

Science & Mathematics DIVISION



Ronald D. Meyers, M.S.
Division Chair

Understanding the environment of human life, the center of God's creation, is an important task for the Christian. The physical, biological and mathematical sciences emphasize the study of our relationship to that complex environment. Majors and minors are equipped to understand, interact, and glorify God in these areas.

This division offers majors in Biology, Computer Science, Mathematics, and Pre-professional (Pre-Dental, Pre-Medical, Pre-Veterinary), as well as group major in Science Studies for Teacher Education. Minors may be taken in Biology, Chemistry, Computer Science, General Science, and Mathematics. Students may also take coursework at AuSable Trails Institute of Environmental Studies (see page 57).

Degrees:

- Bachelor of Arts (B.A.)
- Bachelor of Science (B.S.)

Majors:

- Biology
- Biology - Health Sciences Emphasis
- Biology (Secondary Ed.)
- Computer Science
- Environmental Biology
- Mathematics
- Mathematics (Secondary Ed.)
- Pre-professional:
 - Pre-Dental
 - Pre-Medical
 - Pre-Veterinary
- Science Studies Group -
(Elementary & Secondary Ed.)

Minors:

- Biology
- Biology (Secondary Ed.)
- Chemistry
- Computer Science
- General Science
- Mathematics
(Elementary & Secondary Ed.)
- Physics - Secondary Teaching
(in consortium with Calvin College)
- Science Studies Group
(General Science Emphasis -
Elementary & Secondary Ed.)
- Science Studies Group
(Physical Science Emphasis -
Elementary & Secondary Ed.)

Programs:

- AuSable Institute

Science
& Mathematics

Faculty

- Meyers, Ronald D., Associate Professor of Science (1979) (Chair); B.A. (1971), Cedarville College; M.S. (1979), Ohio State University
- Atwood, Peter R., Professor of Mathematics (1975); B.S. (1966), Trinity College; M.A. (1968), Princeton University; Ph.D. (2001), Western Michigan University
- Fryling, James A., Professor of Chemistry (1997); B.S. (1981) United States Air Force Academy; M.S. (1986), Ph.D. (1990) University of Arizona
- Crompton, Nigel E.A., Professor of Biology (2002); B.Sc. (1980), Victoria University of Manchester, England; M.Sc. (1982), Victoria University of Manchester, England; Ph.D. (1987), Justus-Liedig University of Giessen, Germany; D.Sc. (1998), University of Zurich, Switzerland.
- Gates, Raymond R., Associate Professor of Biology (1978); B.A. (1973), Spring Arbor College; M.S. (1976), Central Michigan University.
- Keys, Robert S., Assistant Professor of Science (2002); B.A. (1984), Cornerstone University; M.Ed. (1995), Gannon University; A.B.D. Western Michigan University
- Sanford, Julie A., Instructor of Science (2002); B.A. (1985), Grand Rapids Baptist College; M.En.S. (1988), Miami University.
- Sprague, Thomas B., Professor of Mathematics (1996); B.S. (1980), Central Michigan University; M.A. (1982), Dallas Theological Seminary; M.A. (1985), Michigan State University; Ph.D. (1990), Western Michigan University
- Wortz, M. Dale, Associate Professor of Science & Mathematics (2002); B.S. (1973), Evangel College; M.A.T. (1976) University of Memphis; Ed.D. (2002), University of Sarasota

Criteria for Graduation as a Division Major is listed in the **Academic Information** section under Graduation Requirements on page 53.

Degree information for the Bachelor of Arts and Bachelor of Science degrees along with major and minor listings by division can be found in the catalog section entitled **Degree Information**. (See page 69.)

Majors & Minors

BIOLOGY MAJOR (Bachelor of Arts)

General Education Core requirements for the Bachelor of Arts degree are listed in the **Degree Information** section. (See page 69.)

Required Courses	Credit Hours
BIO 151	Foundations of Biological Science4
BIO 225	Botany4
BIO 233	Zoology4
BIO 351	Genetics4
ECO 341	Ecology4
SCI 380	Internship3

BIO 451	Molecular Cell Biology	.4
BIO 400	Biological Perspectives	.2
Electives in Biology (must be upper-level)		.4

Total .33

Required Cognates*

CHM 111	Principles of General Chemistry	.4
CHM 112	Principles of Organic and Biochemistry	.4
Electives in Mathematics		.6
(Not MAT 096, 097, 107, 110, 211 or 212)		

BIOLOGY MINOR

Required Courses	Credit Hours
BIO 151	Foundations of Biological Sciences .4
BIO 225	Botany .4
BIO 233	Zoology .4
Electives in Biology (must be upper-level) .8	

Total .20

Required Cognate*

CHM 111	Principles of General Chemistry	.4
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*A cognate is a course that supports the success of completing a major program.

BIOLOGY MAJOR FOR SECONDARY TEACHERS (Bachelor of Arts)

General Education Core requirements for the Bachelor of Arts degree are listed in the Degree Information section. (See page 69.)

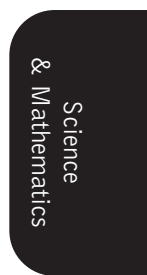
Required Courses	Credit Hours
BIO 151	Foundations of Biological Science .4
BIO 225	Botany .4
One of the following: .4	
BIO 241	Anatomy and Physiology I
BIO 242	Anatomy and Physiology II
BIO 233	Zoology .4
BIO 351	Genetics .4
ECO 341	Ecology .4
SCI 361	Origins .3
BIO 451	Molecular Cell Biology .4
BIO 400	Biological Perspectives .2

Total .33

Required Cognates*

CHM 111	Principles of General Chemistry	.4
CHM 112	Principles of Organic and Biochemistry	.4
MAT 151/ BUS 211	Statistics	.3

*A cognate is a course that supports the success of completing a major program.



BIOLOGY MINOR FOR SECONDARY TEACHERS

Required Courses		Credit Hours
BIO 151	Foundations of Biological Sciences . . . . .	.4
BIO 225	Botany . . . . .	.4
One of the following: . . . . .		.4
	BIO 241 Anatomy and Physiology I	
	BIO 242 Anatomy and Physiology II	
BIO 233	Zoology4
BIO 341	Ecology4
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Total20

Required Cognate*		
CHM 111	Principles of General Chemistry4

*A cognate is a course that supports the success of completing a major program.

Biology Major for Secondary Teachers Four Year Program Illustration

Freshman year

REL 100	Christian Foundations I . . . . .	.3
ENG 113	Freshman Rhetoric . . . . .	.4
MAT 123	Functions & Trigonometry or	
MAT 131	Calculus I . . . . .	.3
SCI 100	Found.Scientific Inquiry . . . . .	.4
IDS 100	Foundations of Inquiry . . . . .	.2
COM 111	Speech Communication . . . . .	.3
KIN 100	Foundations of Wellness . . . . .	.2
PSY 232	Developmental Psychology . . . . .	.3
BIO 151	Foundations of Bio. Science . . . . .	.4
IDS 200	Rel.Communities & Culture . . . . .	.3
REL 101	Christian Foundations II . . . . .	.3
Total Freshman Hours (Approx.) . . . . .		.34

Sophomore year

EDU 230	Prin. & Phil. of Ed. . . . .	.3
ENG 223	Intro to Literature . . . . .	.3
HIS 113	World Civilization . . . . .	.3
CHM 111	General Chemistry . . . . .	.4
BIO 225	Botany or	
BIO 241	Anatomy & Physiology I . . . . .	.4
EDU 283	School Observation Pract. . . . .	.1
MAT 151/ BUS 211	Statistics . . . . .	.3
BIO 233	Zoology . . . . .	.4
CHM 112	Organic & Biochemistry . . . . .	.4
BIO 242	Anatomy & Physiology II . . . . .	.4
(if BIO 241 not taken) or Minor Course		
EDU 323	Div. Populations . . . . .	.3
Total Sophomore Hours (Approx.) . . . . .		.36

Junior year

EDU 344	Content Area Literacy . . . . .	.3
EDU 381	Educational Psychology . . . . .	.3
EDU 352	Christian Theology . . . . .	.3
BIO 351	Genetics . . . . .	.4
Minor Course . . . . .		.4
or BIO 225 Botany (if not taken previously)		
XXX	Minor Methods course . . . . .	.3
One of the following: . . . . .		.3
FAR 211	Intro to Fine Arts	
HIS 114	World. Civ. I	
HIS 115	American Studies	
KIN XXX	Lifetime activity . . . . .	.1
SCI 361	Origins . . . . .	.3
BIO 451	Molecular Cell Biology . . . . .	.4
Total Junior Hours (Approx) . . . . .		.32

Senior year

EDU 262	Computers & Tech. in Edu. . . . .	.3
SCI 465	Secondary Science Methods . . . . .	.3
ECO 341	Ecology . . . . .	.4
BIO 400	Biological Perspectives . . . . .	.2
EDU 484	Secondary Dir. Teaching . . . . .	.12
Minor course and/or elective . . . . .		.3
Total Senior Hours (approx.) . . . . .		.27

BIOLOGY MAJOR (Bachelor of Science)

General Education Core requirements for the Bachelor of Science degree are listed in the Degree Information section. (See page 69.)

Program Specific Core Additions:

PHI 211	Introduction to Philosophy	.4
One of the following		.3
PSY 111	General Psychology	
SOC 111	Introduction to Sociology	

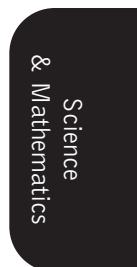
Major Requirements

Required Courses		Credit Hours
BIO 151	Foundations of Biological Science	.4
BIO 225	Botany	.4
BIO 233	Zoology	.4
ECO 341	Ecology	.4
BIO 351	Genetics	.4
BIO 352	Microbiology	.4
SCI 361	Origins	.3
SCI 380	Internship	.3
BIO 400	Biological Perspectives	.2
BIO 451	Molecular Cell Biology	.4
SCI 495	Senior Research Project & Seminar	.2
Electives	BIO, ECO	at least 4
Total		.42

Required Cognates* (Satisfies minor requirement.)

Required Courses		Credit Hours
CHM 121	General Chemistry I	.4
CHM 122	General Chemistry II	.4
CHM 231	Organic Chemistry I	.4
CHM 232	Organic Chemistry II	.4
CHM 472	Biochemistry	.4
PHY 211	General Physics I	.4
PHY 212	General Physics II	.4
MAT 151/ BUS 211	Statistics	.3
One of the following:		.3(4)
MAT 124	Precalculus and Discrete Math	
MAT 131	Calculus I	
Total		.34(35)

*A cognate is a course that supports the success of completing the major program.



BIOLOGY MAJOR - HEALTH SCIENCES EMPHASIS (Bachelor of Science)

General Education Core requirements for the Bachelor of Science degree are listed in the Degree Information section. (See page 69.)

Program Specific Core Additions:

PHI 111	Introduction to Philosophy	.4
One of the following		.3
PSY 111	General Psychology	
SOC 111	Introduction to Sociology	

Major

Required Courses	Credit Hours
BIO 151	Foundations of Biological Science4
BIO 241	Anatomy and Physiology I4
BIO 242	Anatomy and Physiology II4
BIO 233	Zoology4
BIO 351	Genetics4
BIO 352	Microbiology4
SCI 361	Origins3
SCI 380	Internship3
BIO 451	Molecular Cell Biology4
BIO 400	Biological Perspectives2
SCI 495	Senior Research Project & Seminar2
Electives	BIO chosen from:at least 4
	BIO 341 Anatomical Kinesiology
	BIO 342 Exercise Physiology
	BIO 343 Biomechanics
	BIO 347 Introduction to Nutrition
	SCI 362 Biomedical Ethics
	SCI 480 Advanced Topics
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	Total42

Required Cognate* (satisfies minor requirement)

Required Courses	Credit Hours
CHM 121	General Chemistry I4
CHM 122	General Chemistry II4
CHM 231	Organic Chemistry I4
CHM 232	Organic Chemistry II4
CHM 472	Biochemistry4
PHY 211	General Physics I4
PHY 212	General Physics II4
MAT 151/ BUS 211	Statistics3
One of the following:	.3(4)
MAT 124	Precalculus and Discrete Math
MAT 131	Calculus I
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	Total34(35)

*A cognate is a course that supports the success of completing the major program.

CHEMISTRY MINOR

Required Courses	Credit Hours
CHM 121 General Chemistry I	4
CHM 122 General Chemistry II	4
CHM 411 Perspectives in Chemistry	2
Chemistry Electives	12
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Total	22

COMPUTER SCIENCE MAJOR (Bachelor of Arts)

General Education Core requirements for the Bachelor of Arts degree are listed in the Degree Information section. (See page 69.)

Required Courses	Credit Hours
CSC 151 Hardware and Software Concepts	3
CSC 121 Introduction to Programming	4
CSC 352 Data Communications	3
CSC 325 Database Program Development	3
CSC 421 Programming Languages	3
CSC 451 Theory of Operating Systems	3
CSC 380 Internship	3
Three Electives from:	9
CSC 221 Visual Basic	
CSC 224 C++ Programming	
CSC 280 Topics in Computing	
CSC 331 Numerical Analysis	
CSC 435 Theory of Computing	
CSC 400 History of the Mathematical Sciences	3
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Total	37

Required Cognate*

(to be completed no later than the Fall semester of the Sophomore year)

Required Courses	Credit Hours
One of the following:	3(4)
MAT 243 Discrete Mathematics (3)	
MAT 131 Calculus I (4)	

*A cognate is a course that supports the success of completing the major program.

COMPUTER SCIENCE MINOR

Required Courses	Credit Hours
CSC 151 Hardware and Software Concepts	3
CSC 121 Introduction to Programming	4
CSC 231 Data Structures and Algorithms	3
Four electives from:	12
CSC 221 Visual BASIC	
CSC 280 Topics in Computing	
CSC 224 C++ Programming	
CSC 325 Database Program Development	
CSC 331 Numerical Analysis	
CSC 332 Systems Analysis	



CSC 352	Data Communications
CSC 421	Principles of Programming Languages
CSC 431	Applied Software Project
CSC 451	Theory of Operating Systems
CSC 470	Advanced Readings
CSC 480	Advanced Topics
CSC 490	Independent Study

Total22

ENVIRONMENTAL BIOLOGY MAJOR (Bachelor of Science)

General Education Core requirements for the Bachelor of Science degree are listed in the Degree Information section. (See page 69.)

Program Specific Core Additions:

Required Courses	Credit Hours
PHI 211	Introduction to Philosophy3
One of the following:	. . . . .3
PSY 111	General Psychology
SOC 111	Introduction to Sociology

Major:

Required Courses	Credit Hours
BIO 111	Introduction to Biological Sciences4
BIO 151	Foundations of Biological Sciences4
BIO 225	Botany4
BIO 233	Zoology4
ECO 341	Ecology4
SCI 380	Internship (Environmental Biology related)3
BIO 300-400	Electives at Cornerstone University4
ECO 300-400	Electives at AuSable Institute8
BIO 400	Biological Perspectives2
One of the following:	. . . . .4
BIO 431	Vertebrate Zoology
ECO 311	AuSable/Field Biology
ECO 321	AuSable/Animal Zoology
ECO 322	AuSable/Aquatic Biology
ECO 346	AuSable/Winter Stream Ecology
ECO 442	Advanced Field Studies
One of the following:	. . . . .4
BIO 351	Genetics
BIO 352	Microbiology

Total45

General Science Minor II (required)

Required Courses	Credit Hours
CHM 121	General Chemistry I4
CHM 122	General Chemistry II4
CHM 112	Prin. Of Organic/Biochemistry4
ECO 332	AuSable/Environmental Chem.4
SCI 262	Geology (or GEOL 216 at AuSable)4

Total20

Required Cognate*

Required Courses	Credit Hours
MAT 151/	
BUS 211 Statistics . . . . .	.3
One of the following: . . . . .	.3/4
MAT 123 Functions & Trig (3)	
MAT 131 Calculus I (4)	
Total	
	.71/72

*A cognate is a course that supports the success of completing the major program.

AuSable Certificate strongly recommended from one of the following areas:

- Stewardship Ecologists •Land Resources Analyst •Environmental Analyst •Water Resources Analyst•Naturalist

GENERAL SCIENCE MINOR

Required Courses	Credit Hours
Two physical science courses (CHM, PHY, SCI designations) . . .	.8
Two biological science courses (BIO, ECO designations) . . . . .	.8
One other physical or biological science course . . . . .	.4
Total	
	.20

MATHEMATICS MAJOR (Bachelor of Arts)

General Education Core requirements for the Bachelor of Science degree are listed in the Degree Information section. (See page 69.)

Required Courses	Credit Hours
MAT 131 Calculus I . . . . .	.4
MAT 132 Calculus II . . . . .	.4
MAT 233 Differential Equations . . . . .	.3
MAT 234 Multivariate Calculus . . . . .	.3
MAT 241 Applied Linear Algebra . . . . .	.3
MAT 245 Mathematical Proof . . . . .	.3
MAT 252 Computer Statistics . . . . .	.3
MAT 331 Numerical Analysis . . . . .	.3
MAT 333 Real Analysis . . . . .	.3
MAT 341 Modern Algebra . . . . .	.3
MAT 380 Internship . . . . .	.3
MAT 400 History of the Mathematical Sciences . . . . .	.3
Total	
	.38



Required Cognate*

Required Courses	Credit Hours
One of the following: . . . . .	.4
CSC 121 Introduction to Programming	
CSC 151 Hardware and Software Concepts	

*A cognate is a course that supports the success of completing the major program.

MATHEMATICS MAJOR FOR SECONDARY TEACHERS (Bachelor of Arts)

General Education Core requirements for the Bachelor of Arts degree are listed in the Degree Information section. (See page 69.)

Required Courses	Credit Hours
MAT 131 Calculus I .....	.4
MAT 132 Calculus II .....	.4
MAT 233 Differential Equations .....	.3
MAT 234 Multivariate Calculus .....	.3
MAT 241 Applied Linear Algebra .....	.3
MAT 245 Mathematical Proof .....	.3
MAT 252 Computer Statistics .....	.3
MAT 333 Real Analysis .....	.3
MAT 341 Modern Algebra .....	.3
MAT 372 Geometry .....	.3
MAT 400 History of the Mathematical Sciences .....	.3
Total .....	.35

Required Cognate*

Required Courses	Credit Hours
One of the following: .....	.4
CSC 121 Introduction to Programming	
CSC 151 Hardware and Software Concepts	

*A cognate is a course that supports the success of completing the major program.

MATHEMATICS MAJOR (Bachelor of Science)

General Education Core requirements for the Bachelor of Science degree are listed in the Degree Information section. (See page 69.)

Program Specific Core Additions:

Required Courses	Credit Hours
MAT 131 Calculus I .....	.4
MAT 132 Calculus II .....	.4
CSC 121 Introduction to Programming .....	.4
CSC 151 Hardware and Software Concepts .....	.4
PHY 111 Physics for Scientists and Engineers I .....	.5
PHY 112 Physics for Scientists and Engineers II .....	.5
PHI 211 Philosophy .....	.3
One of the following: .....	.3
PSY 111 Psychology	
SOC 111 Sociology	
Total .....	.32

Major

Required Courses	Credit Hours
MAT 233 Differential Equations .....	.3
MAT 234 Multivariate Calculus .....	.3
MAT 241 Applied Linear Algebra .....	.3
MAT 243 Discrete Mathematics .....	.3
MAT 245 Mathematical Proofs .....	.3
MAT 252 Computer Statistics .....	.3

CSC 231	Data Structures	.3
MAT 331	Numerical Analysis	.3
MAT 333	Real Analysis	.3
MAT 341	Modern Algebra	.3
MAT 400	History of the Mathematical Sciences	.3
MAT 380	Internship	.3
MAT 480	Advanced Topics	.3
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Total		.39

MATHEMATICS MINOR

Required Courses		Credit Hours
MAT 131	Calculus I	.4
MAT 132	Calculus II	.4
MAT 234	Multivariate Calculus	.3
MAT 241	Applied Linear Algebra	.3
Three from the following:		.9
MAT 233	Differential Equations	
MAT 252	Computer Statistics	
MAT 333	Real Analysis	
MAT 331	Numerical Analysis	
MAT 341	Modern Algebra	
MAT 400	History of the Mathematical Sciences	
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Total		.23

Required Cognate*

Required Courses		Credit Hours
One of the following:		.4
CSC 121	Introduction to Programming	
CSC 151	Hardware and Software Concept	

*A cognate is a course that supports the success of completing the major program.

MATHEMATICS MINOR FOR ELEMENTARY TEACHERS

Required Courses		Credit Hours
MAT 123	Functions and Trigonometry	.3
MAT 131	Calculus I	.4
One of the following:		.3
MAT 151/		
BUS 211	Statistics	
MAT 252	Computer Statistics	
MAT 211	Math for the Elementary Teacher	.3
MAT 212	Geometry for the Elementary Teacher	.3
One elective from the following:		.3
MAT 132	Calculus II (4)	
MAT 372	Modern Geometry	
One computer programming course		.3
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Total (must be at least)		22



MATHEMATICS MINOR FOR SECONDARY TEACHERS

Required Courses	Credit Hours
MAT 131 Calculus I . . . . .	.4
MAT 132 Calculus II . . . . .	.4
MAT 234 Multivariate Calculus . . . . .	.3
MAT 241 Applied Linear Algebra . . . . .	.3
MAT 252 Computer Statistics . . . . .	.3
Two electives from the following: . . . . .	.6
MAT 233 Differential Equations	
MAT 333 Real Analysis	
MAT 341 Modern Algebra	
MAT 372 Modern Geometry	
MAT 400 History of the Mathematical Sciences	
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	Total23

Required Cognate*

Required Courses	Credit Hours
One of the following:4
CSC 121 Introduction to Programming	
CSC 151 Hardware and Software Concepts	

*A cognate is a course that supports the success of completing the major program.

PHYSICS MINOR FOR SECONDARY TEACHERS

Students wishing to pursue this consortium minor should meet with the certification officer from the Teacher Education Department during or before their sophomore year. Students will be evaluated by a Calvin advisor who will develop an appropriate program. Consortium minors are subject to final approval by Calvin College.

Required Courses	Credit Hours
PHY 111 Physics for Science and Engineering I . . . . .	.5
PHY 112 Physics for Science and Engineering II . . . . .	.5
PHYS 226 Introduction to Modern Physics4
PHYS 382 Modern Physics Laboratory2
Physics electives (approved)8
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	Total24

PRE-PROFESSIONAL MAJOR (Pre-Medical, Pre-Dental, Pre-Veterinary) (Bachelor of Arts)

General Education Core requirements for the Bachelor of Arts degree are listed in the Degree Information section (See page 69.) Students electing a Pre-Professional major are not required to complete a minor. Students wishing to pursue this major must meet with the appropriate professional advisor to ensure that all graduate school requirements are met.

Required Courses	Credit Hours
BIO 151 Foundations of Biological Science . . . . .	.4
BIO 241 Anatomy and Physiology I . . . . .	.4
BIO 242 Anatomy and Physiology II . . . . .	.4
BIO 233 Zoology . . . . .	.4
BIO 351 Genetics . . . . .	.4

BIO 352	Microbiology	.4
SCI 380	Internship	.3
BIO 451	Molecular Cell Biology	.4
BIO 400	Biological Perspectives	.2
SCI Electives from the following:		.4
BIO 431	Vertebrate Zoology	
SCI 361	Origins	
SCI 480	Advanced Topics Seminar	
SCI 362	Biomedical Ethics	

Required Cognates*

Required Courses		Credit Hours
MAT 131	Calculus I	.4
MAT 132	Calculus II	.4
CHM 121	General Chemistry I	.4
CHM 122	General Chemistry II	.4
CHM 231	Organic Chemistry I	.4
CHM 232	Organic Chemistry II	.4
PHY 211	General Physics I	.4
PHY 212	General Physics II	.4
Total		.69

*A cognate is a course that supports the success of completing the major program.

SCIENCE STUDIES GROUP MAJOR FOR ELEMENTARY AND SECONDARY TEACHERS (Bachelor of Arts) (To be replaced by Integrated Science major in 2004)

General Education Core requirements for the Bachelor of Arts degree are listed in the Degree Information section. (See page 69.)

Required Courses		Credit Hours
SCI 111	Physical Science	.4
BIO 151	Foundations of Biological Science	.4
BIO 225	Botany	.4
CHM 111	General Chemistry	.4
BIO 242	Anatomy & Physiology II	.4
BIO 233	Zoology	.4
One of the following		.4
ECO 241	Envir. Science (Elem.)	
ECO 341	Ecology (Secondary)	
SCI 261	Astronomy	.4
SCI 262	Geology	.4
Total		.36

Students who exempt out of any course should select electives from CHM 112 Organic & Biochemistry or BIO 241 Anatomy and Physiology I.



SCIENCE STUDIES GROUP MINOR FOR ELEM. AND SEC. TEACHERS

(To be replaced by Integrated Science major in 2004)

General Science Emphasis

Required Courses	Credit Hours
SCI 111 Physical Science . . . . .	.4
BIO 151 Foundations of Biological Science . . . . .	.4
ECO 241 Environmental Science . . . . .	.4
SCI 262 Geology . . . . .	.4
One additional biological science . . . . .	.4
One additional physical science . . . . .	.4
<hr/> Total	<hr/> .24

Physical Science Emphasis (For Biology majors only)

Required Courses	Credit Hours
CHM 121 General Chemistry I . . . . .	.4
CHM 122 General Chemistry II . . . . .	.4
SCI 261 Astronomy . . . . .	.4
SCI 262 Geology . . . . .	.4
PHY 211 Physics I . . . . .	.4
PHY 212 Physics II . . . . .	.4
<hr/> Total	<hr/> .24

Students should meet the physical science core with one of the above.

Course Descriptions

<u>Dept./Level</u>	<u>Course Name</u>	<u>Credits/Frequency</u>
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(See page 80 for codes)

BIOLOGY

BIO 111	Introduction to Biological Sciences	4/1
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An introductory course in Biology in which plants and animals are used to illustrate basic biological principles. The course will examine the relationships among living organism, including man, and his environment. It is designed to increase student awareness and appreciation of organisms in nature as well as the natural history of selected plants and animals. The laboratory includes the identification of common organisms living in West Michigan during field trips. This course is for non-science majors and minors and satisfies the core requirement for Lab Science.

BIO 151	Foundations of Biological Science	4/1
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This course is designed to provide a natural science foundation for all science majors and minors. Foundational concepts in cell biology/chemistry, genetics (classical and molecular) and microbiology will be stressed in both lecture and lab. This course satisfies the core requirement for Lab Science.

BIO 225	Botany	4/2
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Studies basic plant science, including the structure, reproduction, and ecological relationships among plants. Lecture and lab. This course satisfies the core requirement for Lab Science. Prerequisite: An advanced high school biology course or BIO 111 or BIO 151.

- BIO 233 Zoology 4/2**
 Introduction to the basic principles of zoology, including development, distinguishing characteristics and interactions of the major animal kinds, with special emphasis on the invertebrates. Lecture and lab. This course satisfies the core requirement for Lab Science. Prerequisites: BIO 111 or BIO 151 or advanced high school biology course.
- BIO 241 Anatomy and Physiology I 4/2**
 A systems approach to the structure and function of the human body with special emphasis on disease process as it relates to dysfunction along with practical applications for a life-style of healthful living. Includes integumentary, skeletal, muscular, nervous, and endocrine systems. Laboratory experiences will use microscopic and lab animal investigation. Stresses the homeostatic function and intricacy of the body and its analogies to the Body of Christ, the Church. Lecture and lab. This course satisfies the core requirement for Lab Science.
- BIO 242 Anatomy and Physiology II 4/2**
 A systems approach to the structure and function of the human body with special emphasis on disease process as it relates to dysfunction, along with practical applications for a life-style of healthful living. Includes cardiovascular, digestive, respiratory, lymphatic, urinary, and reproductive systems. Laboratory experiences will use microscopic and lab animal investigation. Stresses the homeostatic function and intricacy of the body and its analogies to the Body of Christ, the Church. Lecture and lab. This course satisfies the core requirement for Lab Science.
- BIO 331 Ornithology 4/5**
 Study of bird anatomy, behavior, life cycles, migration, distribution, and economic relations. Field work is concerned with identification by sight and song and observing the habitat requirements of each species. Lecture and lab. Prerequisite: BIO 233
- BIO 341 Anatomical Kinesiology (KIN 341) 3/2**
 This course is designed as a functionally specific approach to the musculoskeletal system. Emphasis will be placed on the qualitative analysis and description of human movement. Prerequisite: BIO241
- BIO 342 Exercise Physiology (KIN 342) 4/2**
 A study of the physiological responses of the healthy human body to exercise. This course includes topics such as energy systems, nutrition, conditioning, exercise testing, and exercise prescriptions. Prerequisites: BIO 241 and BIO 242.
- BIO 343 Biomechanics (KIN 343) 4/2**
 The study of the internal and external forces that act upon a human body during movement and the effects produced by these forces. Special emphasis will be given to sport-related movements. Prerequisite: BIO 241 and BIO 242.
- BIO 347 Introduction to Nutrition (KIN 347) 3/2**
 This course is designed to study foods and their effects upon health, development, and performance of the human. Students will develop an understanding of healthful and performance nutrition as it relates to optimal health and physical performance. Also, students will study energy pathways in the body and the six basic nutrients related to performance. Additionally, the students will investigate body composition and weight control. Prerequisite: BIO 242.



BIO 351 Genetics 4/2

A study of classical Mendelian genetics, as well as the current molecular basis of gene expression. Lab investigations include inherited traits studies with a variety of organisms from bacteria to humans. Prerequisites: CHM 112, BIO 233, MAT 151.

BIO 352 Microbiology 4/4

A survey study of the structure and function of micro-organisms, with an emphasis on bacteria. Lab included basic techniques in the isolation, identification and culture of micro-organisms. Lecture and lab. Prerequisite: BIO 151 or BIO 233.

BIO 400 Biological Perspectives 2/6

This course is a senior capstone course for Biology and Pre-Professional Majors, and investigates the ethical and theological issues confronting one choosing a biology-related career. Emphasis will be placed upon constructing a personal, Christian philosophical framework. Students will address these concepts as they investigate and evaluate relevant biological issues. Prerequisite: Upper-class Biology or Pre-Professional Major.

BIO 431 Vertebrate Zoology 4/4

Introduction to the characteristics of the seven classes of vertebrate animals, their structure and life history. Lecture and lab. Prerequisite: BIO 233

BIO 451 Molecular Cell Biology 4/4

Examines the structure, function, differentiation and reproduction of cells at all levels of organization with special emphasis on current research in biological problems. Lab experience includes modern techniques in molecular analysis. Lecture and lab. Prerequisite: BIO 351

CHEMISTRY**CHM 111 Principles of General Chemistry 4/2**

Investigation of the composition and properties of substances and the changes they can undergo. Special emphasis on laws of chemical combination, theories of atomic structure, periodic trends, kinetic theory, and chemical and physical equilibria as well as activities to communicate the centrality of chemistry to historical development, modern civilization, and life itself. Explores proper biblical stewardship in chemical manufacturing, disposal, and use. Lecture and lab. This course satisfies the core requirement for Lab Science. Prerequisite: MAT 123 Function & Trigonometry or equivalent.

CHM 112 Principles of Organic and Biochemistry 4/2

Study of the structure, properties, reactions, and interactions of the compounds of carbon and the molecules of life. Special emphasis upon the relationship of macromolecular structure and function to their components. Explores and utilizes chemical theory in the understanding of simple and complex molecular behavior. Laboratory exercises concentrate on synthesis, identification and investigation of both natural and man-made products. Lecture and lab. Prerequisite: CHM 111

CHM 121 General Chemistry I 4/2
Investigation of the composition and properties of substances and the changes they can undergo. Special emphasis on laws of chemical combination, theories of atomic structure, periodic trends, and chemical and physical equilibria as well as activities to communicate the centrality of chemistry to historical development, modern civilization, and life itself. Explores proper biblical stewardship in chemical manufacturing, disposal, and use. Lecture and lab. This course satisfies the core requirement for Lab Science.
Prerequisite: MAT 123 Functions & Trigonometry or its equivalent.

CHM 122 General Chemistry II 4/2
A continuation of CHM 121 with emphasis on reaction types and rates, electrochemistry, equilibria, group properties, nuclear chemistry, and qualitative analysis. Addresses environmental concerns and safe handling and disposal of chemicals. Chemical demonstrations as well as laboratory experiments are used throughout the course. Lecture and lab. This course satisfied the core requirement Lab Science. Prerequisite: CHM 121.

CHM 231 Organic Chemistry I 4/4
A study of carbon compounds including nomenclature, physical and chemical behavior, synthesis, reactions and mechanisms. Laboratory investigations will include micro as well as macro techniques for synthesis and analysis. Lecture and lab. Prerequisite: CHM 122 or equivalent.

CHM 232 Organic Chemistry II 4/4
A continuation of CHM 231 with special emphasis on the biological significance of the functional groups studied in that course. Natural products and polymers will also be covered. Laboratory investigations will include micro as well as macro techniques for synthesis and analysis. Lecture and lab. Prerequisite: CHM 231.

CHM 411 Perspectives in Chemistry 2/4
Investigation in the history, philosophy, curricular structure, methodology, key ideas and concepts of chemistry. Emphasis will be given to the central role in technology and society as well as stewardship issues of production, utilization, and disposal.
Prerequisites: Minimum of three chemistry courses and at least junior standing.

CHM 472 Biochemistry 4/4
Investigation of biologically important molecules including proteins, lipids, carbohydrates, and nucleic acids. Metabolic and biochemical problems will be explored. Lecture and lab. Prerequisite: CHM 232.

COMPUTER INFORMATION SYSTEMS

CSC 112 Introduction to Spreadsheets 1/1
An understanding of spreadsheets and their use in financial applications.

CSC 121 Introduction to Programming 4/2
This is the first course in programming. Topics include the design, coding, testing, and documentation of programs written in a modern high-level language. Fundamental issues of object-oriented programming, efficiency, and complexity are introduced in the context of programming and problem solving.

CSC 352 Data Communications 3/4
A study of technical topics related to data communications and networks. This course will cover transmission media, analog and digital signals, data transmission, multiplexing, local area and wide area network protocols, and network topologies. There will also be some coverage of network operating systems and computer telephony integration.
Prerequisite: CSC 151.

CSC 380 Internship 1-6/1
Practical work experience in a situation where decisions are made concerning equipment or programming or workflow operations. Prerequisite: Permission of instructor.

CSC 400 History of the Mathematical Sciences (MAT 400) 3/6
The development of the mathematical sciences historically and logically. Examines their influences on modern western culture, as well as major vocational issues and trends from a Christian worldview. Project portfolio requires research, problem solving, and exposition, demonstrating technical competence and personal Christian philosophy.
Prerequisites: CSC 231, MAT 131 or 243, and one additional upper-level CSC course.

CSC 421 Principles of Programming Languages 3/6
A survey of the properties of various programming languages, as an introduction to the general principles of programming language design and implementation. Topics include a study of language syntax (e.g.. lexical properties and parsing), language processors (compilers, interpreters, and direct execution), language representations (e.g.. data and control structures, binding, and semantic models), and language styles (procedural, functional, object, logic, and modular programming). Prerequisite: CSC 231 and proficiency in at least 2 approved programming languages.

CSC 423 Compiler Construction 3/6
Principles and practice of constructing translators for programming languages including topics such as lexical and syntactic analysis, formal grammar, symbol tables, and optimization. Substantial programming projects in compiler construction are required. Prerequisite: CSC 231 Data Structures

CSC 431 Applied Software Project 3/6
Application of computer programming and system development concepts, principles, and practices to a comprehensive system development project. Prerequisite: CSC 325

CSC 435 Theory of Computing 3/6
Theoretical principles of formal languages, automata, computability, and computational complexity. Selected topics such as finite and pushdown automata, regular expressions, context-free grammar, Turing machines, the halting problem, NP-completeness, and related topics will be included. Prerequisite: MAT 131 or 243, CSC 231.

CSC 451 Theory of Operating Systems 3/6
An historical survey of the development of operating systems, followed by a discussion of fundamental concepts and terminology, together with practical applications to real systems. Topics are selected from basic concepts such as processes and inter-process communication, allocation of shared resources and memory, scheduling, deadlock, file systems, protection and security, with applications to system design and administration. Prerequisite: CSC 231.



CSC 470 Directed Readings 1-3/6

Typically, a student selection of readings in Computer related topics. Consultation with Business/Computer faculty and a complete application form is required. Prerequisites: See General Requirements.

CSC 480 Advanced Topics 1-3/6

Topics of current interest are offered to introduce new course material and to enhance the Business/Computer majors. Prerequisites: To be determined when scheduled.

CSC 490 Independent Study 1-3/6

The study of Computer related topics chosen by the student in consultation with Business/Computer faculty. A complete application form is required. Prerequisites: See General Requirements.

ECOLOGY

ECO 241 Environmental Science 4/2

Addresses the conservation of our soils, wetlands, tropical rain forests, water and air, fish and wildlife, as well as the problems of environmental pollution, energy sources, population, and urban environment. Lecture and lab. Prerequisite: BIO 111 or BIO 151

ECO 341 Ecology 4/4

The study of the interrelationships of living organisms, plant or animal, and their environments. These are studied with a view of discovering the principles that govern relationships. A special emphasis on the different ecosystems of Michigan bogs, marshes, streams, and sand dunes, and man's impact on them, will be studied. Lecture and lab. Prerequisites: BIO 225, 233, and MAT 151.

ECO 342 Field Biology 4/6

First two weeks: Instruction and experience in the use of the tools of the field biologist, trips to different types of ecosystems: forest, field, stream, pond, lake, marsh, and bog. Final week: Travel experience covering points of interest in the Upper Peninsula and Lower Peninsula of Michigan, or the student may elect to work on a field problem in the Grand Rapids area. Prerequisite: BIO 111 or equivalent.

ECO 427 Ecology of the Indian Tropics 4

AuSable Institute, Tiruchirapalli, India

Tropical ecology of South India, including an introduction to and comparative analysis of coastal ecosystems, the plains, and montane tropical ecosystems of the Western Ghats including altitudinal zonation. The course will be taught on-site at a variety of ecosystem preserves and national parks. If suitable arrangements can be made a number of ecosystems will be studied on the Andaman Islands. Topics include tropical ecosystem structure and function, adaptations of flora and fauna, biodiversity surveys, past and present human interactions with the landscape, and autecology of selected plant and animal species. Prerequisite: Upper division standing and at least one ecology course (preferably completed at AuSable)

MAT 124 Precalculus with Discrete Mathematics 3+lab/2

This course emphasizes mathematical logic and reasoning including programming investigations such as limits and differentiation commands. Function analysis, equations and inequalities, polynomials, rational, trigonometric identities, recursion, induction, and combinatorics are covered. Applications will include business and social, physical, life, and computer sciences. Project topics may include systems of equations and inequalities, sequences, networks, polar coordinates and complex numbers, vectors, the derivative and integral in calculus. This course satisfies the core requirement in Mathematics (p. 253). Prerequisite: MAT 123 or the equivalent of two years of algebra, one year of geometry, and a course in trigonometry. Graphing calculator required. TI-83 Plus or TI-92 preferred.

MAT 131 Calculus I 4+lab/2

The study of rates of change for polynomial, exponential, logarithmic, and trigonometric functions, tangent lines, graphs, maximum values, and areas. Applications of calculus will be modeled with graphing calculators. Computer software and/or graphing calculator (TI-92 Plus recommended) is a required tool for this course. This course satisfies the core requirement in Mathematics (p. 253). Prerequisite: MAT 124 or its equivalent.

MAT 132 Calculus II 4+lab/2

Applications of differentiation and integration from MAT 131 will include techniques of integrating functions and series approximations to these functions. Computer software and/or a graphing calculator (TI-89/92/200 recommended) is a required tool for this course. This course satisfies the core requirement in Mathematics (p. 253).

Prerequisite: MAT 131.

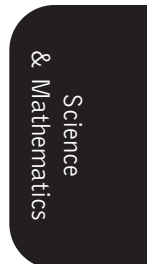
MAT 151/BUS 211 Statistics (SSC 241) 3/1

Descriptive statistics including measures of central tendency and standard deviation, statistical inference with emphasis upon testing of hypotheses and measures of association, and application of these techniques to decision-making and planning. Computer software and/or graphing calculator is required (TI-83 Plus preferred). This course satisfies the core requirement in Mathematics (p. 253). Prerequisite: Core requirement in math.

MAT 211 Math for the Elementary Teacher 3+lab/2

The course integrates elementary and middle school mathematics education content, methods, and technology. Emphasis is on concepts, relationships, problem solving, reasoning, communicating, and connecting ideas in elementary school mathematics. Prospective teachers implement a mathematics curriculum that models NCTM curriculum teaching and evaluation standards and principles. They plan, implement, and evaluate units and lessons in applied arithmetic, pre-geometry, and pre-algebra. Concepts are taught through applications with manipulatives, multimedia technologies, calculators and computers. Students are strongly encouraged to do lab activities via the Learning Center. Lab activities may include diagnosing and tutoring peers and elementary children and micro-teaching with exemplary K-8 grade curriculum materials/software. Prerequisites: Two years of high school algebra / geometry or MAT 110 or its equivalent, and EDU 230, Principles and Philosophy of Education.

- MAT 212 Geometry for the Elementary Teacher 3+lab/2**
 A continuation of MAT 211. Prospective elementary teachers plan, implement, and evaluate units and lessons on basic geometry concepts in two and three dimensions, measurement, transformational geometry, probability, statistics, and algebra. Concepts are taught through applications with manipulatives, multimedia technologies, calculators and computers. Authentic assessment introduced. Students are strongly encouraged to do lab activities via the Learning Center. Prerequisite: MAT 211
- MAT 233 Differential Equations 3/4**
 The study of equations involving derivatives by methods of algebra, series, or computer approximations. Graphing calculators and computers will graph solutions, phase planes, and chaotic systems. Prerequisite: MAT 132.
- MAT 234 Multivariate Calculus 3/4**
 Derivatives and integrals of functions of several variables such as $z=f(x,y)$, Jacobian determinants, volumes, and surface areas. Three-dimensional graphs and chaotic systems will be investigated on graphing calculators and computers. Computer software and/or graphing calculator (TI-89/92/200 preferred) is a required tool for this course. Prerequisite: MAT 132.
- MAT 241 Applied Linear Algebra 3/4**
 The algebra of matrices, determinants, vectors, inverting matrices, diagonalizing matrices, eigenvalues, computer programs, and their applications. Computer software and/or graphing calculator (TI-89/92/200) will be used for calculations and applications to dynamic systems. Prerequisite: MAT 132.
- MAT 243 Discrete Mathematics 3/4**
 A study of fundamental principles of discrete mathematics, with applications to computing. Topics such as sets, functions, relations, counting methods, graph theory, matrix theory, and number theory. An introduction to operation counts and algorithmic complexity. Computer software and/or graphing calculator (TI-89/92/200 preferred) is a required tool. Prerequisite: MAT 123 or permission of the instructor.
- MAT 245 Mathematical Proofs 3/4**
 A course in reading and constructing mathematical proofs. How to start proofs (direct proofs, proofs by cases, proofs by contrapostive, proofs by contradiction); proofs about sets, functions, numbers, inequalities, and equivalence relations; proofs by mathematical induction; understanding the theorems of calculus and linear algebra; and preparing to do proofs in Modern Algebra and Real Analysis. Prerequisite: MAT 234 or MAT 241.
- MAT 252 Computer Statistics 3/4**
 Probability simulations and statistical procedures on graphing calculators and computer statistics programs: random sampling, normal and binomial probability distributions, descriptive statistics and graphs, linear regression and/or ANOVA. Graphing calculator required. Computer software and/or graphing calculator (TI-89/92/200 preferred) is a required tool. Prerequisite: MAT 132.



- MAT 331 Numerical Analysis** 3/4
The numerical solution of nonlinear equations, ordinary differential equations, and systems of linear equations. Numerical approximation of functions, derivatives, and integrals. The analysis of errors. Introduction to writing efficient and reliable numerical software. Prerequisite: CSC 131 and MAT 132. In addition, MAT 241, or permission.
- MAT 333 Real Analysis** 3/4
Construction of the Real Number Field, its properties, proofs and consequences; Infinite sequences and series; continuous and differentiable functions and otherwise; Riemann integrals. Computer software and/or graphing calculator (TI-89/92/200 preferred) is a required tool. Prerequisite: MAT 234 and MAT 245.
- MAT 341 Modern Algebra** 3/4
Groups, rings, and fields and their substructures with examples from transformation groups, matrix rings, and number fields. Computer software and/or graphing calculator (TI-89/92/200 preferred) is a required tool. Prerequisite: MAT 241 and MAT 245.
- MAT 372 Modern Geometry** 3+lab/4
Models and proofs in Euclidean and non-Euclidean geometry from an advanced standpoint. The language and logic of geometry for representing and solving visual problems; points, lines, angles, circles, perimeter, area, 3-D figures, transformations, congruence, and similarity. Emphasis on communicating mathematical arguments with dynamic geometry tools. Internet manipulative and computer explorations appropriate for e-learning in the secondary classroom. Advanced project topics from motion, transformational, topological, projective, conic, axiomatic, differential, discrete, synthetic, hyperbolic, coordinate, finite, fractal, elliptic and spherical geometries. Computer software and/or a TI-92/200 graphing calculator required. Prerequisite: MAT 234, MAT 245, MAT 241 or permission.
- MAT 380 Internship in Mathematical Sciences** 1 - 6/6
An individualized assignment arranged with an agency, business or other organization to provide guided practical experience in a mathematical sciences related career/ministry activity. Prerequisite: Junior standing, consent of instructor, and approval by division chair.
- MAT 400 History of the Mathematical Sciences (Capstone)** 3+lab/4
The development of the mathematical sciences historically and logically. Examines their influence on culture, as well as major vocational issues and trends from a Christian worldview. Thesis, project portfolio requires research, problem solving, and exposition, demonstrating technical competence and personal Christian philosophy. Prerequisite: MAT 333 or MAT 341.
- MAT 470 Readings in Mathematical Sciences** 1- 6/6
Readings in specific mathematical sciences or mathematics education topics in areas of student need and interest. Required periodic reports with related discussions, labs, or creative/classroom activities. Prerequisites: Dependent upon topic selection. Permission of research advisor and instructor. May be repeated.

MAT 471 Secondary Mathematics Education 3+lab/4

Prospective teachers implement a secondary mathematics curriculum that models NCTM curriculum, teaching, and evaluation standards. They plan, implement, and evaluate a unit and lessons in algebra, geometry, functions, probability and statistics, trigonometry, precalculus and discrete mathematics. Explorations with manipulatives, computers, multimedia technologies, Internet, BASIC, calculator programming; statistics, graphing, and drawing tools. Computer software and/or a TI-92/200 graphing calculator is a required tool. Prerequisites: Completed EDU 452, MAT 234, MAT 241, MAT 245.

MAT 480 Advanced Topics in Mathematical Sciences 1-3/6

Selected topics in mathematical modeling, set theory, number theory; topology, complex variables; differential geometry, set theory, number theory; topology, complex variables; differential geometry, modern geometries; abstract linear algebra, advanced matrix algebra, vector analysis, numerical analysis, graph theory, combinatorics, computer programming. Advanced project topics in physics may be selected from Fourier series, transform calculus, partial differential equations, boundary value problems, complex variables, and vector calculus. Prerequisites: Permission of instructor. Designed for mathematical sciences majors' current needs and for students planning graduate study in the physical sciences or applied mathematics. May be repeated.

MAT 490 Independent Study 1 - 3/1

An opportunity to perform independent study/research/creative activity in the various branches of mathematical sciences and allied fields of application. Prerequisites: Major in mathematical sciences; permission of research advisor. Submission and approval of a research proposal must precede registration. May be repeated.

PHYSICS

PHY 111 Physics for Scientists and Engineers I 5/6

An introductory survey of the basic concepts of mechanics, heat, sound, and wave motion. Appropriate for students in the mathematical sciences and engineering. Lecture and lab. This course satisfies the core requirement for Lab Science. Corequisite: MAT 131 Calculus I or equivalent.

PHY 112 Physics for Scientists and Engineers II 5/6

An introductory survey of the basic concepts of electricity, magnetism, light, and modern physics. Appropriate for students in the mathematical sciences and engineering. Lecture and lab. Corequisite: PHY 111 or equivalent and MAT 132 Calculus II or equivalent.

PHY 211 General Physics I 4/2

An introductory survey of the basic concepts of mechanics, heat, sound, and wave motion. Appropriate for students in life sciences. Lecture and lab. This course satisfies the core requirement for Lab Science. Prerequisite: MAT 123 Functions & Trigonometry or equivalent.

PHY 212 General Physics II 4/2

An introductory survey of the basic concepts of electricity, magnetism, light and modern physics. Appropriate for students in life sciences. Lecture and lab. Prerequisite: PHY 211 or equivalent.



SCIENCE**SCI 100 Foundations of Scientific Inquiry 4/1**

This course is designed to introduce students to the role and importance of the sciences in studying God's general revelation in both nature and themselves. A Christian philosophy of science is developed that demonstrates to the student the utility and value as well as the limitations of the natural and social sciences as tools for the empirical investigation of God's creation. Through both classroom and laboratory experience, the student is introduced to the scientific method as a means of knowing from the perspective of a Christian worldview. Integrated lecture and lab.

SCI 111 Physical Science 4/1

Introduction to the explanation and understanding of the natural, non-living world. The processes of information gathering and organizing will be stressed as they relate to the fields of physics, chemistry, geology and astronomy. Emphasis will be given to the biblical framework for each of these disciplines. Lecture and lab. This course satisfies the core requirement for Lab Science. Prerequisite: Core requirement in mathematics.

SCI 261 Astronomy 4/2

A study of the distinctive qualities of the planets, their moons, the stars, and galaxies through laboratory exercises in observations and calculations. Lecture and lab. This course satisfies the core requirement for Lab Science. Prerequisite: MAT 123 Functions & Trigonometry.

SCI 262 Geology 4/2

A study of the materials and processes of the earth, leading to a responsible Christian appreciation for it and its use. Explores basic principles through a survey of the history of the ideas about the earth. Applies basic insights of chemistry, biology, physics, and mathematics to the solution of problems such as earthquakes, volcanic eruptions, floods, marine erosion, the nature and distribution of fossil fuels, metals, ground water, and other mineral resources. Studies man-imposed and natural boundaries to characterize geographic regions. Lecture and lab. This course satisfies the core requirement for Lab Science.

SCI 361 Origins 3/4

A scientific investigation of the feasibility of various origin theories with special emphasis on the creation vs. evolution debate. Explores the difference between origins science and operation science and analyzes the conflict in the Christian scientific community as well as the population at large. Prerequisites: SCI 111, BIO 111 or equivalents.

SCI 362 Biomedical Ethics (PHI 362) 3/4

A study of the ethical issues in modern medicine from a biblical, historical, theological and scientific perspective. The course surveys the current literature on reproductive medicine, organ transplants, genetic technologies, medical research and end-of-life concerns, with particular emphasis upon students developing a biblically-based model for ethical decision making.

SCI 380 Internship 1- 6

This course provides an opportunity to work in a supervised biological setting (e.g., DNR, nature center, public health agency). The experience must include opportunities to apply the theories and concepts learned in the discipline or to enhance biological science research skills.

SCI 461	Philosophy of Science	3/6
Analytical study of the philosophical bases of science and various interdisciplinary relationships.		
SCI 465	Secondary Science Methods	3/2
This course focuses on specific knowledge, skills, and attitudes that are demonstrated by effective science teachers in the secondary schools. Students will learn to design, organize, present, and evaluate the learning of science subject matter utilizing various instructional models and methods of teaching science.		
SCI 470	Readings in Science	1-3/1
SCI 480	Advanced Topics Seminar	3/6
SCI 490	Independent Study	1-3/1
SCI 495	Senior Research Project and Seminar	2/2
Independent laboratory and/or field research of an important scientific problem of interest to researcher and faculty mentor. Student will report findings of research before departmental faculty and science peers. Prerequisites: Senior status, majority of major field of study completed.		

AUSABLE INSTITUTE COURSES

The following courses are offered through the AuSable Trails Institute of Environmental Studies. See p. 57 for further details.

ECO 301	Land Resources	4
Systems-level perspective on land forms and ecosystems. Includes analysis and interpretation of on-site data recorded in the field, remote-sensing data derived from satellite and low-altitude aerial imagery and geographic information systems (GIS). Field trips to and analysis of forests, bogs, marshes, dunes, and rivers. Includes application to policy and land use planning. Prerequisite: One year of introductory science.		
ECO 302	Water Resources	4
Field study of lakes and streams with applications to planning and management. Includes an introduction to limnology and investigation of representative lakes and streams of the region. Prerequisite: One year of general biology and one year of general chemistry.		
ECO 303	Ecological Agriculture	4
Environmental analysis and natural resources in relation to people and policy. The focus is on ethnobotany, ecological agriculture, and land stewardship. It employs a discussion format both in classroom and field settings. Its emphasis is grappling with difficult practical and ethical problems and issues that require deep and persistent thought.		



- ECO 304 Natural Resources Practicum 4**
Global Development and Ecological Stewardship: Environmental analysis and natural resources in relation to society and development issues. The focus is on ecological sustainability and sustainable society in the context of the various factors that are bringing environmental degradation and impoverishment of people and cultures. It deals with topics of tropical agriculture, hunger, poverty, international debt, appropriate technology, relief programs, missionary earthkeeping, conservation of wild nature, land tenure, and land stewardship. It employs a discussion format both in classroom and field settings. Its emphasis is grappling with difficult practical and ethical problems and issues that require deep and persistent thought.
- ECO 305 Ornithology 4**
Biology, behavior, ecology and identification of birds. Work is primarily conducted in the field and covers the major habitats of northern lower Michigan, including wetlands, lakes, rivers, forests, dunes, and open field communities. Emphasis will be placed on identification of the spring bird fauna of northern lower Michigan by sight and by call. Prerequisite: One course in introductory biology or zoology.
- ECO 310 Winter Biology 4**
Biology and environment of Northern Michigan plants and animals in winter condition. Lectures, films, and field experience. Prerequisite: One course in biology.
- ECO 311 Field Botany 4**
Field identification and ecology of vascular plants as components of natural communities in Michigan. Emphasis is placed upon on-site examination of plants in communities such as bog, dune, forest, marsh, meadow, and swamp. Plants difficult to study under field conditions are brought to the laboratory for microscopic examination and identification. Ecological features such as community stratification and plant zonation along ecological gradients are examined. Prerequisite: One year of general biology or one semester of botany.
- ECO 312 Insect Biology and Ecology 4**
A study of insect taxonomy, ecology, life histories, and economic importance. Special attention is given to environmental stewardship issues including use of insecticides, biological control, integrated pest management, and impact of cultivation on formation of pest faunas. Field methods are stressed.
- ECO 315 Woody Plants 4**
Taxonomy, ecology, management, and stewardship of trees and shrubs. Presents the systematic botany of local woody flora including identification by foliage, twigs, wood and bark, and trees of major economic importance worldwide. Given in the context of ethical and global questions of deforestation, global warming trends, old growth forest values, lumbering, forest ecosystem restoration, and land stewardship. Prerequisite: One year of general biology or one semester of botany.
- ECO 321 Animal Ecology 4**
Interrelationships between animals and their biotic and physical environments emphasizing behavioral aspects. A field course that centers on the ecology of northern Michigan fauna from a stewardship perspective. Included are individual student projects. Prerequisite: One year of introductory science.

- ECO 322 Aquatic Biology 4**
Ecology, identification, systematics, culture and care of aquatic plants and animals, and adaptations to freshwater environments. Aquatic life is studied in lakes, ponds, bogs, marshes, streams, and in the laboratory. The course assesses human impact on aquatic species and ecosystems, presents procedures for the stewardship of aquatic habitats, and introduces aquatic restoration ecology. Prerequisite: One year of general biology or one semester each of general zoology and general botany.
- ECO 332 Environmental Chemistry 4**
Principles and analysis of chemical movement and distribution both natural and human-induced in natural environments. Sampling and analytical methods are included for water, soil, and air. Work is conducted both on site in natural habitats and the laboratory. Prerequisite: One year of general chemistry and one semester of either biochemistry or organic chemistry.
- ECO 346 Winter Stream Ecology 4**
Geological, physical and chemical features of streams in winter with a focus on ecological interactions and applications to the stewardship of streams and watersheds. Not open to students who have taken ECO 322.
Prerequisite: One year of general biology.
- ECO 350 Environmental Ethics 4**
Contemporary problems of environmental stewardship are investigated, including use of renewable and non-renewable natural resources, pollution, appropriate land use and development, their world concerns and preservation of wild nature. These problems are set in a historical perspective of human relationships to the natural environment, especially as this relationship is viewed in the light of Christian thought and doctrine. Current attempts to develop a theology of nature and principles of Christian stewardship are considered.
- ECO 361 Natural History in Spring 4**
Springtime plants and animals, their field identification, field biology, behavior and landscape context with a focus on spring flora, amphibia, and birds.
- ECO 411 Advanced Field Botany 4**
Extended field identification and ecology of vascular plants as components of natural communities. Selection and study of a specific plant community for intensive taxonomic and ecological research and preparation of herbarium specimens according to established museum techniques. Taught concurrently with ECO 311. Students who take this as their only course during a given academic session must also enroll in ECO 499 Research for two credits. Prerequisite: Biol 311 Field Botany taken at another Au Sable Institute location.
- ECO 427 Ecology of the Indian Tropics 4**
Tropical ecology of South India, including an introduction to and comparative analysis of coastal ecosystems, the plains, and montane tropical ecosystems of the Western Ghats including altitudinal zonation. The course will be taught on-site at a variety of ecosystem preserves and national parks. If suitable arrangements can be made, a number of ecosystems will be studied on the Andaman Islands. Topics include tropical ecosystem structure and function, adaptations of flora and fauna, biodiversity surveys, past and present human interactions with the landscape, and autecology of selected plant and animal species. Prerequisite: Upper division standing and at least one ecology course (preferably completed at AuSable).



ECO 471 Conservation Biology**4**

Principles of conservation biology with applications to sustainable human society and biospheric integrity. An integrative approach to biology and society that interrelates population biology, ecological principles, biogeochemical cycles, ecosystem functions, and human society in the context of biospheric degradation. The course develops a stewardship perspective rooted in biological principles and directed at conservation of plant and animal species, biotic communities, ecosystems, and human society. Included are topics of human development, poverty, and economic growth.

Prerequisite: One year in biology and one course in ecology, or permission of professor.

ECO 482 Restoration Ecology**4**

Ecological foundations and techniques for ecosystem and biotic community restoration. This course applies ecological principles and environmental ethics to redeeming and restoring degraded and damaged ecosystems and endangered species. Field studies include analysis of restoration and rehabilitation work with the Kirtland Warbler, an officially designated wild river, coastal dunes, kettlehole bogs, old growth forest, deforested lands, degraded residential and farming sites, and abandoned oil wells. A practical field laboratory is included in which techniques are applied to a specific site.

ECO 499 Directed Independent Research**4**

Field or laboratory study of a problem selected by the student in consultation with a professor and presented as a written proposal in advance of the session in which the study is to be conducted. Normally, problems are outgrowths of previous coursework with a given professor. Prerequisite: Permission of professor.