
160 Science and Mathematics

Purpose

The Department of Science and Mathematics offers curricula in biology, chemistry, physics, mathematics, and the earth-space sciences. The department seeks to present the natural sciences and mathematics as disciplines through which students can learn to understand creation and its Creator. They will learn how to exercise stewardship of this knowledge as professionals who seek to make a difference in their vocations for the benefit of family, church, community, and environment.

This department seeks to:

1. Provide a meaningful learning experience in the sciences and mathematics as part of the liberal arts core curriculum.
2. Aid students in developing clear and orderly thinking processes through the use of the techniques of science and mathematics.
3. Assist students in developing a biblical perspective of the sciences, which is essential in understanding the controversial issues such as origin of life, biomedical ethics, and genetic engineering.
4. Prepare students for graduate study or further professional study in the medical, environmental, or agricultural sciences.
5. Prepare secondary teachers with a biblical perspective of science.
6. Prepare students to serve in other science-related vocations.

Personal Requirements

Students who enjoy and excel in high school mathematics and science courses possess the greatest potential for success as graduates of this department. Therefore, to prepare for the mathematics and science curricula, students should take a college preparatory curriculum which includes:

- 4 units of English
 - 4 units of mathematics (algebra, geometry, and trigonometry)
 - 4 units of science (physical science, biology, chemistry, and physics)
 - 3 units of social science
 - 3 units of a single foreign language
- Electives in computers may also be helpful.

Programs of Study

The Department of Science and Mathematics offers the following programs of study:

Bachelor of Arts (B.A.) with majors in:

- Biology
- Chemistry
- Integrated Life Science Education
- Integrated Mathematics Education
- Integrated Physical Science Education
- Integrated Science Education
- Mathematics
- Physics

Bachelor of Science (B.S.) with majors in:

- Biology
- Chemistry
- Computer Science
- Mathematics

Minors in:

- Biology
- Chemistry
- Earth Science
- Mathematics
- Physics

Special programs:

- Environmental Biology
- Medical Technology
- Preagriculture
- Premedical (prehealth professions)
- Prepharmacy
- Prephysical Therapy



Students learn to exercise stewardship of God's creation through proper care and study in the laboratory.

Faculty

Dennis Flentge, *Chairman*, Professor of Chemistry. *Education*: B.S., Texas Lutheran College, 1969; Ph.D., Texas A. & M. University, 1974; Postdoctoral Research Fellow, University of Florida, 1974-75; Texas A & M University, 1976; Summer Faculty Research Fellow, Wright-Patterson Air Force Base, 1981, 1982, 1984-1988, 1990, 1996, 1997; graduate study, University of Wisconsin, summer, 1984. At Cedarville since 1980.

Donald Baumann, Professor of Biology and Chemistry. *Education*: B.S., Iowa State University, 1960; M.S., Iowa State University, 1962; Ph.D., Iowa State University, 1964. At Cedarville since 1964.

Pieder Beeli, Assistant Professor of Physics. *Education*: B.S., Electrical Engineering, University of California at Los Angeles, 1986; M.S., Electrical Engineering, California State University Northridge, 1990; M.S., Physics, University of Notre Dame, 1996; Ph.D., Physics, University of Notre Dame, 1999. At Cedarville since 2000.

Edwin Braithwaite, Associate Professor of Mathematics. *Education*: B.A., Western Washington University, 1966; M.A., Western Washington University, 1968; Ph.D., University of Illinois, 1975. At Cedarville since 1976.

Leroy Eimers, Professor of Physics and Mathematics. *Education*: B.S., Hobart College, 1963; M.S., Syracuse University, 1966; Ph.D., Syracuse University, 1970. At Cedarville since 1981.

Joseph Francis, Associate Professor of Biology. *Education*: B.S., Michigan State University, 1981; Ph.D., Wayne State University, 1988; Postdoctoral Fellow, Department of Pediatrics, University of Michigan, 1988-1991. At Cedarville since 1992.

Darrin Frey, Assistant Professor of Mathematics. *Education*: B.S., University of Nebraska, 1989; Ph.D., University of Michigan, 1995. At Cedarville since 1997.

David M. Gallagher, Associate Professor of Computer Science. *Education*: B.S., Electrical Engineering, United States Air Force Academy, 1978; M.S., Electrical Engineering, Air Force Institute of Technology, 1987; Ph.D., Electrical Engineering, University of Illinois, 1995. At Cedarville since 2000.

Steven Gollmer, Associate Professor of Physics. *Education*: B.S., Pillsbury Baptist Bible College, 1982; B.S., Northern Illinois University, 1985; M.S., University of Illinois, 1986; Ph.D., Purdue University, 1994. At Cedarville since 1994.

Larry Helmick, Professor of Chemistry. *Education*: B.S., Cedarville University, 1963; Ph.D., Ohio University, 1968; postdoctoral research, University of Florida, 1974-75 and summers of 1969, 1970, 1971; University of Illinois, summers of 1972, 1973, 1974; Summer Faculty Research Fellow, NASA-Lewis Research Center, 1980-1987 and 1990-1993, 1998; National Research Council Senior Research Fellow, 1988-1989; Wright Laboratory, Wright-Patterson Air Force Base, 1994-1997. At Cedarville since 1968.

William Jones, Assistant Professor of Biology. *Education*: B.A., Cedarville University, 1981; M.A., University of Akron, 1999. At Cedarville since 1999.

Heather Kuruvilla, Assistant Professor of Biology. *Education*: B.S., Houghton College, 1992; Ph.D., State University of New York at Buffalo, 1997. At Cedarville since 1997.

Mark McClain, Assistant Professor of Chemistry. *Education*: B.A., Cedarville University, 1989; Ph.D., University of Michigan, 1994; Postdoctoral Fellow, Sandia National Laboratories, 1994-96; Summer Faculty Research Fellow, Wright-Patterson Air Force Base, 1997. At Cedarville since 1996.

Douglas Miller, Professor of Chemistry. *Education*: B.S., University of Rochester, 1977; Ph.D., University of Colorado, 1981; postdoctoral research, University of Iowa, 1982; City University of New York, 1982-1984; Summer Faculty Research Fellow, NASA-Lewis Research Center, 1986-1990, 1992. At Cedarville since 1984.

Joni Ormsbee, Assistant Professor of Mathematics. *Education*: B.S., Wright State University, 1987; M.A.T., Miami University, 1992; M.S., Miami University, 1996. At Cedarville since 1998.

Terry Phipps, Professor of Biology. *Education*: B.S., Cedarville University, 1970; M.S., Wright State University, 1974; Ph.D., The Ohio State University, 1987. At Cedarville since 1978.

Kevin Roper, Assistant Professor of Mathematics. *Education*: B.S., Southampton University (England), 1979; M.Ed., University of

South Carolina, 1988; M.A., University of Kentucky, 1992; Ph.D., University of Kentucky, 1995. At Cedarville 1995-97, 2000.

Robert Schumacher, Assistant Professor of Mathematics. *Education*: B.S., Computer Science, United States Air Force Academy, 1970; M.S., Operations Research, Air Force Institute of Technology, 1979. At Cedarville Since 1993.

James Sellers, Associate Professor of Mathematics. *Education*: B.S., University of Texas at San Antonio, 1987; Ph.D., Pennsylvania State University, 1992. At Cedarville since 1992.

John Silvius, Professor of Biology. *Education*: B.A., Malone College, 1969; graduate study, Western Michigan University, 1970; Ph.D., West Virginia University, 1974; postdoctoral study, University of Illinois, 1974-76. At Cedarville since 1979.

Dennis Sullivan, Associate Professor of Biology. *Education*: B.S., Youngstown State University, 1974; M.D., Case Western Reserve University, 1978; Diplomate, American Board of Surgery, 1985; Fellow, American College of Surgeons, 1996. At Cedarville since 1997.

Daniel Wetzel, *Dean, School of Engineering, Nursing, and Science*. Professor of Physics and Mathematics. *Education*: B.S., Morehead State College, 1955; M.S., University of Cincinnati, 1963; Ph.D., The Ohio State University, 1971. At Cedarville since 1963.

John Whitmore, Assistant Professor of Geology. *Education*: B.S., Kent State University, 1985; M.S., Institute for Creation Research, 1991. At Cedarville since 1991.

L. Bert Frye, Associate Professor Emeritus of Physical Science. *Education*: B.S., University of Missouri, 1940; graduate study, Faith Seminary, 1947-48; B.D., Grand Rapids Baptist Seminary, 1953; graduate study, Michigan State University, 1958-59, summer of 1961; University of California (Berkeley), summer of 1960; M.A.T., Miami University, 1964; University of Arizona, summer, 1969; State University of New York (Stony Brook), summer 1970. At Cedarville from 1961 to 1981.

Technical Support Staff

Gordon Dingeldein, Science Laboratory Technician. *Education*: B.S., Southern Illinois University, 1964. At Cedarville since 1996.

Career Opportunities

Graduates of this department have gained admission to outstanding graduate and professional schools around the nation. Careers pursued by graduates include:

- agricultural consultant
- biologist
- botanist
- business actuary
- chemist
- chiropractor
- college professor
- computer scientist
- environmental scientist
- environmental toxicologist
- health professional
- laboratory technician
- mathematician
- pharmacist
- physical therapist
- physicist
- physician
- researcher
- software engineer
- software programmer
- statistician
- teacher
- wildlife biologist

162 Science and Mathematics

Biology - Bachelor of Arts

The **bachelor of arts degree with a major in biology** provides general course background in the biological sciences.

Course requirements involve 75 quarter hours including:

<i>Biology requirements</i>	55
BIO-114 Introduction to Biology	5
BIO-115 General Zoology	5
BIO-116 Introduction to Cell Biology	5
BIO-134 General Botany	5
BIO-200 General Ecology	5
BIO-240 Introduction to Research Methods	2
BIO-306 Genetics	5
BIO-440 Biology Senior Seminar	1
CHEM-151,152,153 General Chemistry I, II, III	12
CHEM-356 Biochemistry	5
CHEM-357 Organic Chemistry I	5
GMTH-185 Precalculus	5
Electives in biology	15

Students with specific career goals may orient the bachelor of arts in biology curriculum toward particular emphases. For example, students pursuing careers in the **health professions** (prephysical therapy students see that section of the catalog) should include:

CHEM-358,359 Organic Chemistry II, III	10
MATH-281 Analytic Geometry and Calculus I	5
PHYS-172 College Physics I	5
PHYS-173 College Physics II	5
PHYS-174 College Physics III	5



Biology professor Bill Jones offers guidance and direction during a laboratory session.

Biology Major (B.A.) Curriculum Summary

Proficiency requirements	0-8
Other General Education Requirements	65-87
Biology major requirements	75
Electives	30-52
Total (minimum, not including proficiency)	192

A complete description of the General Education Requirements is found on page 30.

Suggested Four-Year Curriculum for a Major in Biology - B.A.

First year:

BEGE-171 The Christian Life	4
BEGE-172 Introduction to Bible Study	4
BIO-114 Introduction to Biology	5
BIO-115 General Zoology	5
BIO-116 Introduction to Cell Biology	5
CHEM-151,152,153 General Chemistry I, II, III	12
ENG-110 English Composition I	5
*ENG-140 English Composition II	5
PEF-199 P.A.C.L.	2
Physical Education elective	1
Total	48

Second year:

BEGE-273 Old Testament Survey	4
BEGE-274 New Testament Survey	4
BIO-134 General Botany	5
BIO-200 General Ecology	5
COM-110 Fundamentals of Speech	5
GMTH-185 Precalculus	5
GSS-110 Foundations of Social Science	5
*HUM-140 Introduction to the Humanities	5
*History elective	5
*Literature elective	5
Total	48

Third year:

BEGE-375 God and History	4
BEGE-376 God and the Church	4
BIO-306 Genetics	5
CHEM-356 Biochemistry	5
CHEM-357 Organic Chemistry I	5
Biology electives	10
Humanities elective	5
*Global Awareness elective	4
Electives	5
Total	47

Fourth year:

BIO-440 Biology Senior Seminar	1
Biology electives	10
Electives	38
Total	49

*Courses can be delayed one year in order for students in preprofessional programs to take calculus, physics, and additional organic chemistry.

Biology - Bachelor of Science

The **bachelor of science degree with a major in biology** prepares students for graduate study in the biological sciences by including the course requirements prescribed by many of the leading graduate-level biology degree programs in the nation. This major enhances the student's depth of knowledge in biology and increases the breadth of exposure to chemistry, mathematics, and physics.

Course requirements involve 120 hours including:

<i>Biology requirements</i>	33
BIO-114 Introduction to Biology	5
BIO-115 General Zoology	5
BIO-116 Introduction to Cell Biology	5
BIO-134 General Botany	5
BIO-200 General Ecology	5
BIO-240 Introduction to Research Methods	2
BIO-306 Genetics	5
BIO-440 Biology Senior Seminar	1
<i>Departmental requirements</i>	62
CHEM-151,152,153 General Chemistry I, II, III	12
CHEM-356 Biochemistry	5
CHEM-357,358,359 Organic Chemistry I,II,III	15
MATH-281,282,283 Analytic Geometry and Calculus I,II,III	15
PHYS-271,272,273 General Physics I, II, III	15
Electives (meeting the following criteria)	25
A. Twenty hours must be 300-400 level courses.	
B. Three courses each representing a different emphasis area below must be included.	
C. Additional biology electives: two or more courses selected from <i>one</i> of the emphasis areas below (with part B) to complete <i>three</i> or more courses in the same emphasis area.	
<u>Set I Cellular and Molecular Biology:</u>	
BIO-238 Introductory Microbiology	5
BIO-407 Molecular Biology of the Cell	5
BIO-432 Immunology	5
BIO-450 Topics in Biology	2-5
<u>Set II Organismic Biology:</u>	
BIO-300 Environmental Physiology	5
BIO-316,317 Human Structure and Function I, II	10
BIO-319 Pathophysiology	5
BIO-336 Plant Physiology	5
BIO-411 Vertebrate Embryology	5
<u>Set III Comparative Emphasis - Taxonomy/Morphology:</u>	
BIO-238 Introductory Microbiology	5
BIO-312 Invertebrate Zoology	5
BIO-313 Vertebrate Zoology	5
BIO-334 Plant Taxonomy and Ecology	5
<u>Set IV Environmental Physiology/Ecology:</u>	
BIO-300 Environmental Physiology	5
BIO-334 Plant Taxonomy and Ecology	5
BIO-336 Plant Physiology	5
BIOA-340 Topics in Environmental Biology	5
BIO-405 Environmental Biology Internship	5-10
<u>Set V Laboratory Methodology and Independent Study:</u>	
BIO-400 Independent Study in Biology	2-4
BIO-405 Environmental Biology Internship	2-10
BIO-436 Radiation Biology	5
BIO-450 Topics in Biology	2-5
MATH-384 Probability and Statistics	5

Biology Major (B.S.) Curriculum Summary

Proficiency requirements	0-8
Other General Education Requirements	65-87
Biology major requirements	120
Electives	0-7
Total (minimum, not including proficiency)	192

A complete description of the General Education Requirements is found on page 30.

Suggested Four-Year Curriculum for a Major in Biology - B.S.

First year:

BEGE-171 The Christian Life	4
BEGE-172 Introduction to Bible Study	4
BIO-114 Introduction to Biology	5
BIO-115 General Zoology	5
BIO-116 Introduction to Cell Biology	5
CHEM-151,152,153 General Chemistry I, II, III	12
COM-110 Fundamentals of Speech	5
ENG-110 English Composition I	5
ENG-140 English Composition II	5
PEF-199 P.A.C.L.	2
Total	52

Second year:

BEGE-273 Old Testament Survey	4
BIO-134 General Botany	5
BIO-200 General Ecology	5
CHEM-357,358,359 Organic Chemistry I, II, III	15
MATH-281,282,283 Analytic Geometry/Calculus I, II, III ...	15
Biology elective	5
Physical Education elective	1
Total	50

Third year:

BEGE-274 New Testament Survey	5
BIO-306 Genetics	5
CHEM-356 Biochemistry	5
GSS-100 Foundations of Social Science	5
PHYS-271,272,273 General Physics I, II, III	15
Biology electives	10
Global Awareness elective	4
Total	49

Fourth year:

BEGE-375 God and History	4
BEGE-376 God and the Church	4
BIO-440 Biology Senior Seminar	1
HUM-140 Introduction to Humanities	5
Biology electives	15
History elective	5
Humanities elective	5
Literature elective	5
Total	44

Students interested in careers in **environmental biology** should see that section of the catalog. Students anticipating **graduate study** in biology should consider completing the bachelor of science in biology curriculum.

164 Science and Mathematics

Chemistry - Bachelor of Arts

The **bachelor of arts degree with a major in chemistry** prepares students for careers in the health professions, technical business professions, and other science related vocations.

Course requirements involve 80 quarter hours including:

<i>Chemistry requirements</i>	44
CHEM-151,152,153 General Chemistry I, II, III	12
CHEM-254 Quantitative Analysis	4
CHEM-357,358,359 Organic Chemistry I, II, III	15
CHEM-451,452 Physical Chemistry I, II	8
Chemistry electives	5
<i>Departmental requirements</i>	36
BIO-100 Principles of Biology	5
(or BIO-114 Introduction to Biology	5)
GSCI-440 Seminar	1
MATH-281,282,283 Analytic Geometry and Calculus I,II,III	15
PHYS-271,272,273 General Physics I, II, III	15

Students preparing for **graduate study** should complete the B.S. in chemistry or include:

CHEM-255 Analytical Chemistry	5
CHEM-333 Intermediate Inorganic Chemistry	5
CHEM-356 Biochemistry	5
CHEM-453 Physical Chemistry III	3
CHEM-454 Advanced Inorganic Chemistry	5
MATH-387 Differential Equations	5



Well-equipped chemistry labs enhance the student's ability to interpret laboratory data.

Students preparing for medicine, dentistry, osteopathy, or any of the **health professions** should include:

BIO-114 Introduction to Biology	5
BIO-115 General Zoology	5
CHEM-456 Biochemistry	5
<i>Electives (selected from)</i>	15
BIO-238 Introduction to Microbiology	5
BIO-306 Genetics	5
BIO-313 Vertebrate Zoology	5
(or BIO-411 Vertebrate Embryology	5)
BIO-316,317 Human Structure and Function I, II	10

Chemistry Major Curriculum (B.A.) Summary

Proficiency requirements	0-8
Other General Education Requirements	65-90
Chemistry major requirements	80
Electives	22-47
Total (minimum, not including proficiency)	192

A complete description of the General Education Requirements is found on page 30.

Suggested Four-Year Curriculum for a Major in Chemistry - B.A.

First Year:

BEGE-171 The Christian Life	4
BEGE-172 Introduction to Bible Study	4
CHEM-151,152,153 General Chemistry I, II, III	12
ENG-110 English Composition I	5
ENG-140 English Composition II	5
MATH-281,282,283 Analytic Geometry/Calculus I, II, III	15
PEF-199 P.A.C.L.	2
Physical Education elective	1
Total	48

Second Year:

BEGE-273 Old Testament Survey	4
BEGE-274 New Testament Survey	4
BIO-114 Introduction to Biology	5
(or BIO-100 Principles of Biology	5)
CHEM-254 Quantitative Analysis	4
HUM-140 Introduction to the Humanities	5
COM-110 Fundamentals of Speech	5
GSS-100 Foundations of Social Science	5
PHYS-271,272,273 General Physics I, II, III	15
Total	47

Third Year:

BEGE-375 God and History	4
BEGE-376 God and the Church	4
CHEM-357,358,359 Organic Chemistry I, II, III	15
History elective	5
Humanities elective	5
Literature elective	5
Electives	12
Total	50

Fourth Year:

CHEM-451,452 Physical Chemistry I, II	8
GSCI-440 Seminar	1
Chemistry elective	5
Social Science/Global Awareness elective	4
Electives	29
Total	47

Chemistry - Bachelor of Science

The **bachelor of science degree with a major in chemistry** prepares students for graduate study in chemistry and for careers in industry, research, or the health professions. The degree requirements provide training in each of the primary areas of chemistry with the necessary support in mathematics, physics, and biology.

Course requirements involve 103 quarter hours including:

<i>Chemistry requirements</i>	62
CHEM-151,152,153 General Chemistry I, II, III	12
CHEM-254 Quantitative Analysis	4
CHEM-255 Analytical Chemistry	5
CHEM-333 Intermediate Inorganic Chemistry	4
CHEM-357,358,359 Organic Chemistry I, II, III	15
*CHEM-451,452,453 Physical Chemistry I, II, III	11
Chemistry electives	11
<i>Departmental requirements</i>	41
BIO-100 Principles of Biology	5
(or BIO-114 Introduction to Biology	5)
GSCI, BIO, CHEM, MATH, or PHYS elective	5
GSCI-440 Seminar	1
MATH-281,282,283 Analytic Geometry and Calculus I, II, III	15
PHYS-271,272,273 General Physics I, II, III	15
*PHYS-378,379 Modern Physics I, II (10 hrs) may be substituted for CHEM-453 Physical Chemistry III.	

Students preparing for medicine, dentistry, osteopathy, or any of the **health professions** should include:

BIO-114 Introduction to Biology	5
BIO-115 General Zoology	5
BIO-116 Introduction to Cell Biology	5
CHEM-456 Biochemistry	5
<i>Electives (selected from)</i>	15
BIO-238 Introduction to Microbiology	5
BIO-306 Genetics	5
BIO-313 Vertebrate Zoology	5
(or BIO-411 Vertebrate Embryology	5)
BIO-316,317 Human Structure and Function I, II	10



Opportunities for independent research enable students to develop important skills for the future.

Chemistry Major (B.S.) Curriculum Summary:

Proficiency requirements	0-8
Other General Education Requirements	65-78
Chemistry major requirements	103
Electives	11-24
Total (minimum, not including proficiencies)	192

A complete description of the General Education Requirements is found on page 30.

Suggested Four-Year Curriculum for a Major in Chemistry - B.S.

First Year:

BEGE-171 The Christian Life	4
BEGE-172 Introduction to Bible Study	4
CHEM-151,152,153 General Chemistry I, II, III	12
ENG-110 English Composition I	5
ENG-140 English Composition II	5
MATH-281,282,283 Analytic Geometry/Calculus I, II, III	15
PEF-199 P.A.C.L.	2
Physical Education elective	1
Total	48

Second Year:

BEGE-273 Old Testament Survey	4
BEGE-274 New Testament Survey	4
BIO-100 Principles of Biology	5
(or BIO-114 Introduction to Biology	5)
CHEM-254 Quantitative Analysis	4
CHEM-255 Analytical Chemistry	5
COM-110 Fundamentals of Speech	5
GSS-100 Foundations of Social Science	5
PHYS-271,272,273 General Physics I, II, III	15
Total	47

Third Year:

BEGE-375 God and History	4
BEGE-376 God and the Church	4
CHEM-333 Intermediate Inorganic Chemistry	4
CHEM-357,358,359 Organic Chemistry I, II, III	15
HUM-140 Introduction to the Humanities	5
Chemistry elective	5
History elective	5
Literature elective	5
GSCI, BIO, CHEM, MATH or PHYS elective	5
Total	52

Fourth Year:

CHEM-451,452,453 Physical Chemistry I, II, III	11
GSCI-440 Seminar	1
Chemistry electives	6
Social Science/Global Awareness elective	4
Humanities electives	5
Electives	18
Total	45

166 Science and Mathematics

Computer Science - Bachelor of Science

The **computer science major** provides coursework and training in computer science. Patterned closely after the curriculum model proposed by the Computer Science Accreditation (CSA) Commission of the CSA Board, this major prepares students for careers as software engineers, software programmers, and computer scientists.

Course requirements involve 95 quarter hours including:

<i>Computer science core requirements</i>	44
CS-221 Computer Science II	4
CS-320 Programming Language Survey	4
CS-329 Operating Systems	4
CS-330 Data Structures	4
CS-401,402,403 Software Engineering I, II, III	9
ENGR-191 Digital Logic Design	4
ENGR-280 'C' Programming	3
ENGR-316 Microprocessors	4
ENGR-480 Professional Ethics	4
MIS-328 Database Developments	4
<i>Mathematics requirements</i>	44
CHEM-158 Chemistry for Engineers	5
MATH-281,282,283 Analytic Geometry and Calculus I, II, III	15
MATH-303 Logic and Methods of Proof	5
MATH-355 Discrete Mathematics: Graph Theory	4
MATH-384 Probability and Statistics	5
PHYS-271,272 General Physics I, II	10
<i>Technical electives (selected from):</i>	7
CS-420 Programming Languages	4
ENGR-416 Computer Architecture and Advanced Microprocessors	3
MATH-394 Linear Algebra	5
MIS-340 Data Communications and Networking	4
Other advanced courses with departmental approval	5

Computer Science Major (B.S.) Curriculum Summary

Proficiency requirements	0-8
Other General Education Requirements	70-92
Computer Science major requirements	96
Electives	4-26
Total (minimum, not including proficiency)	192

A complete description of the General Education Requirements is found on page 30.

Suggested Four-Year Curriculum for a Major in Computer Science - B.S.

First year:

BEGE-171 The Christian Life	4
BEGE-172 Introduction to Bible Study	4
ENG-110 English Composition I	5
ENG-140 English Composition II	5
ENGR-191 Digital Logic Design	4
ENGR-280 'C' Programming	3
GSS-100 Foundations of Social Science	5
MATH-281,282,283 Analytic Geometry and Calculus I, II, III	15
PEF-199 P.A.C.L.	2
PHYS-271 General Physics I	5
Total	52

Second year:

BEGE-273 Old Testament Survey	4
BEGE-274 New Testament Survey	4
BIO-100 Principles of Biology	5
COM-110 Fundamentals of Speech	5
CS-320 Programming Language Survey	4
CS-330 Data Structures	4
ENGR-316 Microprocessors	4
HUM-140 Introduction to the Humanities	5
MATH-303 Logic and Methods of Proof	5
MIS-222 Structured Programming	4
PHYS-272 General Physics II	5
Physical Education elective	1
Total	50

Third year:

BEGE-375 God and History	4
BEGE-376 God and the Church	4
CHEM-158 Chemistry for Engineers	5
CS-329 Operating Systems	4
CS-401 Software Engineering I	3
MATH-355 Discrete Mathematics: Graph Theory	4
MATH-384 Probability and Statistics	5
MATH-394 Linear Algebra	5
MIS-328 Database Developments	4
History elective	4
Social Science elective	5
Total	47

Fourth year:

CS-402,403 Software Engineering II, III	6
CS-420 Programming Languages	4
ENGR-416 Advanced Microprocessors	3
ENGR-480 Professional Ethics	4
MIS-421 Software Development	3
Humanities elective	5
Literature elective	5
Electives	14
Total	44

Integrated Life Science Education

The **integrated life science education major** prepares students to teach life science in public and Christian schools in grades 7-12. For additional information about teaching, see the Education Department section of this catalog.

Course requirements for science and mathematics involve 90 quarter hours including:

BIO-114 Introduction to Biology	5
BIO-115 General Zoology	5
BIO-116 Introduction to Cell Biology	5
BIO-134 General Botany	5
BIO-200 General Ecology	5
BIO-238 Introductory Microbiology	5
BIO-240 Introduction to Research Methods	2
BIO-306 Genetics	5
BIO-440 Biology Senior Seminar	1
<i>Biology electives (selected from)</i>	10
BIO-300 Environmental Physiology	5
BIO-312 Invertebrate Zoology	5
BIO-313 Vertebrate Zoology	5
BIO-316,317 Human Structure and Function I, II	10
BIO-334 Plant Taxonomy and Ecology	5
BIO-336 Plant Physiology	5
BIO-340 Topics in Environmental Biology	5
BIO-407 Molecular Biology of the Cell	5
CHEM-151,152 General Chemistry I, II	8
CHEM-356 Biochemistry	5
CHEM-357 Organic Chemistry I	5
GSCI-160 Introduction to Earth and Space Science	5
GMTH-185 Precalculus	5
(or MATH 281 Analytic Geometry and Calculus I	5)
PHYS-172,173 College Physics I, II	10
SCED-301 Teaching Science-Adolescents/Young Adults	2
SCED-321 Clinical Teaching in Science or Mathematics	2

<i>Professional education requirements</i>	51
EDSE-302 Teaching Thinking Skills	2
EDSE-316 Principles of Teaching	4
EDSE-317 Principles of Teaching (Clinical)	4
EDSE-470 Student Teaching and Seminar	15
EDSP-202 Teaching Children with Exceptionalities	3
EDSP-206 Special Education Field Experience	1
EDSP-401 Principles of Inclusion	1
EDU-100 The Education Profession	1
EDU-101 Contemporary Christian School	0
EDU-200 Introduction to Teaching	3
EDU-204 Multicultural Field Experience	2
EDU-210 Technology in the Classroom	2
EDU-250 Educational Psychology	4
EDU-310 Classroom Planning and Assessment	3
EDU-350 Reading in the Content Area	3
*EDU-450 Philosophy of Education	3
*Satisfies humanities General Education Requirement	

Integrated Life Science Education Summary

Proficiency requirements	0-8
Other General Education Requirements	65-87
Biology Major requirements	90
Professional Education requirements	51
Total (minimum, not including proficiency)	206

A complete description of the General Education Requirements is found on page 30.

Suggested Four-Year Curriculum for a Major in Integrated Life Science Education - B.A.

<i>First year:</i>	
BEGE-171 The Christian Life	4
BEGE-172 Introduction to Bible Study	4
BIO-114 Introduction to Biology	5
BIO-115 General Zoology	5
BIO-116 Introduction to Cell Biology	5
CHEM-151,152 General Chemistry I, II	8
EDU-100 The Education Profession	1
ENG-110,140 English Composition I, II	10
GMTH-185 Precalculus	5
(or MATH-281 Analytic Geometry and Calculus I	5)
PEF-199 P.A.C.L.	2
Physical Education elective	1
Total	50

<i>Second year:</i>	
BEGE-273 Old Testament Survey	4
BEGE-274 New Testament Survey	4
BIO-134 General Botany	5
BIO-200 General Ecology	5
BIO-240 Introduction to Research Methods	2
CHEM-356 Biochemistry	5
CHEM-357 Organic Chemistry I	5
COM-110 Fundamentals of Speech	5
EDSP-202 Teaching Children with Exceptionalities	3
EDSP-206 Special Education Field Experience	1
EDU-101 Contemporary Christian School	0
EDU-200 Introduction to Teaching	3
EDU-204 Multicultural Field Experience	2
EDU-210 Technology in the Classroom	2
GSS-100 Foundations of Social Science	5
Total	51

<i>Third year:</i>	
BEGE-375 God and History	4
BEGE-376 God and the Church	4
BIO-238 Introductory Microbiology	5
EDSE-302 Teaching Thinking Skills	2
EDSE-316 Principles of Teaching	4
EDSE-317 Principles of Teaching (Clinical)	4
EDSP-401 Principles of Inclusion	1
EDU-250 Educational Psychology	4
EDU-310 Classroom Planning and Assessment	3
GSCI-160 Introduction to Earth and Space Science	5
HUM-140 Introduction to the Humanities	5
PHYS-172,173 College Physics I, II	10
Biology elective	5
Total	56

<i>Fourth year:</i>	
BIO-306 Genetics	5
BIO-440 Biology Senior Seminar	1
COM-210 Voices of Diversity	4
EDSE-470 Student Teaching and Seminar	12-16
EDU-450 Philosophy of Education	3
SCED-301 Teaching Science for Adolescents/Young Adults	2
SCED-321 Clinical Teaching Science or Math	2
Biology elective	5
Global Awareness elective	3
History elective	5
Literature elective	5
Social Science elective	4
Total	51-55

168 Science and Mathematics

Integrated Mathematics Education

The **integrated mathematics education major** prepares students to teach mathematics in public and Christian schools in grades 7-12. For additional information about teaching, see the Education Department section of this catalog.

Course requirements for mathematics involve 70-71 quarter hours including:

MATH-281,282,283 Analytic Geometry/Calculus I, II, III ..	15
MATH-301 Research Methods in Mathematics	2
MATH-303 Logic and Methods of Proof	5
*MATH-370 Introduction to Higher Mathematical Concepts .	5
MATH-384 Probability and Statistics	5
MATH-401 Capstone Experience in Mathematics	2
MATH-441 Euclidean and Non-Euclidean Geometries	5
PHYS-271,272,273 General Physics I, II, III	15
SCED-302 Teaching Math for Adolescents/Young Adults	2
SCED-321 Clinical Teaching of Science and Math	2

One course from the following:

MIS-124 Computer Programming–Basic	3
MIS-221 FORTRAN Programming	4
MIS-222 Structured Programming	4

One course from the following:

MATH-355 Discrete Mathematics: Graph Theory	4
MATH-356 Discrete Mathematics: Combinatorics	4
Electives from 300 & 400 Mathematics Courses	5

Professional education requirements

EDSE-302 Teaching Thinking Skills	2
EDSE-316 Principles of Teaching	4
EDSE-317 Principles of Teaching (Clinical)	4
EDSE-470 Student Teaching and Seminar	15
EDSP-202 Teaching Children with Exceptionalities	3
EDSP-206 Special Education Field Experience	1
EDSP-401 Principles of Inclusion	1
EDU-100 The Education Profession	1
EDU-101 Contemporary Christian School	0
EDU-200 Introduction to Teaching	3
EDU-204 Multicultural Field Experience	2
EDU-210 Technology in the Classroom	2
EDU-250 Educational Psychology	4
EDU-310 Classroom Planning and Assessment	3
EDU-350 Reading in the Content Area	3
EDU-450 Philosophy of Education	3

*MATH-370 may be replaced by taking the following three courses: MATH-360 Number Theory, MATH-394 Linear Algebra, and MATH-461 Abstract Algebra I.

Mathematics Education Curriculum Summary

Proficiency requirements	0-8
Other General Education Requirements	69-89
Major requirements	70-71
Professional Education requirements	51
Electives	0-2
Total (minimum, not including proficiency)	192

A complete description of the General Education Requirements is found on page 30.

Suggested Four-Year Curriculum for a Major in Mathematics Education - B.A.

First year:

BEGE-171 The Christian Life	4
BEGE-172 Introduction to Bible Study	4
COM-110 Fundamentals of Speech	5
EDU-100 The Education Profession	1
ENG-110 English Composition I	5
ENG-140 English Composition II	5
GSS-100 Foundations of Social Science	5
MATH-281,282,283 Analytic Geometry and Calculus I, II, III	15
PEF-199 P.A.C.L. Physical Education elective	1
Total	47

Second year:

BEGE-273 Old Testament Survey	4
BEGE-274 New Testament Survey	4
EDSP-202 Teaching Children with Exceptionalities	3
EDSP-206 Special Education Field Experience	1
EDU-101 Contemporary Christian School	0
EDU-200 Introduction to Teaching	3
EDU-204 Multicultural Field Experience	2
EDU-210 Technology in the Classroom	2
HUM-140 Introduction to the Humanities	5
MATH-303 Logic and Methods of Proof	5
MATH-441 Euclidean and Non-Euclidean Geometries	5
PHYS-271,272,273 General Physics I, II, III	15
Total	49

Third year:

BEGE-375 God and History	4
BEGE-376 God and the Church	4
BIO-100 Principles of Biology	5
EDSE-302 Teaching Thinking Skills	2
EDSE-316 Principles of Teaching	4
EDSE-317 Principles of Teaching Clinical	4
EDSP-401 Principles of Inclusion	1
EDU-250 Educational Psychology	4
EDU-310 Classroom Planning and Assessment	3
MATH-301 Research Methods in Mathematics	2
MATH-370 Introduction to Higher Mathematical Concepts	5
MATH-384 Probability and Statistics	5
Computer Programming elective (MIS)	3-4
History elective	5
Total	51-52

Fourth year:

COM-210 Voices of Diversity	4
EDSE-470 Student Teaching	15
EDU-450 Philosophy of Education	3
MATH-401 Capstone Experience in Mathematics	2
SCED-302 Teaching Math for Adolescents/Young Adults	2
SCED-321 Clinical Teaching Science or Math	2
Discrete Mathematics elective	4
Global Awareness elective	3
Literature elective	5
Math elective(s)	5
Social Science elective	4
Total	49

Integrated Physical Science Education

The **integrated physical science education major** prepares students to teach physical science in public and Christian schools in grades 7-12. For additional information about teaching, see the Education Department section of this catalog.

Course requirements involve 101-102 quarter hours including:

BIO-114 Introduction to Biology	5
BIO-116 Introduction to Cell Biology	5
CHEM-151,152,153 General Chemistry I, II, III	12
CHEM-356 Biochemistry	5
CHEM-357 Organic Chemistry I	5
GSCI-166 Introduction to Physical Geology	5
GSCI-220 Origins	5
GSCI-230 Oceanography	5
GSCI-264 Introductory Astronomy	5
GSCI-440 Seminar	1
MATH-281,282,283 Analytic Geometry and Calculus I, II, III	15
MATH-387 Differential Equations	5
PHYS-271,272,273 General Physics I, II, III	15
PHYS-378 Modern Physics I	5
<i>Physics electives (selected from)</i>	4-5
PHYS-301,302 Intermediate Physics Lab I, II	4
PHYS-311 Introduction to Theoretical Mechanics	5
PHYS-331 Thermal Physics	5
PHYS-379 Modern Physics II	5
SCED-301 Teaching Science for Adolescents/Young Adults	2
SCED-321 Clinical Teaching Science or Math	2

Professional education requirements

EDSE-302 Teaching Thinking Skills	2
EDSE-316 Principles of Teaching	4
EDSE-317 Principles of Teaching (Clinical)	4
EDSE-470 Student Teaching	15
EDSP-202 Teaching Children with Exceptionalities	3
EDSP-206 Special Education Field Experience	1
EDSP-401 Principles of Inclusion	1
EDU-100 The Education Profession	1
EDU-101 Contemporary Christian School	0
EDU-200 Introduction to Teaching	3
EDU-204 Multicultural Field Experience	2
EDU-210 Technology in the Classroom	2
EDU-250 Educational Psychology	4
EDU-310 Classroom Planning and Assessment	3
EDU-350 Reading in the Content Area	3
*EDU-450 Philosophy of Education	3

*Satisfies humanities General Education Requirement

Integrated Physical Science Education Curriculum Summary

Proficiency requirements	0-8
Other General Education Requirements	65-87
Major requirements	101-102
Professional Education requirements	51
Total (minimum, not including proficiency)	217

A complete description of the General Education Requirements is found on page 30.

Suggested Four-Year Curriculum for the major in Integrated Physical Science Education

First year:

BEGE-171 The Christian Life	4
BEGE-172 Introduction to Bible Study	4
CHEM-151,152,153 General Chemistry I, II, III	12
EDU-100 The Education Profession	1
ENG-110 English Composition I	5
ENG-140 English Composition II	5
GSCI-230 Oceanography	5
MATH-281,282,283 Analytic Geometry/Calculus I, II, III	15
PEF-199 P.A.C.L.	2
Physical Education elective	1
Total	54

Second year:

BEGE-273 Old Testament Survey	4
BEGE-274 New Testament Survey	4
BIO-114 Introduction to Biology	5
BIO-116 Introduction to Cell Biology	5
CHEM-356 Biochemistry	5
CHEM-357 Organic Chemistry I	5
COM-110 Fundamentals of Speech	5
EDSP-202 Teaching Children with Exceptionalities	3
EDSP-206 Special Education Field Experience	1
EDU-101 Contemporary Christian School	0
EDU-200 Introduction to Teaching	3
EDU-204 Multicultural Field Experience	2
EDU-210 Technology in the Classroom	2-3
GSCI-166 Introduction to Physical Geology	5
GSCI-264 Introductory Astronomy	5
MATH-387 Differential Equations	5
Total	59-60

Third year:

BEGE-375 God and History	4
BEGE-376 God and the Church	4
EDSE-302 Teaching Thinking Skills	2
EDSE-316 Principles of Teaching	4
EDSE-317 Principles of Teaching Clinical	4
EDSP-401 Principles of Inclusion	1
EDU-250 Educational Psychology	4
EDU-310 Classroom Planning and Assessment	3
GSS-100 Foundations of Social Science	5
HUM-140 Introduction to Humanities	5
PHYS-271,272,273 General Physics I, II, III	15
Literature elective	5
Total	56

Fourth year:

COM-210 Voices of Diversity	4
EDSE-470 Student Teaching and Seminar	12-16
EDU-450 Philosophy of Education	3
GSCI-220 Origins	5
GSCI-440 Seminar	1
PHYS-378 Modern Physics I	5
SCED-301 Teaching Science for Adolescents/Young Adults	2
SCED-321 Clinical Teaching Science or Math	2
Global Awareness elective	3
Physics elective(s)	4-5
Social Science elective	4
Total	45-50

170 Science and Mathematics

A complete description of the General Education Requirements is found on page 30.

Suggested Four-Year Curriculum for a Major in Integrated Science Education - B.A.

First year:

BEGE-171 The Christian Life	4
BEGE-172 Introduction to Bible Study	4
BIO-114 Introduction to Biology	5
BIO-115 General Zoology	5
BIO-116 Introduction to Cell Biology	5
CHEM-151,152 General Chemistry I, II	8
EDU-100 The Education Profession	1
ENG-110,140 English Composition I, II	5
ENG-140 English Composition II	5
GMTH-185 Precalculus	
or MATH-281 Analytic Geometry and Calculus I	5
GSCI-264 Introduction to Astronomy	5
PEF-199 P.A.C.L.	2
Physical Education elective	1
Total	55

Second year:

BEGE-273 Old Testament Survey	4
BEGE-274 New Testament Survey	4
BIO-134 General Botany	5
BIO-200 General Ecology	5
CHEM-356 Biochemistry	5
CHEM-357 Organic Chemistry I	5
COM-110 Fundamentals of Speech	5
EDSP-202 Teaching Children with Exceptionalities	3
EDSP-206 Special Education Field Experience	1
EDU-101 Contemporary Christian School	0
EDU-200 Introduction to Teaching	3
EDU-204 Multicultural Field Experience	2
EDU-210 Technology in the Classroom	2
GSCI-166 Introduction to Physical Geology	5
GSCI-220 Origins	5
GSS-100 Foundations of Social Science	5
Total	59

Third year:

BEGE-375 God and History	4
BEGE-376 God and the Church	4
BIO-238 Introductory Microbiology	5
EDSE-302 Teaching Thinking Skills	2
EDSE-316 Principles of Teaching	4
EDSE-317 Principles of Teaching Clinical	4
EDSP-401 Principles of Inclusion	1
EDU-250 Educational Psychology	4
EDU-310 Classroom Planning and Assessment	3
HUM-140 Introduction to the Humanities	5
PHYS-172,173,174 College Physics I, II, III	15
Biology elective	5
Chemistry elective	5
Total	61

Fourth year:

BIO-306 Genetics	5
COM-210 Voices of Diversity	4
EDSE-470 Student Teaching	15
EDU-450 Philosophy of Education	3
GSCI-440 Seminar	1
SCED-301 Teaching Science for Adolescents/Young Adults	2
SCED-321 Clinical Teaching Science or Math	2
Chemistry elective	5
Global Awareness elective	3
GSCI- elective	5
History elective	5
Literature elective	5
Social Science elective	4
Total	59

Integrated Science Education

The **integrated science education major** prepares students to teach science in public and Christian schools in grades 7-12. For additional information about teaching, see the Education Department section of this catalog.

Course requirements for science and mathematics involve 112-113 quarter hours including:

BIO-114 Introduction to Biology	5
BIO-115 General Zoology	5
BIO-116 Introduction to Cell Biology	5
BIO-134 General Botany	5
BIO-200 General Ecology	5
BIO-238 Introductory Microbiology	5
BIO-306 Genetics	5
<i>Electives (selected from)</i>	<i>5</i>
BIO-300 Environmental Physiology	5
BIO-312 Invertebrate Zoology	5
BIO-313 Vertebrate Zoology	5
BIO-316 Human Structure and Function I	5
BIO-317 Human Structure and Function II	5
BIO-334 Plant Taxonomy and Ecology	5
BIO-336 Plant Physiology	5
BIOA-340 Topics in Environmental Biology	5
BIO-407 Molecular Biology of the Cell	5
CHEM-151,152 General Chemistry I, II	8
CHEM-356 Biochemistry	5
CHEM-357 Organic Chemistry I	5
<i>Chemistry Electives (selected from)</i>	<i>9-10</i>
CHEM-254 Quantitative Analysis	4
CHEM-358 Organic Chemistry II	5
CHEM-359 Organic Chemistry III	5
GSCI-166 Introduction to Physical Geology	5
GMTH-185 Precalculus	5
(or MATH-281 Analytic Geometry and Calculus I	5)
GSCI-220 Origins	5
GSCI-264 Introduction to Astronomy	5
GSCI-440 Seminar	1
<i>Elective (selected from)</i>	<i>5</i>
GSCI-167 Introduction to Historical Geology	5
GSCI-230 Introduction to Oceanography	5
GSCI-240 General Meteorology	5
PHYS-172,173,174 College Physics I, II, III	15
SCED-301 Teaching Science for	
Adolescents/Young Adults	2
SCED-321 Clinical Teaching of Science or Math	2
<i>Professional education requirements</i>	<i>51</i>
EDSE-302 Teaching Thinking Skills	2
EDSE-316 Principles of Teaching	4
EDSE-317 Principles of Teaching Clinical	4
EDSE-470 Student Teaching and Seminar	15
EDSP-202 Teaching Children with Exceptionalities	3
EDSP-206 Special Education Field Experience	1
EDSP-401 Principles of Inclusion	1
EDU-100 The Education Profession	1
EDU-101 Contemporary Christian School	0
EDU-200 Introduction to Teaching	3
EDU-204 Multicultural Field Experience	2
EDU-210 Technology in the Classroom	2

EDU-250 Educational Psychology	4
EDU-310 Classroom Planning and Assessment	3
EDU-350 Reading in the Content Area	3
*EDU-450 Philosophy of Education	3
*Satisfies humanities General Education Requirement	

Integrated Science Education Summary

Proficiency requirements	0-8
Other General Education Requirements	65-87
Major requirements	112-113
Professional Education requirements	51
Total (minimum, not including proficiency)	228

Mathematics - Bachelor of Arts

The **bachelor of arts degree with a major in mathematics** provides coursework and training in advanced mathematics. Because of the general nature of this curriculum and opportunity to complement the major with electives from other fields of study, this curriculum provides excellent preparation for graduate study in areas that require good quantitative and/or analytical skills such as philosophy, business, and theology. This liberal arts major also prepares students for a wide variety of career opportunities that require a general bachelor of arts degree. The flexibility of this major enables students to select their mathematics and other electives to meet educational or career goals.

Students should include courses in astronomy, chemistry, and physics as general electives.

Course requirements involve 64 quarter hours including:

<i>Mathematics core requirements</i>	44
MATH-281,282,283 Analytic Geometry and Calculus I, II, III	15
MATH-301 Research Methods in Mathematics	2
MATH-303 Logic and Methods of Proof	5
MATH-387 Differential Equations	5
(or MATH-441 Euclidean and Non-Euclidean Geometry	5)
MATH-401 Capstone Experience in Mathematics	2
PHYS-271,272,273 General Physics I, II, III	15
<i>Electives</i> (selected from MATH-300 and MATH-400 level courses including at least one course from each of the following sets)	20
<u>Set I:</u>	
MATH-355 Discrete Mathematics: Graph Theory	4
MATH-356 Discrete Mathematics: Combinatorics	4
MATH-384 Probability and Statistics	5
<u>Set II:</u>	
MATH-360 Number Theory	5
MATH-394 Linear Algebra	5
MATH-461 Abstract Algebra I	4
<u>Set III:</u>	
MATH-374 Complex Variables	5
MATH-441 Euclidean and Non-Euclidean Geometry	5
MATH-445 Topology	5
MATH-471 Real Variables I	4

Mathematics Major (B.A.) Curriculum Summary

Proficiency requirements	0-8
Other General Education Requirements	70-90
Mathematics major requirements	64
Electives	38-58
Total (minimum, not including proficiency)	192

*A complete description of the General Education
Requirements is found on page 30.*

Suggested Four-Year Curriculum for a Major in Mathematics - B.A.

First year:

BEGE-171 The Christian Life	4
BEGE-172 Introduction to Bible Study	4
COM-110 Fundamentals of Speech	5
ENG-110 English Composition I	5
ENG-140 English Composition II	5
GSS-100 Foundations of Social Science	5
MATH-281,282,283 Analytic Geometry and Calculus I, II, III	15
PEF-199 P.A.C.L.	2
Physical Education elective	1
Social Science/Global Awareness elective	4
Total	50

Second year:

BEGE-273 Old Testament Survey	4
BEGE-274 New Testament Survey	4
HUM-140 Introduction to the Humanities	5
MATH-303 Logic and Methods of Proof	5
MATH-387 Differential Equations	5
(or MATH-441 Euclidean and Non-Euclidean Geometry	5)
PHYS-271,272,273 General Physics I, II, III	15
History elective	5
Literature elective	5
Total	48

Third year:

BEGE-375 God and History	4
BEGE-376 God and the Church	4
MATH-301 Research Methods in Mathematics	2
Biology elective	5
Humanities elective	5
Mathematics electives	10
Electives	20
Total	50

Fourth year:

MATH-401 Capstone Experience in Mathematics	2
Mathematics electives	10
Electives	35
Total	47



Dedicated professors present mathematical functions with God's Word as the foundation of all Truth.

172 Science and Mathematics

Mathematics - Bachelor of Science

The **bachelor of science degree with a major in mathematics** prepares students for graduate study in mathematics. The curriculum includes the course requirements prescribed by many of the leading graduate-level mathematics programs in the nation.

Students should include courses in astronomy, chemistry, and physics as general electives.

Course requirements involve 79 hours:

<i>Mathematics core requirements</i>	37
MATH-281,282,283 Analytic Geometry and Calculus I, II, III	15
MATH-301 Research Methods in Mathematics	2
MATH-303 Logic and Methods of Proof	5
PHYS-271,272,273 General Physics I,II, III	15
<i>Advanced mathematics requirement</i>	5
MATH-387 Differential Equations	5
(or MATH-441 Euclidean and Non-Euclidean Geometry	5)
MATH-401 Capstone Experience in Mathematics	2
<i>Electives</i> (meeting the following criteria)	35
A. At least one course from each of the following sets must be included:	
<u>Set I:</u>	
MATH-355 Discrete Mathematics: Graph Theory	4
MATH-356 Discrete Mathematics: Combinatorics	4
MATH-384 Probability and Statistics	5
<u>Set II:</u>	
MATH-360 Number Theory	5
MATH-394 Linear Algebra	5
MATH-461 Abstract Algebra I	4
<u>Set III:</u>	
MATH-374 Complex Variables	5
MATH-441 Euclidean and Non-Euclidean Geometry	5
MATH-445 Topology	5
MATH-471 Real Variables I	4
B. At least one of the following eight quarter hour pairs must be completed:	
<u>Pair I:</u>	
MATH-355 Discrete Mathematics: Graph Theory	4
MATH-356 Discrete Mathematics: Combinatorics	4
<u>Pair II:</u>	
MATH-384 Probability and Statistics	5
MATH-411 Applied Statistics	3
<u>Pair III:</u>	
MATH-461 Abstract Algebra I	4
MATH-462 Abstract Algebra II	4
<u>Pair IV:</u>	
MATH-471 Real Variables I	4
MATH-472 Real Variables II	4

C. Additional 300- and 400- level MATH electives not already taken.

Mathematics Major (B.S.) Curriculum Summary

Proficiency requirements	0-8
Other General Education Requirements	70-90
Mathematics major requirements	79
Electives	23-43
Total (minimum, not including proficiency)	192

A complete description of the General Education Requirements is found on page 30.

Suggested Four-Year Curriculum for a Major in Mathematics - B. S.

First year:

BEGE-171 The Christian Life	4
BEGE-172 Introduction to Bible Study	4
COM-110 Fundamentals of Speech	5
ENG-110 English Composition I	5
ENG-140 English Composition II	5
GSS-100 Foundations of Social Science	5
MATH-281,282,283 Calculus I, II, III	15
PEF-199 P.A.C.L.	2
Physical Education elective	1
Global Awareness elective	4
Total	50

Second year:

BEGE-273 Old Testament Survey	4
BEGE-274 New Testament Survey	4
HUM-140 Introduction to the Humanities	5
MATH-303 Logic and Methods of Proof	5
MATH-387 Differential Equations	5
(or MATH-441 Euclidean and Non-Euclidean Geometry	5)
PHYS-271,272,273 General Physics I, II, III	15
History elective	5
Literature elective	5
Total	48

Third year:

BEGE-375 God and History	4
BEGE-376 God and the Church	4
MATH-301 Research Methods in Mathematics	2
Humanities elective	5
Mathematics electives	13
Biology elective	5
Electives	16
Total	49

Fourth year:

MATH-401 Capstone Experience in Mathematics	2
Mathematics electives	22
Electives	24
Total	48

Physics

The **physics major** prepares students for graduate study in physics or for employment opportunities in industry. The curriculum includes courses prescribed by leading graduate-level physics programs in the nation.

Students should include courses in mathematics and chemistry as general electives.

Course requirements involve 79 quarter hours:

<i>Physics core requirements</i>	69
CHEM-158 Chemistry for Engineers	5
GSCI-440 Seminar	1
MATH-281,282,283 Analytic Geometry and Calculus I, II, III	15
MATH-387 Differential Equations	5
MATH-388 Advanced Calculus I	5
PHYS-271,272,273 General Physics I, II, III	15
PHYS-301,302 Intermediate Physics Laboratory I, II	4
PHYS-311 Introduction to Theoretical Mechanics	5
PHYS-352 Electromagnetic Theory I	5
PHYS-378 Modern Physics I	5
PHYS-401,402 Advanced Physics Laboratory I, II	4
<i>Electives</i> (selected from PHYS-300 and 400 level courses): ..	10
PHYS-331 Thermal Physics	5
PHYS-379 Modern Physics II	5
PHYS-451 Optics	5
PHYS-452 Electromagnetic Theory II	5
PHYS-491 Mathematical Methods for Physicists	5
PHYS-499 Topics in Physics	1-5

Physics Major Curriculum Summary

Proficiency requirements	0-8
Other General Education Requirements	70-90
Physics major requirements	79
Electives	23-43
Total (minimum, not including proficiency)	192

A complete description of the General Education Requirements is found on page 30.

Suggested Four-Year Curriculum for a Major in Physics

First year:

BEGE-171 The Christian Life	4
BEGE-172 Introduction to Bible Study	4
CHEM-158 Chemistry for Engineers	5
ENG-110 English Composition I	5
ENG-140 English Composition II	5
MATH-281, 282, 283 Calculus I, II, III	15
PEF-199 P.A.C.L.	2
PHYS-271 General Physics I	5
Global Awareness elective	4
Total	49

Second year:

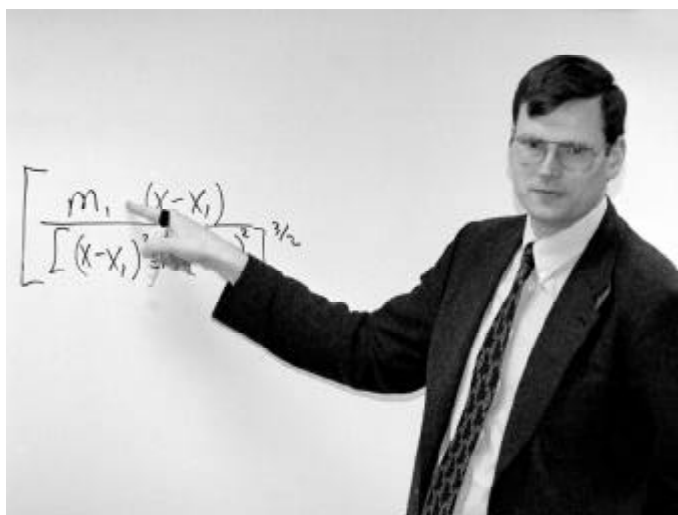
BEGE-273 Old Testament Survey	4
BEGE-274 New Testament Survey	4
COM-110 Fundamentals of Speech	5
GSS-100 Foundations of Social Science	5
MATH-387 Differential Equations	5
MATH-388 Advanced Calculus I	5
PHYS-272, 273 General Physics II, III	10
PHYS-311 Introduction to Theoretical Mechanics	5
Biology elective	5
Physical Education elective	1
Total	49

Third year:

BEGE-375 God and History	4
BEGE-376 God and the Church	4
HUM-140 Introduction to Humanities	5
PHYS-301,302 Intermediate Physics Laboratory I, II	4
PHYS-352 Electromagnetic Theory I	5
History elective	5
Humanities elective	5
Literature elective	5
Physics electives	10
Total	47

Fourth year:

GSCI-440 Seminar	1
PHYS-378 Modern Physics I	5
PHYS-401,402 Advanced Physics Laboratory I, II	4
Electives	37
Total	47



Steven Gollmer, Professor of Physics, offers expert teaching in the classroom that will prepare his students for successful careers.

174 Science and Mathematics

Minors

The minors in the Department of Science and Mathematics are designed to provide non-majors with additional background in the biological sciences, mathematics, and physical sciences.

Course requirements for the **biology minor** involve 25 quarter hours including:

BIO-114 Introduction to Biology	5
BIO-115 General Zoology	5
BIO-116 Introduction to Cell Biology	5
BIO-134 General Botany	5
Biology electives (200-level or above)	5

Course requirements for the **chemistry minor** involve 24 quarter hours including:

CHEM-151,152,153 General Chemistry I, II, III	12
CHEM-254 Quantitative Analysis	4
CHEM-357 Organic Chemistry I	5
Chemistry electives	3

Course requirements for the **earth science minor** involve 25 quarter hours including:

GSCI-166 Introduction of Physical Geology	5
GSCI-167 Historical Geology	5
GSCI-230 Introduction to Oceanography	5
GSCI-240 General Meteorology	5
GSCI-264 Introduction to Astronomy	5

Course requirements for the **mathematics minor** involve 25 quarter hours including:

MATH-281,282,283 Analytic Geometry and Calculus I, II, III	15
Mathematics electives (300- or 400- level courses)	10

Course requirements for the **physics minor** involve 25 quarter hours selected from:

PHYS-271,272,273 General Physics I, II, III	15
PHYS-352 Electromagnetic Theory I	5
PHYS-378,379 Modern Physics I, II	10

Environmental Biology

The **environmental biology curriculum** within the biology major provides undergraduate preparation for students who are pursuing careers in such fields as conservation biology, wildlife biology, environmental toxicology, and environmental health. In addition to formal courses in biology, chemistry, and mathematics, employment criteria for these professions include prior experience (e.g. as a summer employee or intern), field biology skills (i.e. plant/animal taxonomy, habitat assessment and improvement), interpersonal skills, mathematical and communication skills, and the ability to reason critically and integrate across disciplines.

Students are advised to complete the core requirements for the B.S. in biological sciences, including elective courses from Sets I and III, with emphasis upon Set IV (Environmental Physiology/Ecology), which includes the option of enrolling in courses taught at AuSable Institute in northern Michigan or in the Pacific Northwest (see details under course description of BIOA-340 Topics in Environmental Biology).

Students pursuing *environmental education* (e.g. interpretive naturalist) may also elect to complete requirements for state teacher licensure through the University Education Department. The environmental biology curriculum can also serve as a useful component for students who plan to serve in missions ministries through programs related to soil, water, and plant/animal resource management.

Preagriculture

The **preagriculture curriculum** is designed to satisfy the technical and nontechnical requirements of the first two years of a typical agriculture program. Students should research agricultural schools to which they wish to transfer at the junior level so that application materials can be completed in advance of deadlines. The program includes one year of general requirements and a second year of agricultural science or agricultural business.

Course requirements include core requirements and an emphasis in either agriculture business or agriculture science.

Core requirements include:

BEGE-171 The Christian Life	4
BEGE-172 Introduction to Bible Study	4
BIO-114 Introduction to Biology	4
BIO-116 Introduction to Cell Biology	5
CHEM-151,152 General Chemistry I, II	8
COM-110 Fundamentals of Speech	5
ENG-110 English Composition I	5
ENG-140 English Composition II	5
GMTH-185 Precalculus	5
(or MATH-281 Analytic Geometry and Calculus I	5)
GSS-100 Foundations of Social Science	5
HUM-140 Introduction to the Humanities	5



Students gain an understanding of scientific functions and principles through instructional field trips with professors.

The preagriculture student should confer with his advisor to select electives based upon:

- (a) the requirements of the school to which he will transfer after leaving Cedarville University;
- (b) the specific agricultural program he wishes to enter.

The **agriculture business emphasis** prepares students for careers in the industry and business phases of agriculture.

Course requirements include:

Two courses (selected from):	10
ACCT-211 Principles of Accounting	5
BIO-115 General Zoology	5
BIO-134 General Botany	5
BIO-200 General Ecology	5
BIO-238 Introductory Microbiology	5
BIO-306 Genetics	10
BUS-211 Statistics	3
ECON-231,332 Macro and Microeconomics	8
MGMT-350 Principles of Organization and Management	4
MIS-100 Introduction to Computers	2
Humanities electives	10
Social Science elective	5

The **agriculture science emphasis** prepares students for careers including agronomy, animal science, food science, and horticulture.

Course requirements include:

BIO-115 General Zoology	5
BIO-134 General Botany	5
CHEM-357,358,359 Organic Chemistry I, II, III	15
MATH-282 Analytic Geometry and Calculus II	5
MATH-384 Probability and Statistics	5
Biological science elective	5
(or CHEM-356 Biochemistry	5)
Humanities elective	5
Social Science elective	5

Medical Technology

A medical technology option is available within the biology major. The student must spend one year in a hospital internship program to become a certified medical technologist.

Prerequisites to the hospital internship include: 24 hours of biology, 24 hours of chemistry, one mathematics course, and completion of all General Education Requirements.

Students may do an internship during their senior year with 48 hours of transfer credit applied to the biology major upon successful completion of the internship. Many students complete the requirements for a biology major first and then take the internship after graduation from Cedarville University.

Predental, Premedical, Preoptometric, Preosteopathic, and Preveterinary Medicine

Cedarville students have been successful in gaining admission to medical/professional schools. Though no specific major is required by these schools, students typically choose majors in biology or chemistry. The premedical advisor will arrange the course sequence.

The following courses are usually required by the professional colleges:

Biology electives (selected from):	15
BIO-114 Introduction to Biology	5
BIO-115 General Zoology	5
BIO-238 Introductory Microbiology	5
BIO-306 Genetics	5
BIO-313 Vertebrate Zoology	5
(or BIO-411 Vertebrate Embryology	5)
BIO-316,317 Human Structure and Function I, II	10
CHEM-151, 152, 153 General Chemistry I, II, III	12
CHEM-356 Biochemistry	5
CHEM-357, 358, 359 Organic Chemistry I, II, III	15
MATH-281 Analytic Geometry and Calculus I	5
PHYS-172, 173, 174 College Physics I, II, III	15

Prepharmacy

The **prepharmacy curriculum** enables a student to obtain the first two years of the five-year pharmacy program at Cedarville University. To ensure that specific course requirements may be met through Cedarville courses, the student should select the pharmacy college he or she plans to attend as early as possible and obtain a catalog describing the specific course requirements.

Generally the following courses should be included in the two years the prepharmacy student attends Cedarville:

BIO-114 Introduction to Biology	5
BIO-115 General Zoology	5
BIO-116 Introduction to Cell Biology	5
BIO-134 General Botany	5
BIO-238 Introductory Microbiology	5
BIO-316 Human Structure and Function I	5
CHEM-151,152,153 General Chemistry I, II, III	12
CHEM-357,358,359 Organic Chemistry I, II, III	15
COM-110 Fundamentals of Speech	5
ENG-110 English Composition I	5
ENG-140 English Composition II	5
GSS-100 Foundations of Social Science	5
MATH-281 Analytic Geometry and Calculus I	5
PHYS-172,173,174 College Physics I, II, III	15
PSYCH-160 General Psychology	5

176 Science and Mathematics

Prephysical Therapy

The **prephysical therapy program** prepares students for admission to graduate-level schools of physical therapy and generally satisfies the prerequisites prescribed by the American Physical Therapy Association (A.P.T.A.) accredited graduate schools. Students should contact the specific schools they wish to attend to determine the exact prerequisites for those schools. Physical therapy schools favor students who have gained practical experience in the field. Consequently, prephysical therapy students should obtain a minimum of 100 clock hours of experience in assisting a licensed physical therapist prior to their senior year.

Competition for admission to physical therapy schools remains fierce. The prephysical therapy curriculum, which satisfies the requirements for a degree in biology, provides students with many health-related, postgraduate study options. These options include optometric, chiropractic, and graduate schools.

Course requirements include:

BIO-114 Introduction to Biology	5
BIO-115 General Zoology	5
BIO-116 Introduction to Cell Biology	5
BIO-134 General Botany	5
BIO-200 General Ecology	5
BIO-238 Microbiology	5
BIO-306 Genetics	5
BIO-316,317 Human Structure and Function I, II	10
BIO-319 Pathophysiology	5
**BUS-211,212 Statistics	6
CHEM-151,152,153 General Chemistry I, II, III	12
CHEM-356 Biochemistry	5
CHEM-357 Organic Chemistry I	5
COM-324 Interpersonal Communication	3
GMTH-185 Precalculus	5
GSCI-440 Senior Seminar	1
MIS-100 Introduction to Computers	2
MIS-220 Computer Information Systems	3
PEA-365 Therapeutic Exercise	3
PEA-366 Modalities in Athletic Training	3
PEA-394 Structural Kinesiology	3
PHYS-172,173,174 College Physics I, II, III	15
PYCH-160 General Psychology	5
PYCH-260 Human Development	4
PYCH-264 Psychology of Abnormal Behavior	5
PYCH-330 Health Psychology	4
**PYCH-261 Psychological Statistics is an acceptable alternative to BUS-211,212.	

Recommended electives include:

NSG-315 Nutrition of Individuals and Families	3
PEA-255 Basic Athletic Training	3
PEM-390 Physiology of Exercise	4
PEM-392 Kinesiology	3
PYCH-263 Psychology of Aging	5
PYCH-372 Psychology of Personality	4

Course Descriptions

General Education

Designed to meet the General Education Requirements for graduation (except where noted). These courses will not count toward graduation requirements for majors found in the department of science and mathematics unless they are specifically listed in the curriculum requirements for a major. A student majoring in science or mathematics may take these courses only as electives. However, any course listed for science or mathematics major or minor may also count toward fulfilling General Education Requirements.

BIO-100 Principles of Biology—A,W,Sp,Su **5 hours**

Emphasizes basic life processes and the principles by which these processes operate at the ecological, organismic, and cellular levels of organization with emphasis on human responsibility toward life at all levels. Four lectures and one two-hour laboratory per week. (Fee:\$35)

BIO-101 Environmental Biology—Su **5 hours**

Emphasizes relationships among living organisms and the environment. Classroom discussion, frequent field studies, and student projects will teach students to integrate biological and Christian stewardship principles, and apply them toward understanding local community and global environmental problems. (Fee: \$35)

BIO-216,217 Human Anatomy and Physiology I,II—A,W **5 hours each quarter**

Survey of the principal systems of the human body with emphasis on both structure and function. BIO-216 includes a review of basic biology plus the skeletal, muscular, and nervous systems.

BIO-217 includes the endocrine, respiratory, cardiovascular, digestive, urinary, and reproductive systems. Four lectures and one two-hour laboratory per week. *Prerequisite: BIO-100 Principles of Biology, or CHEM-154 Principles of Chemistry, or permission of instructor.* (Fee: \$35)

CHEM-154 Principles of Chemistry—A **5 hours**

For non-science majors, an introduction to atomic structure, ionic and covalent bonding, stoichiometry, kinetic theory, solutions and equilibria, nuclear chemistry, nomenclature, structure, and reactions of organic compounds. Four lectures and one two-hour laboratory per week. (Fee: \$35)

CHEM-158 Chemistry for Engineers—W **5 hours**

Study of the states of matter, energy, and chemical change. Laboratory will stress quantitative skills. Four lectures and one two-hour laboratory per week. *Prerequisite: high school chemistry and Algebra II.* (Fee: \$35)

GMTH-100 Intermediate Algebra—W **4 hours**

Review of algebraic principles, which are then extended to the solution of polynomial equations, systems of linear equations, and inequalities with an emphasis on computational proficiency. Other topics covered are rational and radical equations, functional notation, and exponential and logarithmic functions. This course is designed to prepare the student for GSCI-184 College Algebra or other mathematics courses of comparable difficulty. The class time consists of three hours of lecture and two one-hour laboratories per week. May not be applied toward the 192 quarter hours needed for graduation nor toward the science and mathematics General Education Requirement.

GMTH-180 Introduction to Mathematics—A,Sp **5 hours**

Introduction to mathematical concepts including voting theory, apportionment and fair division, models of population growth, and graph theory.

GMTH-184 College Algebra—A,W **5 hours**

Introduction to methods of algebraic analysis. Includes, but may not be limited to, many topics of intermediate algebra: the field axioms, linear functions, inequalities, systems of equations, determinants, and quadratic functions. This course, in conjunction with GSCI-185, is designed to help prepare the student for calculus. *Prerequisite: two years of high school mathematics or permission of instructor.*

GMTH-185 Precalculus—A,Sp **5 hours**

Introduction to the principles of trigonometry and possibly some advanced topics in algebra. Coverage includes, but may not be limited to, trigonometric and circular functions, triangle problems, and vectors. This course, in conjunction with GSCI-184, is designed to help prepare the student for calculus. *Prerequisite: GSCI-184 College Algebra.*

GMTH-190 Calculus for Business and Social Science—A,W,Sp 5 hours

Introduction to the concepts of differential and integral calculus for students of business and the social sciences. Numerous applications from these areas will be considered. Does not apply toward major in mathematics.

GSCI-160 Principles of Earth and Space Science—Sp,Su 5 hours

Survey of the sciences of geology, oceanography, meteorology, and astronomy. Will be studied from both evolutionary and creationist perspectives. About half the course will deal with the basic fundamentals of geology, considering the main rock types and geological activities of the earth. Also includes a brief overview of the processes and composition of the oceans and the atmosphere and a consideration of the science of astronomy and the origin of the universe. Labs will include activities in each of these subjects. Field trips will be taken to learn about the local geology. Four lectures and one two-hour laboratory per week. (Fee: \$35)

GSCI-161 Principles of Physical Science—W,Su 5 hours

Introductory study of the sciences of physics and chemistry with emphasis on basic concepts and principles as well as the development of foundational laws pertaining to these disciplines. Four lectures and one two-hour laboratory per week. (Fee: \$35)

GSCI-162 Chemistry and the Environment—A 5 hours

An introduction to the foundational philosophical and chemical principles of environmental concern and their application for air/land/water quality, energy production, waste disposal, and household chemical usage. Four lectures and one two-hour laboratory per week. (Fee: \$35)

GSCI-166 Introduction to Physical Geology—A,W,Su 5 hours

Introduction to the study of the earth and its processes. Minerals, fossils, and igneous, sedimentary, and metamorphic rocks will be studied. Earth processes such as volcanoes, earthquakes, weathering, streams, glaciers, plate movements, and mountain building will be examined both from evolutionary and creationist perspectives with special emphasis on how the Flood has affected these processes and features. A field trip of southwest Ohio will examine the rocks, glacial features, and fossils of the area. Four lectures and one two-hour laboratory per week. (Fee: \$35)

GSCI-167 Historical Geology 5 hours

The earth's geological history from both creationist and evolutionary perspectives will be studied from its early history to the present. Topics of study include plate tectonics, biological evolution and the meaning of the fossil record, and the correlation and dating of rocks. Special emphasis will be placed on how the Flood has affected the earth's original creation and form. A field trip will study local fossils and their depositional history. Four weekly lectures and one weekly two-hour laboratory. *Prerequisite: GSCI-160 Principles of Earth and Space Science, or GSCI-166 Introduction to Physical Geology.* (Fee: \$35)

GSCI-210 Ethics of Human Reproduction—A 5 hours

Course is designed to deal with several topics pertaining to human sexuality: biology of human reproduction, conception control, infanticide, abortion, sexually transmitted diseases, biblical standards of sexuality, and teaching biblical sexuality to children and teens. *Prerequisite: BIO-100 Principles of Biology; GSS-100 Foundations of Social Science.*

GSCI-220 Origins 5 hours

Two models for the origin of the universe, life, and man are developed. The two models, creation and evolution, are examined using available scientific evidence and predictions based on each model and compared with the scientific evidence. Does not satisfy the biological science or physical science General Education Requirement. Four lectures and one one-hour laboratory per week. *Prerequisite: BIO-100 Principles of Biology; GSCI-160 Principles of Earth and Space Science or equivalent.*

GSCI-222 Physical Science for Elementary Education 5 hours

Introduction to a selection of core concepts of physics and chemistry for preservice elementary education teachers. Students will develop methods of learning science, with emphasis on inquiry, scientific method, and integrating common everyday objects and experiences with a view toward cultivating the excitement of studying the Creator's Creation. Does not satisfy the physical science General Education Requirement.

GSCI-230 Introduction to Oceanography—W 5 hours

Introductory survey of the oceans and the processes that occur in and around them. Major topics discussed will include currents, coastlines, plate tectonics, marine sediments, waves, tides, composition of sea water, and interaction of the ocean with the atmosphere and marine life forms and their habitats. Four lectures and two hours of laboratory exercises per week, and projects (some out of class). (Fee: \$35)

GSCI-240 General Meteorology—Sp 5 hours

Survey of basic meteorological principles and weather systems. Topics covered will include the vertical structure of the atmosphere, cloud development and precipitation, optical effects of the atmosphere, wind systems, air masses, fronts, and severe weather. Labs will be used to develop basic meteorological skills such as observation of local weather, decoding and interpretation of meteorological data, and introductory weather forecasting. Four lectures and one two-hour laboratory per week. *Prerequisite: high school physics; GSCI-185 Precalculus or equivalent or permission of instructor.* (Fee: \$35)

GSCI-264 Introductory Astronomy—Sp 5 hours

Designed to explore concepts, principles, and laws pertaining to a God-created universe, with some emphasis on techniques used to obtain this knowledge. Four lectures per week, laboratory by arrangement including field observations at the college observatory. *Prerequisite: high school geometry; permission of instructor.* (Fee: \$35)

Departmental Courses

SCED-301 Teaching Science—A 2 hours

Designed to introduce prospective secondary school science teachers to the curriculum, materials, and methods of classroom and laboratory science teaching. Attention will be given to the philosophical and education psychology theories that are currently influencing science education and the methods of instruction which arise from these theories. Students will identify and evaluate appropriate instructional strategies, materials, and professional resources in science education.

SCED-302 Teaching Mathematics—A 2 hours

Designed to introduce prospective secondary school mathematics teachers to the curriculum, materials, and methods of mathematics classroom teaching.

SCED-321 Clinical Teaching in Science or Mathematics —A,W,Sp 2 hours

Students are assigned to assist a college instructor in classroom and laboratory teaching, evaluation, and related responsibilities. The student must complete 40 clock hours of clinical involvement in the teaching field for which certification is desired. Students desiring certification in an additional field must complete an additional one credit hour, representing 20 clock hours of experience. *Prerequisite: admission to the teacher education program.*

GSCI-440 Seminar—A,W,Sp 1 hour

Students present a paper from library or laboratory research. Each student must obtain approval of the topic from his advisor and seminar instructor and must set the date of presentation before enrolling in the course. The student must also attend a minimum of 10 seminars during the senior year. Guest lecturers and faculty members may present papers at the invitation of the instructor. Required of all science and mathematics majors. Capstone course. *Prerequisite: senior status and attendance of a minimum of 10 seminars during the sophomore and junior years.*

Biological Science

BIO-114 Introduction to Biology—A 5 hours

Structure and function of plant and animal cells with emphasis on central concepts. This is the first biology course for majors; open to others with high school biology and chemistry background. Four lectures and one two-hour laboratory per week. (Fee: \$35)

BIO-115 General Zoology—Sp 5 hours

Survey of the animal kingdom and of zoological principles with an introduction to anatomy, physiology, and classification. Three lectures and two two-hour laboratories per week. *Prerequisite: BIO-114 Introduction to Biology.* (Fee: \$35)

178 Science and Mathematics

BIO-116 Introduction to Cell Biology—W 5 hours

Foundational knowledge of cell biology including membrane and organelle function, basic metabolism, transport of metabolites, and cell signaling. Three or four lectures and one three- or four-hour laboratory, totaling seven hours each week. *Prerequisite: BIO-114 Introduction to Biology.* (Fee: \$35)

BIO-134 General Botany—A 5 hours

Survey of the vascular plants, bryophytes, algae, and fungi with an introduction to their anatomy, physiology, taxonomy, and economic importance. Three lectures and two two-hour laboratories per week. *Prerequisite: BIO-114 Introduction to Biology.* (Fee: \$35)

BIO-200 General Ecology—Sp 5 hours

Study of the interrelationships between living organisms and environment with emphasis upon environmental physiology, ecosystem and community ecology, and environmental stewardship. Laboratories feature field studies of representative aquatic and terrestrial ecosystems. Three (or four) lectures and one three-hour (or four-hour) laboratory, totaling seven contact hours per week. *Prerequisite: BIO-115 General Zoology; BIO-134 General Botany.* (Fee: \$35)

BIO-238 Introductory Microbiology—W 5 hours

Study of bacteria, fungi, and viruses and their relationship to man's economy and hygiene. Basic laboratory techniques are stressed. Three lectures and three two-hour laboratories per week. *Prerequisite: BIO-114 Introduction to Biology; CHEM-151 General Chemistry.* (Fee: \$35)

BIO-240 Introduction to Research Methods 2 hours

This course will provide guidance and experience in writing the components of a research proposal. The final assignment will consist of a short research proposal on a topic of the student's choosing. In addition, there will be an attendance requirement of 5 biology seminars during the quarter in which the student registers for the course. *Prerequisites: BIO-114 Introduction to Biology; BIO-115 General Zoology; BIO-116 Introduction to Cell Biology; ENG-140 English Composition II; and permission of instructor.* (Fee: \$35)

BIO-300 Environmental Physiology 5 hours

Study of physiological mechanisms and adaptations by which plants, animals, and humans regulate life processes in response to light, temperature, moisture, and chemical substances in their environment. Three lectures and one three-hour laboratory per week; contact hours include one four-day weekend trip into the "north woods." *Prerequisite: BIO-115 General Zoology; BIO-134 General Botany; CHEM-152 General Chemistry II.* (Fee \$35)

BIO-306 Genetics—A 5 hours

Study of the principles of heredity and their application to plant, animal, and human life. Four lectures and one three-hour laboratory per week. *Prerequisite: BIO-114 Introduction to Biology; GSCI-185 Precalculus.* (Fee: \$35)

BIO-312 Invertebrate Zoology—Sp 5 hours

Survey of representative invertebrates to include taxonomic, morphological, and evolutionary relationships. Three lectures and two three-hour laboratories per week. *Prerequisite: BIO-115 General Zoology.* (Fee: \$35) (even years)

BIO-313 Vertebrate Zoology—W 5 hours

Study of the various vertebrate groups with emphasis upon vertebrate taxonomy and anatomy. Three lectures and two three-hour laboratories per week. *Prerequisite: BIO-115 General Zoology.* (Fee: \$35)

BIO-316,317 Human Structure and Function I, II—W,Sp 5 hours each quarter

Study of structure and function of the human body with emphasis on body systems. Four lectures and one three-hour laboratory per week. *Prerequisite: BIO-115 General Zoology.* (Fee: \$35)

BIO-319 Pathophysiology—Sp 5 hours

Study of the abnormal functions of the human body during disease processes. Four lectures and one case study discussion group per week. *Prerequisite: BIO-217 Human Anatomy and Physiology or BIO-317 Human Structure and Function (BIO-317 may be taken concurrently).*

BIO-334 Plant Taxonomy and Ecology—Sp 5 hours

Field botany students learn to identify vascular plant species, collect and preserve specimens, and associate them with their respective taxonomic families and biotic communities. Two lectures and two

three-hour laboratories per week; some extended field trips.

Prerequisite: BIO-134 General Botany. (Fee: \$35)

BIO-336 Plant Physiology—W 5 hours

Study of the unique physiological processes of plant life such as plant and soil-water relationships, mineral nutrition, photosynthesis, and mechanisms that enable plants to coordinate their growth and development in response to environmental stimuli. Four lectures and one three-hour laboratory per week. *Prerequisite: BIO-134 General Botany; CHEM-357 Organic Chemistry I.* (Fee: \$35) (odd years)

BIOA-340 Topics in Environmental Biology 5 hours each

Each course emphasizes Christian stewardship of natural resources as its integrative theme. Students should register under BIO-340A Topics in Environmental Biology. Selected course titles will appear on the transcript when the work is completed. Choice can be made from four course sequences, which, if completed in addition to requirements for the biology major, will earn certification in one of the following areas designed to prepare students for employment or graduate study: (1) Interpretive Naturalist, (2) Water Resource Analyst, (3) Land Resource Analyst, and (4) Environmental Analyst.

Includes a selection of five-hour courses taught at AuSable Institute by faculty of various evangelical Christian colleges:

BIOA/GEOG-266 Natural History of the Pacific Northwest

BIOA/GEOL/GEOG-301 Land Resources

BIOA-302 Limnology (Water Resources)

BIOA/GEOG-303 Natural Resources Practicum

BIOA/GEOG-304 Natural Resources Practicum: Global Development and Ecological Sustainability

BIOA-305 Ornithology

BIOA-311 Field Botany

BIOA-312 Insect Biology and Ecology

BIOA-315 Woody Plants

BIOA-321 Animal Ecology

BIOA-322 Aquatic Biology

BIOA-342 Fish Biology and Ecology

BIOA-361 Natural History in Spring

BIOA-377 Marine Invertebrates

BIOA-411 Advanced Field Botany

BIOA-417 Marine Stewardship

BIOA-427 Ecology of the Indian Tropics

BIOA/GEO-471 Conservation Biology

BIOA-477 Plant Ecology

BIOA-482 Restoration Ecology

CHEM-332 Environmental Chemistry

GEOA/GEOG-217 Field Geology of the Pacific Northwest

GEOG-216 Field Geology

BIO-400 Independent Study in Biology 1-4 hours

Independent experimental study involving a particular biological phenomenon. Submission and approval of a research proposal must precede registration. *Prerequisite: major in biology and permission of advisor.* (Fee: \$5/hour)

BIO-405 Environmental Biology Internship 4-10 hours

Opportunity to participate in an internship experience, arranged in conjunction with local or state agencies. Provides experience in activities such as nature interpretation, plant and animal cataloging, habitat restoration, ecological studies, and administration of environmentally related projects of community concern. *Prerequisite: BIO-200 General Ecology; CHEM-357 Organic Chemistry.*

BIO-407 Molecular Biology of the Cell—W 5 hours

Study of the cell with special emphasis on molecular organization and function. Four lectures and one three-hour laboratory per week. *Prerequisite: BIO-114 Introduction to Biology; CHEM-357 Organic Chemistry; BIO-306 Genetics.* (Fee: \$35) (even years)

BIO-411 Vertebrate Embryology—W 5 hours

Study of the initiation and development of tissues and organs with emphasis on embryonic development of vertebrates, including the human. Three lectures and two three-hour laboratories per week. *Prerequisite: BIO-115 General Zoology.* (Fee: \$30) (odd years)

BIO-432 Immunology 5 hours

Study of the human immune system, including descriptions of basic immunological phenomena, biochemistry of antibodies and antigens, the cellular and genetic components of the immune response, and immunopathology. Four lectures and one three-hour laboratory per week. *Prerequisite: BIO-114 Introduction to Biology; BIO-238 Introductory Microbiology.* (Fee: \$35)

BIO-436 Radiation Biology—A **5 hours**

The effects of ionizing radiation on biological systems and methods of using radioisotopes. Introductory material on radiation physics and dosimetry is included. The laboratory exercises introduce the student to basic instrumentation and techniques in safely handling radioisotopes. The course may be applied to either a biology or a chemistry major. Three lectures and two two-hour laboratories per week.

Prerequisite: one year of chemistry; one course in biology; one course in mathematics. (Fee: \$35)

BIO-440 Biology Senior Seminar—A,W,Sp **1 hour**

In this capstone course required of all senior biology majors, students compile data from laboratory, field study, or extensive literature research and give an oral presentation. Approval of the topic must be given by the student's academic advisor. The student must also attend a minimum of 10 seminars during the senior year. *Prerequisites: BIO-240 Introduction to Research Methods, senior status, and attendance of a minimum of 10 seminars prior to the senior year.*

(Fee: \$35). (odd years)

BIO-450 Topics in Biology **2-5 hours**

Topics of special interest by the biology faculty from the areas of modern biology.

Chemistry

CHEM-151,152,153 General Chemistry I, II, III—A,W,Sp
4 hours each quarter

Fundamental facts and principles of chemistry. Quantitative techniques are stressed in the laboratory during the first two quarters. Three lectures and one three-hour laboratory per week. *Prerequisite: CHEM-154 Principles of Chemistry or high school chemistry.* (Fee: \$35)

CHEM-254 Quantitative Analysis—W **4 hours**

Study of the theory, techniques, and calculations involved in gravimetric and volumetric analysis of inorganic substances. Three lectures and one three-hour laboratory per week. *Prerequisite: CHEM-152 General Chemistry.* (Fee: \$35)

CHEM-255 Analytical Chemistry—Sp **5 hours**

Continuation of CHEM-254 Quantitative Analysis, emphasis on instrumental analysis. Three lectures and two three-hour laboratories per week. *Prerequisite: CHEM-254 Quantitative Analysis.* (Fee: \$35)

CHEM-333 Intermediate Inorganic Chemistry—W **4 hours**

Detailed study of the fundamental concepts, bonding, structure, and reactivity with an emphasis on the descriptive chemistry of the elements. Laboratory exercises involve application of spectroscopy to inorganic syntheses. Three lectures and one three-hour laboratory per week. *Prerequisite: CHEM-254 Quantitative Analysis.* (Fee: \$35)

CHEM-356 Biochemistry—Sp **5 hours**

Study of carbohydrates, lipids, proteins, and nucleoproteins, and their relationship to life and metabolic processes. Four lectures and one three-hour laboratory per week. *Prerequisite: CHEM-357 Organic Chemistry or BIO-238 Introductory Microbiology.* (Fee: \$35)

CHEM-357,358,359 Organic Chemistry I, II, III—A,W,Sp
5 hours each quarter

Detailed study of the general principles, aliphatics, aromatics, and natural products. Emphasis is placed on mechanism. Fall and winter quarters: four lectures and one three-hour laboratory per week. Spring quarter: three lectures and two three-hour qualitative organic analysis laboratories per week. *Prerequisite: CHEM-152 General Chemistry.* (Fee: \$35)

CHEM-450 Independent Study in Chemistry **1-4 hours**

Independent experimental study of some chemical phenomenon. *Prerequisite: CHEM-255 Analytical Chemistry; CHEM-359 Organic Chemistry III; CHEM-451 Physical Chemistry I.* (Fee: \$5/hour)

CHEM-451,452,453 Physical Chemistry I, II, III
4 hours autumn and winter quarters
3 hours spring quarter

Study of the properties of chemical systems, including the fundamentals of thermodynamics, chemical dynamics, and quantum mechanics. Autumn and Winter quarters: three lectures and one three-hour laboratory per week. Spring quarter: three lectures. *Prerequisite: CHEM-254 Quantitative Analysis or PHYS-273 General Physics.*

(Fee: \$35) (odd years)

CHEM-454 Advanced Inorganic Chemistry **5 hours**

Modern concepts of the structure of matter, nature of the chemical bond, complex ions, and the periodic properties of the elements.

Prerequisite: CHEM-333 Intermediate Inorganic Chemistry; CHEM-451 Physical Chemistry I. (even years)

CHEM-455 Topics in Chemistry **2-5 hours**

Topics of special interest are selected by the chemistry faculty from the areas of modern chemistry. May be repeated once for credit.

Prerequisite: CHEM-451 Physical Chemistry I; permission of instructor.

CHEM-470 Advanced Chemistry Laboratory—Sp **3 hours**

Advanced laboratory experience designed to integrate organic and inorganic synthesis with analytical, physical, and instrumental analysis techniques. One lecture and two three-hour laboratories per week. *Prerequisite: CHEM-452 Physical Chemistry II.* (Fee: \$35)

Computer Science

CS-221 Computer Science II—A **4 hours**

Structured programming concepts are developed through programming assignments in a high level language. The program development process, top-down design, stepwise refinement, as well as the analysis of algorithms and data structures will be used to develop sound problem-solving techniques. Intended as the second programming course for CS majors. *Prerequisite: ENGR-280 C Programming or permission of instructor.* (Fee: \$35)

CS-320 Programming Language Survey **4 hours**

Systematic study of the principles, concepts, and mechanisms of computer programming languages: their syntax, semantics, and pragmatics; the processing and interpretations of computer programs; programming paradigms; and language design. Illustrative examples will be selected from a variety of programming language paradigms. *Prerequisite: MIS-222 Structured Programming.*

CS-401 Software Programming **3 hours**

Introduction to software engineering principles focusing on software management concepts, software project scheduling, software quality assurance, and software project planning. *Prerequisite: CS-330 Data Structures.*

CS-402 Software Engineering II **3 hours**

Builds upon the software project management skills learned in Software Engineering I. Focuses on software analysis, software design, and software testing. *Prerequisite: CS-328 Database Development; CS-329 Operating Systems; CS-401 Software Engineering I.*

CS-403 Software Engineering III **3 hours**

Builds upon the software analysis and design skills learned in Software Engineering II. Focuses on more advanced topics including object-oriented design, formal methods, client/server software engineering, and CASE tools. Capstone course. *Prerequisite: CS-320 Language Survey; CS-402 Software Engineering II; ENGR-316 Microprocessors.*

CS-495 Independent Study **2-4**

Independent research in the various branches of computer science and allied fields of application. Submission and approval of a research proposal must precede registration. *Prerequisite: a major in computer science and permission of the research instructor.*

Mathematics

MATH-281 Analytic Geometry and Calculus I—A,W **5 hours**

First course of a three-course sequence covering basic concepts of analytic geometry and single variable calculus. Includes limits, derivatives, applications of the derivative, and single variable integration with introduction to numeric integration techniques. *Prerequisite: GSCI-185 Precalculus or equivalent; permission of instructor.*

MATH-282 Analytic Geometry and Calculus II—W,Sp **5 hours**

The second course of a three-course sequence covering the basic concepts of analytic geometry and single variable calculus. Includes calculus-based development of the logarithmic and exponential functions along with other transcendental functions, applications of integration, additional integration techniques, sequences, series, and expansion of functions into Taylor and power series. *Prerequisite: MATH-281 Analytic Geometry and Calculus I.*

MATH-283 Analytic Geometry and Calculus III—A,Sp **5 hours**

Third course of a three-course sequence covering basic concepts of analytic geometry and single variable calculus. Includes concept

180 Science and Mathematics

sections, plane curves, parametric equations, polar coordinates, vectors and geometry in three-space, vectors, and vector calculus. *Prerequisite: MATH-282 Analytic Geometry and Calculus II.*

MATH-301 Research Methods in Mathematics—Sp 2 hours

This course will introduce the mathematics major to the various resources and methods available for researching topics in mathematics. This could include the use of library resources at Cedarville University, use of Internet resources, WWW searches, and a tour of the library at a larger university, where journals and indexes of importance can be referenced. *Prerequisites: MATH-303 Logic and Methods of Proof; ENG-140 English Composition II.* (Fee: \$35)

MATH-303 Logic and Methods of Proof—A 5 hours

Introduction to formal mathematical logic; emphasis on preparing students for the abstraction of upper-division courses. Special attention is given to the development of students' skills with a variety of methods of proof, using examples from numerous areas. *Prerequisite: MATH-282 Analytic Geometry and Calculus II.*

MATH-355 Discrete Mathematics: Graph Theory—W 4 hours

Introduction to the basic concepts of graph theory and discrete mathematics problem-solving. Topics covered include elements of graph theory, covering circuits, graph coloring, trees and searching, and network algorithms. Forms an eight-hour sequence with MATH-356 Discrete Mathematics: Combinatorics. *Prerequisite: MATH-303 Logic and Methods of Proof.* (odd years)

MATH-356 Discrete Mathematics: Combinatorics—Sp 4 hours

Study of combinatorial reasoning, focusing on enumeration. Intended to develop a proficiency in methods of enumerative problem solving. Topics chosen from areas such as counting methods for arrangements and selections, permutations and combinations, generating functions, partitions, and recurrence relations. *Prerequisite: MATH-303 Logic and Methods of Proof.* (odd years)

MATH-360 Number Theory—A 5 hours

Introduction to most of the topics of elementary number theory such as modular arithmetic, prime factorizations, linear diophantine equations, the Chinese remainder theorem, quadratic reciprocity, Pythagorean triples, number theoretic functions, and related topics. Concrete examples will illustrate the concepts and abstract reasoning will develop the theories considered in the courses. *Prerequisite: MATH-303 Logic and Methods of Proof.* (odd years)

MATH-370 Introduction to Higher Mathematical Concepts—Sp 5 hours

An introduction to the basic ideas of Number Theory, Abstract Algebra and Linear Algebra. Factorization of integers, congruence modulo m , Fermat's Theorem, groups, rings, fields, vector spaces, systems of linear equations, determinants and inverses, unique factorization, and factoring polynomials over \mathbf{R} , \mathbf{C} and \mathbf{Z} . *Does not count towards B.A. or B.S majors in mathematics. Prerequisites: MATH-303 Logic and Methods of Proof; MATH-283 Analytic Geometry and Calculus III.*

MATH-374 Complex Variables—Sp 5 hours

Introduction to complex arithmetic, differentiation: analytic functions, Cauchy-Riemann equations, harmonic functions, elementary functions and their mapping properties, integration: Cauchy's Theorem, Cauchy's Integral Formula, Taylor and Laurent series, poles, residues, and the residue theorem. *Prerequisite: MATH-283 Analytic Geometry and Calculus III.* (odd years)

MATH-384 Probability and Statistics—W 5 hours

Probability models, random variables, binomial, T, chi square and F distributions, sample spaces, estimation, and hypotheses tests are studied from theoretical and practical viewpoints. *Prerequisite: MATH-283 Analytic Geometry and Calculus III.*

MATH-387 Differential Equations—A,W 5 hours

Study of the standard techniques employed in the solution of differential equations with emphasis on those arising from physical problems. *Prerequisite: MATH-283 Analytic Geometry and Calculus III.*

MATH-388 Advanced Calculus I—A,W 5 hours

Introduction to differential calculus of several variables, multiple integrals, vector analysis, line integrals, surface integrals, and an abbreviated introduction to linear algebra, matrix algebra, and determinants. *Prerequisite: MATH-283 Analytic Geometry and Calculus III.*

MATH-389 Advanced Calculus II—Sp 5 hours

Topics in function theory, vector analysis, differential calculus of several variables, vector differential calculus, integral calculus of several variables, vector integral calculus, and infinite series. *Prerequisite: MATH-388 Advanced Calculus I.*

MATH-394 Linear Algebra—Sp 5 hours

Introduction to the algebra of linear equations, including determinants, matrices, vector spaces, eigenvalues, eigenvectors, and linear mapping. *Prerequisite: MATH-282 Analytic Geometry and Calculus II.* (even years)

MATH-401 Capstone Experience in Mathematics—A,W 2 hours

The course will allow the student to deeply research an important topic in mathematics, both individually and collectively, and to present his findings from library research as well as personal work. *Prerequisite: MATH-301 Research Methods in Mathematics, 25 hours of 300- or 400-level courses, and permission of instructor.* (Fee: \$20)

MATH-411 Applied Statistics—Sp 3 hours

Topics chosen from the following: regression analysis, queuing theory, inventory theory, decision analysis, simulation, quality control, and reliability theory. *Prerequisite: MATH-384 Probability and Statistics.*

MATH-441 Euclidean and Non-Euclidean Geometries—Sp 5 hours

Rigorous treatment of the foundations of Euclidean geometry; an introduction to hyperbolic geometry with emphasis on its Euclidean models. *Prerequisite: MATH-303 Logic and Methods of Proof.* (even years)

MATH-445 Topology—A 5 hours

Introduction to elementary point set topology; emphasis on illustrating how the familiar concepts of closed and open intervals, continuity of functions, and various geometrical properties have been generalized from classical mathematics. Topics include: metric spaces, topological space theory, separation axioms, covering properties, compactness, connectedness, metrizable, and complete metric spaces. *Prerequisite: MATH-303 Logic and Methods of Proof.* (even years)

MATH-461,462 Abstract Algebra I, II—A,W 4 hours

Introduction to sets and logic, and the development of algebraic systems, groups, rings, integral domains, fields, and other advanced topics. *Prerequisite: MATH-303 Logic and Methods of Proof.* (even years)

MATH-471,472 Real Variables I, II—A,W 4 hours

Introduction to the real number system's algebraic, order, completeness, and cardinality properties, the topology of Cartesian spaces \mathbf{R}^n and functions including continuity and uniform continuity, connectedness, convexity, compactness, various types of convergence, limits, differentiability, and Riemann integration, measurability, and L_p spaces. *Prerequisite: MATH-283 Analytic Geometry and Calculus III; MATH-303 Logic and Methods of Proof.* (odd years)

MATH-480 Topics in Mathematics 2-5 hours

Some typical topics are complex variables, matrix algebra, vector analysis, numerical analysis, introduction to computer programming, partial differential equations, and mathematical modeling. *Prerequisite: permission of instructor.*

MATH-490 Independent Study in Mathematics 1-4 hours

Independent research in the various branches of mathematics and allied fields of application. Submission and approval of a research proposal must precede registration. *Prerequisite: major in mathematics and permission of research advisor.*

MATH-491 Mathematical Methods for Physicists—A,W,Sp 5 hours

Advanced mathematical methods used in the solution of physics problems. Topics include curvilinear coordinates, vector analysis, and Fourier, Bessel, and Legendre solutions to partial differential equations. *Prerequisite: PHYS-311 Theoretical Mechanics or PHYS-378 Modern Physics I; MATH-387 Differential Equations; MATH-388 Advanced Calculus I.*

Physics

PHYS-172 College Physics I—A 5 hours

Basic concepts of mechanics, including kinematics, motion in two dimensions, force and motion, work and energy, momentum, circular

motion, and gravitation. Four lectures and one two-hour laboratory per week. *Prerequisite: high school trigonometry, or GSCI-185 Precalculus, or equivalent.* (Fee: \$35) (even years)

PHYS-173 College Physics II—W **5 hours**
 Fluids, liquids and gases, heat and thermodynamics, waves, electricity and magnetism, and AC circuits. Four lectures and one two-hour laboratory per week. *Prerequisite: PHYS-172 College Physics I or equivalent.* (Fee: \$35) (even years)

PHYS-174 College Physics III—Sp **5 hours**
 Geometrical and physical optics, relativity theory, quantum theory, and other topics from modern physics. Four lectures and one two-hour laboratory per week. *Prerequisite: PHYS-173 College Physics II or equivalent.* (Fee: \$35) (even years)

PHYS-271 General Physics I—A,Sp **5 hours**
 Basic concepts of linear and rotational motion in three dimensions, oscillatory motion, gravitation, and fluid mechanics. Four lectures and one two-hour laboratory each week. *Prerequisite: MATH-281,282,283 Analytic Geometry and Calculus I, II, III. MATH-283 may be coenrolled with permission of instructor.* (Fee: \$35)

PHYS-272 General Physics II—A,W **5 hours**
 Basic concepts of wave motion, thermodynamics and electricity, and magnetism. Four lectures and one two-hour laboratory per week. *Prerequisite: MATH-281,282,283 Analytic Geometry and Calculus I,II,III; PHYS-271 General Physics I.* (Fee: \$35)

PHYS-273 General Physics III—W,Sp **5 hours**
 Intermediate concepts in electricity and magnetism, light, optics, and a basic introduction to modern physics. Four lectures and one two-hour laboratory per week. *Prerequisite: MATH-281,282,283 Analytical Geometry and Calculus I, II, III; PHYS-272 General Physics II; permission of instructor.* (Fee: \$35)

PHYS-301,302 Intermediate Physics Lab I,II **2 hours**
 Designed to reinforce concepts of the advanced physics courses and develop critical research and analysis skills. The Intermediate Laboratory sequence over two quarters provides experience in oscillatory motion and waves, intermediate mechanics, intermediate electricity, intermediate magnetism, thermodynamics, and quantum mechanics. During the two-quarter sequence, laboratory skills for planning, setup, documentation, and analysis using the scientific method will be emphasized. *Prerequisite: PHYS-273 General Physics III; permission of instructor.* (Fee: \$35)

PHYS-311 Introduction to Theoretical Mechanics **5 hours**
 Derivation of the motion of a point object through three dimensional space. Topics include an advanced treatment of Newtonian mechanics in three dimensions, accelerated frames of reference, central forces, and an introduction to Lagrangian mechanics. *Prerequisite: PHYS-273 General Physics III. Corequisite: MATH-387 Differential Equations.* (odd years)

PHYS-331 Thermal Physics **5 hours**
 Study of the relationship between energy and matter through the use of thermodynamics and statistical mechanics. Topics include: heat, work, entropy, phase transformations, statistical distributions, and kinetic theory. *Prerequisite: PHYS-273 General Physics III.* (odd years)

PHYS-352 Electromagnetic Theory I **5 hours**
 Electricity and magnetism from an advanced viewpoint using the methods of vector calculus. Includes electrostatics, Gauss' Law, circuit theory, introductory electronics, Poisson's equation, Laplace's equation, dielectric media, electric currents, magnetic fields. *Prerequisite: PHYS-273 General Physics III; MATH-388 Advanced Calculus I.*

PHYS-378,379 Modern Physics I,II—A,W **5 hours**
 Extension of basic concepts of modern physics learned in PHYS-271, 272, 273 General Physics I, II, III. Topics include structure of matter, electricity and light, kinetic theory, x-rays, nuclear reactions, atomic and nuclear structure, and radioactivity. *Prerequisite: PHYS-273 General Physics.* (even years)

PHYS-401,402 Advanced Physics Lab I, II **2 hours**
 Advanced laboratory experience designed to reinforce concepts of the advanced physics courses and to develop critical research design, documentation, analysis, and presentation skills. The Advanced Laboratory sequence over two quarters provides additional experience in optical, radiation, wave, advanced mechanics, advanced electromagnetism, advanced thermodynamics, and quantum mechanics. Laboratory skills for planning, setup, documentation, analysis, and briefing

using the scientific method will be emphasized. *Prerequisite: PHYS-302 Intermediate Physics Laboratory II and permission of instructor.* (Fee: \$35)

PHYS-451 Optics **5 hours**
 Introduction to the study of classical and modern optics, including the electromagnetic basis of optics, geometric optics, interference, diffraction, dispersion, and holography. *Prerequisite: PHYS-273 General Physics III; MATH-388 Advanced Calculus I.*

PHYS-452 Electromagnetic Theory II **5 hours**
 Continuation of PHYS-352. Includes electromagnetic induction, magnetic properties of matter, magnetic energy, slowly varying currents, Maxwell's equations and their applications, and introductory electrodynamics. *Prerequisite: PHYS-352 Electromagnetic Theory I.*

PHYS-490 Independent Study in Physics **1-4 hours**
 Independent research in the various branches of physics and allied fields of application. Submission and approval of a research proposal must precede registration. (Fee: \$5 per hour)

PHYS-491 Mathematical Methods for Physicists **5 hours**
 Advanced mathematical methods used in the solution of physics problems. Topics include curvilinear coordinates, vector analysis, and Fourier, Bessel, and Legendre solutions to partial differential equations. *Prerequisite: PHYS-311 Theoretical Mechanics or PHYS-378 Modern Physics I; MATH-387 Differential Equations; MATH-388 Advanced Calculus I.*

PHYS-499 Topics in Physics **5 hours**
 Study of topics of interest from modern and classical physics such as quantum theory, relativity, statistical mechanics, lasers, solid state physics, advanced classical mechanics and atmospheric physics. *Prerequisite: PHYS-273 General Physics III; MATH-388 Advanced Calculus I.*



Full-time professors, rather than teaching assistants, work closely with students on science laboratory projects.