

## BIOLOGY &amp; BIOCHEMISTRY

## Department of BIOLOGY & BIOCHEMISTRY

### Mission Statement

The mission of the Department of Biology and Biochemistry is to teach students the foundational concepts and skills of the sciences through a Christian worldview. Students are trained to apply the scientific method, to analyze observations quantitatively and qualitatively, and to integrate knowledge between scientific disciplines. Students learn to value scientific inquiry as a means of exploring God's general revelation in the natural world.

The Department of Biology & Biochemistry prepares students for careers in science and for a wide variety of professional schools, including graduate programs in biology, biochemistry, and health professions such as medicine, nursing, physician assistant, dentistry, chiropractic, pharmacy, and physical therapy. Biology and biochemistry exert more influence in our society than ever before, and the department strives to be in the vanguard of an approach to education based on inquiry and critical thinking within the framework of a Christian worldview.

NOTE: WHEN A STUDENT RECEIVES A "U" GRADE FOR THE LAB PORTION OF A SCIENCE COURSE, HE/SHE RECEIVES CREDIT FOR THE COURSE, BUT THE COURSE DOES NOT COUNT FOR LABORATORY SCIENCE CREDIT IN CORE CURRICULUM.

## Biochemistry Major Bachelor of Science

Biochemistry is the study of carbohydrates, proteins, lipids, nucleic acids, and the processes of these molecules in the body. A rapidly developing and relatively new discipline within the sciences, biochemistry intersects with physiology, medicine, cell biology, genetics, etc. In recent years the pace of biochemical discovery has accelerated due to the profound transformation wrought by recombinant DNA technology. Biochemistry majors will be well prepared to enter the work force or pursue graduate degrees, medical school, or other professional training. The degree is granted upon completion of credits specified on pages 48–49 (40 credits must be successfully completed in 3000- or 4000-level courses).

- **Scientific & Quantitative Literacy** courses in core curriculum: natural science courses PHY1101/1101L or 1201/1201L; mathematics course MAT2121.
- **Biochemistry majors** must receive a C- or better in all prerequisite courses. In addition, biochemistry majors must have a cumulative grade point average of at least 2.0 in all courses with BIO, CHE, and PHY prefixes in order to graduate.

### Required Courses . . . . . 49–50 cr

BIO1011	Principles of Biology I . . . . .	4
BIO1012	Principles of Biology II . . . . .	4
BIO3231	Biochemistry I . . . . .	5
BIO3232	Biochemistry II . . . . .	4
BIO3246	Genetics <b>or</b>	
BIO4841/CHE4841	Research/Chemistry Research . . . . .	4–5
BIO4835	Senior Seminar [ <b>OCE, WCE</b> ] . . . . .	2
CHE1021	Principles of Chemistry I . . . . .	4
CHE1022	Principles of Chemistry II . . . . .	4
CHE3101	Organic Chemistry I . . . . .	5
CHE3102	Organic Chemistry II . . . . .	5
CHE3321	Physical Chemistry . . . . .	4
PHY1102	Fundamentals of Physics II . . . . .	4

Students are strongly encouraged to take additional BIO courses to count towards the general elective requirements.

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## Biology Major Bachelor of Science

Through a sequence of core courses, the biology major provides students with a comprehensive study of the various sub-disciplines of biology including cell and molecular biology, organismal biology, genetics, and ecology. Opportunities for research, independent study, and practical internships further strengthen each student's degree and résumé. The major is a flexible program that contains four unique tracks: Cellular and Molecular Biology, Environmental Biology, General Biology, and Pre-Medical/Pre-Professional Biology. After completing the biology core requirements, students are able to select from a wide variety of science electives to prepare for any profession in the biological sciences: **Clinical Health Sciences**, including medical, dental, veterinary, physician assistant, doctor of nurse practitioner, public health, physical therapy, chiropractic, etc.; **Research Sciences**, including biomedical industry, M.S. and Ph.D. programs in cellular and molecular biology, plant and environmental science, forensic science, genetics, etc. The degree is granted upon completion of credits specified on pages 48–49 (40 credits must be successfully completed in 3000- or 4000-level courses).

### Cellular and Molecular Biology Track (49–51 cr)

- **Scientific & Quantitative Literacy** courses in core curriculum: natural science course CHE1021; mathematics course MAT2055 or higher.
- **For all natural science courses**, must receive a C- or better in all prerequisite courses. In addition, biology majors and minors must have a cumulative grade point average of at least 2.0 in all courses with BIO, CHE, and PHY prefixes in order to graduate.

<b>Biology Core</b> . . . . .	<b>19 cr</b>	<b>Selectives</b> . . . . .	<b>4–5 cr</b>
BIO1011 Principles of Biology I . . . . .	4	BIO3157 Human Anatomy . . . . .	4
BIO1012 Principles of Biology II . . . . .	4	BIO3158 Human Physiology . . . . .	4
BIO2113 Principles of Biology III . . . . .	4	BIO3231 Biochemistry I . . . . .	5
BIO4835 Senior Seminar [OCE, WCE] . . . . .	2	BIO3232 Biochemistry II . . . . .	4
CHE3101 Organic Chemistry I . . . . .	5	BIO3236 Immunology . . . . .	4
		BIO4355 Developmental Biology . . . . .	4
		BIO4841/CHE4841 Research/Chemistry Research . . . . .	1–4
<b>Required Courses</b> . . . . .	<b>26–27 cr</b>	BIO4995 Biology Internship . . . . .	1–4
BIO3145 Microbiology . . . . .	4	MAT courses numbered 2122 or higher	
BIO3246 Genetics . . . . .	5	CHE courses numbered 3321 or higher	
BIO3347 Cell Physiology <b>or</b>		PHY courses numbered 1102 or higher	
BIO3348 Cell Biology . . . . .	4–5	Au Sable Institute* courses	
CHE1022 Principles of Chemistry II . . . . .	4		
CHE3102 Organic Chemistry II . . . . .	5		
PHY1101 Fundamentals of Physics I <b>or</b>			
PHY1201 Engineering Physics I . . . . .	4		

Students are strongly encouraged to take additional BIO, MAT, PHY, or CHE courses to count towards the general elective requirements and gain experience through research or internship opportunities.

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\* SEE RELATED INFORMATION ON PAGES 19–20 AND 37–38

### Environmental Biology Track (49 cr)

- **Theological Philosophy** course in core curriculum: PHI2016.
- **Scientific & Quantitative Literacy** courses in core curriculum: natural science course CHE1021; mathematics course MAT2055 or higher.
- **For all natural science courses**, must receive a C- or better in all prerequisite courses. In addition, biology majors and minors must have a cumulative grade point average of at least 2.0 in all courses with BIO, CHE, and PHY prefixes in order to graduate.

<b>Biology Core</b> . . . . .	<b>19 cr</b>	<b>Selectives</b> . . . . .	<b>14 cr</b>
BIO1011 Principles of Biology I . . . . .	4	BIO2015 Sustainable Urban Agriculture . . . . .	2
BIO1012 Principles of Biology II . . . . .	4	BIO2116 Animal Biology . . . . .	4
BIO2113 Principles of Biology III . . . . .	4	BIO2805 Our Changing Climate . . . . .	4
BIO4835 Senior Seminar [OCE, WCE] . . . . .	2	BIO3015 Field Ornithology . . . . .	4
CHE3101 Organic Chemistry I . . . . .	5	BIO3145 Microbiology . . . . .	4
		BIO3215 Plant Biology . . . . .	4
		BIO3246 Genetics . . . . .	5
<b>Required Courses</b> . . . . .	<b>16 cr</b>	BIO3276 Field Biology . . . . .	4
ASI3620 Environmental Applications for GIS . . . . .	4	BIO4841/CHE4841 Research/Chemistry Research . . . . .	1–4
BIO3175 Ecology . . . . .	4	BIO4995 Biology Internship . . . . .	1–4
BIO3277 Conservation Biology . . . . .	4	Au Sable Institute* courses . . . . .	4–12
CHE1022 Principles of Chemistry II <b>or</b>			
ASI3320 Environmental Chemistry* . . . . .	4		

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## BIOLOGY &amp; BIOCHEMISTRY

## General Biology Track (50 cr)

- **Scientific & Quantitative Literacy** courses in core curriculum: natural science course CHE1021; mathematics course MAT2055 or higher.
- **For all natural science courses**, must receive a C- or better in all prerequisite courses. In addition, biology majors and minors must have a cumulative grade point average of at least 2.0 in all courses with BIO, CHE, and PHY prefixes in order to graduate.

<b>Biology Core</b> .....	<b>19 cr</b>
BIO1011 Principles of Biology I .....	4
BIO1012 Principles of Biology II .....	4
BIO2113 Principles of Biology III .....	4
BIO4835 Senior Seminar <b>[OCE, WCE]</b> .....	2
CHE3101 Organic Chemistry I .....	5

<b>Required Courses</b> .....	<b>9 cr</b>
BIO3246 Genetics .....	5
PHY1101 Fundamentals of Physics I <b>or</b>	
PHY1201 Engineering Physics I .....	4

<b>Biology Electives</b> .....	<b>22 cr</b>
BIO1025 Medical Terminology .....	2
BIO2015 Sustainable Urban Agriculture .....	2
BIO2116 Animal Biology .....	4
BIO2825 Honors Topics in Biology .....	2 or 4
BIOX805 Topics in Biology .....	2–4
BIO3015 Field Ornithology .....	4
BIO3145 Microbiology .....	4
BIO3157 Human Anatomy .....	4
BIO3158 Human Physiology .....	4
BIO3159 Pathophysiology .....	4

BIO3175 Ecology .....	4
BIO3215 Plant Biology .....	4
BIO3231 Biochemistry I .....	5
BIO3232 Biochemistry II .....	4
BIO3236 Immunology .....	4
BIO3276 Field Biology .....	4
BIO3277 Conservation Biology .....	4
BIO3347 Cell Physiology .....	4
BIO3348 Cell Biology .....	5
BIO4355 Developmental Biology .....	4
BIO4841/CHE4841 Research/Chemistry Research .....	1–4
Au Sable Institute* courses .....	4–8
Additional BIO-prefix courses numbered 2116 or higher	
MAT-prefix courses numbered 2055 or higher	

Students are strongly encouraged to take additional BIO, MAT, PHY or CHE courses to count towards the general elective requirements and gain experience through research or internship opportunities.

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## Pre-Medical/Pre-Professional Biology Track (56–58 cr)

- **Theological Philosophy** course in core curriculum: PHI2016.
- **Scientific & Quantitative Literacy** courses in core curriculum: natural science course CHE1021\*; mathematics course MAT2055 or higher.
- **For all natural science courses**, must receive a C- or better in all prerequisite courses. In addition, biology majors and minors must have a cumulative grade point average of at least 2.0 in all courses with BIO, CHE, and PHY prefixes in order to graduate.

<b>Biology Core</b> .....	<b>19 cr</b>
BIO1011 Principles of Biology I* .....	4
BIO1012 Principles of Biology II .....	4
BIO2113 Principles of Biology III .....	4
BIO4835 Senior Seminar <b>[OCE, WCE]</b> .....	2
CHE3101 Organic Chemistry I* .....	5

<b>Required Courses</b> .....	<b>27 cr</b>
BIO3231 Biochemistry I* .....	5
BIO3246 Genetics .....	5
CHE1022 Principles of Chemistry II* .....	4
CHE3102 Organic Chemistry II* .....	5
PHY1101 Fundamentals of Physics I* <b>or</b>	
PHY1201 Engineering Physics I* .....	4
PHY1102 Fundamentals of Physics II* <b>or</b>	
PHY1202 Engineering Physics II* .....	4

<b>Selectives</b> .....	<b>10–12 cr</b>
BIO1025 Medical Terminology .....	2
BIO2116 Animal Biology .....	4
BIO3145 Microbiology .....	4
BIO3157 Human Anatomy* .....	4
BIO3158 Human Physiology* .....	4

BIO3159 Pathophysiology .....	4
BIO3236 Immunology .....	4
BIO3347 Cell Physiology .....	4
BIO3348 Cell Biology .....	5
BIO4355 Developmental Biology .....	4
BIO4841/CHE4841 Research*/Chemistry Research* .....	1–4
BIO4995 Biology Internship .....	1–4
Au Sable Institute** courses .....	4

Students are strongly recommended to have a GPA of 3.5 or higher in order to be competitive for professional programs. Students are strongly encouraged to take additional BIO courses and PSY1005, 2108, and SOC1035 to count towards the 16 credits in the enhanced curriculum (free electives) needed for the total of 125 credits for the degree program. Courses should be selected based in part on material covered in entrance exams and requirements for the student's desired professional program. Additionally, students should gain experience through research or internship opportunities.

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\* COURSES TYPICALLY NEEDED FOR THE MCAT OR MEDICAL SCHOOL RÉSUMÉ  
\*\* SEE RELATED INFORMATION ON PAGES 19–20 AND 37–38

Biology Minor . . . . . 16 cr

**Required Courses:** BIO1011, BIO1012; BIO2113; 4 credits selected from courses with BIO prefix numbered 3000 or higher.

Chemistry Minor . . . . . 17–18 cr

**Required Courses:** CHE1021, 1022, 3101; one course selected from CHE3102, 3321, BIO3231, 3232.

Environmental Science Minor . . . . . 16 cr

**Required Courses:** BIO2113, 3175, SCI1010; 4 credits selected from 2116, 3215, 3276, 3277, approved topics courses, or department chair-approved courses from Au Sable Institute.\*

\*SEE RELATED INFORMATION ON PAGES 19–20 AND 37–38

Science Minor . . . . . 16 cr

**Required Courses:** 16 credits in courses with BIO, CHE, or PHY prefixes (must include courses from at least two disciplines)

Science and Theology Minor . . . . . 20 cr

**Required Courses:**

- Two courses (8 credits) with BIO, CHE, PHY, or SCI prefix
- 8 credits selected from BIA/BIB prefix (2–4 credits); BIO4841 (2–4 cr); BIO4995 (2–4 credits); PHI3035; PHI3805 (Topics); SCI1008; one additional BIO-, CHE-, PHY-, or SCI-prefix course (4 credits)
- SCI3037

## BIOLOGY &amp; BIOCHEMISTRY

## Environmental Science and Business Major Bachelor of Science

The Environmental Science and Business major is designed to prepare students for a career in environmental resource management in an organization that is focused on this industry or in a business that wants to apply environmental concerns to its business practices. The program combines the application of economics and business to issues associated with the environment and the use of natural resources. Graduates can pursue jobs in management, advocacy, marketing, and consulting. Students have the choice of a General Business track or a Marketing track. The degree is granted upon completion of credits specified on pages 48–49 (40 credits must be successfully completed in 3000- or 4000-level courses).

- **Scientific & Quantitative Literacy** courses in core curriculum: natural science course CHE1021; mathematics course MAT1035 or 2055.

### Required Courses . . . . . 24 cr

BIO2113	Principles of Biology III . . . . .	4
BUS4435	Business Ethics [OCE, WCE] . . . . .	4
SCI1010	Environmental Science . . . . .	4

Au Sable Institute\* course:

ASI3040	International Development and Environmental Sustainability . . . . .	4
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#### Select 8 credits from the following:

BIO2015	Sustainable Urban Agriculture . . . . .	2
BIO3175	Ecology . . . . .	4
BIO3276	Field Biology . . . . .	4
BIO3277	Conservation Biology . . . . .	4

Approved BIO/SCI topics courses . . . . . 4

Au Sable Institute\* courses:

ASI3010	Land Resources . . . . .	4
ASI3030	Ecological Agriculture . . . . .	4
ASI3430	Sustainability, Tropical Agriculture and Missions . . . . .	4
ASI4710	Conservation Biology . . . . .	4
ASI4820	Restoration Ecology . . . . .	4

### Track . . . . . 25–28 cr

Select from General Business or Marketing. Requirements are listed below.

#### General Business Track (26–28 cr)

ACC2101	Principles of Financial Accounting . . . . .	4
BUS1115	Introduction to Spreadsheets . . . . .	2
BUS3835	Professional Experience Seminar . . . . .	2
ECO2211	Introduction to Economics . . . . .	2
ECO2212	Principles of Macroeconomics . . . . .	2
FIN2221	Finance I . . . . .	2
MGT2271	Management . . . . .	4
MGT3075	Entrepreneurship . . . . .	2
MKT1085	Principles of Marketing . . . . .	4

#### Select one of the following:

BUS3235	Global Business . . . . .	4
BUS3331	Business Law - Contract and Agency . . . . .	3
MGT3276	Operations Management . . . . .	2
MGT4267	Project Management . . . . .	2
MKT3186	Consumer Behavior and Research . . . . .	4
MKT3188	Advertising and Promotion . . . . .	4

#### Marketing Track (25 cr)

BUS3331	Business Law - Contract and Agency . . . . .	3
BUS3835	Professional Experience Seminar . . . . .	2
ECO2211	Introduction to Economics . . . . .	2
ECO2212	Principles of Macroeconomics . . . . .	2
MKT1085	Principles of Marketing . . . . .	4
MKT3165	Digital Marketing . . . . .	4
MKT3186	Consumer Behavior and Research . . . . .	4
MKT3188	Advertising and Promotion . . . . .	4

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## Health Sciences Major Bachelor of Science

The Health Sciences major is primarily intended for students who intend to pursue the Masters in Nursing, Masters in Physician Assistant, Doctor of Physical Therapy, Masters in Nutrition, Masters in Public Health, etc. The degree is granted upon completion of credits specified on pages 48–49 (40 credits must be successfully completed in 3000- or 4000-level courses).

- **Theological Philosophy** course in core curriculum: PHI2016
- **Scientific & Quantitative Literacy** courses in core curriculum: natural science course BIO1011; mathematics course MAT2055.
- **Health Sciences majors** must receive a C- or better in all prerequisite courses. In addition, Health Sciences majors must have a cumulative grade point average of at least 2.0 in all courses with BIO, CHE, HPE, and HSC prefixes in order to graduate.

### Required Courses . . . . . 46–47 cr

BIO1025	Medical Terminology . . . . .	2
BIO3145	Microbiology . . . . .	4
BIO3157	Human Anatomy . . . . .	4
BIO3158	Human Physiology . . . . .	4
BIO3159	Pathophysiology . . . . .	4
CHE1021	Principles of Chemistry I . . . . .	4
CHE1022	Principles of Chemistry II <b>or</b>	
CHE3101	Organic Chemistry I . . . . .	4–5
HPE3006	Human Nutrition . . . . .	4
HSC4835	Senior Seminar for the Health Sciences [ <b>OCE, WCE</b> ] . . . . .	2
HSC4995	Health Sciences Internship . . . . .	2
PSY1005	Introduction to Psychology . . . . .	4
PSY2108	Lifespan Psychology . . . . .	4
	BIO-prefix course numbered 1012 or above . . . . .	4

Work experience as a Certified Nursing Assistant is highly recommended.

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### Health Sciences Minor . . . . . 24 cr

**Required Course:** BIO1011; select 20 credits from the following: BIO-, CHE-, HPE-, KIN-, PHY-, PSY-, or SOC-prefix courses, or other courses approved by the Dean of the College of Behavioral & Natural Sciences. BIO1009 may not be counted in the minor.

### Beta Beta Beta Biological Society

This prestigious National Biology Honors Society exists to provide educational and service opportunities to biology students. Membership is based upon sophomore class standing and earned GPA. Members plan and participate in society-sponsored activities such as guest speakers, career round-table discussions, field trips, research presentations, community service, and social gatherings.