
BI 221 Comparative Anatomy (4 cr.)	
BI 321 Embryology (4 cr.)	
BI 426 Human Histology (4 cr.)	
BI 427 Ecological Animal Physiology (4 cr.)	
Biology Electives	**4-6**
Any BI courses above 220.	
Other Required Courses	**28**
CH 111 General Chemistry I* [III]	5
CH 112 General Chemistry II* [III]	5
Chemistry Electives 200 level or above	8
PH 201, PH 202 College Physics I and II [III] *or* PH 220, PH 221 Introductory Physics I, II [III]	10

**Transfer students may satisfy this requirement with a minimum of 4 semester hours.*

Minor Programs

Biology Minor

Total Credits Required for Minor	**20**
BI 111 Introductory Biology: Principles	4
BI 112 Introductory Biology: Diversity	4
Biology Electives	**12**

Biology Education Minor

Total Credits Required for Minor	**20-29**
BI 111 Introductory Biology: Principles	4
BI 112 Introductory Biology: Diversity	4
BI 210 Principles of Ecology	4
BI 312 Genetics	4
Biology Electives	**4-5**
Choose from the following:	
BI 202 Human Physiology (5 cr.)	
BI 222 Animal Physiology (4 cr.)	
BI 303 General Microbiology (5 cr.)	
BI 313 Cell Biology (4 cr.)	
BI 315 Evolution (4 cr.)	
BI 431 Plant Physiology (4 cr.)	
MSED 340 Fundamental Concepts in Science*	4
MSED 350 Methods and Materials in the Teaching of Science Education*	4

**Not required if major is chemistry education, earth science education, physics education or integrated science education.*

Human Biology Minor

A minor in human biology provides students with an introduction to the human body. Students who minor in human biology will have a strong introduction to the clinical sciences.

Total Credits Required for Minor	**20-21**
BI 201 Human Anatomy	3
BI 202 Human Physiology	5
Biology Electives	**12-13**
Choose credits from the following:	
BI 203 Medical Microbiology (5 cr.)	
BI 206 Human Genetics (3 cr.)	
BI 312 Genetics (4 cr.)	
BI 321 Embryology (4 cr.)	
BI 405 Immunology (3 cr.)	
BI 425 Endocrinology (3 cr.)	
BI 426 Human Histology (4 cr.)	