Biology

The Biology program grants several majors, including Biology, B.S.; Biology, B.A.; Aquatic Biology, B.S.; Life Science Specialty, Science Education, B.S.; and Medical Laboratory Science, B.S. In addition, students may choose from several emphases within the Biology major, including Wildlife Management, Medical Sciences, and Cellular and Molecular Biology. From field to laboratory studies, the Biology program offers diverse opportunities for personal and professional study and growth.

Programs

- Aquatic Biology, B.S. (Wetlands Ecology Emphasis) *major*
- Aquatic Biology, B.S. (Fisheries Biology Emphasis) *major*
- Aquatic Biology, B.S. (Aquatic Systems Emphasis) *major*
- Biochemistry, Cellular and Molecular Biology, B.S. (Cellular and Molecular Emphasis) *major*
- Biochemistry, Cellular and Molecular Biology, B.S. (Biochemistry Emphasis) *major*
- Biology, B.A. *major*
- Biology, B.S. *major*
- Biology, B.S. (Medical Sciences Emphasis (Optional)) *major*
- Medical Laboratory Science, B.S. ((3 + 1 Option)) *major*
- Medical Laboratory Science, B.S. ((4 + 1 Option)) *major*
- Science Education, B.S. (Life Science Specialty (Teacher Licensure)) *major*
- Wildlife Biology, B.S. *major*
- Aquatic Systems *minor*
- Biology *minor*
- Fisheries Biology *minor*
- Wetlands Ecology *minor*
- Wildlife Biology *minor*

Career Directions

Agricultural Sales
Allied Health Professions
Aquatic Biology
Biotechnology
Clinical Laboratory Sciences
Consultant
Education
Field Biology
Fisheries Biology
Food Sciences
Government Service
Industry
Invertebrate Zoology
Laboratory Biology
Medical Professions
Microbiology
Natural History
Pharmaceutical and Biomedical Products Sales
Research
Science and Technical Writing
Wetlands Science
Wildlife Sciences
Also: Graduate Study

Preparation

Recommended High School Courses

Algebra
Biology
Chemistry
Physics
Precalculus
Trigonometry

Aquatic Biology, B.S. *major*
Wetlands Ecology Emphasis

Required Credits: 72
Required GPA: 2.50

I REQUIRED BIOLOGY CORE COURSES

Complete the following courses:

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 1500 Diversity of Life (4 credits)
- BIOL 2360 Genetics (4 credits)
- BIOL 2610 General Ecology (3 credits)

II REQUIRED AQUATIC BIOLOGY CORE COURSES

Complete the following courses:

- BIOL 3361 Limnology (4 credits)
- BIOL 3362 Streams and Rivers (4 credits)
- BIOL 3830 Aquatic Plants and Algae (4 credits)
- BIOL 4200 Freshwater Invertebrates (4 credits)
- BIOL 4534 Ichthyology (4 credits)
- CHEM 3507 Analytical Chemistry (3 credits)
  or ENVR 4220 Sampling and Analysis (4 credits)
  or GEOL 3211 Environmental Hydrology (3 credits)
  or GEOL 3212 Hydrogeology (3 credits)
- GEOG 3231 Introduction to Geographic Information Systems (3 credits)

III CAPSTONE PROJECT

CAPSTONE PROJECT The Aquatic Biology capstone project, completed in the senior year, provides a culminating experience that integrates the knowledge and skills learned in previous courses and applies them to a scholarly activity. Examples of capstone projects may include original research projects or internships with state and federal agencies. The capstone project must be designed or chosen by the student in consultation with a faculty mentor or advisor, who must approve the project before work begins. Students should consult with their faculty mentor or advisor before their senior year commences. All capstone projects will include a written and oral component. Specific

capstone requirements vary by field of emphasis. Refer to requirements as listed in specific emphases. CHOOSE ONE OF THE FOLLOWING THREE OPTIONS:

COMPLETE THE FOLLOWING COURSE:

- BIOL 4894 Advanced Research Project I (2 credits)

COMPLETE THE FOLLOWING COURSE:

- BIOL 4895 Advanced Research Project II (2 credits)

COMPLETE THE FOLLOWING COURSES:

- BIOL 4894 Advanced Research Project I (2 credits)
- BIOL 4895 Advanced Research Project II (2 credits)

WETLANDS ECOLOGY EMPHASIS

REQUIRED CORE COURSES:
COMPLETE THE FOLLOWING COURSES:

- BIOL 3840 Wetlands Ecology (3 credits)
  or ENVR 3840 Wetlands Ecology (3 credits)
- BIOL 3844 Wetlands Ecology Lab (1 credit)
- BIOL 4030 Wetland Delineation and Classification (3 credits)

ELECTIVE CORE COURSES
SELECT A MINIMUM OF 6 CREDITS FROM THE FOLLOWING:

- BIOL 3120 Soils (4 credits)
  or GEOL 3120 Soils (4 credits)
- BIOL 3420 Human Dimensions of Wildlife and Fisheries Management (3 credits)
  or ENVR 4210 Environmental Law and Policy (3 credits)
- BIOL 3610 Principles of Wildlife Management (3 credits)
- BIOL 3630 Conservation Biology (3 credits)
  or GEOG 3630 Conservation Biology (3 credits)
- BIOL 3723 Ecosystem Ecology (3 credits)
- BIOL 3850 Marine Biology (3 credits)
- GEOG 3232 Intermediate Geographic Information Systems (3 credits)

V REQUIRED COURSES IN RELATED FIELDS

COMPLETE THE FOLLOWING COURSES:

- CHEM 1111 General Chemistry I (4 credits)
  or CHEM 2211 Principles of Chemistry I (4 credits)
- CHEM 1112 General Chemistry II (4 credits)
  or CHEM 2212 Principles of Chemistry II (4 credits)
- STAT 2610 Applied Statistics (4 credits)
  or PSY 3401 Basic Statistics for Research (4 credits)

SELECT 1 OF THE FOLLOWING COURSES:

- PHYS 1101 General Physics I (4 credits)
- PHYS 2101 University Physics I (4 credits)

Program Learning Outcomes | Aquatic Biology, B.S.

1. Communicate: Effectively present research using common, professional formats (written and/or verbal). This includes using figures, graphs, tables, and illustrations to promote dissemination and clarity of knowledge.

2. Create Purpose or Hypothesis: Provide justification for the importance of pursuing a project or construct a testable hypothesis (or hypotheses).

3. Observe and Question: Integrate information or observations to promote curiosity and question generation.

4. Recognize Larger Implications: Demonstrate understanding of the ethical/social dimensions or societal implications of science, recognize inherent biases, and communicate scientific ideas to non-science audiences.

5. Re-engage: Demonstrate an ability to re-engage with the research process by identifying sources of error, possible limitations of their research, next steps in a project, or re-designing more appropriate experimental methods/controls.

6. Research: Plan and execute research, experiments, data collection, analysis of the results, and/or synthesis of new or coalesced knowledge.

7. Review Research Literature: Search and review appropriate sources with a goal of independent information discovery or critically identifying knowledge gaps.

Suggested Semester Schedule | Aquatic Biology, B.S., Wetlands Emphasis

The following is a list of required Aquatic Biology Major, B.S., Wetlands Emphasis courses arranged by year. This schedule is intended to assist students in planning their courses. There is some flexibility in this schedule, but graduation within four years will require close adherence to the specified sequence of courses. Always consult your academic advisor in Aquatic Biology as to the proper courses and sequence of courses needed for graduation. Note: With proper student planning and in consultation with the Aquatic Biology academic advisor a student may complete his or her academic degree in 120 semester credits. It is possible, in some circumstances, that courses in a student's Core Curriculum program may be used in his or her academic major.

Freshman

- BIOL1400
- BIOL1500
- CHEM1111
  or CHEM2211
- CHEM1112
  or CHEM2212
- Core Curriculum requirements

Sophomore

- BIOL2360
- BIOL2610
- PHYS1101
  or PHYS2101
- STAT2610
  or PSY3401
- Core Curriculum requirements

Junior

- BIOL3361
- BIOL3362

- BIOL3830
- BIOL4030
- CHEM3507
  or ENVR4220
  or GEOL3211
  or GEOL3212
- Complete Core Curriculum requirements
- Elective courses in field of emphasis

Senior

- BIOL3840
  or ENVR3840
- BIOL3844
- BIOL4200
- GEOG3231
- Capstone Project
- Elective courses in field of emphasis

Aquatic Biology, B.S. *major*
Fisheries Biology Emphasis

Special Note: Students seeking fisheries certification through the American Fisheries Society are encouraged to carefully select their Liberal Education courses to include 9 credits from courses related to composition, technical writing and/or verbal communications.

Required Credits: 73
Required GPA: 2.50

I REQUIRED BIOLOGY COURSES

Complete the following courses:

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 1500 Diversity of Life (4 credits)
- BIOL 2360 Genetics (4 credits)
- BIOL 2610 General Ecology (3 credits)

II REQUIRED AQUATIC BIOLOGY CORE COURSES

Complete the following courses:

- BIOL 3361 Limnology (4 credits)
- BIOL 3362 Streams and Rivers (4 credits)
- BIOL 3830 Aquatic Plants and Algae (4 credits)
- BIOL 4200 Freshwater Invertebrates (4 credits)
- BIOL 4534 Ichthyology (4 credits)
- CHEM 3507 Analytical Chemistry (3 credits)
  or ENVR 4220 Sampling and Analysis (4 credits)
  or GEOL 3211 Environmental Hydrology (3 credits)
  or GEOL 3212 Hydrogeology (3 credits)
- GEOG 3231 Introduction to Geographic Information Systems (3 credits)

III CAPSTONE PROJECT

CAPSTONE PROJECT The Aquatic Biology capstone project, completed in the senior year, provides a culminating experience that integrates the knowledge and skills learned in previous courses and applies them to a scholarly activity. Examples of capstone projects may include original research projects or internships with state and federal agencies. The capstone project must be designed or chosen by the student in consultation with a faculty mentor or advisor, who must approve the project before work begins. Students should consult with their faculty mentor or advisor before their senior year commences. All capstone projects will include a written and oral component. Specific capstone requirements vary by field of emphasis. Refer to requirements as listed in specific emphases.

Complete the following courses:

- BIOL 4898 Fisheries Research I (2 credits)
- BIOL 4899 Fisheries Research II (2 credits)

FISHERIES BIOLOGY EMPHASIS

Required Core Courses
Comlete the following course:

- BIOL 4545 Fisheries Management (4 credits)

Elective Core Courses
Select a minimum of 6 credits from the following:

- BIOL 2339 Ethics of Fish and Wildlife Management (3 credits)
- BIOL 3400 Fish & Wildlife Law and Administration (3 credits)
- BIOL 3420 Human Dimensions of Wildlife and Fisheries Management (3 credits)
- ENVR 3040 Environmental Economics (3 credits)
  or ECON 3040 Environmental Economics (3 credits)
- ENVR 3600 Environmental Justice and Sustainability (3 credits)
- ENVR 4210 Environmental Law and Policy (3 credits)

V REQUIRED COURSES IN RELATED FIELDS

Complete the following courses:

- CHEM 1111 General Chemistry I (4 credits)
  or CHEM 2211 Principles of Chemistry I (4 credits)
- CHEM 1112 General Chemistry II (4 credits)
  or CHEM 2212 Principles of Chemistry II (4 credits)

Select 2 of the following courses:

- ENVR 3800 Sustainability Analytics & Modeling (3 credits)
- GEOG 4265 Spatial Analysis (3 credits)
- MATH 2471 Calculus I (5 credits)
- PSY 3401 Basic Statistics for Research (4 credits)
- PSY 4403 Advanced Statistics and Research Design (4 credits)
- STAT 2610 Applied Statistics (4 credits)
- STAT 3610 Time Series Analysis (3 credits)

Select 1 of the following courses:

- PHYS 1101 General Physics I (4 credits)
- PHYS 2101 University Physics I (4 credits)

Program Learning Outcomes | Aquatic Biology, B.S.

1. Communicate: Effectively present research using common, professional formats (written and/or verbal). This includes using figures, graphs, tables, and illustrations to promote dissemination and clarity of knowledge.

2. Create Purpose or Hypothesis: Provide justification for the importance of pursuing a project or construct a testable hypothesis (or hypotheses).

3. Observe and Question: Integrate information or observations to promote curiosity and question generation.

4. Recognize Larger Implications: Demonstrate understanding of the ethical/social dimensions or societal implications of science, recognize inherent biases, and communicate scientific ideas to non-science audiences.

5. Re-engage: Demonstrate an ability to re-engage with the research process by identifying sources of error, possible limitations of their research, next steps in a project, or re-designing more appropriate experimental methods/controls.

6. Research: Plan and execute research, experiments, data collection, analysis of the results, and/or synthesis of new or coalesced knowledge.

7. Review Research Literature: Search and review appropriate sources with a goal of independent information discovery or critically identifying knowledge gaps.

Suggested Semester Schedule | Aquatic Biology, B.S., Fisheries Biology Emphasis

Freshman

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 1500 Diversity of Life (4 credits)
- CHEM 1111 General Chemistry I (4 credits)
  or CHEM 2211 Principles of Chemistry I (4 credits)
- CHEM 1112 General Chemistry II (4 credits)
  or CHEM 2212 Principles of Chemistry II (4 credits)
- Core Curriculum Requirements

Sophomore

- BIOL 2360 Genetics (4 credits)
- BIOL 2610 General Ecology (3 credits)
- PHYS 1101 General Physics I (4 credits)
  or PHYS 2101 University Physics I (4 credits)
- Core Curriculum Requirements
- Math/Statistics Requirements

Junior

- BIOL 3361 Limnology (4 credits)
- BIOL 3362 Streams and Rivers (4 credits)
- BIOL 3830 Aquatic Plants and Algae (4 credits)
- BIOL 4200 Freshwater Invertebrates (4 credits)
- CHEM 3507 Analytical Chemistry (3 credits)
  or ENVR 4220 Sampling and Analysis (4 credits)
  or GEOL 3211 Environmental Hydrology (3 credits)
  or GEOL 3212 Hydrogeology (3 credits)
- Elective courses in field of emphasis
- Complete Core Curriculum Requirements
- Math/Statistics Requirements

Senior

- BIOL 4534 Ichthyology (4 credits)
- BIOL 4545 Fisheries Management (4 credits)
- BIOL 4898 Fisheries Research I (2 credits)
- BIOL 4899 Fisheries Research II (2 credits)
- GEOG 3231 Introduction to Geographic Information Systems (3 credits)
- Elective courses in field of emphasis

.

Aquatic Biology, B.S. *major*
Aquatic Systems Emphasis

Required Credits: 74
Required GPA: 2.50

I REQUIRED BIOLOGY CORE COURSES

COMPLETE THE FOLLOWING COURSES:

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 1500 Diversity of Life (4 credits)
- BIOL 2360 Genetics (4 credits)
- BIOL 2610 General Ecology (3 credits)

II REQUIRED AQUATIC BIOLOGY CORE COURSES

COMPLETE THE FOLLOWING COURSES:

- BIOL 3361 Limnology (4 credits)
- BIOL 3362 Streams and Rivers (4 credits)
- BIOL 3830 Aquatic Plants and Algae (4 credits)
- BIOL 4200 Freshwater Invertebrates (4 credits)
- BIOL 4534 Ichthyology (4 credits)
- CHEM 3507 Analytical Chemistry (3 credits)
  or ENVR 4220 Sampling and Analysis (4 credits)
  or GEOL 3211 Environmental Hydrology (3 credits)
  or GEOL 3212 Hydrogeology (3 credits)
- GEOG 3231 Introduction to Geographic Information Systems (3 credits)

III CAPSTONE PROJECT

CAPSTONE PROJECT The Aquatic Biology capstone project, completed in the senior year, provides a culminating experience that integrates the knowledge and skills learned in previous courses and applies them to a scholarly activity. Examples of capstone projects may include original research projects or internships with state and federal agencies. The capstone project must be designed or chosen by the student in consultation with a faculty mentor or advisor, who must approve the project before work begins. Students should consult with their faculty mentor or advisor before their senior year commences. All capstone projects will include a written and oral component. Specific capstone requirements vary by field of emphasis. Refer to requirements as listed in specific emphases. CHOOSE ONE OF THE FOLLOWING THREE OPTIONS:

COMPLETE THE FOLLOWING COURSE:

- BIOL 4894 Advanced Research Project I (2 credits)

COMPLETE THE FOLLOWING COURSE:

- BIOL 4895 Advanced Research Project II (2 credits)

COMPLETE THE FOLLOWING COURSES:

- BIOL 4894 Advanced Research Project I (2 credits)
- BIOL 4895 Advanced Research Project II (2 credits)

AQUATIC SYSTEMS EMPHASIS

REQUIRED CORE COURSES
COMPLETE THE FOLLOWING COURSE:

- BIOL 3850 Marine Biology (3 credits)

ELECTIVE CORE COURSES
SELECT A MINIMUM OF 9 CREDITS FROM THE FOLLOWING:

- BIOL 3310 Entomology (3 credits)
- BIOL 3420 Human Dimensions of Wildlife and Fisheries Management (3 credits)
- BIOL 3610 Principles of Wildlife Management (3 credits)
- BIOL 3630 Conservation Biology (3 credits)
  or GEOG 3630 Conservation Biology (3 credits)
- BIOL 3723 Ecosystem Ecology (3 credits)
- BIOL 4620 Evolution (3 credits)
- GEOG 3232 Intermediate Geographic Information Systems (3 credits)

ADDITIONAL ELECTIVES
SELECT AN ADDITIONAL 3-4 CREDITS OF BIOLOGY ELECTIVES AT THE 3000 LEVEL OR ABOVE.

V REQUIRED COURSES IN RELATED FIELDS

COMPLETE THE FOLLOWING COURSES:

- CHEM 1111 General Chemistry I (4 credits)
  or CHEM 2211 Principles of Chemistry I (4 credits)
- CHEM 1112 General Chemistry II (4 credits)
  or CHEM 2212 Principles of Chemistry II (4 credits)
- STAT 2610 Applied Statistics (4 credits)
  or PSY 3401 Basic Statistics for Research (4 credits)

SELECT 1 OF THE FOLLOWING COURSES:

- PHYS 1101 General Physics I (4 credits)
- PHYS 2101 University Physics I (4 credits)

Program Learning Outcomes | Aquatic Biology, B.S.

1. Communicate: Effectively present research using common, professional formats (written and/or verbal). This includes using figures, graphs, tables, and illustrations to promote dissemination and clarity of knowledge.

2. Create Purpose or Hypothesis: Provide justification for the importance of pursuing a project or construct a testable hypothesis (or hypotheses).

3. Observe and Question: Integrate information or observations to promote curiosity and question generation.

4. Recognize Larger Implications: Demonstrate understanding of the ethical/social dimensions or societal implications of science, recognize inherent biases, and communicate scientific ideas to non-science audiences.

5. Re-engage: Demonstrate an ability to re-engage with the research process by identifying sources of error, possible limitations of their research, next steps in a project, or re-designing more appropriate experimental methods/controls.

6. Research: Plan and execute research, experiments, data collection, analysis of the results, and/or synthesis of new or coalesced knowledge.

7. Review Research Literature: Search and review appropriate sources with a goal of independent information discovery or critically identifying knowledge gaps.

Suggested Semester Schedule | Aquatic Biology, B.S., Aquatic Systems Emphsais

The following is a list of required Aquatic Biology Major, B.S., Aquatic Systems Emphasis courses arranged by year. This schedule is intended to assist students in planning their courses. There is some flexibility in this schedule, but graduation within four years will require close adherence to the specified sequence of courses. Always consult your academic advisor in Aquatic Biology as to the proper courses and sequence of courses needed for graduation. Note: With proper student planning and in consultation with the Aquatic Biology academic advisor a student may complete his or her academic degree in 120 semester credits. It is possible, in some circumstances, that courses in a student's Core Curriculum program may be used in his or her academic major.

Freshman

- BIOL1400
- BIOL1500
- CHEM1111
  or CHEM2211
- CHEM1112
  or CHEM2212
- Core Curriculum Requirements

Sophomore

- BIOL2360
- BIOL2610
- PHYS1101
  or PHYS2101
- STAT2610
  or PSY3401
- Core Curriculum Requirements

Junior

- BIOL3361
- BIOL3362
- BIOL3830
- CHEM3507
  or ENVR4220
  or GEOL3211
  or GEOL3212
- Elective courses in field of emphasis
- Complete Core Curriculum Requirements

Senior

- BIOL4200
- BIOL4534
- GEOG3231
- Capstone Project
- Elective courses in field of emphasis

Biochemistry, Cellular and Molecular Biology, B.S.

major

Cellular and Molecular Emphasis

Required Credits: 75
Required GPA: 2.25

I REQUIRED COURSES

BIOLOGY CORE

Complete the following courses:

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 2360 Genetics (4 credits)
- BIOL 3380 Molecular Genetics (3 credits)
- BIOL 3590 Cell Biology (3 credits)
- BIOL 3710 Microbiology (4 credits)

CHEMISTRY CORE

Complete the following courses:

- CHEM 2211 Principles of Chemistry I (4 credits)
- CHEM 2212 Principles of Chemistry II (4 credits)
- CHEM 3311 Organic Chemistry I (3 credits)
- CHEM 3312 Organic Chemistry II (3 credits)
- CHEM 3371 Organic Chemistry Laboratory I (1 credit)
- CHEM 3372 Organic Chemistry Laboratory II (1 credit)
- CHEM 4411 Biochemistry I (3 credits)
- CHEM 4412 Biochemistry II (3 credits)
- CHEM 4471 Biochemistry Laboratory I (1 credit)

RELATED FIELD REQUIREMENTS

Select one of the following groups:

GROUP 1:

- PHYS 1101 General Physics I (4 credits)
- PHYS 1102 General Physics II (4 credits)

GROUP 2:

- PHYS 2101 University Physics I (4 credits)
- PHYS 2102 University Physics II (4 credits)

SEMINARS

Complete the following courses:

- BCMB 1000 Biochemistry, Cell and Molecular Biology Careers (BCMB Careers) (1 credit)
- BCMB 3000 Biochemistry, Cell and Molecular Biology Research (BCMB Research) (1 credit)

TECHNIQUES CORE

Select one of the following:

- BCMB 3074 Molecular Techniques (2 credits)
  or BIOL 3074 Molecular Techniques (2 credits)

Select one of the following:

- BCMB 3075 Cellular Techniques (2 credits)
- BIOL 3075 Cellular Techniques (2 credits)
- BCMB 4476 Techniques in Biotechnology and Biochemistry (2 credits)
- CHEM 4476 Techniques in Biotechnology and Biochemistry (2 credits)

RESEARCH

SELECT ONE OF THE FOLLOWING GROUPS:

GROUP 1:

- BIOL 4894 Advanced Research Project I (2 credits)
- BIOL 4895 Advanced Research Project II (2 credits)

GROUP 2:

- CHEM 4894 Research I (2 credits)
- CHEM 4895 Research II (2 credits)

II REQUIRED EMPHASIS - CELLULAR AND MOLECULAR BIOLOGY

BIOLOGY ELECTIVES

Select 3 courses:

- BIOL 3250 Human Anatomy (4 credits)
- BIOL 3260 Human Physiology (4 credits)
- BIOL 3300 Introduction to Hematology (4 credits)
- BIOL 3580 Immunology (3 credits)
- BIOL 4270 Histology (4 credits)
- BIOL 4360 Developmental and Tumor Biology (3 credits)
- BIOL 4447 Genomics (3 credits)
- BIOL 4460 Stem Cells and Regenerative Medicine (3 credits)
- BIOL 4470 Introduction to Vaccinology (4 credits)
- BIOL 4715 Clinical Microbiology (3 credits)

CHEMISTRY ELECTIVES

Select one of the following groups:

GROUP 1:

- CHEM 3507 Analytical Chemistry (3 credits)
- CHEM 3570 Analytical Chemistry Laboratory (1 credit)

GROUP 2:

- CHEM 4614 Medicinal Chemistry: Drug Design (3 credits)
- CHEM 4615 Medicinal Chemistry: Drug Action (3 credits)

RELATED FIELD REQUIREMENTS

Complete one of the following courses:

- MATH 2471 Calculus I (5 credits)
- STAT 2610 Applied Statistics (4 credits)

Suggested Semester Schedule | Biochemistry, Cellular, and Molecular Biology, B.S.
Cellular and Molecular Biology emphasis

Freshman:

- BIOL 1400 Cellular Principles (4 credits)
- CHEM 2211 Principles of Chemistry I (4 credits)
- BIOL 2360 Genetics (4 credits)
- CHEM 2212 Principles of Chemistry II (4 credits)
- BCMB 1000 Biochemistry, Cell and Molecular Biology Careers (BCMB Careers) (1 credit)

Sophomore:

- BIOL 3590 Cell Biology (3 credits)
- CHEM 3311 Organic Chemistry I (3 credits)
- PHYS 1101 General Physics I (4 credits)
  or PHYS 2101 University Physics I (4 credits)

- BIOL 3380 Molecular Genetics (3 credits)
- CHEM 3312 Organic Chemistry II (3 credits)
- BCMB 3074 Molecular Techniques (2 credits)
  or BIOL 3074 Molecular Techniques (2 credits)
- PHYS 1102 General Physics II (4 credits)
  or PHYS 2102 University Physics II (4 credits)

Junior:

- BIOL 3710 Microbiology (4 credits)
- CHEM 4411 Biochemistry I (3 credits)
- BCMB 3075 Cellular Techniques (2 credits)
  or BIOL 3075 Cellular Techniques (2 credits)
- CHEM 4412 Biochemistry II (3 credits)
- BCMB 3000 Biochemistry, Cell and Molecular Biology Research (BCMB Research) (1 credit)
- STAT 2610 Applied Statistics (4 credits)
  or MATH 2471 Calculus I (5 credits)
- Emphasis Biology elective

Senior:

- BIOL 4894 Advanced Research Project I (2 credits)
- BIOL 4895 Advanced Research Project II (2 credits)
- Emphasis Chemistry elective(s)
- Emphasis Biology electives

Biochemistry, Cellular and Molecular Biology, B.S.

major

Biochemistry Emphasis

Required Credits: 80
Required GPA: 2.25

I REQUIRED COURSES

BIOLOGY CORE

Complete the following courses:

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 2360 Genetics (4 credits)
- BIOL 3380 Molecular Genetics (3 credits)
- BIOL 3590 Cell Biology (3 credits)
- BIOL 3710 Microbiology (4 credits)

CHEMISTRY CORE

Complete the following courses:

- CHEM 2211 Principles of Chemistry I (4 credits)
- CHEM 2212 Principles of Chemistry II (4 credits)
- CHEM 3311 Organic Chemistry I (3 credits)
- CHEM 3312 Organic Chemistry II (3 credits)
- CHEM 3371 Organic Chemistry Laboratory I (1 credit)
- CHEM 3372 Organic Chemistry Laboratory II (1 credit)
- CHEM 4411 Biochemistry I (3 credits)
- CHEM 4412 Biochemistry II (3 credits)
- CHEM 4471 Biochemistry Laboratory I (1 credit)

RELATED FIELD REQUIREMENTS

Select one of the following groups:

GROUP 1:

- PHYS 1101 General Physics I (4 credits)
- PHYS 1102 General Physics II (4 credits)

GROUP 2:

- PHYS 2101 University Physics I (4 credits)
- PHYS 2102 University Physics II (4 credits)

SEMINARS

Complete the following courses:

- BCMB 1000 Biochemistry, Cell and Molecular Biology Careers (BCMB Careers) (1 credit)
- BCMB 3000 Biochemistry, Cell and Molecular Biology Research (BCMB Research) (1 credit)

TECHNIQUES CORE

Select one of the following:

- BCMB 3074 Molecular Techniques (2 credits)
  or BIOL 3074 Molecular Techniques (2 credits)

Select one of the following:

- BCMB 3075 Cellular Techniques (2 credits)
- BIOL 3075 Cellular Techniques (2 credits)
- BCMB 4476 Techniques in Biotechnology and Biochemistry (2 credits)
- CHEM 4476 Techniques in Biotechnology and Biochemistry (2 credits)

RESEARCH

SELECT ONE OF THE FOLLOWING GROUPS:

GROUP 1:

- BIOL 4894 Advanced Research Project I (2 credits)
- BIOL 4895 Advanced Research Project II (2 credits)

GROUP 2:

- CHEM 4894 Research I (2 credits)
- CHEM 4895 Research II (2 credits)

II REQUIRED EMPHASIS - BIOCHEMISTRY

CHEMISTRY

Complete the following courses:

- CHEM 3507 Analytical Chemistry (3 credits)
- CHEM 3570 Analytical Chemistry Laboratory (1 credit)
- CHEM 4614 Medicinal Chemistry: Drug Design (3 credits)
- CHEM 4615 Medicinal Chemistry: Drug Action (3 credits)

CHEMISTRY ELECTIVES

Select one of the following groups:

GROUP 1:

- CHEM 4510 Instrumental Methods of Analysis (3 credits)
- CHEM 4571 Instrumental Analysis Laboratory I (1 credit)

GROUP 2:

- CHEM 4711 Physical Chemistry I (3 credits)
- CHEM 4771 Physical Chemistry Laboratory I (1 credit)

GROUP 3:

- CHEM 3811 Intermediate Inorganic Chemistry (3 credits)
- CHEM 4871 Inorganic Chemistry Laboratory I (1 credit)

BIOLOGY ELECTIVES

Select one of the following:

- BIOL 3250 Human Anatomy (4 credits)
- BIOL 3260 Human Physiology (4 credits)
- BIOL 3300 Introduction to Hematology (4 credits)
- BIOL 3580 Immunology (3 credits)
- BIOL 4270 Histology (4 credits)
- BIOL 4360 Developmental and Tumor Biology (3 credits)
- BIOL 4447 Genomics (3 credits)
- BIOL 4460 Stem Cells and Regenerative Medicine (3 credits)
- BIOL 4470 Introduction to Vaccinology (4 credits)
- BIOL 4715 Clinical Microbiology (3 credits)

RELATED FIELD REQUIREMENTS

Complete one of the following courses:

- MATH 2471 Calculus I (5 credits)
- STAT 2610 Applied Statistics (4 credits)

Suggested Semester Schedule | Biochemistry, Cellular, and Molecular Biology, B.S.
Biochemistry emphasis

Freshman:

- BIOL 1400 Cellular Principles (4 credits)
- CHEM 2211 Principles of Chemistry I (4 credits)
- BIOL 2360 Genetics (4 credits)
- CHEM 2212 Principles of Chemistry II (4 credits)
- BCMB 1000 Biochemistry, Cell and Molecular Biology Careers (BCMB Careers) (1 credit)
- MATH 2471 Calculus I (5 credits)
  or STAT 2610 Applied Statistics (4 credits)

Sophomore:

- BIOL 3590 Cell Biology (3 credits)
- CHEM 3311 Organic Chemistry I (3 credits)
- BIOL 3380 Molecular Genetics (3 credits)
- CHEM 3312 Organic Chemistry II (3 credits)
- BCMB 3074 Molecular Techniques (2 credits)
  or BIOL 3074 Molecular Techniques (2 credits)
- CHEM 3507 Analytical Chemistry (3 credits)

Junior:

- BIOL 3710 Microbiology (4 credits)
- CHEM 4411 Biochemistry I (3 credits)
- PHYS 2101 University Physics I (4 credits)
- CHEM 4412 Biochemistry II (3 credits)
- BCMB 3000 Biochemistry, Cell and Molecular Biology Research (BCMB Research) (1 credit)
- BCMB 4476 Techniques in Biotechnology and Biochemistry (2 credits)
  or CHEM 4476 Techniques in Biotechnology and Biochemistry (2 credits)
- PHYS 2102 University Physics II (4 credits)

Senior:

- CHEM 4894 Research I (2 credits)
- CHEM 4895 Research II (2 credits)
- CHEM 4614 Medicinal Chemistry: Drug Design (3 credits)
- CHEM 4615 Medicinal Chemistry: Drug Action (3 credits)
- Emphasis Chemistry elective(s)
- Emphasis Biology elective

Biology, B.A. *major*

Required Credits: 40
Required GPA: 2.25

I REQUIRED BIOLOGY CORE COURSES

Complete the following courses:

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 1500 Diversity of Life (4 credits)
- BIOL 2360 Genetics (4 credits)
- BIOL 2610 General Ecology (3 credits)

II REQUIRED BIOLOGY ELECTIVES

Select 25 semester credit electives from Biology courses (except 1000 level BIOL classes and BIOL 2925) to achieve a minimum of 40 semester credits in BIOL courses. These electives can also include any of the following options from other departments:

a. CHEM 4411
b. CHEM 4471
c. ENVR 4400
d. ENVR 4500

Program Learning Outcomes | Biology, B.A.

1. Communicate: Effectively present research using common, professional formats (written and/or verbal). This includes using figures, graphs, tables, and illustrations to promote dissemination and clarity of knowledge.

2. Create Purpose or Hypothesis: Provide justification for the importance of pursuing a project or construct a testable hypothesis (or hypotheses).

3. Observe and Question: Integrate information or observations to promote curiosity and question generation.

4. Recognize Larger Implications: Demonstrate understanding of the ethical/social dimensions or societal implications of science, recognize inherent biases, and communicate scientific ideas to non-science audiences.

5. Re-engage: Demonstrate an ability to re-engage with the research process by identifying sources of error, possible limitations of their research, next steps in a

project, or re-designing more appropriate experimental methods/controls.

6. Research: Plan and execute research, experiments, data collection, analysis of the results, and/or synthesis of new or coalesced knowledge.

7. Review Research Literature: Search and review appropriate sources with a goal of independent information discovery or critically identifying knowledge gaps.

Suggested Semester Schedule | Biology, B.A.

The following is a list of required Biology Major, B.A. courses arranged by year. This schedule is intended to assist students in planning their courses. There is some flexibility in this schedule, but graduation within four years will require close adherence to the specified sequence of courses. Always consult your Biology academic advisor as to the proper courses and sequence of courses needed for graduation.

Freshman

- BIOL1400
- BIOL1500
- Core Curriculum requirements
- Consult with your Biology academic advisor

Sophomore

- BIOL2360
- BIOL2610
- Writing course
- Biology degree requirements
- Core Curriculum requirements
- Consult with your Biology academic advisor

Junior

- Biology degree requirements
- Core Curriculum requirements
- Consult with your Biology academic advisor

Senior

- Complete Biology degree requirements
- Complete Core Curriculum requirements
- Consult with your Biology academic advisor

Biology, B.S. *major*

Required Credits: 60
Required GPA: 2.25

I REQUIRED BIOLOGY CORE COURSES

Complete the following courses:

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 1500 Diversity of Life (4 credits)
- BIOL 2360 Genetics (4 credits)
- BIOL 2610 General Ecology (3 credits)

II REQUIRED BIOLOGY ELECTIVES

Select Biology course electives (2000 level or above) to achieve a minimum of 40 credits. (BIOL 2925 is excluded as an option) Electives can include one of the following options from other departments.

- ENVR 4400 Environmental Microbiology (3 credits)
- ENVR 4500 Environmental Toxicology (4 credits)

III CAPSTONE PROJECT

The Biology capstone project, completed in the senior year, provides a culminating experience that integrates the knowledge and skills learned in previous courses and applies them to a scholarly activity. Examples of capstone projects may include original research projects, internships with state or federal agencies or shadowing experiences with professionals. The capstone project must be designed or chosen by the student in consultation with a faculty mentor or advisor, who must approve the project before work begins. Students should consult with their faculty mentor or advisor before their senior year commences. All capstone projects will include a written and oral component.

The capstone project may be completed in one of the following ways (2-4 credits):

1. Complete BIOL 4894 OR BIOL 4895 (2 credits):

- BIOL 4894 Advanced Research Project I (2 credits)
- BIOL 4895 Advanced Research Project II (2 credits)

2. Complete BIOL 4894 AND BIOL 4895 (2 credits each):

- BIOL 4894 Advanced Research Project I (2 credits)
- BIOL 4895 Advanced Research Project II (2 credits)

3. Complete BIOL 4449 (4 credits):

- BIOL 4449 Gene Expression (4 credits)

IV REQUIRED COURSES IN RELATED FIELDS

A. Select 1 of the following groups (8 credits):

GROUP 1:

- CHEM 2211 Principles of Chemistry I (4 credits)
- CHEM 2212 Principles of Chemistry II (4 credits)

GROUP 2:

- CHEM 1111 General Chemistry I (4 credits)
- CHEM 1112 General Chemistry II (4 credits)

B. Complete 8 credits from the following courses:

- CHEM 3311 Organic Chemistry I (3 credits)
- CHEM 3371 Organic Chemistry Laboratory I (1 credit)
- CHEM 3312 Organic Chemistry II (3 credits)
- CHEM 3372 Organic Chemistry Laboratory II (1 credit)
- CHEM 4411 Biochemistry I (3 credits)
- CHEM 4471 Biochemistry Laboratory I (1 credit)
- PHYS 1101 General Physics I (4 credits)
  or PHYS 2101 University Physics I (4 credits)
- PHYS 1102 General Physics II (4 credits)
  or PHYS 2102 University Physics II (4 credits)

C. Select 1 of the following courses:

- MATH 2471 Calculus I (5 credits)
- STAT 2610 Applied Statistics (4 credits)

- PSY 3401 Basic Statistics for Research (4 credits)

Program Learning Outcomes | Biology, B.S.

1. Communicate: Effectively present research using common, professional formats (written and/or verbal). This includes using figures, graphs, tables, and illustrations to promote dissemination and clarity of knowledge.

2. Create Purpose or Hypothesis: Provide justification for the importance of pursuing a project or construct a testable hypothesis (or hypotheses).

3. Observe and Question: Integrate information or observations to promote curiosity and question generation.

4. Recognize Larger Implications: Demonstrate understanding of the ethical/social dimensions or societal implications of science, recognize inherent biases, and communicate scientific ideas to non-science audiences.

5. Re-engage: Demonstrate an ability to re-engage with the research process by identifying sources of error, possible limitations of their research, next steps in a project, or re-designing more appropriate experimental methods/controls.

6. Research: Plan and execute research, experiments, data collection, analysis of the results, and/or synthesis of new or coalesced knowledge.

7. Review Research Literature: Search and review appropriate sources with a goal of independent information discovery or critically identifying knowledge gaps.

Biology, B.S. *major*
Medical Sciences Emphasis (Optional)

Required Credits: 73
Required GPA: 2.25

I REQUIRED BIOLOGY CORE COURSES

Complete the following courses:

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 1500 Diversity of Life (4 credits)
- BIOL 2360 Genetics (4 credits)
- BIOL 2610 General Ecology (3 credits)

II REQUIRED MEDICAL SCIENCES CORE COURSES

Complete the following courses:

- BIOL 3250 Human Anatomy (4 credits)
- BIOL 3260 Human Physiology (4 credits)
- BIOL 3710 Microbiology (4 credits)

III CAPSTONE PROJECT

The Biology capstone project, completed in the senior year, provides a culminating experience that integrates the knowledge and skills learned in previous courses and applies them to a scholarly activity. Examples of capstone projects may include original research projects, internships with state or federal agencies or shadowing experiences with professionals.

The capstone project must be designed or chosen by the student in consultation with a faculty mentor or advisor, who must approve the project before work begins. Students should consult with their faculty mentor or advisor before their senior year commences. All capstone projects will include a written and oral component.

The capstone project may be completed in one of the following ways (2-4 credits):

1. Complete BIOL 4894 OR BIOL 4895 (2 credits):

- BIOL 4894 Advanced Research Project I (2 credits)
- BIOL 4895 Advanced Research Project II (2 credits)

2. Complete BIOL 4894 AND BIOL 4895 (2 credits each):

- BIOL 4894 Advanced Research Project I (2 credits)
- BIOL 4895 Advanced Research Project II (2 credits)

3. Complete BIOL 4449 (4 credits):

- BIOL 4449 Gene Expression (4 credits)

IV REQUIRED MEDICAL SCIENCES ELECTIVES

Select 16 credits of electives from the following:

- BIOL 3300 Introduction to Hematology (4 credits)
- BIOL 3337 Science Communication (3 credits)
- BIOL 3338 Science Communication Lab (1 credit)
- BIOL 3339 Bioethics (3 credits)
- BIOL 3380 Molecular Genetics (3 credits)
- BIOL 3580 Immunology (3 credits)
- BIOL 3590 Cell Biology (3 credits)
- BIOL 4210 Parasitology (4 credits)
- BIOL 4270 Histology (4 credits)
- BIOL 4360 Developmental and Tumor Biology (3 credits)
- BIOL 4447 Genomics (3 credits)
- BIOL 4460 Stem Cells and Regenerative Medicine (3 credits)
- BIOL 4470 Introduction to Vaccinology (4 credits)
- CHEM 4411 Biochemistry I (3 credits)
- CHEM 4471 Biochemistry Laboratory I (1 credit)

V REQUIRED COURSES IN RELATED FIELDS

A. Select 1 of the following groups:

GROUP 1:

- CHEM 2211 Principles of Chemistry I (4 credits)
- CHEM 2212 Principles of Chemistry II (4 credits)

GROUP 2:

- CHEM 1111 General Chemistry I (4 credits)
- CHEM 1112 General Chemistry II (4 credits)

B. Select 1 of the following courses:

- MATH 2471 Calculus I (5 credits)
- STAT 2610 Applied Statistics (4 credits)
- PSY 3401 Basic Statistics for Research (4 credits)

C. Complete 2 courses from the following:

- PHYS 1101 General Physics I (4 credits)
  or PHYS 2101 University Physics I (4 credits)
- PHYS 1102 General Physics II (4 credits)

or PHYS 2102 University Physics II (4 credits)

D. Complete the following courses:

- CHEM 3311 Organic Chemistry I (3 credits)
- CHEM 3371 Organic Chemistry Laboratory I (1 credit)

- CHEM 3312 Organic Chemistry II (3 credits)
- CHEM 3372 Organic Chemistry Laboratory II (1 credit)

Program Learning Outcomes | Biology, B.S.

1. Communicate: Effectively present research using common, professional formats (written and/or verbal). This includes using figures, graphs, tables, and illustrations to promote dissemination and clarity of knowledge.

2. Create Purpose or Hypothesis: Provide justification for the importance of pursuing a project or construct a testable hypothesis (or hypotheses).

3. Observe and Question: Integrate information or observations to promote curiosity and question generation.

4. Recognize Larger Implications: Demonstrate understanding of the ethical/social dimensions or societal implications of science, recognize inherent biases, and communicate scientific ideas to non-science audiences.

5. Re-engage: Demonstrate an ability to re-engage with the research process by identifying sources of error, possible limitations of their research, next steps in a project, or re-designing more appropriate experimental methods/controls.

6. Research: Plan and execute research, experiments, data collection, analysis of the results, and/or synthesis of new or coalesced knowledge.

7. Review Research Literature: Search and review appropriate sources with a goal of independent information discovery or critically identifying knowledge gaps.

Medical Laboratory Science, B.S. *major* (3 + 1 Option)

Required Credits: 87
Required GPA: 2.25

REQUIRED CLINICAL STUDIES 3 + 1 OPTION

In this option, the student completes the required Medical Laboratory Science and Core Curriculum courses at Bemidji State University, and then applies for admission to the clinical year program through the University of North Dakota or other affiliated institution. Please be aware admission to a clinical year program is competitive and not guaranteed; however, completion of a clinical year is required to complete a MLS 3+1 major. Additionally, a minimum 2.80 GPA in science courses is a requirement for admission to a clinical year program. The Medical Laboratory Science student must consult with the Medical Laboratory Science advisor at the start of the academic program and regularly throughout the course of study. The student must complete the Bemidji State University Core Curriculum requirements before the clinical year of study.

I REQUIRED COURSES

COMPLETE THE FOLLOWING COURSES:

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 2360 Genetics (4 credits)
- BIOL 3074 Molecular Techniques (2 credits)
  or BCMB 3074 Molecular Techniques (2 credits)
- BIOL 3260 Human Physiology (4 credits)
- BIOL 3300 Introduction to Hematology (4 credits)
- BIOL 3580 Immunology (3 credits)
- BIOL 3710 Microbiology (4 credits)
- BIOL 4210 Parasitology (4 credits)
- BIOL 4715 Clinical Microbiology (3 credits)
- CHEM 2211 Principles of Chemistry I (4 credits)
- CHEM 2212 Principles of Chemistry II (4 credits)
- CHEM 3311 Organic Chemistry I (3 credits)
- CHEM 3371 Organic Chemistry Laboratory I (1 credit)
- CHEM 4411 Biochemistry I (3 credits)

SELECT 1 OF THE FOLLOWING COURSES:

- MATH 1170 College Algebra (3 credits)
- MATH 1470 Precalculus (3 credits)

II REQUIRED CLINICAL STUDIES

Clinical year courses, taken during the senior year beginning with summer term, are taken through entrance into the clinical year program at the University of North Dakota or at affiliated hospitals. The clinical year will consist of at least 37 credits.

NOTE: A clinical year position is not guaranteed. Students must apply for a clinical year position in October of the junior year. Please see advisor regarding the clinical year of study.

The following courses are recommended, but not required for completion of the major:

- BIOL 1500 Diversity of Life (4 credits)
- STAT 2610 Applied Statistics (4 credits)
  or PSY 3401 Basic Statistics for Research (4 credits)
- CHEM 3312 Organic Chemistry II (3 credits)
- CHEM 3372 Organic Chemistry Laboratory II (1 credit)
- CHEM 4471 Biochemistry Laboratory I (1 credit)

Suggested Semester Schedule | Medical Laboratory Science, B.S. 3+1 option

The following is a list of Medical Laboratory Science courses arranged by year. This suggested schedule is intended to help students plan their courses without course conflicts.

Freshman

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 2360 Genetics (4 credits)
- CHEM 2211 Principles of Chemistry I (4 credits)
- CHEM 2212 Principles of Chemistry II (4 credits)
- ENGL 1151 Composition (3 credits)
- ENGL 2152 Argument and Exposition (3 credits)
- MATH 1170 College Algebra (3 credits)
  or MATH 1470 Precalculus (3 credits)
- Additional core curriculum requirements

Sophomore

- BCMB 3074 Molecular Techniques (2 credits)
  or BIOL 3074 Molecular Techniques (2 credits)
- BIOL 3260 Human Physiology (4 credits)
- BIOL 3710 Microbiology (4 credits)
- BIOL 4210 Parasitology (4 credits)
- CHEM 3311 Organic Chemistry I (3 credits)
- CHEM 3371 Organic Chemistry Laboratory I (1 credit)
- Additional Core Curriculum requirements

Junior

- BIOL 3300 Introduction to Hematology (4 credits)
- BIOL 3580 Immunology (3 credits)
- BIOL 4715 Clinical Microbiology (3 credits)
- CHEM 4411 Biochemistry I (3 credits)
- CHEM 4471 Biochemistry Laboratory I (1 credit)
- STAT 2610 Applied Statistics (4 credits)
  or PSY 3401 Basic Statistics for Research (4 credits)
- Any remaining Core Curriculum requirements

Senior

- Clinical year courses

Medical Laboratory Science, B.S. *major* (4 + 1 Option)

Required Credits: 108
Required GPA: 2.25

REQUIRED CLINICAL STUDIES 4 + 1 OPTION

NOTE: After completing the clinical year courses, students will receive a double major: Biology, B.S. and Medical Laboratory Science, B.S. In this option, the student completes a Biology, B.S., major at Bemidji State University, and then applies for admission to the clinical year program through the University of North Dakota or other affiliated institution. Be aware that a 2.80 gpa in in science courses is one requirement for entrance into the clinical year program. This option may be of interest to students considering a pre-professional program such as pre-medicine, pre-physician's assistant, or other pre-professional area. Students have the option of pursuing a health-related career in Medical Laboratory Science but also gain clinical hours and experience that can facilitate admission to pre-professional programs.

I REQUIRED BIOLOGY COURSES

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 1500 Diversity of Life (4 credits)
- BIOL 2360 Genetics (4 credits)
- BIOL 2610 General Ecology (3 credits)
- BIOL 3074 Molecular Techniques (2 credits)
  or BCMB 3074 Molecular Techniques (2 credits)
- BIOL 3260 Human Physiology (4 credits)
- BIOL 3300 Introduction to Hematology (4 credits)
- BIOL 3580 Immunology (3 credits)
- BIOL 3710 Microbiology (4 credits)
- BIOL 4210 Parasitology (4 credits)
- BIOL 4715 Clinical Microbiology (3 credits)

II CAPSTONE PROJECT

The Biology capstone project, completed in the senior year, provides a culminating experience that integrates the knowledge and skills learned in previous courses and applies them to a scholarly activity. Examples of capstone projects may include original research projects, internships with state or federal agencies, shadowing experiences with professionals, or successfully passing professional/ graduate school entrance exams. The capstone project must be designed or chosen by the student in consultation with a faculty mentor or advisor, who must approve the project before work begins. Students should consult with their faculty mentor or advisor before their senior year commences. All capstone projects will include a written and oral component (except for professional/graduate school entrance exams).

PLEASE NOTE: For students admitted to a clinical year program, the required clinical studies (see Section IV below)can be used to satisfy the Capstone Project requirement.

Alternatively, the capstone project may be completed in one of the following ways (0-4 credits):

1. Students using a professional or graduate entrance exam as their capstone project must register for this course. Students must place in at least the 60th percentile on their exam to successfully complete this course.

- BIOL 4800 Advanced Project Certification (0 credit)

2. Complete BIOL 4894 OR BIOL 4895 (2 credits):

- BIOL 4894 Advanced Research Project I (2 credits)
- BIOL 4895 Advanced Research Project II (2 credits)

3. Complete BIOL 4894 AND BIOL 4895 (2 credits each):

- BIOL 4894 Advanced Research Project I (2 credits)
- BIOL 4895 Advanced Research Project II (2 credits)

III REQUIRED COURSES IN RELATED FIELDS

COMPLETE THE FOLLOWING COURSES:

- CHEM 2211 Principles of Chemistry I (4 credits)
- CHEM 2212 Principles of Chemistry II (4 credits)
- CHEM 3311 Organic Chemistry I (3 credits)
- CHEM 3312 Organic Chemistry II (3 credits)
- CHEM 3371 Organic Chemistry Laboratory I (1 credit)
- CHEM 3372 Organic Chemistry Laboratory II (1 credit)
- CHEM 4411 Biochemistry I (3 credits)
- CHEM 4471 Biochemistry Laboratory I (1 credit)

- PHYS 1101 General Physics I (4 credits)
  or PHYS 2101 University Physics I (4 credits)
- PHYS 1102 General Physics II (4 credits)
  or PHYS 2102 University Physics II (4 credits)

- STAT 2610 Applied Statistics (4 credits)
  or PSY 3401 Basic Statistics for Research (4 credits)

IV REQUIRED CLINICAL STUDIES

Clinical year courses, taken after the senior year beginning with summer term, are taken through entrance into the clinical year program at the University of North Dakota or at affiliated hospitals. The clinical year will consist of at least 37 credits.

NOTE: A clinical year position is not guaranteed. Students must apply for a clinical year position in October of the junior year. Please see advisor regarding the clinical year of study.

Science Education, B.S. *major* Life Science Specialty (Teacher Licensure)

Required Credits: 83
Required GPA: 2.50

Core Courses for Science Teaching in Grades 5-8

Complete the following courses:

- BIOL 1400 Cellular Principles (4 credits)
  or BIOL 1110 Human Biology (4 credits)
- BIOL 1500 Diversity of Life (4 credits)
  or BIOL 1120 General Biology: Evolution And Ecology (3 credits)
- CHEM 2211 Principles of Chemistry I (4 credits)
  or CHEM 1111 General Chemistry I (4 credits)
- CHEM 2212 Principles of Chemistry II (4 credits)
  or CHEM 1112 General Chemistry II (4 credits)
- GEOL 1110 Physical Geology (4 credits)
- SCI 3100 Integrative Science for Teachers (4 credits)
- SCI 3450 Science Methods For Grades 5-8 (4 credits)
  or ED 3410 Secondary Science Methods (4 credits)

REQUIRED PROFESSIONAL EDUCATION COURSES

Complete the following courses with a minimum 2.50 GPA:

- ED 3100 Introduction to the Foundations of Public School Education (3 credits)
- ED 3110 Educational Psychology (3 credits)
- ED 3140 Human Diversity and Educational Equity (3 credits)
- ED 3350 Principles and Strategies of Teaching (3 credits)
- ED 3780 Inclusive Teaching and Classrooms (3 credits)
- ED 4737 Content Area Reading (3 credits)
- ED 4799 The Professional Teacher (1 credit)

Complete the following course:

- HLTH 3400 Health and Drugs in Society (2 credits)

Complete 12 credits of student teaching:

- ED 4830 Student Teaching - Secondary (1-12 credits)

LIFE SCIENCE SPECIALTY

A. Required Biology Courses
Complete the following courses:

- BIOL 2360 Genetics (4 credits)
- BIOL 2610 General Ecology (3 credits)
- BIOL 3710 Microbiology (4 credits)
- BIOL 4620 Evolution (3 credits)
- BIOL 3720 Plant Form and Function (4 credits)
  or BIOL 3830 Aquatic Plants and Algae (4 credits)
- BIOL 4894 Advanced Research Project I (2 credits)
  or BIOL 4895 Advanced Research Project II (2 credits)

B. Required Biology Elective

Select 1 of the following courses:

- BIOL 3150 Animal Behavior (3 credits)
- BIOL 3310 Entomology (3 credits)
- BIOL 4510 Ornithology (3 credits)
- BIOL 4520 Mammalogy (3 credits)
- BIOL 4534 Ichthyology (4 credits)

Suggested Semester Schedule | Science Education, B.S. Life Science Specialty (Teacher Licensure)

The following is a list of required Science (Life Science) Major, B.S. courses arranged by year. This schedule is intended to assist students in planning their courses. There is some flexibility in this schedule, but graduation within four years will require close adherence to the specified sequence of courses. Always consult your Biology academic advisor as to the proper courses and sequence of courses needed for graduation. It is possible, in some circumstances, that courses in a student's Core Curriculum program may be used in his or her academic major.

Freshman

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 1500 Diversity of Life (4 credits)
- CHEM 2211 Principles of Chemistry I (4 credits)
- Core Curriculum requirements

Sophomore

- BIOL 2360 Genetics (4 credits)
- BIOL 2610 General Ecology (3 credits)
- BIOL 4894 Advanced Research Project I (2 credits) or BIOL 4895
- BIOL 3720 Plant Form and Function (4 credits)
- GEOL 1110 Physical Geology (4 credits)
- PHYS 1101 General Physics I (4 credits)
  or PHYS 2101 University Physics I (4 credits)
- Consider starting Professional Education sequence
- Core Curriculum requirements

Junior

- BIOL 3710 Microbiology (4 credits)
- SCI 3100 Integrative Science for Teachers (4 credits)
- SCI 3450 Science Methods For Grades 5-8 (4 credits)
- Other Professional Education requirements
- Core Curriculum requirements

Senior

- Biology Elective (BIOL 3150, 3310, 3510, 4520, or 4534)
- BIOL 4620 Evolution (3 credits)
- Complete Professional Education requirements, including one semester of student teaching
- Complete Core Curriculum requirements

Wildlife Biology, B.S. *major*

Required Credits: 74
Required GPA: 2.25

I REQUIRED BIOLOGY CORE COURSES

Complete the following courses:

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 1500 Diversity of Life (4 credits)
- BIOL 2610 General Ecology (3 credits)

II REQUIRED WILDLIFE BIOLOGY CORE COURSES

Complete the following courses:

- BIOL 3610 Principles of Wildlife Management (3 credits)
- BIOL 4510 Ornithology (3 credits)
- BIOL 4520 Mammalogy (3 credits)
- GEOG 3231 Introduction to Geographic Information Systems (3 credits)
- GEOG 3232 Intermediate Geographic Information Systems (3 credits)
- BIOL 3630 Conservation Biology (3 credits)
  or GEOG 3630 Conservation Biology (3 credits)
  or BIOL 4330 Upland Wildlife Management (3 credits)
  or BIOL 4530 Ecology and Management of Large Mammals (3 credits)

Select two of the following courses:

- BIOL 2360 Genetics (4 credits)
- BIOL 3150 Animal Behavior (3 credits)
- BIOL 3310 Entomology (3 credits)
- BIOL 3850 Marine Biology (3 credits)
- BIOL 4210 Parasitology (4 credits)
- BIOL 4534 Ichthyology (4 credits)
- BIOL 4620 Evolution (3 credits)

Select two of the following courses, with at least one being BIOL 3170 or BIOL 3730 or BIOL 3830:

- BIOL 3170 Dendrology (2 credits)
- BIOL 3730 Plant Diversity (4 credits)
- BIOL 3830 Aquatic Plants and Algae (4 credits)

- BIOL 3720 Plant Form and Function (4 credits)
- BIOL 4623 Forest Ecology (4 credits)

Select two of the following courses:

- BIOL 3420 Human Dimensions of Wildlife and Fisheries Management (3 credits)
- BIOL 3400 Fish & Wildlife Law and Administration (3 credits)
  or ENVR 4210 Environmental Law and Policy (3 credits)
- POL 3230 Environmental Politics (3 credits)
- ENVR 3600 Environmental Justice and Sustainability (3 credits)

III REQUIRED WILDLIFE BIOLOGY ELECTIVES

Select two additional Biology courses (3-8 credits) at the 2000 level or above, except BIOL 2925:

IV CAPSTONE PROJECT

Complete the following course:

- BIOL 4780 Wildlife Management Techniques (5 credits)

V REQUIRED COURSES IN RELATED FIELDS

Complete the following courses:

- CHEM 1111 General Chemistry I (4 credits)
  or CHEM 2211 Principles of Chemistry I (4 credits)
- CHEM 1112 General Chemistry II (4 credits)
  or CHEM 2212 Principles of Chemistry II (4 credits)

Select 1 of the following courses:

- STAT 2610 Applied Statistics (4 credits)
- PSY 3401 Basic Statistics for Research (4 credits)

Select 1 of the following courses:

- PHYS 1101 General Physics I (4 credits)
- PHYS 2101 University Physics I (4 credits)
- GEOL 1110 Physical Geology (4 credits)
- GEOL 1120 Intro to Fossils and History of Planet Earth (4 credits)
- BIOL 3120 Soils (4 credits)
- GEOL 3120 Soils (4 credits)

Select 1 of the following courses:

- MATH 2471 Calculus I (5 credits)
- ENVR 4220 Sampling and Analysis (4 credits)
- GEOG 4265 Spatial Analysis (3 credits)
- PSY 4403 Advanced Statistics and Research Design (4 credits)

Suggested Semester Schedule | Wildlife Biology, B.S.

Freshman

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 1500 Diversity of Life (4 credits)
- CHEM 1111 General Chemistry I (4 credits)
  or CHEM 2211 Principles of Chemistry I (4 credits)
- CHEM 1112 General Chemistry II (4 credits)
  or CHEM 2212 Principles of Chemistry II (4 credits)
- Core Curriculum requirements

Sophomore

- BIOL 2610 General Ecology (3 credits)
- STAT 2610 Applied Statistics (4 credits)
  or PSY 3401 Basic Statistics for Research (4 credits)
- Wildlife Biology degree requirements
- Core Curriculum requirements
- Consult with your academic advisor

Junior

- Wildlife Biology degree requirements
- Complete Core Curriculum requirements
- Consult with your Biology acadmic advisor

Senior

- Capstone Project
- Complete Wildlife Biology degree requirements
- Consult with your Biology academic advisor

Aquatic Systems *minor*

Required Credits: 25
Required GPA: 2.25

I REQUIRED BIOLOGY CORE COURSES

Complete the following courses:

- BIOL 1500 Diversity of Life (4 credits)
- BIOL 2610 General Ecology (3 credits)

II REQUIRED AQUATIC BIOLOGY CORE COURSES

Complete the following courses:

- BIOL 3361 Limnology (4 credits)
- BIOL 3362 Streams and Rivers (4 credits)
- BIOL 3840 Wetlands Ecology (3 credits)
  or ENVR 3840 Wetlands Ecology (3 credits)
- BIOL 3844 Wetlands Ecology Lab (1 credit)
- BIOL 3850 Marine Biology (3 credits)
- BIOL 3723 Ecosystem Ecology (3 credits)

Biology *minor*

Required Credits: 24
Required GPA: 2.00

I REQUIRED BIOLOGY CORE COURSES

COMPLETE THE FOLLOWING COURSES:

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 1500 Diversity of Life (4 credits)
- BIOL 2360 Genetics (4 credits)
- BIOL 2610 General Ecology (3 credits)

II REQUIRED BIOLOGY ELECTIVES

Select 9 credits from the following areas with at least 1 course in each area.

SUBORGANISMAL
SELECT 1 OF THE FOLLOWING COURSES:

- BIOL 2750 Medical Microbiology (3 credits)
- BIOL 3260 Human Physiology (4 credits)
- BIOL 3300 Introduction to Hematology (4 credits)
- BIOL 3380 Molecular Genetics (3 credits)
- BIOL 3580 Immunology (3 credits)
- BIOL 3590 Cell Biology (3 credits)
- BIOL 3720 Plant Form and Function (4 credits)
- BIOL 4270 Histology (4 credits)

ORGANISMAL
SELECT 1 OF THE FOLLOWING COURSES:

- BIOL 2110 Human Anatomy and Physiology (5 credits)
- BIOL 4200 Freshwater Invertebrates (4 credits)
- BIOL 3250 Human Anatomy (4 credits)
- BIOL 3310 Entomology (3 credits)
- BIOL 3710 Microbiology (4 credits)
- BIOL 3730 Plant Diversity (4 credits)
- BIOL 3830 Aquatic Plants and Algae (4 credits)
- BIOL 4210 Parasitology (4 credits)
- BIOL 4510 Ornithology (3 credits)
- BIOL 4520 Mammalogy (3 credits)
- BIOL 4534 Ichthyology (4 credits)

Fisheries Biology *minor*

Required Credits: 26
Required GPA: 2.25

I REQUIRED BIOLOGY CORE COURSES

Complete the following courses:

- BIOL 1500 Diversity of Life (4 credits)
- BIOL 2610 General Ecology (3 credits)

II REQUIRED FISHERIES BIOLOGY CORE COURSES

Complete the following courses:

- BIOL 3361 Limnology (4 credits)
- BIOL 3362 Streams and Rivers (4 credits)
- BIOL 4534 Ichthyology (4 credits)
- BIOL 4545 Fisheries Management (4 credits)

III REQUIRED FISHERIES BIOLOGY ELECTIVES

Select one of the following courses:

- BIOL 2339 Ethics of Fish and Wildlife Management (3 credits)
- BIOL 3400 Fish & Wildlife Law and Administration (3 credits)
- BIOL 3420 Human Dimensions of Wildlife and Fisheries Management (3 credits)
- ENVR 3040 Environmental Economics (3 credits)
  or ECON 3040 Environmental Economics (3 credits)
- ENVR 3600 Environmental Justice and Sustainability (3 credits)
- ENVR 4210 Environmental Law and Policy (3 credits)
- POL 3230 Environmental Politics (3 credits)

Wetlands Ecology *minor*

Required Credits: 25
Required GPA: 2.00

I REQUIRED BIOLOGY CORE COURSES

COMPLETE THE FOLLOWING COURSES:

- BIOL 1400 Cellular Principles (4 credits)
- BIOL 1500 Diversity of Life (4 credits)

II REQUIRED BIOLOGY AND ENVIRONMENTAL STUDIES

COMPLETE THE FOLLOWING COURSES:

- BIOL 2610 General Ecology (3 credits)
- BIOL 3830 Aquatic Plants and Algae (4 credits)
  or BIOL 3730 Plant Diversity (4 credits)
- BIOL 3840 Wetlands Ecology (3 credits)
  or ENVR 3840 Wetlands Ecology (3 credits)
- BIOL 3844 Wetlands Ecology Lab (1 credit)
- BIOL 4030 Wetland Delineation and Classification (3 credits)
- BIOL 3400 Fish & Wildlife Law and Administration (3 credits)
  or ENVR 4210 Environmental Law and Policy (3 credits)

Wildlife Biology *minor*

Required Credits: 24
Required GPA: 2.25

I REQUIRED BIOLOGY CORE COURSES

Complete the following courses:

- BIOL 1500 Diversity of Life (4 credits)
- BIOL 2610 General Ecology (3 credits)

II REQUIRED WILDLIFE BIOLOGY CORE COURSES

Complete the following courses:

- BIOL 3610 Principles of Wildlife Management (3 credits)
- BIOL 4510 Ornithology (3 credits)
- BIOL 4520 Mammalogy (3 credits)

Select 1 of the following courses:

- BIOL 3170 Dendrology (2 credits)
- BIOL 3730 Plant Diversity (4 credits)
- BIOL 3830 Aquatic Plants and Algae (4 credits)

Select 1 of the following courses:

- BIOL 3630 Conservation Biology (3 credits)
  or GEOG 3630 Conservation Biology (3 credits)
- BIOL 4330 Upland Wildlife Management (3 credits)
- BIOL 4530 Ecology and Management of Large Mammals (3 credits)

Select 1 of the following courses:

- BIOL 3400 Fish & Wildlife Law and Administration (3 credits)
- BIOL 3420 Human Dimensions of Wildlife and Fisheries Management (3 credits)
- POL 3230 Environmental Politics (3 credits)
- ENVR 3600 Environmental Justice and Sustainability (3 credits)
- ENVR 4210 Environmental Law and Policy (3 credits)

Biochem, Cellular & Molecular Biology Courses

BCMB 1000 Biochemistry, Cell and Molecular Biology Careers (BCMB Careers) (1 credit)
An introduction to biochemistry, cell and molecular biology careers and curriculum planning for BCMB majors or students considering pursuing a BCMB degree.

BCMB 3000 Biochemistry, Cell and Molecular Biology Research (BCMB Research) (1 credit)
An introduction to biochemistry, cell and molecular biology research available at BSU and professionally. Covers the basics of research and medical ethics. Identifying a research mentor for senior research projects and preparing a preliminary research proposal. Prerequisite(s): BCMB 1000.

BCMB 3074 Molecular Techniques (2 credits)
This is a hybrid lecture and lab-based course and is an introduction to several common molecular-based techniques. Students will learn basic pipetting, protein assays, electrophoresis, PCR, and other molecular genetic techniques. Prerequisite(s): BIOL 1400, BIOL 2360, CHEM 2211, CHEM 2212; or consent of instructor.

BCMB 3075 Cellular Techniques (2 credits)
This course is the one of two options for completion of techniques core requirement for the BCMB major and for specific Biology majors. Includes an introduction to cell culture, cell imaging, cell-based assays, and stem cell biology. Prerequisite(s): BIOL 3074 or BCMB 3074.

BCMB 4476 Techniques in Biotechnology and Biochemistry (2 credits)
This course is one of two options for completion of the techniques core requirement for the BCMB major. The structure of the course consists of a combined lecture and lab. The course provides students with opportunities to learn advanced laboratory techniques in biotechnology and biochemistry. Prerequisite(s): CHEM 4471 or BCMB 3074 or BIOL 3074. (Also offered under CHEM 4476)

BCMB 4917 DIS Tchg Assoc | (1-2 credits)
Directed Independent Study | Teaching Associate

All-University Courses

The course numbers listed below, not always included in the semester class schedule, may be registered for by consent of the advisor, instructor, or department chair, or may be assigned by the department when warranted. Individual registration requires previous arrangement by the student and the completion of any required form or planning outline as well as any prerequisites.

1910, 2910, 3910, 4910 DIRECTED INDEPENDENT STUDY
1920, 2920, 3920, 4920 DIRECTED GROUP STUDY
1930, 2930, 3930, 4930 EXPERIMENTAL COURSE
1940, 2940, 3940, 4940 IN-SERVICE COURSE
1950, 2950, 3950, 4950 WORKSHOP, INSTITUTE, TOUR
1960, 2960, 3960, 4960 SPECIAL PURPOSE INSTRUCTION
1970, 2970, 3970, 4970 INTERNSHIP
1980, 2980, 3980, 4980 RESEARCH
1990, 2990, 3990, 4990 THESIS

Biology Courses

BIOL 1110 Human Biology (4 credits)
General introduction to biology, focusing on humans, including topics on cell biology, genetics, molecular biology, form and function of organ systems, and the interaction between humans and their environment. Intended for nonbiology majors. Lecture and laboratory. [Core Curriculum Goal Area 3 (LC)]

BIOL 1111 Anatomy and Physiology for Allied Health I (4 credits)
This course is designed as the first semester of a year-long human anatomy and physiology course for allied health students including nursing and community health. The course covers aspects of the structure, function, and development of the human body from the cellular level through an introduction to the nervous system. Both lecture and laboratory are required.

BIOL 1112 Anatomy and Physiology for Allied Health II (4 credits)
This course is designed as the second semester of a year-long human anatomy and physiology course for allied health students including nursing and community health. The course covers aspects of the structure, function, and development of the human body from the nervous system through digestion and nutrition. Both lecture and laboratory are required. Prerequisite: BIOL 1111.

BIOL 1120 General Biology: Evolution And Ecology (3 credits)
A general introduction to biology with an emphasis on evolution, ecology, and the diversity of life. Intended for nonbiology majors. Includes laboratory simulations and field exercises. [Core Curriculum Goal Area 3 and 10]

BIOL 1300 Medical Terminology (2 credits)
A study of anatomical and medical terminology by examining word roots, prefixes, and suffixes. Designed to assist pre-professional and allied health students who desire to increase their usage and understanding of medical terminology. This course does not satisfy any Biology major or minor degree requirements.

BIOL 1400 Cellular Principles (4 credits)
Lecture | An introduction to the structure and function of living systems, with an emphasis on basic mechanisms and concepts in biochemistry and in cellular and molecular biology. Intended for biology majors and minors, preprofessional students, and open to any student wishing to fulfill their Core Curriculum requirement. Lecture and laboratory. [Core Curriculum Goal Area(s) 3 (LC)]

BIOL 1410 Cellular Principles Lab (0 credit)
Lab | An introduction to the structure and function of living systems, with an emphasis on basic mechanisms and concepts in biochemistry and in cellular and molecular biology. Intended for biology majors and minors, preprofessional students, and open to any student wishing to fulfill their Core Curriculum requirement. Lecture and laboratory. [Core Curriculum Goal Area(s) 3 (LC)] Student must register for BIOL 1400 (Lecture) and BIOL 1410 (Lab).

BIOL 1500 Diversity of Life (4 credits)
Lecture | An introduction to living organisms, with an emphasis on the basic mechanisms and concepts in organismal biology, ecology, and evolutionary biology. Topics include taxonomy and classification of the major groups of plants and animals, structure and function, development, and behavior. Intended for biology majors and minors, preprofessional students, and open to any student wishing to fulfill their Core Curriculum requirement. Lecture and laboratory. [Core Curriculum Goal Area 3 (LC)]

BIOL 1510 Diversity of Life Lab (0 credit)
Lab | An introduction to living organisms, with an emphasis on the basic mechanisms and concepts in organismal biology, ecology, and evolutionary biology. Topics include taxonomy and classification of the major groups of plants and animals, structure and function, development, and behavior. Intended for biology majors and minors, preprofessional students, and open to any student wishing to fulfill their Core Curriculum requirement. [Core Curriculum Goal Area 3 (LC).]

BIOL 2110 Human Anatomy and Physiology (5 credits)
The structure, function, and development of the human body. Lecture and laboratory. Prerequisite(s): BIOL 1400 or BIOL 1500.

BIOL 2339 Ethics of Fish and Wildlife Management (3 credits)
This class is designed to explore the ethical aspects of various fish and wildlife management related topics in order to better understand how ethical viewpoints at both the social and political levels have influenced natural resource policy throughout history at the local, regional, and global scales. [Core Curriculum Goal Area 9]

BIOL 2360 Genetics (4 credits)
Fundamental principles of heredity in plants, animals, and microorganisms. Includes both classical and molecular genetic approaches to studying organisms. Prerequisites: BIOL 1400.

BIOL 2610 General Ecology (3 credits)
Introduction to the interrelationships of organisms and their environments, emphasizing the historic development of fundamental principles at the levels of individual, population, community, and ecosystem through examination of theoretical and empirical findings. Prerequisites: BIOL 1110, 1120 or BIOL 1400, 1500 or consent of instructor.

BIOL 2750 Medical Microbiology (3 credits)
Introduction to pathogenic microorganisms, the interaction of pathogens and the immune system, transmission of infections, and methods of controlling infections. The laboratory portion of the class covers aseptic technique, pure culture techniques, microscopy, and diagnostic microbiology. This course is intended primarily for Nursing majors. Prerequisites: (BIOL 1110 or BIOL 1111 or BIOL 1400) and (CHEM 1110 or CHEM 1111 or CHEM 2211)

BIOL 2925 People of the Environment: Biological Perspectives (3 credits)
Discussion and evaluation of current environmental biology topics, including biodiversity, ecosystems, biological resources, and human impact on the environment. This course fulfills Core Curriculum requirements only and does not satisfy and Biology major or minor degree requirements. [**Core Curriculum Goal Area(s) 10]

BIOL 3074 Molecular Techniques (2 credits)
This is a hybrid lecture and lab-based course and is an introduction to several common molecular-based techniques. Students will learn basic pipetting, protein assays, electrophoresis, PCR, and other molecular genetic techniques. Prerequisite(s): BIOL 1400, BIOL 2360, CHEM 2211, CHEM 2212; or consent of instructor.

BIOL 3075 Cellular Techniques (2 credits)
This course is the one of two options for completion of techniques core requirement for the BCMB major and for specific Biology majors. Includes an introduction to cell culture, cell imaging, cell-based assays, and stem cell biology. Prerequisite(s): BIOL 3074 or BCMB 3074.

BIOL 3120 Soils (4 credits)
Introduction to principles of soil genesis, classification, physical and chemical properties, and biological significance. Lecture and laboratory. Prerequisites: (BIOL 1400 or BIOL 1120) and (GEOL 1110 or BIOL 1500) or consent of instructor. May not be offered every year.

BIOL 3150 Animal Behavior (3 credits)
Introduction to the study of the diversity, physiology, ecological context, and evolutionary development of behavior of invertebrate and vertebrate animals. Prerequisite: BIOL 1400 and BIOL 1500, or PSY 1100.

BIOL 3170 Dendrology (2 credits)
The main function of a dendrology class is to learn the identification and basic ecology of woody plants (trees, shrubs, woody vines) for a region, along with the basic vocabulary used to describe woody plants. Prerequisite(s): (BIOL 1400, 1500, and 2610) or consent of instructor.

BIOL 3250 Human Anatomy (4 credits)
Anatomical structure of the human body, from individual organ systems to the integrated whole. BIOL 1400.

BIOL 3260 Human Physiology (4 credits)
Physiological and pathophysiological principles and control mechanisms of organ systems within humans. Lecture and laboratory. Prerequisites: BIOL 1400 and (CHEM 1111 or CHEM 2211); or consent of instructor.

BIOL 3299 Virology (3 credits)
This course explores virology, which is the study of viruses that infect all manner of life on earth. We will focus on animal viruses and those that impact human health. Important discoveries from viruses that infect microbes, plants, and non-human animals will be included. Prerequisite(s): One year introductory biology or consent of instructor.

BIOL 3300 Introduction to Hematology (4 credits)
Introduction to the principles of blood cell formation, function, and associated disorders. Lecture and Laboratory. Prerequisites: BIOL 1400, CHEM 2211, and CHEM 2212. BIOL 2360 or BIOL 3380 is recommended.

BIOL 3310 Entomology (3 credits)
The biology of insects and their importance. Prerequisites: BIOL 1400 and BIOL 1500, or consent of instructor.

BIOL 3337 Science Communication (3 credits)
Explores the foundations of scientific thinking and communication and develops practical skills in finding, understanding, and thinking critically about scientific results and consensus. [BSU Focus: Performance and Participation]

BIOL 3338 Science Communication Lab (1 credit)
All students in the Biology Baccalaureate Partnership at North Hennepin Community College are expected to co-enroll in this 1 credit face-to-face section on the NHCC campus when taking BIOL 3337 online. The on-campus discussion section will cover supplementary topics and material and is intended to build scientific community and communications skills among the BBP cohort. The lab section will not impact the main course grades. Co-requisite BIOL 3337.

BIOL 3339 Bioethics (3 credits)
In this online Bioethics course we will grapple with the many philosophical, ethical, and practical questions created by advances in medicine and biology using a combination of readings, case studies, scientific literature, and popular culture. The course has undergraduate and graduate sections and is intended for students in their Junior year of college or later. Topics include prenatal testing, abortion, assisted suicide, human augmentation/transhumanism, cloning, disability rights, animal rights, genetically modified organisms, and environmental ethics. [Core Curriculum Goal Area(s) 9]

BIOL 3361 Limnology (4 credits)
Introduction to the biology, chemistry, geology, and physics of lakes and streams. Lecture, field, and laboratory work. Prerequisites: BIOL 1400, BIOL 1500, BIOL 2610, CHEM 1111 or CHEM 2211, CHEM 1112 or CHEM 2212, or consent of instructor.

BIOL 3362 Streams and Rivers (4 credits)
An introduction to the physical characteristics, chemistry, and biology of lotic systems such as streams and rivers. Includes information on morphology, hydrology, and alteration of these natural systems. Includes laboratory simulations and field exercises. Lecture and laboratory. Prerequisites: BIOL 1400 and BIOL 1500, or consent of instructor.

BIOL 3380 Molecular Genetics (3 credits)
Study of the structure, replication, repair, expression, regulation, and change of genetic material. Introduction to theory and procedures by which recombinant DNA molecules are formed, cloned, and expressed. Prerequisites: BIOL 1400 and BIOL 2360.

BIOL 3400 Fish & Wildlife Law and Administration (3 credits)
This course is for majors in natural resources, biology, and related fields. The lectures throughout the course will cover the history, philosophy, evolution, and application of these laws in the management of fish, wildlife, and other renewable resources for the benefit of the public. The course concludes with contemporary economic, administrative and political aspects of fish and wildlife management. The course fulfills some certification requirements of The Wildlife Society and the American Fisheries Society and is recommended for students planning graduate study or employment in natural resources management. Prerequisite: BIOL 2610.

BIOL 3420 Human Dimensions of Wildlife and Fisheries Management (3 credits)
This course is for majors in natural resources, biology, and related fields. The lectures throughout the course will cover the history, philosophy, evolution, and application of human dimensions in wildlife and fisheries management. The course fulfills some certification requirements of The Wildlife Society and the American Fisheries Society and is recommended for students planning graduate study or employment in natural resources management. Prerequisite: BIOL 2610.

BIOL 3580 Immunology (3 credits)
The study of disease fighting mechanisms of the innate and adaptive immune systems. Prerequisites: BIOL 2360 and one year of chemistry.

BIOL 3590 Cell Biology (3 credits)
Microscopic anatomy and physiological mechanisms of plant and animal cells. Gene control of cellular metabolism, mechanism of energy utilization in cells and pathways of synthesis of molecules. Prerequisites: (BIOL 2360 or BIOL 3380) and (CHEM 2211, CHEM 2212) or consent of instructor.

BIOL 3610 Principles of Wildlife Management (3 credits)
Introduction to the field of wildlife management, including the biological principles important to the understanding of wildlife populations and the management strategies implemented by natural resource managers. Prerequisite(s): BIOL 1500 and BIOL 2610.

BIOL 3630 Conservation Biology (3 credits)
Principles and theories of conservation biology. Topics include biodiversity, threats to biodiversity, extinctions, management of threatened and endangered species, managing habitats for conservation, and methods to mitigate biodiversity loss. Prerequisites: BIOL 1400 and BIOL 1500, or consent of instructor. Also GEOG 3630.

BIOL 3710 Microbiology (4 credits)
Structure, classification, and physiology of bacteria and related microorganisms. Lecture and laboratory. Prerequisites or Corequisites: One year introductory biology and one year introductory chemistry or consent of instructor.

BIOL 3720 Plant Form and Function (4 credits)
Structure, function, and development of vascular plants. Interrelationships between anatomical structures and physiological processes and how plants cope with environmental challenges. Lecture and laboratory. Prerequisites: BIOL 1400, 1500 and one year of college chemistry or consent of instructor.

BIOL 3723 Ecosystem Ecology (3 credits)
Fundamentals of the study of ecosystems, with emphasis on the integration of abiotic and biotic components in the development of ecosystem processes. Comparisons and interactions between terrestrial, wetland, aquatic, and atmospheric systems across the major biomes. Prerequisite: BIOL 2610.

BIOL 3730 Plant Diversity (4 credits)
Classification, phylogeny, collection, field identification, and uses of wild plants. Lecture and laboratory. Prerequisites: BIOL 1400 and BIOL 1500 or consent of instructor.

BIOL 3830 Aquatic Plants and Algae (4 credits)
Survey of the morphology, physiology, taxonomy, systematics, and ecology of algae and aquatic vascular plants. Lecture, laboratory, and field study. Prerequisites: BIOL 1400 and BIOL 1500.

BIOL 3840 Wetlands Ecology (3 credits)
Survey course develops a basic understanding of the terminology, classification, ecology, values, and conservation of wetlands. Covers wetland systems from around the world, with emphasis on wetlands in North America. Prerequisites: BIOL 1400 and BIOL 1500, or consent of instructor.

BIOL 3844 Wetlands Ecology Lab (1 credit)
Laboratory course to supplement BIOL/ENVR 3840 Wetlands Ecology. Intended to strengthen a basic understanding of the terminology, classification, ecology, values, and conservation of wetlands. Prerequisite or Corequisite: BIOL/ENVR 3840 or consent of instructor.

BIOL 3850 Marine Biology (3 credits)
Lecture course introducing major concepts and theories. Includes physical and chemical components of the oceans, with special interest paid to the major groups of organisms living in marine systems. Emphasis on the different types of marine systems (coral reefs, mangroves, open water, etc.). Prerequisites: BIOL 1400 and 1500. Might not be offered every year.

BIOL 3910 Directed Independent Study (3 credits)
Arranged individual study.

BIOL 4030 Wetland Delineation and Classification (3 credits)
This training course for the identification, delineation, and classification of wetlands covers the major types of wetlands and their general delineation procedures. Hydrological, soil, and vegetation characteristics will be used to identify and map wetland boundaries. Focuses on current regulations as established by the US Army Corps of Engineers' 1987 Wetland Delineation Manual with additional regulations specific for the state of Minnesota. Satisfies the requirements for basic delineation training as specified by the Corps of Engineers and certification programs in many states. Prerequisites: BIOL 1400, 1500, or consent of instructor.

BIOL 4200 Freshwater Invertebrates (4 credits)
Morphology and functional roles of representative freshwater invertebrates and their ecological interrelationships. Lecture and laboratory. Prerequisite: BIOL 1400, BIOL 1500, BIOL 3361, BIOL 3362, and junior status, or consent of instructor.

BIOL 4210 Parasitology (4 credits)
The biology of animal parasites, their identification, biochemistry, immunology, and epidemiology. Lecture and laboratory. Prerequisites: BIOL 1400, 1500, or consent of instructor.

BIOL 4270 Histology (4 credits)
Microscopic anatomy of vertebrate tissues and organs with functional correlations. Lecture and laboratory. Prerequisites: BIOL 1400 and BIOL 1500, BIOL 3250, and BIOL 3260. Might not be offered every year.

BIOL 4330 Upland Wildlife Management (3 credits)
An advanced pre-professional course for majors in natural resources, biology, and related fields. Lectures cover the history, philosophy, evolution, and application of wildlife management with a focus on upland wildlife as a renewable, sustainable natural resource. The course fulfills some professional certification requirements of The Wildlife Society and is recommended for students planning graduate study or employment in natural resources management. Prerequisite: BIOL 3610.

BIOL 4360 Developmental and Tumor Biology (3 credits)
Investigation of the mechanisms leading to the development of multicellular animal organisms from a fertilized egg. In contrast, the course also investigates how cells within a multicellular organism can become misregulated, leading to cancer. Prerequisites: BIOL 1400, BIOL 2360.

BIOL 4447 Genomics (3 credits)
Genomics is the study of the content, structure, organization, evolution, and conservation of whole genomes. Because of its reliance on precision instrumentation and scale, and the unprecedented volume of data produced, genomics is unusual among biological disciplines in its integration of engineering, statistics, and information science. Genomics also requires the biologist to engage in systems thinking by taking a wide view of the dynamic physical and informational network that comprises a single genome. One must further consider the human genome as itself a component of an even larger network of genomes that make up the holobiont-that's us plus our always-changing resident community of microbial pals. After covering these and other topics, and carrying out a substantial genome annotation project for the lab component of the course, we explore personal genomics, or how all this information and understanding affects our lives as 21st century human beings. Prerequisite: BIOL 2360.

BIOL 4448 Genomics Lab (2 credits)
All students in the Biology Baccalaureate Partnership at North Hennepin Community College are expected to co-enroll in this 2 credit face-to-face section on the NHCC campus when taking BIOL4447 online. This lab section consists of a hands-on genome annotation project in collaboration with the national Genomics Education Partnership, as well as practice using other bioinformatics tools and databases. Prerequisites: BIOL2360, co-enrollment with BIOL4447.

BIOL 4449 Gene Expression (4 credits)
While mutations in genomic DNA play a major role in human health and disease, the control of gene expression plays the pivotal role in establishing developmental patterning, cellular differentiation, responsiveness to environmental stimuli, and defense against pathogens and invasive genetic elements. Changes in genomic DNA over time are a key driver of evolution, but the control of gene expression is also a major generator of species diversity and a driver of genome structure and function. Chromosomes in eukaryotic nuclei are made up of a combination of DNA and proteins packaged and compacted into a composite called chromatin-in turn, chromatin structure and modification determines whether a gene is "open" for transcription or closed. One of the most efficient and well-characterized systems for studying the relationship between chromatin and gene expression is the so-called position effect variegation (PEV) in the compound eye of Drosophila melanogaster, in which the variable expression of a reporter transgene allows reproducible measurement of gene expression in response to genetic and environmental factors. We will use a combination of classroom and laboratory approaches to understand and complete original research projects using this system. Successful completion of this course satisfies BSU Biology's capstone requirement. Prerequisite: BIOL 2360.

BIOL 4460 Stem Cells and Regenerative Medicine (3 credits)
This course is designed as an introduction to stem cell biology and the medical applications of stem cells including in the field of regenerative medicine. Prerequisite(s): BIOL 2360.

BIOL 4470 Introduction to Vaccinology (4 credits)
This course will introduce students to the field of vaccinology and aspects of the bioscience industry related to vaccine discovery, production, and testing. Students will learn about the history of vaccines; the production of vaccines in a regulated environment; the benefits and concerns with vaccine use. The course will include a discussion of vaccine types, delivery, efficacy, and safety. Students will learn about the mechanism of action of different vaccines; traditional verses modern vaccine production methods, the process of clinical trials and approval for new vaccines; and discuss ethical concerns related to vaccine use. Prerequisite(s): BIOL 2360.

BIOL 4510 Ornithology (3 credits)
Morphology, ecology, behavior, classification, distribution, and evolution of birds. Lecture, laboratory, and field study (early morning field trips and one or two all-day field trips). Prerequisites: BIOL 1500 and BIOL 2610, or consent of instructor.

BIOL 4520 Mammalogy (3 credits)
Morphology, ecology, behavior, classification, distribution, and evolution of mammals. Lecture and laboratory. Prerequisite(s): BIOL 1500 and BIOL 2610, or consent of instructor.

BIOL 4530 Ecology and Management of Large Mammals (3 credits)
Large mammals are socially and ecologically important components of the landscape and are intensively managed by wildlife agencies and private landowners. The primary focus of the course will be on life-histories, investigative techniques, and management of the major large mammals in Minnesota; white-tailed deer, black bear, wolves, moose, and elk. Biology, management, and research of large mammals from the western United States (i.e., mule deer, cougar, bison, pronghorn antelope, bighorn sheep, brown bear, etc.) will also be discussed. Students will be introduced to current issues concerning the political and social aspects of big game management. Prerequisite(s): BIOL 3610.

BIOL 4534 Ichthyology (4 credits)
An overview of morphology, physiology, behavior, taxonomy, systematics, and ecology of fishes. This course emphasizes the evolution of ecological adaptations and the origin and conservation of biodiversity. Lecture, laboratory, and field work. Prerequisites: BIOL 1400 and BIOL 1500, or consent of instructor.

BIOL 4545 Fisheries Management (4 credits)
Theory and methods of fisheries management with an emphasis on quantitative methods and ecosystem management. Lecture and extensive field and laboratory work. Prerequisites: BIOL 3361 and BIOL 3362, or consent of instructor.

BIOL 4620 Evolution (3 credits)
Patterns and processes of biological evolution. Topics include phylogenies, speciation, extinctions, biogeography, adaptations, sexual selection, and behavior, with an emphasis on vertebrates and invertebrates. Prerequisite: BIOL 2360 or consent of instructor.

BIOL 4623 Forest Ecology (4 credits)
Fundamentals of forest ecology, including study of tree growth, tree demography, forest community dynamics, and ecosystem processes. Students also learn to identify forest trees native to the region and basic techniques of forest stand description. Prerequisite: BIOL 2610 or consent of instructor. Might not be offered every year.

BIOL 4715 Clinical Microbiology (3 credits)
Clinical techniques used to identify medically important microorganisms will be examined. Correlate the presence of microorganisms to health and disease. Prerequisite(s): BIOL 3710.

BIOL 4780 Wildlife Management Techniques (5 credits)
This course emphasizes application of ecological principles, knowledge, and practical field skills to data collection used in the management of wildlife resources and their habitats. Use of literature, development of basic field and laboratory skills, and application of management and research principles are integral. Designed for upper level students who have met prerequisites, and graduate students, who are preparing for professional careers in wildlife conservation, natural sciences, and related areas of natural resources management. The course helps fulfill The Wildlife Society professional certification requirements. Prerequisite: BIOL 3610.

BIOL 4800 Advanced Project Certification (0 credit)
A course designed to document a students successful completion of a professional or graduate school entrance exam, with a student placing in at least the 60th percentile. This course is one of the options for completing the capstone project requirement in Biology.

BIOL 4894 Advanced Research Project I (2 credits)
This course provides a culminating experience that integrates the knowledge and skills learned in previous courses and applies them to a scholarly activity. Examples of an advanced research project may include an original research project, internship, or shadowing experience with a professional. Prerequisite: Junior status and consent of instructor.

BIOL 4895 Advanced Research Project II (2 credits)
This course is a continuation of BIOL 4894 for students who undertake a year-long research project. The course provides a culminating experience that integrates the knowledge and skills learned in previous courses and applies them to a scholarly activity. Examples of an advanced research project may include an original research project, internship, or shadowing experience with a professional. Prerequisite: Junior status and consent of instructor.

BIOL 4898 Fisheries Research I (2 credits)
Independent field projects based on the background and interests of the students and the instructor. Designed to give students experience developing original research objectives, designing methods, collecting data, and writing a research manuscript that conveys that research to their peers. Prerequisites: Completion of the Area II required writing course for the B.S. or B.A. Biology major, junior status and consent of instructor.

BIOL 4899 Fisheries Research II (2 credits)
This course is a continuation of BIOL 4898. It is designed to give students experience analyzing data, drawing conclusions, completing and preparing a research manuscript for publication, and developing an oral presentation for a professional meeting. Prerequisites: BIOL 4898, Completion of the Area II required writing course for the B.S. or B.A. Biology major, junior status and consent of instructor.

BIOL 4910 Directed Independent Study (3 credits)
Arranged individual study.

BIOL 4917 DIS Tchg Assoc | (1-2 credits)
Directed Independent Study | Teaching Associate

All-University Courses

The course numbers listed below, not always included in the semester class schedule, may be registered for by consent of the advisor, instructor, or department chair, or may be assigned by the department when warranted. Individual registration requires previous arrangement by the student and the completion of any required form or planning outline as well as any prerequisites.

1910, 2910, 3910, 4910 DIRECTED INDEPENDENT STUDY
1920, 2920, 3920, 4920 DIRECTED GROUP STUDY
1930, 2930, 3930, 4930 EXPERIMENTAL COURSE
1940, 2940, 3940, 4940 IN-SERVICE COURSE
1950, 2950, 3950, 4950 WORKSHOP, INSTITUTE, TOUR
1960, 2960, 3960, 4960 SPECIAL PURPOSE INSTRUCTION
1970, 2970, 3970, 4970 INTERNSHIP
1980, 2980, 3980, 4980 RESEARCH
1990, 2990, 3990, 4990 THESIS