



Cornerstone
UNIVERSITY®
BUILD A LIFE THAT MATTERS

Grand Rapids, Michigan

KINESIOLOGY, SCIENCE, ENGINEERING & MATHEMATICS DIVISION



Ned Keller, Ph.D.
Division Chair

The Kinesiology, Science, Engineering and Math Division equips students to love and worship Christ through the study of His creation. Mathematics explores the beauty and order of creation as revealed through symbolic representation and logical implications. The physical sciences explore matter and its interactions. The biological sciences explore life in all of its intricate design. Kinesiology explores human movement and its effects. All of these areas are explored from the foundational theme that as God's image-bearers, humans are called to wisely steward God's marvelous creation.

Students who major or minor in KSEM Division fields will be equipped to influence their culture for Christ as skilled professionals in health care, education, the sciences and other important segments of society. Specifically, the division offers majors in biology, environmental biology, engineering, exercise science and for teacher education, majors in integrated science, mathematics and physical education. Pre-medical, pre-veterinary, pre-dental, pre-physician's assistant and pre-pharmacy students are well prepared for their professional education through their individual major. Minors may be taken in biology, chemistry, coaching, general science, integrated science, mathematics and physical education.

Cornerstone University is distinguished by its emphasis on the hands-on, experiential study of nature and is a founding member of the AuSable Institute of Environmental Studies. Cornerstone students can participate in the AuSable Institute field programs as part of their degree requirements.

DEGREES

Associate of Science (A.S.)
Bachelor of Arts (B.A.)
Bachelor of Science (B.S.)
Bachelor of Science in
Engineering (B.S.E.)

MAJORS

Biology (B.A.)
Biology (Secondary; B.A.)
Engineering (B.S.E.)
Data Science
Design and Innovation
Environmental
Management
Environmental Biology (B.S.)
Naturalist
Water Resources
Wildlife Biology
Exercise Science (B.S.)
Cardiovascular Rehabilitation
Pre-Occupational Therapy
Pre-Physical Therapy
Integrated Comprehensive Science
(Secondary; B.A.)
Integrated Science Major
(Elem & Secondary; B.A.)
Mathematics (B.A. & B.S.)
Mathematics (Secondary; B.A.)
Physical Education (K-12; B.A.)
Pre-Dental (B.S.)
Pre-Medical (B.S.)
Pre-Pharmacy (B.S.)
Pre-Physician's Assistant (B.S.)
Pre-Veterinary (B.S.)

MINORS

Biology
Biology (Secondary)
Chemistry
Chemistry (Secondary)
Coaching
General Science
Integrated Science (Elementary)
Mathematics
Mathematics (Elementary &
Secondary)
Physical Education
Physical Education for Secondary

PROGRAMS

AuSable Institute

FACULTY

Keller, Charles N., Professor of Science (Chair); B.A. and B.S., University of Kansas; Ph.D., University of Kansas

Crompton, Nigel E.A., Professor of Biology; B.Sc., Victoria University of Manchester, England; M.Sc., Victoria University of Manchester, England; Ph.D., Justus-Liedig University of Giessen, Germany; D.Sc., University of Zurich, Switzerland

Devereaux, Stephen M., Assistant Professor of Mathematics; B.S., Cedarville University; M.A., Western Michigan University; Ph.D., Western Michigan University

Fryling, James A., Professor of Chemistry; B.S., United States Air Force Academy; M.S., Ph.D., University of Arizona; M.A., Grand Rapids Theological Seminary

Gates, Raymond R., Associate Professor of Biology; B.A., Spring Arbor University; M.S., Central Michigan University

Greene, Michael K., Assistant Professor of Engineering; B.S., Auburn University; M.S., Naval Postgraduate School

Hoffman, Robert K., Assistant Professor of Mathematics; B.S., Western Michigan University; M.A., Western Michigan University

Keys, Robert S., Professor of Science; B.A., Cornerstone University; M.Ed., Gannon University; Ph.D., Western Michigan University

Sackett, James R., Assistant Professor of Kinesiology; B.A., Adrian College; M.S., Ball State University; Ph.D., University at Buffalo

Wideman, Charles, Instructor of Science; B.A., Cornerstone University; B.S., Calvin College

Williams, Sherry, Assistant Professor of Kinesiology; B.A., Central Michigan University; M.A., Western Michigan University

Zainea, Kimberly A., Associate Professor of Kinesiology; B.A., Cedarville College; M.A., University of Dayton

CRITERIA FOR GRADUATION AS A DIVISION MAJOR

See in the Academic Information section under Graduation Requirements.

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.

ASSOCIATE OF SCIENCE

HEALTH SERVICES

Required Courses

Credit Hours

General Education Core

COM-112	Communication in Culture	3
ENG-212	Writing in Culture	3
ENG-223	Intro to Literature	3
HIS-114	World Civilization II	3
HUM-311	Imagination in Culture	3
IDS-103	CU Foundations	1
IDS-104	CU Foundations	1
MAT-108	Intermediate Algebra	3
MAT-151/BUS-211	Statistics	3
PHI-211	Philosophy in Culture	3
PSY-111	Intro to Psychology	3
PSY-235	Lifespan Development Psychology	3
REL-104	Old Testament Literature	3
REL-204	New Testament Literature	3
SOC-111	Intro to Sociology	3

Science Courses

BIO-151	General Biology	4
BIO-241	Anatomy & Physiology I	4
BIO-242	Anatomy & Physiology II	4
BIO-347	Intro to Nutrition	3
BIO-352	Microbiology	4
CHM-111	Principles of General Chemistry	4
CHM-212	Principles of Organic and Biochemistry	4
SCI-345	Epidemiology for Nursing	3

Total **71**

NOTE: A qualified Pathophysiology must be taken prior to entry at Detroit Mercy. Students must meet both English and Math competency requirements. See Degree Information Section.

BACHELOR OF ARTS MAJORS & MINORS

BIOLOGY MAJOR *(requires a minor)*

General Education Core requirements for the Bachelor of Arts degree are listed in the Degree Information section.

Required Courses	Credit Hours
BIO-151 General Biology.....	4
BIO-225 Botany.....	4
BIO-233 Zoology.....	4
BIO-351 Genetics.....	4
BIO-400 Capstone Seminar: Bioethics & Argument Theory.....	3
SCI-380 Internship.....	3
SCI-495 Senior Research Project.....	1
SCI-496 Senior Research Seminar.....	1
Electives in Biology/Ecology (must be upper-level).....	12
Total.....	36

Required Cognates*

CHM-111 Principles of General Chemistry.....	4
CHM-212 Principles of Organic and Biochemistry.....	4
Electives in Mathematics (<i>Not MAT-096, 107, 108, 110, or 312</i>).....	6

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

BIOLOGY MINOR

Required Courses	Credit Hours
BIO-151 General Biology.....	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 *(requires a minor)*

General Education Core requirements for the Bachelor of Arts degree are listed in the Degree Information section.

Required Courses	Credit Hours
BIO-151 General Biology.....	4
BIO-161 Human Biology.....	4
BIO-225 Botany.....	4
BIO-233 Zoology.....	4
BIO-351 Genetics.....	4
BIO-400 Capstone Seminar: Bioethics & Argument Theory.....	3
BIO-451 Molecular Cell Biology.....	4
ECO-341 Ecology.....	4
SCI-361 Evolution & Origins.....	3
Total.....	34

Required Cognates*

CHM-111 Principles of General Chemistry.....	4
CHM-212 Principles of Organic and Biochemistry.....	4
MAT-151 Statistics.....	3
SCI-465 Secondary Science Methods.....	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 General Biology.....	4
BIO-161 Human Biology.....	4
BIO-225 Botany.....	4
BIO-233 Zoology.....	4
ECO-341 Ecology.....	4
Total.....	20

Required Cognate*

CHM-111 Principles of General Chemistry.....	4
SCI-465 Secondary Science Methods.....	3

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

INTEGRATED SCIENCE GROUP MAJOR FOR ELEMENTARY TEACHERS *(requires a minor)*

Required Courses		Credit Hours
Earth/Space Science		
ECO-241	Environmental Science	4
SCI-261	Astronomy	4
SCI-262	Geology	4
SCI-263	Atmosphere & Weather	2
SCI-400	Capstone Seminar: Integrated Science	2
Life Sciences		
BIO-151	General Biology	4
BIO-161	Human Biology	4
BIO-233	Zoology	4
Physical Sciences		
CHM-111	Principles of General Chemistry	4
PHY-211	General Physics I (Prerequisite: MAT-121, 122 or 131)	4
SCI-201	Integrated Science for Elementary Teachers (core requirement)	3
Total39

INTEGRATED SCIENCE GROUP MINOR FOR ELEMENTARY TEACHERS

Required Courses		Credit Hours
Earth/Space Science		
SCI-261	Astronomy	4
SCI-262	Geology	4
SCI-263	Atmosphere & Weather	2
SCI-400	Capstone Seminar: Integrated Science	2
Life Sciences		
BIO-151	General Biology	4
ECO-241	Environmental Science	4
Physical Sciences		
CHM-111	Principles of General Chemistry	4
SCI-201	Integrated Science for Elementary Teachers (core requirement)	3
Total27

INTEGRATED SCIENCE MAJOR FOR SECONDARY TEACHERS *(requires a minor)*

Required Courses		Credit Hours
Comprehensive		
ECO-241	Environmental Science	4
SCI-361	Evolution & Origins	3
SCI-400	Capstone Seminar: Integrated Science	2
Earth/Space Science		
SCI-261	Astronomy	4
SCI-262	Geology	4
SCI-263	Atmosphere & Weather	2
Life Sciences		
BIO-151	General Biology	4
BIO-233	Zoology	4
BIO-351	Genetics	4
Physical Sciences		
CHM-111	Principles of General Chemistry	4
CHM-212	Principles of Organic & Biochemistry	4
PHY-211	General Physics I (Prerequisite: MAT-121, 122 or 131)	4
Total43

INTEGRATED COMPREHENSIVE SCIENCE MAJOR FOR SECONDARY TEACHERS

(does not require a minor)

Required Courses		Credit Hours
Comprehensive		
SCI-361	Evolution & Origins	3
SCI-400	Capstone Seminar: Integrated Science	2
Earth/Space Science		
ECO-241	Environmental Science	4
SCI-261	Astronomy	4
SCI-262	Geology	4
SCI-263	Atmosphere & Weather	2

Life Sciences

BIO-151	General Biology	4
BIO-225	Botany	4
BIO-233	Zoology	4
BIO-351	Genetics	4

Physical Sciences

CHM-111	Principles of General Chemistry	4
CHM-212	Principles of Organic & Biochemistry	4
PHY-211	General Physics I (Prerequisite: MAT-121, 122 or 131)	4
PHY-212	General Physics II	4

Total **51**

MATHEMATICS MAJOR *(requires a minor)*

General Education Core: Requirements for the Bachelor of Arts degree are listed in the Degree Information section.

Required Courses		Credit Hours
MAT-131	Calculus I	5
MAT-132	Calculus II	5
MAT-233	Differential Equations	3
MAT-234	Multivariate Calculus	3
MAT-241	Applied Linear Algebra	3
MAT-244	Methods of Mathematical Research	3
MAT-245	Mathematical Proofs	3
MAT-251	Probability and Statistics	3
MAT-333	Real Analysis	3
MAT-341	Modern Algebra	3
MAT-380	Internship	3
MAT-401	Capstone Seminar for Mathematics	3
Total		40

MATHEMATICS MINOR

Required Courses		Credit Hours
MAT-131	Calculus I	5
MAT-132	Calculus II	5
MAT-241	Applied Linear Algebra	3
MAT-243	Discrete Mathematics	3
MAT-245	Mathematical Proofs	3
MAT-251	Probability and Statistics	3
<i>Two from the following: (See course listings for prerequisites)</i>		6
MAT-233	Differential Equations	
MAT-234	Multivariate Calculus	
MAT-333	Real Analysis	
MAT-341	Modern Algebra	
MAT-400	Capstone Seminar: The History of Mathematical Sciences	
Total		28

MATHEMATICS MAJOR FOR SECONDARY TEACHERS *(requires a minor)*

General Education Core: Requirements for the Bachelor of Arts degree are listed in the Degree Information section.

Required Courses		Credit Hours
MAT-131	Calculus I	5
MAT-132	Calculus II	5
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-251	Probability and Statistics	3
MAT-333	Real Analysis	3
MAT-341	Modern Algebra	3
MAT-400	Capstone Seminar: The History of Mathematical Sciences	3
Total		37

MATHEMATICS MINOR FOR ELEMENTARY TEACHERS

Required Courses		Credit Hours
MAT-131	Calculus I	5
MAT-151	Statistics	3
MAT-243	Discrete Mathematics	3
MAT-312	Elementary Mathematics & Methods and Field Experience	4
<i>Choose three of the following:</i>		9-11
MAT-110	College Math	
MAT-121	College Algebra	
MAT-122	Pre-calculus	
MAT-132	Calculus II	
MAT-233	Differential Equations	
MAT-234	Multivariate Calculus	
MAT-241	Applied Linear Algebra	
MAT-245	Mathematical Proofs	
MAT-400	Capstone Seminar: The History of Mathematical Sciences	
Total		24-26

MATHEMATICS MINOR FOR SECONDARY TEACHERS

Required Courses		Credit Hours
MAT-131	Calculus I	5
MAT-132	Calculus II	5
MAT-151	Statistics	3
MAT-241	Applied Linear Algebra	3
MAT-243	Discrete Mathematics	3
MAT-245	Mathematical Proofs	3
MAT-400	Capstone Seminar: The History of Mathematical Sciences	3
<i>One of the following:</i>		3
MAT-233	Differential Equations	
MAT-234	Multivariate Calculus	
Total		28

PHYSICAL EDUCATION MAJOR FOR K-12 CERTIFICATION *(requires a minor)*

(Secondary Program Track Only)

General Education Core: Requirements for the Bachelor of Arts degree are listed in the Degree Information section.

Students should follow the professional education program required for secondary education and will have an elementary and secondary student teaching experience.

Required Courses		Credit Hours
BIO-241	Anatomy and Physiology I	4
BIO-242	Anatomy and Physiology II	4
KIN-211	History and Principles of Kinesiology	3
KIN-243	Strategies for Teaching Physical Education K-12	3
KIN-251	Motor Development and Learning	3
KIN-342	Exercise Physiology (Prerequisite: BIO-241 and 242)	3
KIN-344	Adapted Physical Education K-12	2
KIN-345	Measurement and Evaluation	3
KIN-357	Physical Education in Preschools & Elementary Schools <i>(Prerequisite: KIN-243)</i>	3
KIN-359	Physical Education in Secondary Schools <i>(Prerequisite: KIN-243)</i>	3
KIN-362	First Aid, Injury Prevention and Treatment	3
KIN-401	Capstone Seminar: Ethics in Teaching Physical Education <i>(Professor Permission)</i>	2
KIN-441	Organization and Administration	3
KIN-461	Skill and Performance Competencies*	1
Total		40

*Students must sign up with the instructor for KIN-461 at the time they decide to major in Physical Education.

PHYSICAL EDUCATION MINOR

General Education Core: Requirements for the Bachelor of Arts degree are listed in the Degree Information section.

Required Courses	Credit Hours
BIO-241 Anatomy and Physiology I	4
BIO-242 Anatomy and Physiology II	4
KIN-211 History and Principles of Kinesiology	3
KIN-251 Motor Development and Learning	3
KIN-341 Anatomical Kinesiology (Prerequisite: BIO-241)	4
KIN-362 First Aid, Injury Prevention and Treatment	3
KIN-461 Skill and Performance Competencies*	1
<i>Choose one of the following:</i>	3
KIN-231 Principles of Coaching	
KIN-243 Strategies for Teaching Physical Education K-12	
KIN-342 Exercise Physiology	
KIN-344 Adapted Physical Education	
KIN-345 Measurement and Evaluation	
KIN-441 Organization and Administration	
Total	25

*Students must sign up with the instructor for KIN-461 at the time they decide to minor in physical education.

PHYSICAL EDUCATION MINOR FOR SECONDARY TEACHERS

Students who minor in physical education must meet the core activity program course requirements in physical education. (Grades 6-12 endorsed).

Required Courses	Credit Hours
BIO-241 Anatomy and Physiology I	4
BIO-242 Anatomy and Physiology II	4
KIN-211 History and Principles of Kinesiology	3
KIN-243 Strategies for Teaching Physical Activities K-12	3
KIN-251 Motor Development and Learning	3
KIN-344 Adapted Physical Education K-12	2
KIN-359 P.E. in Secondary Schools (Prerequisite: KIN-243)	3
KIN-362 First Aid, Injury Prevention, and Treatment (Prerequisites: BIO-241 & 242 or permission of instructor)	3
KIN-401 Capstone Seminar: Ethics in Teaching Physical Education (professor permission)	2
KIN-461 * Skill and Performance Competencies	1
Total	28

*Students must sign up with the instructor for KIN-461 at the time they decide to minor in physical education.

BACHELOR OF SCIENCE MAJORS & MINORS

CHEMISTRY MINOR (ALSO FOR SECONDARY TEACHERS)

Required Courses	Credit Hours
CHM-121 General Chemistry I	4
CHM-122 General Chemistry II	4
CHM-411 Perspectives in Chemistry	2
Chemistry Electives: (200 level or above)	8
<i>One of the following:</i>	4
CHM-212 Principles of Organic & Biochemistry	
CHM-472 Biochemistry	
Total	22

COACHING MINOR

Students enrolled in the Coaching minor must complete their lab science core requirement with BIO-241.

Required Courses	Credit Hours
BIO-242 Anatomy & Physiology II	4
KIN-231 Principles of Coaching	3
KIN-341 Anatomical Kinesiology	4
KIN-342 Exercise Physiology	3
KIN-362 First Aid & Injury Prevention	3
<i>One of the following:</i>	3
BIO-347 Intro to Nutrition	
PSY-362 Sport & Exercise Psychology	
KIN-370 Coaching Practicum	1
Total	21

ENVIRONMENTAL BIOLOGY MAJOR *(no minor required)*

General Education Core: Requirements for the Bachelor of Science degree are listed in the Degree Information section.

Biology Core Courses		Credit Hours
BIO-151	General Biology.....	4
BIO-225	Botany.....	4
BIO-233	Zoology.....	4
BIO-400	Capstone Seminar: Bioethics & Argument Theory.....	3
ECO-241	Environmental Science.....	4
ECO-341	Ecology.....	4
ECO-342	Field Biology.....	4
ECO-442	Advanced Field Studies.....	4
SCI-262	Geology.....	4
SCI-361	Evolution & Origins.....	3
SCI-380	Internship.....	3
SCI-495	Senior Research Project.....	1
SCI-496	Senior Research Seminar.....	1
Total.....		.43
Environmental Biology Specific Courses		
BIO-351	Genetics.....	4
Upper Level Elective in BIO or ECO.....		4
Upper Level AuSable Electives.....		12
<i>One of the following:</i>		4
BIO-331	Ornithology.....	
BIO-431	Vertebrate Zoology.....	
Total.....		.24
Program Total.....		.67
Required Cognates*		
CHM-111	Principles of General Chemistry.....	4
CHM-212	Principles of Organic and Biochemistry.....	4
MAT-121	College Algebra.....	3
MAT-151	Statistics.....	3
*A cognate is a course which supports the success of completing a major program		
Total Hours including Required Cognates.....		.81

ENVIRONMENTAL BIOLOGY - NATURALIST MAJOR *(no minor required)*

General Education Core: Requirements for the Bachelor of Science degree are listed in the Degree Information section.

Biology Core Courses		Credit Hours
BIO-151	General Biology.....	4
BIO-225	Botany.....	4
BIO-233	Zoology.....	4
BIO-400	Capstone Seminar: Bioethics & Argument Theory.....	3
ECO-241	Environmental Science.....	4
ECO-341	Ecology.....	4
ECO-342	Field Biology.....	4
ECO-442	Advanced Field Studies.....	4
SCI-262	Geology.....	4
SCI-361	Evolution & Origins.....	3
SCI-380	Internship.....	3
SCI-495	Senior Research Project.....	1
SCI-496	Senior Research Seminar.....	1
Total.....		.43
Environmental Naturalist Specific Courses		
COM-212	Interpersonal Communication.....	3
COM-322	Advanced Public Speaking.....	3
ECO-355	Watersheds in Global Development.....	4
ECO-361	Field Biology in Spring.....	4
ECO-482	Restoration Ecology.....	4
SCI-400	Integrated Science Capstone.....	2
SCI-465	Secondary Science Methods.....	3
<i>One of the following:</i>		4
BIO-331	Ornithology.....	
BIO-431	Vertebrate Zoology.....	
Total.....		.27
Program Total.....		.70

Required Cognates*

CHM-111	Principles of General Chemistry	4
CHM-212	Principles of Organic and Biochemistry	4
MAT-121	College Algebra	3
MAT-151	Statistics	3

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

Total Hours including Required Cognates84

ENVIRONMENTAL BIOLOGY - WATER RESOURCES MAJOR *(no minor required)*

General Education Core: Requirements for the Bachelor of Science degree are listed in the Degree Information section.

Biology Core Courses **Credit Hours**

BIO-151	General Biology	4
BIO-225	Botany	4
BIO-233	Zoology	4
BIO-400	Capstone Seminar: Bioethics & Argument Theory	3
ECO-241	Environmental Science	4
ECO-341	Ecology	4
ECO-342	Field Biology	4
ECO-442	Advanced Field Studies	4
SCI-262	Geology	4
SCI-361	Evolution & Origins	3
SCI-380	Internship	3
SCI-495	Senior Research Project	1
SCI-496	Senior Research Seminar	1

Total43

Water Resources Specific Courses

BIO-351	Genetics	4
BIO-352	Microbiology	4
BIO-431	Vertebrate Zoology	4
ECO-302	Lake Ecology and Management	4
ECO-322	Aquatic Biology	4
ECO-331	Environmental Chemistry	4

Total24

Program Total67

Required Cognates*

CHM-111	Principles of General Chemistry	4
CHM-212	Principles of Organic and Biochemistry	4
MAT-121	College Algebra	3
MAT-151	Statistics	3

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

Total Hours including Required Cognates81

ENVIRONMENTAL BIOLOGY - WILDLIFE BIOLOGY MAJOR *(no minor required)*

General Education Core: Requirements for the Bachelor of Science degree are listed in the Degree Information section.

Biology Core Courses **Credit Hours**

BIO-151	General Biology	4
BIO-225	Botany	4
BIO-233	Zoology	4
BIO-400	Capstone Seminar: Bioethics & Argument Theory	3
ECO-241	Environmental Science	4
ECO-341	Ecology	4
ECO-342	Field Biology	4
ECO-442	Advanced Field Studies	4
SCI-262	Geology	4
SCI-361	Evolution & Origins	3
SCI-380	Internship	3
SCI-495	Senior Research Project	1
SCI-496	Senior Research Seminar	1

Total43

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Wildlife Biology Specific Courses

BIO-331	Ornithology	4
BIO-351	Genetics	4
BIO-431	Vertebrate Zoology	4
ECO-301	Land Resources	4
ECO-311	Field Botany	4
ECO-345	Wildlife Ecology	4

Total **24**

Program Total **.67**

Required Cognates*

CHM-111	Principles of General Chemistry	4
CHM-212	Principles of Organic and Biochemistry	4
MAT-121	College Algebra	3
MAT-151	Statistics	3

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

Total Hours including Required Cognate **81**

Elective courses not required in major to meet potential Wildlife Certification requirements

COM-322	Advanced Public Speaking	3
ECO-310	Environmental Law & Policy	4
MAT-131	Calculus I	5
MAT-132	Calculus II	5

EXERCISE SCIENCE MAJOR *(does not require a minor)*

General Education Core: Requirements for the Bachelor of Science degree are listed in the Degree Information section.

Program Core

Credit Hours

BIO-151	General Biology	4
BIO-241	Anatomy and Physiology I	4
BIO-242	Anatomy and Physiology II	4
KIN-341	Anatomical Kinesiology <i>(Prerequisite: BIO-241)</i>	4

One of the following: 3-5

MAT-110	College Math
MAT-121	College Algebra
MAT-122	Pre-calculus
MAT-131	Calculus I

Required Courses

Credit Hours

BIO-347	Introduction to Nutrition	3
KIN-211	History and Principles of Kinesiology	3
KIN-251	Motor Development and Learning	3
KIN-342	Exercise Physiology <i>(Prerequisite: BIO-241/242 & KIN-346)</i>	3
KIN-345	Measurement and Evaluation <i>(Prerequisite: Math core requirement)</i>	3
KIN-346	Exercise Testing & Prescriptions <i>(Prerequisite: BIO-241/242)</i>	3
KIN-362	First Aid and Injury Prevention	3
KIN-380*	Internship <i>(ExSCI, PT, and OT Majors ONLY. Cardiac Rehab majors take KIN-380 in their own concentration - see below)</i>	6
KIN-400	Professional Capstone Seminar <i>(Prerequisite: MAT-151)</i>	2
MAT-151	Statistics	3

Total **51-53**

*Cardiac Rehabilitation - see below

EXERCISE SCIENCE MAJOR with a Cardiac Rehabilitation Concentration *(does not require a minor)*

This program is designed for students intending to pursue the field of Cardiac Rehabilitation following graduation. These courses will help prepare the student to sit for the American College of Sports Medicine (ACSM) Exercise Specialist Certification Exam.

In addition to the Program Specific Core and Major Courses listed previously, students must also complete the following courses:

Required Courses

Credit Hours

BIO-353	Pathophysiology	3
KIN-361	ECG (Electrocardiography)	2
KIN-364	Cardiovascular Disease and Risk Management	3
KIN-380*	Internship	12
PSY-239	Adult Psychology	3
SCI-242	Medical Terminology	2
SCI-346	Pharmacology	3

Total **28**

*500 documented clinical hours in one experience required to take ACSM certification exam

EXERCISE SCIENCE MAJOR with a Pre-Occupational Therapy Concentration *(does not require a minor)*

This program is designed for students intending to pursue graduate education in Occupational Therapy. These courses represent the most common pre-requisite courses for OT programs, but it remains the student's responsibility to ensure that their desired graduate school's requirements have been met.

In addition to the Program Specific Core and Major Courses listed previously, students must also complete the following courses:

Required Courses		Credit Hours
PSY-111	General Psychology	3
PSY-235	Lifespan Development Psychology	3
PSY-353	Abnormal Psychology	3
PSY-441	Physiological Psychology	3
SOC-111	Introduction to Sociology	3
SCI-242	Medical Terminology	2
Total		17

EXERCISE SCIENCE MAJOR with a Pre-Physical Therapy Concentration *(does not require a minor)*

This program is designed for students intending to pursue graduate education in Physical Therapy. These courses represent the most common pre-requisite courses for PT programs, but it remains the student's responsibility to ensure that their desired graduate school's requirements have been met.

In addition to the Program Specific Core and Major Courses listed previously, students must also complete the following courses:

Required Courses		Credit Hours
PHY-211	General Physics I	4
PHY-212	General Physics II	4
PSY-111	General Psychology	3
<i>One of the following:</i>		3-5
MAT-121	College Algebra	
MAT-122	Pre-calculus	
MAT-131	Calculus I	
<i>One of the following options:</i>		4-8
CHM-111	Principles of General Chemistry	
CHM-121/122	General Chemistry I & II	
Total		18-24

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 *(does not require a minor)*

General Education Core requirements for the Bachelor of Science degree are listed in the Degree Information section.

Required Courses		Credit Hours
MAT-131	Calculus I	5
MAT-132	Calculus II	5
MAT-233	Differential Equations	3
MAT-234	Multivariate Calculus	3
MAT-241	Applied Linear Algebra	3
MAT-244	Methods of Mathematical Research	3
MAT-245	Mathematical Proofs	3
MAT-251	Probability and Statistics	3
MAT-333	Real Analysis	3
MAT-341	Modern Algebra	3
MAT-380	Internship	3
MAT-401	Capstone Seminar for Mathematics	3
MAT-480	Advanced Topics in Mathematical Sciences	3
PHY-221	Physics for Scientists and Engineers I	5
Total		48

PRE-DENTAL MAJOR *(does not require a minor)*

General Education Core requirements for the Bachelor of Science degree are listed in the Degree Information section.

Biology Core Courses		Credit Hours
BIO-151	General Biology.....	4
BIO-233	Zoology.....	4
BIO-351	Genetics.....	4
BIO-400	Capstone Seminar: Bioethics & Argument Theory.....	3
SCI-361	Evolution & Origins.....	3
SCI-380	Internship.....	3
SCI-495	Senior Research Project.....	1
SCI-496	Senior Research Seminar.....	1
Total.....		23

Pre-Dental		Credit Hours
BIO-241	Anatomy & Physiology I.....	4
BIO-242	Anatomy & Physiology II.....	4
BIO-352	Microbiology.....	4
BIO-451	Molecular Cell Biology.....	4
<i>Choose at least two of the following:</i>		6-8
BIO-347	Intro to Nutrition	
BIO-353	Pathophysiology	
BIO-431	Vertebrate Zoology	
CHM-472	Biochemistry	
SCI-346	Pharmacology	
SCI-423	Neuroscience	
Total.....		22-24

Required Cognate* (satisfies minor requirement)

Required Courses		Credit Hours
CHM-121	General Chemistry I.....	4
CHM-122	General Chemistry II.....	4
CHM-230	Organic Chemistry I Lab.....	2
CHM-231	Organic Chemistry I.....	3
CHM-232	Organic Chemistry II.....	3
CHM-233	Organic Chemistry II Lab.....	2
MAT-151	Statistics.....	3
PHY-211	Physics I.....	4
PHY-212	Physics II.....	4
<i>One of the following:</i>		3-5
MAT-121	College Algebra	
MAT-122	Pre-calculus	
MAT-131	Calculus I	

Total.....		32-34
Total Program Hours.....		77-81

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

PRE-MEDICAL MAJOR *(does not require a minor)*

General Education Core requirements for the Bachelor of Science degree are listed in the Degree Information section.

Biology Core Courses		Credit Hours
BIO-151	General Biology.....	4
BIO-233	Zoology.....	4
BIO-351	Genetics.....	4
BIO-400	Capstone Seminar: Bioethics & Argument Theory.....	3
SCI-361	Evolution & Origins.....	3
SCI-380	Internship.....	3
SCI-495	Senior Research Project.....	1
SCI-496	Senior Research Seminar.....	1
Total.....		23

Pre-Medical		Credit Hours
BIO-241	Anatomy & Physiology I.....	4
BIO-242	Anatomy & Physiology II.....	4
BIO-352	Microbiology.....	4
BIO-451	Molecular Cell Biology.....	4
<i>Choose at least two of the following:</i>		6-8
BIO-347	Intro to Nutrition	
BIO-353	Pathophysiology	
BIO-431	Vertebrate Zoology	
CHM-472	Biochemistry	

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KIN-341	Anatomical Kinesiology
KIN-342	Exercise Physiology
KIN-346	Exercise Testing & Prescription
SCI-423	Neuroscience
SCI-346	Pharmacology

Total **22-24**

Required Cognate* (satisfies minor requirement)

Required Courses		Credit Hours
CHM-121	General Chemistry I	4
CHM-122	General Chemistry II	4
CHM-230	Organic Chemistry I Lab	2
CHM-231	Organic Chemistry I	3
CHM-232	Organic Chemistry II	3
CHM-233	Organic Chemistry II Lab	2
MAT-151	Statistics	3
PHY-211	Physics I	4
PHY-212	Physics II	4
PSY-111	General Psychology	3
SOC-111	Introduction to Sociology	3
<i>One of the following:</i>		3-5
MAT-121	College Algebra	
MAT-122	Pre-calculus	
MAT-131	Calculus I	

Total **38-40**

Total Program Hours **83-87**

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

PRE-PHARMACY MAJOR (*does not require a minor*)

General Education Core requirements for the Bachelor of Science degree are listed in the Degree Information section.

Biology Core Courses		Credit Hours
BIO-151	General Biology	4
BIO-233	Zoology	4
BIO-351	Genetics	4
BIO-400	Capstone Seminar: Bioethics & Argument Theory	3
SCI-361	Evolution & Origins	3
SCI-380	Internship	3
SCI-495	Senior Research Project	1
SCI-496	Senior Research Seminar	1

Total **23**

Pre-Pharmacy		Credit Hours
BIO-241	Anatomy & Physiology I	4
BIO-242	Anatomy & Physiology II	4
BIO-352	Microbiology	4
BIO-451	Molecular Cell Biology	4
CHM-472	Biochemistry	4
<i>Choose at least one of the following:</i>		3-4
BIO-347	Intro to Nutrition	
BIO-353	Pathophysiology	
BIO-431	Vertebrate Zoology	
SCI-346	Pharmacology	
SCI-423	Neuroscience	

Total **23-24**

Required Cognate* (satisfies minor requirement)

Required Courses		Credit Hours
CHM-121	General Chemistry I	4
CHM-122	General Chemistry II	4
CHM-230	Organic Chemistry I Lab	2
CHM-231	Organic Chemistry I	3
CHM-232	Organic Chemistry II	3
CHM-233	Organic Chemistry II Lab	2
MAT-131	Calculus I	5
MAT-151	Statistics	3
PHY-211	Physics I	4
PHY-212	Physics II	4

Total **34**

Total Program Hours **80-81**

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

PRE-PHYSICIAN'S ASSISTANT MAJOR *(does not require a minor)*

General Education Core requirements for the Bachelor of Science degree are listed in the Degree Information section.

Biology Core Courses		Credit Hours
BIO-151	General Biology.....	4
BIO-241	Anatomy & Physiology I.....	4
BIO-242	Anatomy & Physiology II.....	4
BIO-351	Genetics.....	4
BIO-352	Microbiology.....	4
BIO-400	Capstone Seminar: Bioethics & Argument Theory.....	3
SCI-361	Evolution & Origins.....	3
SCI-380	Internship.....	3
SCI-495	Senior Research Project.....	1
SCI-496	Senior Research Seminar.....	1
Total.....		31

Pre-Professional		Credit Hours
<i>Choose one of the following:</i>		2-4
BIO-347	Intro to Nutrition	
BIO-353	Pathophysiology	
BIO-451	Molecular Cell Biology	
KIN-341	Anatomical Kinesiology	
KIN-342	Exercise Physiology	
KIN-346	Exercise Testing & Prescription	
SCI-242	Medical Terminology	
SCI-346	Pharmacology	
SCI-423	Neuroscience	
Total.....		33-35

Required Cognate* (satisfies minor requirement)

Required Courses		Credit Hours
CHM-121	General Chemistry I.....	4
CHM-122	General Chemistry II.....	4
CHM-212	Principles of Organic & Biochemistry.....	4
MAT-151	Statistics.....	3
PSY-111	General Psychology.....	3
PSY-235	Lifespan Development Psychology.....	3
<i>One of the following:</i>		3-4
MAT-121	College Algebra	
MAT-122	Pre-calculus	
<i>Choose one of the following groups:</i>		4-5
Group One:		
CHM-230	Organic Chemistry I Lab	
CHM-231	Organic Chemistry I	
Group Two:		
PHY-211	Physics I	
Total.....		28-30

Total Program Hours..... **61-65**

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

NOTE: Students pursuing the PA pre-professional major should be aware that graduate PA programs vary greatly in the prerequisite courses required to enter those programs. Electives should be chosen to satisfy the entry requirements for the school of interest to the student. Note that in addition to the curricular requirements, most PA graduate programs require from 500 to 1000 verified hours of health care or helping care experience.

PRE-VETERINARY MAJOR *(does not require a minor)*

General Education Core requirements for the Bachelor of Science degree are listed in the Degree Information section.

Biology Core Courses		Credit Hours
BIO-151	General Biology.....	4
BIO-233	Zoology.....	4
BIO-351	Genetics.....	4
BIO-400	Capstone Seminar: Bioethics & Argument Theory.....	3
SCI-361	Evolution & Origins.....	3
SCI-380	Internship.....	3
SCI-495	Senior Research Project.....	1
SCI-496	Senior Research Seminar.....	1
Total.....		23

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Pre-Veterinary		Credit Hours
BIO-241	Anatomy & Physiology I	4
BIO-242	Anatomy & Physiology II	4
BIO-352	Microbiology	4
BIO-431	Vertebrate Zoology	4
BIO-451	Molecular Cell Biology	4
<i>Choose at least one of the following:</i>		3-4
BIO-347	Intro to Nutrition	
BIO-353	Pathophysiology	
CHM-472	Biochemistry	
SCI-361	Pharmacology	
SCI-423	Neuroscience	
Total		23-24

Required Cognate* (satisfies minor requirement)

Required Courses		Credit Hours
CHM-121	General Chemistry I	4
CHM-122	General Chemistry II	4
CHM-230	Organic Chemistry I Lab	2
CHM-231	Organic Chemistry I	3
CHM-232	Organic Chemistry II	3
CHM-233	Organic Chemistry II Lab	2
MAT-151	Statistics	3
PHY-211	Physics I	4
PHY-212	Physics II	4
<i>One of the following:</i>		3-5
MAT-121	College Algebra	
MAT-122	Pre-calculus	
MAT-131	Calculus I	
Total		32-34

Total Program Hours	78-81
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*A cognate is a course that supports the success of completing the major program.

BACHELOR OF SCIENCE IN ENGINEERING MAJORS

DATA SCIENCE ENGINEERING MAJOR *(does not require a minor)*

General Education Core requirements for the Bachelor of Science in Engineering degree are listed in the Degree Information section.

Engineering Core Courses		Credit Hours
CHM-111	Chemistry I (CU)	4
EGR-214	Circuit Analysis I (CU)	4
EGR-220	Measurement & Data Analysis (CU)	1
EGR-226	Introduction to Digital Systems (CU)	4
EGR-380	Internship (min. 2 experiences) (CU)	6
EGR-485	Capstone Project & Ethics (CU)	1
EGR-486	Capstone Project II (CU)	2
GEGR-106	Introduction to Engineering Design I (GVSU)	3
GEGR-107	Introduction to Engineering Design II (GVSU)	3
GEGR-209	Mechanics and Machines (GVSU)	4
GEGR-250	Materials Science and Engineering (GVSU)	4
GEGR-309	Machine Design I (GVSU)	4
GEGR-345	Dynamic Systems Modeling & Control (GVSU)	4
MAT-131	Calculus I (CU)	5
MAT-132	Calculus II (CU)	5
MAT-234	Multivariate Calculus (CU)	3
MAT-235	Differential Equations & Linear Algebra for Engineers (CU)	3
MAT-251	Probability and Statistics (CU)	3
PHY-221	Physics for Science & Engineering I (CU)	5
PHY-222	Physics for Science & Engineering II (CU)	5
<i>Choose one of the following:</i>		4
GEGR-360	Thermodynamics (GVSU)	
GEGR-362	Thermal & Fluid Systems (GVSU)	
Total		77

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Data Science Major

CIS-216	Introduction to Data Management (CU)	3
CIS-218	Introduction to Application Dev (CU)	3
CIS-335	Data Mining (GVSU)	3
EGR-336	Project Management (CU)	3
GEGR-367	Manufacturing Processes (GVSU)	4
GEGR-440	Production Models (GVSU)	3
GSTA-216	Intermediate Applied Statistics (GVSU)	3
GSTA-321	Applied Regression (GVSU)	3
GSTA-426	Multivariate Data Analysis (GVSU)	3
Total		28
Program Total		105

DESIGN & INNOVATION ENGINEERING MAJOR *(does not require a minor)*

General Education Core requirements for the Bachelor of Science in Engineering degree are listed in the Degree Information section.

Engineering Core Courses		Credit Hours
CHM-111	Chemistry I (CU)	4
EGR-214	Circuit Analysis I (CU)	4
EGR-220	Measurement & Data Analysis (CU)	1
EGR-226	Introduction to Digital Systems (CU)	4
EGR-380	Internship (min. 2 experiences) (CU)	6
EGR-485	Capstone Project & Ethics (CU)	1
EGR-486	Capstone Project II (CU)	2
GEGR-106	Introduction to Engineering Design I (GVSU)	3
GEGR-107	Introduction to Engineering Design II (GVSU)	3
GEGR-209	Mechanics and Machines (GVSU)	4
GEGR-250	Materials Science and Engineering (GVSU)	4
GEGR-309	Machine Design I (GVSU)	4
GEGR-345	Dynamic Systems Modeling & Control (GVSU)	4
MAT-131	Calculus I (CU)	5
MAT-132	Calculus II (CU)	5
MAT-234	Multivariate Calculus (CU)	3
MAT-235	Differential Equations & Linear Algebra for Engineers (CU)	3
MAT-251	Probability and Statistics (CU)	3
PHY-221	Physics for Science & Engineering I (CU)	5
PHY-222	Physics for Science & Engineering II (CU)	5
	Choose one of the following:	4
	GEGR-360 Thermodynamics (GVSU)	
	GEGR-362 Thermal & Fluid Systems (GVSU)	
Total		77

Design & Innovation Engineering Major

EGR-336	Project Management (CU)	3
GEGR-301	Analytical Tools for Product Design (GVSU)	4
GEGR-367	Manufacturing Processes (GVSU)	4
IDS-101	Creativity, Innovation and Problem Solving (CU)	2
IDS-202	Creativity in the Conceptual Age (CU)	4
IDS-205	Strategies for Innovative Thought & Design I (CU)	3
IDS-312	Science of Human Innovation (CU)	3
IDS-313	Strategies for Innovative Thought & Design II (CU)	3
IDS-413	Strategies for Innovative Thought & Design III (CU)	3
MDA-112	Design Drawing I (CU)	3
Total		32
Program Total		109

ENGINEERING MANAGEMENT MAJOR *(does not require a minor)*

General Education Core requirements for the Bachelor of Science in Engineering degree are listed in the Degree Information section.

Engineering Core Courses		Credit Hours
CHM-111	Chemistry I (CU)	4
EGR-214	Circuit Analysis I (CU)	4
EGR-220	Measurement & Data Analysis (CU)	1
EGR-226	Introduction to Digital Systems (CU)	4
EGR-380	Internship (min. 2 experiences) (CU)	6
EGR-485	Capstone Project & Ethics (CU)	1

EGR-486	Capstone Project II (CU)	2
GEGR-106	Introduction to Engineering Design I (GVSU)	3
GEGR-107	Introduction to Engineering Design II (GVSU)	3
GEGR-209	Mechanics and Machines (GVSU)	4
GEGR-250	Materials Science and EGR (GVSU)	4
GEGR-309	Machine Design I (GVSU)	4
GEGR-345	Dynamic Systems Modeling & Control (GVSU)	4
MAT-131	Calculus I (CU)	5
MAT-132	Calculus II (CU)	5
MAT-234	Multivariate Calculus (CU)	3
MAT-235	Differential Equations & Linear Algebra for Engineers (CU)	3
MAT-251	Probability and Statistics (CU)	3
PHY-221	Physics for Science & Engineering I (CU)	5
PHY-222	Physics for Science & Engineering II (CU)	5
	<i>Choose one of the following:</i>	4
	GEGR-360 Thermodynamics (GVSU)	
	GEGR-362 Thermal & Fluid Systems (GVSU)	
Total		77

Management Major

ACC-221	Accounting I (CU)	3
ACC-222	Accounting II (CU)	3
ECN-232	Microeconomics (CU)	3
EGR-336	Project Management (CU)	3
GEGR-367	Manufacturing Processes (GVSU)	4
GEGR-440	Production Models (GVSU)	3
MGT-231	Principles of Management (CU)	3
	<i>Choose two of the following:</i>	6
	FIN-341 Principles of Finance (CU)	
	MGT-333 Operations Management (CU)	
	MGT-335 Organizational Behavior (CU)	
	MGT-337 Entrepreneurship (CU)	
	MKT-251 Principles of Marketing (CU)	
Total		28

Program Total **105**

ENVIRONMENTAL ENGINEERING MAJOR *(does not require a minor)*

General Education Core requirements for the Bachelor of Science in Engineering degree are listed in the Degree Information section.

Engineering Core Courses		Credit Hours
CHM-111	Chemistry I (CU)	4
EGR-214	Circuit Analysis I (CU)	4
EGR-220	Measurement & Data Analysis (CU)	1
EGR-226	Introduction to Digital Systems (CU)	4
GEGR-106	Introduction to Engineering Design I (GVSU)	3
GEGR-107	Introduction to Engineering Design II (GVSU)	3
GEGR-209	Mechanics and Machines (GVSU)	4
GEGR-250	Materials Science and Engineering (GVSU)	4
GEGR-309	Machine Design I (GVSU)	4
GEGR-345	Dynamic Systems Modeling & Control (GVSU)	4
EGR-380	Internship (min. 2 experiences) (CU)	6
EGR-485	Capstone Project & Ethics (CU)	1
EGR-486	Capstone Project II (CU)	2
MAT-131	Calculus I (CU)	5
MAT-132	Calculus II (CU)	5
MAT-234	Multivariate Calculus (CU)	3
MAT-235	Differential Equations & Linear Algebra for Engineers (CU)	3
MAT-251	Probability and Statistics (CU)	3
PHY-221	Physics for Science & Engineering I (CU)	5
PHY-222	Physics for Science & Engineering II (CU)	5
	<i>Choose one of the following:</i>	4
	GEGR-360 Thermodynamics (GVSU)	
	GEGR-362 Thermal & Fluid Systems (GVSU)	
Total		77

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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. **Lab fee applied.** *Corequisite: CHM-232.*

COMPUTER INFORMATION SYSTEMS

Grand Valley State University

GCIS-335 **Data Mining** **3/2**
Data mining is the application of computational techniques to the discovery of useful information in large data sets. This course will provide a hands-on study of computational methods for such knowledge discovery. Topics include clustering, classification techniques, and selected data mining software. Course offered winter semester. *Prerequisites: CIS-218 and MAT-251.*

ECOLOGY

ECO-241 **Environmental Science** **4/2**
Studies how ecological principles, philosophy, economics, sociology and politics interact with identifying and solving environmental issues. Topics include: air quality, water quantity and quality, population dynamics, energy sources, types of waste, sustainability, environmental policy and legislation, and pertinent government agencies. Lecture and lab. **Lab fee applied.**

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. **Lab fee applied.** *Prerequisites: EGR-106 or BIO-225 and 233, and MAT-151.*

ECO-342 **Field Biology** **4/4**
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. **Lab fee applied.** *Prerequisites: EGR-106 or BIO-225 and BIO-233*

ECO-442 **Advanced Field Studies** **variable credit/6**
A field-oriented course in the study of the relationships of the fauna and flora of special segment of the biosphere such as Northern Ireland, Yellowstone National Park or the Florida peninsula. Students spend most of the time on location experiencing the ecology of the area. **Lab fee applied.**

ENGINEERING

Cornerstone University

EGR-214 **Circuit Analysis I** **4/6**
The first of a two-course sequence in linear circuit analysis. Topics include Ohm's Law, Kirchhoff's Laws, node voltage and mesh current analysis, Thevenin's and Norton's Theorems, superposition, basic operation of diodes, transistors, operational amplifiers and transformers, capacitance, inductance, and time-domain analysis of first order circuits. **Lab fee applied.** *Prerequisite: PHY-222*

EGR-220 **Measurement and Data Analysis** **1/6**
Measurement and data analysis lab that complements MAT-234. This course uses hands-on engineering tests and experiments to build understanding of applied statistical analysis. The use of various measurement and data-acquisition tools and data analysis techniques are introduced. Technical writing in the form of lab reports is introduced and emphasized. *Prerequisites: MAT-131 and ENG-212. Co-requisite: MAT-251.*

EGR-226 **Introduction to Digital Systems** **4/6**
A first course in the analysis and design of digital systems. Provides an introduction to digital systems and microcontroller programming, Boolean algebra, combinational and sequential logic, microprocessor architecture, C programming for microcontrollers. Laboratory. **Lab fee applied.** *Prerequisites: Grade of C or better in GEGR-107.*

EGR-336 **Project Management** **3/2**
This course will examine key factors related to successful completion of both large and small projects. Topics will include project selection, chartering, scope, resources, scheduling, budgeting, controlling, termination and team leadership. Students will approach learning through a semester-long project planning activity. *Prerequisite: GEGR-107 and MGT-231*

EGR-380 **Internship** **1-6/6**
This course provides an opportunity to work in a supervised engineering setting. The experience must include opportunities to apply the theories and concepts learned in the discipline of engineering. *Prerequisite: GEGR-107*

EGR-437 **Environmental Engineering** **4/4**
An analysis of the impact of human development (industrial, commercial and residential) on air, land, and water resources. Special emphasis is placed on environmental engineering practices related to environmental laws and regulations. Additional topics include the development of environmental engineering plans and designs. **Lab fee applied.** *Prerequisites: ECO-241 and GEGR-360 or equivalent.*

EGR-485 Senior Engineering Capstone Project I 1/6
An independent investigation of theoretical or experimental design problems in engineering. The nature and scope of the project are determined by the student in consultation with the instructor and depend upon the facilities available. Normally this project is carried out during the entire senior year, with one-hour of credit during the first semester and two hours of credit during the second semester. A written technical report is required. All seniors meet together each week to discuss their projects with each other and their supervisor. Laboratory. **Lab fee applied.** *Prerequisite: EGR-336.*

EGR-486 Senior Engineering Capstone Project II 2/6
Continuation of student's work in EGR-485. Both an oral report and a final written technical report are required. *Prerequisites: EGR-485.*

Grand Valley State University

GEGR-106 Intro to Engineering Design I 3/1
A first course in the principles and practice of multi-disciplinary engineering analysis, design, construction, and evaluation. Topics include graphical communication, solid modeling, computer-aided manufacturing, computer programming fundamentals, structured programming, and principles of digital and analog electronics. Professional skills such as teamwork, problem solving, and communication (oral and written) are emphasized. *Corequisite: MAT-131.*

GEGR-107 Intro to Engineering Design II 3/1
A second course in the principles and practice of multi-disciplinary engineering analysis, design, construction, and evaluation. Topics include graphical communication, solid modeling, computer aided manufacturing, computer programming fundamentals, structured programming, and principles of digital and analog electronics. Professional skills such as teamwork, problem solving, and communication (oral and written) are emphasized. *Prerequisites: GEGR-106 and MAT-131.*

GEGR-209 Mechanics and Machines 4/1
Forces and moment, equilibrium, Free Body Diagrams. Introduction of machine elements: gears, belts, chains, shafts. Stress/strain: normal and shear stresses due to bending and torsion. Design and analysis of welds, fasteners: bolts and rivets in engineering structures. Principles of mechanical design: synthesis and selection methods of basic off-the-shelf machine components. *Prerequisites: MAT-132 and PHY-221. Declared as an engineering major.*

GEGR-250 Material Science and Engineering 4/1
The internal structure, composition, and processing of metals, polymers, and ceramics are related to their properties, end use, performance, and application in engineering. Materials selection exercises are included. *Prerequisites: CHM-111 and PHY-222.*

GEGR-301 Analytical Tools for Product Design 4/2
Analytic methods in product design are integrated into a coherent design process that includes: gathering customer requirements, establishing specifications, generating alternative concepts, estimating feasibility, concept selection, embodiment design, design refinement, prototyping, and project planning. *Prerequisite: GEGR-250.*

GEGR-309 Machine Design I 4/2
Topics include shear and bending stresses in beams, beam deflections, statically indeterminate beams, planar combined loading, triaxial stress and strain transformations, static failure theories, fatigue failure theories, surface failures, belt and chain drives, clutches and brakes, finite element analysis for planar loading, and introduction to strain gauges and rosettes. *Prerequisite: GEGR-209.*

GEGR-345 Dynamics Systems & Modeling 4/2
An introduction to mathematical modeling of mechanical, thermal, fluid, and electrical systems. Topics include equation formulation, Laplace transform methods, transfer functions, system response and stability, Fourier methods, frequency response, feedback control, control actions, block diagrams, state variable formulation, and computer simulation. Emphasis on mechanical systems. *Prerequisites: EGR-214 and MAT-235.*

GEGR-360 Thermodynamics 4/1
Basic concepts of thermodynamics and an introduction to heat transfer. Properties of pure substances, equation of state, work, heat, first and second laws of thermodynamics, closed systems and control volume analysis, irreversibility and availability, refrigeration and power cycles, thermodynamic relations, introduction to conduction, convection, radiation, heat transfer, and heat exchange design. *Prerequisites: PHY-222 and MAT-235.*

GEGR-362 Thermal & Fluid Systems 4/2 (Summer)
Thermal system engineering is primarily a study of energy: its forms, transformations, the transfer of it, and efficiency related to its transfer and use. This course includes the thermodynamic, fluid mechanics, and heat transfer principles required to understand the design of thermal systems found in product designs and manufacturing. *Prerequisites: PHY-222 and MAT-235.*

GEGR-365 Fluid Mechanics 4/2
Topics include fluid statics, control volume analysis, continuity, momentum, energy, Bernoulli equation, dimensional analysis and similitude, laminar and turbulent flows, boundary layers, differential analysis, external flow, lift and drag, internal flow, pump selection, introduction to turbo-machinery, and open channel flow. *Prerequisite: GEGR-360.*

GEGR-367 Manufacturing Processes 4/1
The fundamentals of manufacturing processes and the machinery of production. The forming of metals, plastics, ceramics, and composites with an emphasis on the economics of engineering designs and designs that can be practically manufactured. Computer aided manufacturing and quality control processes. *Prerequisite: GEGR-250.*

KIN-127 Introduction to Martial Arts 1/1
 This activity course is designed to introduce the student to the basic principles of the Martial Arts from a Christian perspective and open the student's mind to the possibilities of the Martial Arts being used for Christian ministry. Each student will be working toward earning an actual an actual novice rank in the traditional Japanese Karate style of Shinsei Wado-Ryu Karate-Do. Students will learn solid, time-proven Martial skills that are effective for self-defense as well as disciplining the body, mind and spirit. **External fee applied.**

KIN-129 Beginning Dance 1/2
 An introduction for the beginner dancer, including basic rhythm and terminology necessary for individual and partner dancing. Line, Ballroom, Swing, and other popular forms of dance will be explored throughout the course.

KIN-132 Coed Soccer 1/2
 The study and practice of rules, basic fundamentals, strategy, team play, and game etiquette. Opportunities will be given to the student to test skills against other players through tournament play.

KIN-133 Volleyball 1/1
 The study and practice of the basic techniques in the game of volleyball. The course includes topics such as ready position, serve, set, forearm pass, rules of the game, and strategy. Opportunities are given to test skills against other class members through tournament play.

KIN-143 Jogging 1/2
 To provide students with a thorough understanding of aerobic activity and its application to physical conditioning. The content of this course also includes general Biomechanics of jogging, flexibility, nutrition, a proper Christian viewpoint of jogging as a lifetime fitness activity.

KIN-144 Ladies Weight Training & Fitness Class 1/2
 This class will be an introduction of weight training and fitness opportunities for the college female. It will emphasize proper technique and safety precautions for weight lifting while promoting the importance of a healthy and personal physical fitness conditioning program. This course will also educate female students in the importance of the injury prevention through building muscle strength and teaching proper fitness components.

KIN-146 Physical Conditioning 1/2
 For the student who is unable to meet the core requirement of a traditional physical activity course due to physical limitations or disability, this course offers an individualized program of fitness activities set up by both the supervising professor and the student, in consultation with staff from Student Disability Services. Objectives and requirements are set forth in an initial meeting and must be completed by the end of the enrolled semester. The student must have applied for disability accommodations through the Accommodations Review Committee and been approved in order to register for this course.

KIN-147 Physical and Health Education for Classroom Teachers 2/1
 This course is designed to provide classroom teachers with a basic understanding of the purpose of physical education programs at the elementary level. The elementary education major will be equipped with basic theory, methods, and management techniques for providing quality movement experiences for all students with emphasis placed on the needs of individual learners. A variety of teaching methods, organizational techniques, and strategies for integrating physical education across the curriculum will be explored in this course. Various health related topics and their relationship to elementary students will be discussed.

KIN-148 Weight Training 1/1
 An introduction for the beginner to basic techniques and instruction in weight training for both muscular strength and endurance. This course is designed for the development of a personalized weight training program and is desired that this activity leads to lifelong enjoyment for the Christian steward.

KIN-180 Disc (Frisbee) Golf 2/1
 An introduction for the beginner to disc golf, encompassing basic equipment (drivers, mid-range, and putter discs) as well as techniques, rules for different versions of the game, and game etiquette. This course is an opportunity to learn new skills or enhance existing disc golf skills right on Cornerstone's excellent disc golf course. **Course fee applied.**

Varsity Sports 1
 A maximum of two credits will be awarded for participation in two different varsity sports. Students must register for credit at the beginning of the semester their sport is in season. These credits will count as elective credit only, and do not apply toward core physical education requirements or the Physical Education major or minor. Sports included are:

KIN-161	Baseball	KIN-165	Soccer	KIN-171	Golf
KIN-162	Softball	KIN-166	Tennis	KIN-172	Bowling
KIN-163	Basketball	KIN-167	Track	KIN-173	Cheerleading
KIN-164	Volleyball	KIN-168	Cross Country		

PROFESSIONAL PROGRAM COURSES

KIN-211 History and Principles of Kinesiology 3/1
 A study of physical education, sport, and fitness in the context of their historical development and how they have been an integral part of culture pertaining to the psychological, sociological, and philosophical factors that have affected these topics. Vocational opportunities related to the field of Kinesiology will be explored as well as preparation for these vocations. This course includes learning techniques such as tests, informational interviews, readings and presentations.

KIN/MGT-215 Introduction to Sports Management 3/2
 An overview of the diverse field of Sports Management. This course includes an in depth examination of various careers, training and necessary courses of study. Additionally, management skills along with related speaking and writing competencies are emphasized.

- KIN-231 Principles of Coaching 3/2**
The study of the nature and responsibilities of the profession of coaching. Topics include philosophy of coaching, the coach and his/her personality, the athlete and his/her personality, communication, team cohesion, motivation, discipline, teaching techniques, and scouting.
- KIN-243 Strategies for Teaching Physical Activities K-12 3/2**
This course is designed to provide an analysis of the strategies and process of teaching physical education activities appropriate for students PreK-12. The course is an overview of PreK-12 strategies to prepare physical educators develop the instructional skills necessary to teach physical education effectively. The physical education major will be equipped to select, develop and implement units of instruction as well as learn how to write measurable objectives for course activities. Lesson planning and peer teaching will provide the practical experience needed for professional growth.
- KIN-251 Motor Development and Learning 3/2**
A study of childhood growth and development patterns as it relates to motor learning and motor skill acquisition. This course is designed to enhance the understanding of growth and motor behavior/development of children from conception through adulthood. Principles of motor development and learning are explored along with an opportunity to apply them in a lab setting.
- KIN-280 Special Topics in Kinesiology 1-3/6**
- KIN-341 Anatomical Kinesiology 4/2**
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. **Lab fee applied.** *Prerequisite: BIO-241.*
- KIN-342 Exercise Physiology 3/2**
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. Lecture and lab. *Prerequisites: BIO-241, 242 and KIN-346; Recommend: CHM-111.*
- KIN-344 Adapted Physical Education 2/2**
This course is an orientation to the theoretical and practical aspects of teaching physical education for K-12 students with physical and mental disabilities. The focus is on the history and scope of adapted physical education, key techniques required for effective and safe instruction, general needs of special populations, legal issues, development of Individualized Education Programs and accommodation of activities, equipment and instructional materials for special populations. These topics will be studied within the context of our Christian worldview, with special attentions given to issues of equity and individual worth. *Prerequisite: KIN-243 or permission of instructor.*
- KIN-345 Measurement and Evaluation 3/4**
A study of methods for evaluating cognitive, affective, and psychomotor domains of learning in physical education. The course provides opportunity for practical experience in test construction and administration as well as evaluation of the results. Topics such as statistics, fitness testing, grading procedures, and affective checklists will be covered. *Prerequisite: core mathematics requirement.*
- KIN-346 Exercise Testing and Prescription 3/2**
This course will explore theory and practices related to exercise testing and prescription. It will include practical experience in body composition techniques, electrocardiography, muscle strength and endurance testing, flexibility testing and cardiovascular endurance testing. The results of the testing will be used to form appropriate exercise prescriptions according to the American College of Sports Medicine guideline. **Lab fee applied.**
- KIN-357 Physical Education in Preschools and Elem. Schools 3/4**
This course is designed specifically to provide in-depth methods of instruction for teaching preschool and elementary children in physical education programs. The course includes motor development and basic movement education emphasizing movement patterns, fundamental motor skills, manipulative skills, locomotor activities, physical fitness testing, and introduction to sports related skills. Introduction to teaching scope and sequences will be utilized. Lesson planning and peer teaching will provide the practical experience needed for professional growth. *Prerequisites: KIN-243 and KIN-251.*
- KIN-359 Physical Education in Secondary Schools 3/4**
This course is designed specifically to provide in-depth methods of instruction for teaching team and individual sport skills as well as leisure time activities in the secondary school environment. Techniques for management and organization for the middle and high school level students will be emphasized to prepare the physical education major to be an effective teacher. Instruction of teaching scope and sequences will be utilized. Lesson planning and peer teaching will provide the practical experience needed for professional growth. *Prerequisites: KIN-243 and KIN-251.*
- KIN-361 ECG (Electrocardiography) 2/4**
Anatomy and physiology of the heart will be reviewed, including the conduction system and circulatory system, as well as layout of the ECG, essentials of the 12-lead ECG, and lead placement and interpretation. Discussion on how the pathophysiology of the acute MI process affects the normal 12-lead ECGs and the average times in which such effects are evidenced. Students will learn to identify normal 12-lead ECG's ST segments, isoelectric lines, J points, and R-Wave progression. (Offered during May Term). *Prerequisite: BIO-242.*
- KIN-362 First Aid, Injury Prevention, and Treatment 3/2**
Basic principles of injury prevention and care, first aid principles of prevention, injury evaluation and current rehabilitation methods are taught. The student will have active participation in caring for various injuries. **Course fee applied.** *Prerequisite: BIO-241 and 242, or permission of instructor.*
- KIN-364 Cardiovascular Disease Risk and Management 3/4**
Health risk factors associated with cardiovascular and other chronic diseases will be identified and studied. Management and risk to morbidity and mortality will be emphasized. *Prerequisites: BIO-241/242, KIN-342 and KIN-346.*

KIN-370	Practicum in Coaching	1
KIN-380	Internship	*1-6
An opportunity to gain practical experience in settings appropriate for exercise science and coaching. <i>Prerequisites: junior status and approval of divisional chair. *Cardiac Rehabilitation major must take 12 credits of internship.</i>		
KIN-400	Professional Capstone Seminar	2/2
The seminar will examine from a Christian worldview perspective the ethical and professional issues associated with the major. As a capstone course, the seminar will devote time to Christian worldview reflection in regard to a senior's prior academic preparation and future vocational opportunities. The seminar will include significant evaluation instruments including a portfolio, philosophy thesis, skill and performance competencies (KIN-461) and completion of the senior assessment exam for Kinesiology. Students must sign up with the professor at the time they decide to major in exercise science so they can begin work towards meeting competencies in the areas required. Registration to receive credit will be delayed until the seminar year. <i>Prerequisites: MAT-151 and Senior status or approval of divisional chair.</i>		
KIN-401	Capstone Seminar: Ethics in Teaching Physical Education	2/2
The final seminar will examine the ethical and professional issues associated with physical education. The capstone seminar will devote time to reflection on prior academic preparation and future vocational opportunities for the physical educator. The course will include significant evaluation instruments including a portfolio, a physical education philosophy paper, and a created curriculum with daily lesson plans. The physical education major/minor will work closely with the supervising professor to review all completed assignments. <i>Prerequisite: KIN 359.</i>		
KIN-441	Organization and Administration	3/4
The study of organization, administration, planning, implementation, interscholastic activities, and sports/fitness clinics. The students will gain a closer look at the administrative roles at these various settings. Topics will include budget creation and control, program development, leadership techniques, and program evaluation.		
KIN-461	Skill and Performance Competencies	2/1
This course involves a series of experiences to help students understand the many roles of the physical educator. The specific experiences will be planned jointly by the student and the professor as soon as a physical education major or minor is declared. The work will begin towards meeting the competencies in the areas required over the next three years. The goal of this course is to improve the students' personal and professional expertise through participation, observation and coaching opportunities. <i>Corequisite: KIN-401.</i>		
KIN-470	Readings in Physical Education	3/1
Guided readings and periodic reports in areas of student's interest and need. <i>Prerequisite: approval of the division chair.</i>		
KIN-480	Advanced Topics in Kinesiology	1-3/6
KIN-490	Independent Study	3/1
With faculty supervision, the student will research and write on a specific topic or area. Outside involvement in topic is normally required. <i>Prerequisite: approval of the division chair.</i>		

MATHEMATICS

MAT-096	Pre-Algebra	3/2
An individualized review of applied arithmetic. Patterns leading to operations with fractions, decimals, percents and proportions. Graphing, drawing, probability and spreadsheet tools are used in technology activities to learn problem-solving strategies, numerical geometry, pre-algebra, and basic statistics concepts. <i>Prerequisite: Qualifying score on mathematics placement test; this course does not count toward graduation.</i>		
MAT-107	Algebra	3/2
A study of number properties, variation, graphs and equations involving linear, quadratic and exponential functions. This course introduces the use of calculators and/or spreadsheets for the study of functions and data. It does not count toward a major or minor in mathematics. MAT-107 is designed to review the necessary foundations in algebra for MAT-110. <i>Prerequisite: Qualifying score on math placement test; this course does not fulfill the core mathematics requirement.</i>		
MAT-108	Intermediate Algebra	3/2
This class elaborates on the foundation of basic algebra built in MAT-107. A variety of concepts and skills will be introduced to prepare students for work in college level algebra and related subjects. Skills include: factoring; simplifying and solving rational expressions and equations; simplifying and solving exponential and radical expressions and equations; solving linear and quadratic equations; using function notation; graphing lines and parabolas; and writing equations of lines. Topics include: basic scientific and business models; basic applications of geometry and right triangle trigonometry and exponential growth and decay. <i>Prerequisite: Qualifying score on mathematics placement test; this course does not fulfill the core mathematics requirement.</i>		
MAT-110	College Mathematics	3/1
College Mathematics is intended for students majoring in liberal arts or other fields that do not have a specific mathematics requirement. Its purpose is to give students a broad exposure to a variety of applications of mathematics in the real world and to understand related spiritual foundations. Topics include reasoning, voting methods, apportionment, mathematics of finance, logic, shapes and patterns in geometry, networks and directed graphs, and statistics. Computational skill, spatial reasoning, calculator usage, and logical analysis abilities are developed. This course satisfies the core requirement in mathematics. <i>Prerequisite: Qualifying score on math placement test. *Warning: Math, Science, Engineering & Exercise Science Majors check with your advisor for the correct math course.</i>		

MAT-121	College Algebra	3/1
College Algebra introduces the study of polynomial, rational, exponential, and logarithmic functions, in addition to the quadratic formula, geometric series, binomial series, systems of equations and probability. A graphing calculator is required (TI-83/84 or TI-89/92/200 recommended). This course satisfies the core requirement in mathematics. <i>Prerequisite: Qualifying score on math placement test.</i>		
MAT-122	Pre-calculus	4/2
Properties, graphs and applications of the sine, cosine and tangent functions and their reciprocals and inverse functions. Connections with the geometric series, binomial series, quadratic formula and logarithms. A graphing calculator is required (TI-83/84 or TI-89/92/200 recommended). This course satisfies the core requirement in mathematics. <i>Prerequisite: Qualifying score on math placement test.</i>		
MAT-131	Calculus I	5/2
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-84 recommended) is a required tool for this course. This course satisfies the core requirement in mathematics. <i>Prerequisite: Qualifying score on math placement test.</i>		
MAT-132	Calculus II	5/2
Applications of differentiation and integration from MAT-131 will include techniques of integrating functions, series approximations to these functions, and vector functions in motion and space. Computer software and/or a graphing calculator (TI-84 recommended) is a required tool for this course. This course satisfies the core requirement in Mathematics. <i>Prerequisite: MAT-131.</i>		
MAT-151	Statistics	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-83/84 preferred). <i>Prerequisite: Core competency in math.</i>		
MAT-233	Differential Equations	3/2
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. Maple software required. <i>Prerequisite: MAT-132.</i>		
MAT-234	Multivariate Calculus	3/2
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. Maple software and graphing calculator (TI-89/92/200 preferred) are required tools for this course. <i>Prerequisite: MAT-132.</i>		
MAT-235	Differential Equations and Linear Algebra for Engineers	3/2
Introduction to the theory of differential equations by methods of algebra, series or computer approximations. Methods of solution include Laplace transform techniques of linear equations as well as some special types of nonlinear equations. Includes applications in engineering, physical, biological, and social sciences. <i>Prerequisite: MAT-234.</i>		
MAT-241	Applied Linear Algebra	3/2
The algebra of matrices, determinants, vectors, inverting matrices, diagonalizing matrices, eigenvalues and their applications. Maple software and graphing calculator (TI-89/92/200) required for calculations and applications to dynamic systems.		
MAT-243	Discrete Mathematics	3/2
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 graphing calculator (TI-89/92/200 preferred) is a required tool. <i>Prerequisites: MAT-121 or MAT-131.</i>		
MAT-244	Methods of Mathematical Research	3/2
Students in this course will be introduced to the typesetting language of L ^A T _E X, solving mathematical problems with Maple, understanding mathematical articles, locating and researching mathematical topics, and preparing mathematical presentations. Maple software required. <i>Prerequisite: MAT-245 and ENG-212.</i>		
MAT-245	Mathematical Proofs	3/2
A course in reading and constructing mathematical proofs. How to start proofs (direct proofs, proofs by cases, proofs by contrapositive, 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. <i>Prerequisite: ENG-212</i>		
MAT-251	Probability and Statistics	3/2
This is a Calculus-based course in probability and statistics which includes discrete and continuous random variable probability models. Topics include the central limit theorem, sampling distributions, estimation, confidence intervals, hypotheses testing, analysis of variance, and regression analysis. Emphasis will be placed on statistical software to create probability models and run statistical procedures, specific to applications in economics and science. <i>Prerequisites: MAT-131 and MAT-132.</i>		
MAT-312	Elementary Mathematics & Methods and Field Experience	4/1
The course integrates elementary and middle school mathematics education and basic geometry content, methods and technology. Emphasis is on pedagogy, concepts and 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 will apply methods (such as diagnosis and instruction) through a tutoring experience with elementary aged children. <i>Prerequisites: Math competency, EDU-230, acceptance into Teacher Education Program.</i>		

- MAT-333 Real Analysis 3/4**
A first course in the theory of the calculus of a single real variable. Students will study the real number system as a complete ordered field, convergence of sequences and series, continuity and differentiability of functions of a real variable, theory of the Riemann integral and integrable functions. *Prerequisites: MAT-132, 241, 233, or 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. *Prerequisites: MAT-241 and MAT-245.*
- MAT-380 Internship in Mathematical Sciences 1-6/1**
An individualized assignment arranged with an agency, business or other organization to provide guided practical experience in a mathematical sciences related career/ministry activity. *Prerequisites: Junior standing and approval by division chair.*
- MAT-400 Capstone Seminar: The History of Mathematical Science 3/4**
For Math Ed. Majors: 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. *Prerequisites: MAT-241 and MAT-245, or permission.*
- MAT-401 Capstone Seminar for Mathematics 3/2**
Students will research and present an important topic in mathematics using both library research and personal preparation. *Prerequisite: 15 hours of 300-level or above math courses.*
- 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. May be repeated. *Prerequisites: Dependent upon topic selection; permission of research advisor and instructor.*
- MAT-471 Secondary Mathematics Methods 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: MAT-132, 151, 241, and 243.*
- 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. Designed for mathematical sciences majors' current needs and for students planning graduate study in the physical sciences or applied mathematics. May be repeated. *Prerequisite: Permission of instructor.*
- 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. Submission and approval of a research proposal must precede registration. May be repeated. *Prerequisites: Major in mathematical sciences; permission of research advisor.*
- ## PHYSICS
- 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. **Lab fee applied.** Mastering Physics software required. *Prerequisite: MAT-121.*
- 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. **Lab fee applied.** Mastering Physics software required. *Prerequisite: PHY-211.*
- PHY-221 Physics for Scientists and Engineers I 5/2**
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. **Lab fee applied.** Mastering Physics software required. *Corequisite: MAT-131.*
- PHY-222 Physics for Scientists and Engineers II 5/2**
An introductory survey of the electricity, magnetism, light and modern physics. Appropriate for students in the mathematical sciences and engineering. Lecture and Lab. **Lab fee applied.** Mastering Physics software required. *Prerequisite: PHY-221.*

SCIENCE

- SCI-201 Integrated Science for Elementary Teachers 3/2**
A college-level study and application of science concepts contained in the Michigan Grade Level Content Expectations for pre-service elementary teachers. Focus of the course will be on Science Process Skills, Physical Science, Life Science and Earth/Space Science, centering on the integration of these disciplines using inquiry-based learning, labs and field trips. **Lab fee applied.**
Prerequisites/Corequisites: EDU-230 and a declared elementary education program.
- SCI-211 Science of Music 1/4**
This 1-credit laboratory course is designed to introduce students in the B.Music degree program to the methods and limitations of science as a means of inquiry in the context of music and sound. Topics include general wave phenomena such as propagation, Doppler shifts, interference and resonance; specific sound phenomena and applications; elementary acoustics; and numerous applications to music and musical instruments. This course satisfies the core lab science elective for B. Music students and serves as the required prerequisite course for them to register for SCI-311 Science in Culture. The course is simply an elective course for any other students. **Lab fee applied.**
- SCI-242 Medical Terminology 2/2**
This course equips members of the health care professions with a working knowledge of medical vocabulary. Emphasis is placed on definitions, spelling, and pronunciation as it relates to the body. The course is designed for students desiring to pursue health-related careers.
- 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. **Lab fee applied.** *Prerequisite: Core requirement in mathematics.*
- 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. **Lab fee applied.**
- SCI-263 Atmosphere & Weather 2/4**
This primarily on-line course is adapted from the American Meteorological Society *Online Weather Studies*. Students are led through the major aspects of atmospheric composition, weather production and parameters and forecasting models. Does not satisfy lab core requirement.
- SCI-311 Science In Culture 3/1**
This course is a rigorous examination (based on a Christian philosophical worldview) of the nature of science and some of the major scientific ideas and issues affecting our culture. *Prerequisites: Lab science course, PHI-211, Junior or Senior status.*
- SCI-345 Epidemiology for Nursing 3/2**
This course explores the complex determinants of health and is designed to help students use their understanding of these determinants to develop strategies to improve the health of communities and populations. The course introduces students to the history, philosophy and ethics of epidemiology, and emphasizes the application of epidemiology (description, association and causality) to community health policy and practice. The student will analyze how policies and programs impact health outcomes within the current urban and global health care settings. *Corequisite: BIO-352.*
- SCI-346 Pharmacology 3/4**
This course is designed to teach the student principles of pharmacology, including mathematics and calculations, rules and regulations governing medications, medication administration and safety issues. Medications specific to various diseases and disorders will be studied, emphasizing desired effects, side effects, and contraindications. *Prerequisites: BIO-151, 241, and 242.*
- SCI-361 Evolution & Origins 3/2**
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: BIO-111 or 4 credits from SCI, BIO, CHM or PHY courses.*
- 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-400 Capstone Seminar: Integrated Science 2/2**
This course is designed to serve as the culminating course of science content for the integrated science major and minor, just prior to the directed teaching semester. Using the major themes motif, each subject will be explored for the common and varied approaches to understanding its physical, biological and earth/space science content and interconnections. Philosophical underpinnings and ethical considerations will be stressed for each theme along with its outworking. Students will be responsible for developing their own set of alternative solutions for each problem encountered, discovering strategies for communicating integrated content in their classroom and devising techniques to stimulate their students to join the quest. *Prerequisite: Junior or Senior status.*

SCI-423 Neuroscience 3/4
A special topics course which introduces workings of the brain and aspects of personality dealing with these at the level of the nerve cells and brain structures. Learned topics include: Perception, cognition, intelligence, the basis of emotional states, personality disorders and questions of guilt; progressive and degenerate diseases of the mind; nerve impulses and the synapses to understanding drug abuse and addictions; neural pathologies like speech disorders, attention deficit hyperactive disorder and the epilepsies; sensations, reflexes and movement control; brain waves, sleeping and arousal, awareness, consciousness and the soul, along with investigating the neural brain of gender differences. *Prerequisite: BIO-151, BIO-241, or PSY-441, or permission of instructor.*

SCI-465 Secondary Science Methods 3/2
This course focuses on specific knowledge, skills, and attitudes that are demonstrated by effective science teachers in 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 1/1
The senior research project is independently conducted research under the guidance of a science faculty mentor and is taken as a summer credit before taking the senior research seminar (SCI-496) or in the spring after the senior research seminar.

SCI-496 Senior Research Seminar 1/2
The senior research seminar is designed to help students develop the skills necessary to complete their senior research project (SCI-495). Seminars will focus on literature review, scientific writing, use of statistics in writing, creating tables and figures, review-editing of manuscripts and posters and presentations. **Lab fee applied.**

AU SABLE INSTITUTE COURSES

The following courses are offered through the Au Sable Institute of Environmental Studies. See the Off-Campus Programs section on page 45 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 Lake Ecology & Management 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. *Prerequisites: 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 International Development & Environmental Sustainability 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-310 Environmental Law and Policy 4
Analysis of the policy-making process at a local, national, and international scales with examination of environmental policy challenges, including climate change, resource management, and energy development. Students will interact with regional policy-making and land managers in the field to consider linkages between policy and science and ways for science to inform the policy-making process. Environmental ethics, environmental justice, and environmental advocacy will also be considered.

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-318 Marine Biology 4
Marine Biology focuses on intertidal life and marine ecology in oceanic and geophysical contexts. Students study the biology of marine plants and animals in the field, specifically trophic dynamic relationships of eel grass communities and the intertidal zone, workings of the island systems of Puget Sound, ecological roles of sea birds and fishes, population and community structure dynamics, exploitation and oceanic microbialization and biogeochemical processes and their linkages with the biosphere. Marine stewardship and effects of human activity on the marine environment are integral to the course. *Prerequisite: General biology or permission of professor.*

- 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. *Prerequisites: 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. *Prerequisites: One year of general chemistry and one semester of either biochemistry or organic chemistry.*
- ECO-343 Tropical Agriculture and Missions 4**
An introduction to tropical agriculture for working with resource-poor farmers. Topics include the scientific basis behind successful low cost techniques, a survey of major tropical crops and their requirements, and on-site practical work. Selected issues in Christian missions and in community development, and some urban gardening and small animal techniques are also covered. Taught in a rural, mountainous village in Costa Rica in collaboration with a Christian organization aiding redevelopment after an earthquake, with several trips to different ecosystem regions of Costa Rica.
- ECO-345 Wildlife Ecology 4**
Ecology, conservation and stewardship of wildlife species and their habitats. Includes growth and structure of natural and managed populations, environmental and human social factors affecting wildlife communities and wildlife conservation. The course is set in the context of the historical development of the field from management, to ecology, and to the land ethic of Leopold. Includes management and stewardship of non-game and endangered species, and long-term prospects of wildlife in changing environmental, climatic and social contexts. *Prerequisite: One course in biology, or permission of professor.*
- ECO-355 Watersheds in Global Development 4**
Principles of watershed ecology. Includes principles and practice of community-based water monitoring and watershed management for developing and developed countries and data access and analysis using an online relational database and data-to-action strategies. Designed for students in science and public policy, including students interested in missions and development and agencies involved in environmental assessment and community development. *Prerequisite: One year of general biology.*
- ECO-359 Marine Mammals 4**
Biology, behavior, ecology, identification and conservation of the marine mammals of the Pacific Rim. This study area covers some major habitats in Puget Sound and the Salish Sea, with attention to the diving physiology, social behavior, and communications of whales and seals. The course aims to develop a stewardship perspective rooted in biological principles and directed at the global conservation of marine mammals and their ecosystems. Special attention is given to their use by cultures of the region in order to understand current issues. *Prerequisite: One year of general biology or one semester of zoology.*
- ECO-361 Field Biology 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-362 Environmental Applications for Geographic Information Systems 4**
Introduction to the theory and application of spatial analysis for environmental conservation and planning using geographic information systems (GIS) technology in the context of real world conservation problems.
- ECO-365 Insect Ecology of Streams, Forests, and Fields 4**
Life history, behavior, and ecology of terrestrial and aquatic insects, and their roles in pollination, herbivory, predation, agroecosystems, disease and vector epidemiology, invasion ecology, soil ecology, biodiversity, and freshwater ecology. Practical applications include study of Integrated Pest Management (IPM) approaches to reduce negative impacts of pest species in agricultural, subcultural, and medical settings while preserving biodiversity and ecosystem functionality.
- ECO-367 Conservation & Development in 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. *Prerequisites: Upper division standing and at least one ecology course (preferably completed at AuSable).*
- ECO-368 Forest Biology 4**
This course will focus on how plants interact with the abiotic environment and with other organisms. Field trips will provide opportunity to examine various physiological adaptations and population and community processes; and to introduce research approaches in different contexts. Quantitative skills including data collection, management, and basic analysis will be emphasized. *Prerequisite: One year of biology.*
- ECO-390 Directed Individual Study**
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 at Au Sable. *Prerequisite: A study proposal including goals and objectives, methods, protocols for evaluation; to be signed by the professor and program director.*

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

ECO-478 Alpine Ecology 4

Ecology of the mountains of the Pacific Northwest, with particular attention to adaptation of plant and animal life to montane climates and altitudes, and analysis and interpretation of altitudinal zonation of biotic communities with applications to latitudinal biogeography. Also included are topics of physiological responses of organisms to reduced oxygen levels, low temperatures and high altitude radiation regimes. Field work includes on-site studies in the Olympic Mountains of the Olympic Peninsula.

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

Participation in an ongoing research project of the Institute. *Prerequisite: A research proposal including goals and objectives, methods, protocols for evaluation; to be signed by the professor and program director.*

STATISTICS

Grand Valley State University

GSTA-216 Intermediate Applied Statistics (GVSU) 3/1

Project-oriented introduction to major statistical techniques using a statistical package such as SAS or SPSS. Hypothesis testing, {t-test}, multivariate regression, analysis of variance, analysis of co-variance, chi-square tests, non-parametric statistics. Offered every semester. *Prerequisite: MAT-251.*

GSTA-321 Applied Regression (GVSU) 3/2

Multivariate regression analysis with emphasis on application using a statistical software package. Topics include method of least squares, residual analysis, collinearity, data transformation, polynomial regression, general linear model, selecting a best regression model, and logistic regression. *Prerequisite: GSTA-216.*

GSTA-426 Multivariate Data Analysis (GVSU) 3/2

Multivariate analysis with emphasis on application using a statistical package such as SAS or SPSS. Topics include principle components analysis, factor analysis, discriminant analysis, logistic regression, cluster analysis, multivariate analysis of variance, and canonical correlation analysis. *Prerequisite: GSTA-216.*