Use this form to submit proposals for revised majors, minors, concentrations, options, etc.

Note: A department, with its dean’s approval, may change up to two courses per year within an existing major, minor, concentration, option, etc., per year without seeking review of A2C2 and/or graduate Council, provided that (1) the total credits do not increase or decrease for the major, minor, concentration, option, etc., and (2) the change does not affect other departments or the University Studies Program. A2C2 and/or Graduate Council do, however, wish to be informed of these changes. Use form Notifications.

If a department wishes to make more extensive revisions to an existing major, minor, concentration, option, etc., complete and submit this form with the appropriate number of copies. Refer to Regulation 3-4, Policy for Changing the Curriculum, for complete information on submitting proposals for curricular changes.

Department: GEOSCIENCE
Title of Program: BA Major: Geoscience Option
Revised: XX Major ______ Minor ______ Concentration __XX_ Option ______ Other
Total credit hours: 40-42 Classroom Hours 27-29 Lab Hours 13-15
Proposed Implementation Date: Fall 2004

Please attach to this proposal a narrative with the following information:

A. Statement of major focus and objectives of the revised program.

B. New Catalog Content
   1. Provide a list of program content as it would appear in the catalog including required courses, electives, etc., by number and name. Include the number and name for each prerequisite, and all prerequisites of proposed prerequisites. All such prerequisites, and prerequisites of prerequisites, should be included in the total credit hour calculations for the revised program.
   2. New catalog narrative, if any.

C. Description of Revisions, to include
   1. A display of current program requirements next to proposed new requirements for clear, easy comparison.
   2. A clear identification of each proposed change.
   3. The following information for each required or elective course:
      a. Course number and name,
      b. A brief course description, and
      c. A brief statement explaining why the program should include the course.

Attach a Financial and Staffing Data Sheet.

Attach an Approval Form.

Department Contact Person for this Proposal:

Name (please print) ______ Cathy Summa ______ Phone ______ 457-5269 ______ e-mail address ______ csumma@winona.edu ______
Include a Financial and Staffing Data Sheet with any proposal for a new course, new program, or revised program.

Please answer the following questions completely. Provide supporting data.

1. Would this course or program be taught with existing staff or with new or additional staff? If this course would be taught by adjunct faculty, include a rationale.

This program would be offered by existing staff.

2. What impact would approval of this course/program have on current course offerings? Please discuss number of sections of current offerings, dropping of courses, etc.

Approval of this program would impact current course offerings by reducing the total number of courses the department would be required to offer. The introduction of this option serves to streamline our curriculum, while at the same time offering our students the flexibility to pursue interests in other disciplines related to their specific interests in Geoscience. This program would require that students complete fewer credits in Geoscience and complete a required minor/second major.

3. What effect would approval of this course/program have on the department supplies? Include data to support expenditures for staffing, equipment, supplies, instructional resources, etc.

No impact; this program requires no new materials, courses, or resources. It streamlines current offerings and therefore requires we support fewer courses than previously.
## Department Recommendation

<table>
<thead>
<tr>
<th>Department Chair</th>
<th>1/27/04</th>
<th><a href="mailto:csumma@winona.edu">csumma@winona.edu</a></th>
</tr>
</thead>
</table>

**Department Chair**  
Date: 1/27/04  
e-mail address: csumma@winona.edu

**Dean’s Recommendation**  
____ Approved  
____ Disapproved

**Dean of College**  
Date

## A2C2 Recommendation

<table>
<thead>
<tr>
<th>For:</th>
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<td>Minor</td>
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**Chair of A2C2**  
Date

## Graduate Council Recommendation (if applicable)

____ Approved  
____ Disapproved

**Chair of Graduate Council**  
Date

**Director of Graduate Studies**  
Date

## Faculty Senate Recommendation

____ Approved  
____ Disapproved

**President of Faculty Senate**  
Date

## Academic Vice President Recommendation

____ Approved  
____ Disapproved

**Academic Vice President**  
Date

## Decision of President

____ Approved  
____ Disapproved

**President**  
Date

Please forward to Registrar.

Registrar  
Date entered

Please notify department chair via e-mail that curricular change has been recorded.
GEOSCIENCE: Proposal to revise existing BS Water Resource Management Option to BA Major: Geoscience Option

A. Statement of major focus and objectives of the revised program.

BA MAJOR: GEOSCIENCE OPTION

We propose to substantially revise our existing BS option in Water Resource Management (WRM) to offer a BA option in Geoscience. This change is motivated by several factors. In particular, we have found that graduates of the old WRM program are typically poorly prepared for graduate work and, because of the changing job market, have difficulty competing for entry-level jobs with other Geoscience and/or Environmental Science majors. We believe that this is primarily because the existing WRM program lacks an area of concentration, and students fail to connect their work in Geoscience with other important disciplines.

After substantial consideration, and consultation with outside experts in Geology curricular issues, we propose to revise our program to offer an option leading to a Bachelor of Arts in Geoscience. This program is designed specifically to provide students the flexibility to connect their work in Geoscience with another discipline. The program will require that students complete a minor, which must be approved by the Geoscience department. Departmental approval will require that the student demonstrate how he/she intends to connect the chosen minor field with their work in Geology. In addition, each student will be required to complete a research project or an approved internship that explicitly links geologic applications with the chosen minor field. The departmental approval process is not designed to limit students’ options, but rather to encourage students to begin making connections and building career options early in their curriculum. Our goal is to force students to think about their future plans early in their academic experience and to encourage them to be purposeful in their course selection at WSU. It is our hope that this will enable students to graduate in a timelier manner.

Our experience suggests that WSU students are drawn to Geology for a wide variety of reasons. Many of our graduates have completed minors (or double majors) in what might be considered “traditional” disciplines, such as Biology, Chemistry, or Mathematics. However, equally large numbers of our graduates have completed minors (or double majors) in what might, at first glance, seem like unconnected disciplines, such as Art, History, Philosophy, Business, and/or Recreation. It is our firm belief that the very nature of geology lends itself to such connections. For example, some artists seek to represent the world around them; geologists are, in some sense, historians working at a very different time scale; philosophers consider, among other questions, how humans interact with their world and questions of environmental justice; various business enterprises consider questions of environmental impact and sustainable development; and outdoor recreation is increasingly taking on “extreme” adventures that dare people to challenge the earth.

The program we propose is modeled after similar programs at several liberal arts colleges, and is similar to the undergraduate program model completed by three-quarters of our existing departmental faculty. We believe that the flexibility this program offers students will prepare them for graduate work in Geoscience and potentially other disciplines, and will also prepare our graduates to compete for entry-level jobs in geoscience.

B. New Catalog Content

1. Program content as it would appear in the catalog including required courses, electives, etc., by number and name. Include the number and name for each prerequisite, and all prerequisites of proposed prerequisites. All such prerequisites, and prerequisites of prerequisites, should be included in the total credit hour calculations for the revised program.

BA MAJOR: GEOSCIENCE OPTION (40-42 S.H.; Minor* or second major Required)

*Minor/second major field must be approved by Department (see advisor for approval process)

**NOTE TO A2C2: ENG 111 & CMST 191 have NOT been included in credit count for prerequisites since these credits are already included as part of the USP total.

GEOSCIENCE CORE REQUIREMENTS (19 S.H.)

GEOS 120—Dynamic Earth (4) [no prerequisite]
GEOS 130—Earth & Life Through Time (4) [prerequisite: GEOS 120]
GEOS 220—Minerals & Rocks (4) [prerequisite: GEOS 120]
GEOS 240—Watershed Science (4) [prerequisite: GEOS 130]
GEOS 280—Field & Analytical Methods I (2) [co-requisite: GEOS 220; prerequisite: ENG 111]
GEOS 475—Geoscience Seminar (1) [prerequisite: senior standing in the department; instructors permission]

NOTE: Majors in all Geoscience options are urged to take a geology summer field course prior to graduation. This can substitute for an upper-division elective.

**OPTION REQUIREMENTS (10-11 S.H.)

Choose one from each of the three pairs of courses below:

GEOS 315—Surficial Processes & Soils (4) OR GEOS 420—Applied Hydrogeology (4) [prerequisite: GEOS 240]
GEOS 330—Structural Geology (4) OR GEOS 340—Sedimentology & Stratigraphy (4) [prerequisite: GEOS 220; ENG 111 (for GEOS 340)]

§GEOS 399—Internship (2-3) OR GEOS 400—Directed Research in Geoscience (2-3) [prerequisite: departmental approval]

§Internship or Research topic MUST integrate Geoscience and Minor field (see advisor for details).

**NOTE: A student may choose one of the options in each of the above pairs of courses to fulfill option requirements, and may also choose the other option in any or all of the above pairs of courses to fulfill elective requirements (below).**

**GEOSCIENCE ELECTIVES (11 -13 S.H.)**

Choose from the list of approved Geoscience electives pool.

Choices MUST include at least one laboratory course (4 S.H.) numbered 300 or above.

Choices MAY include one additional course from departmental 100-level offerings (in addition to GEOS 120, 130).

**Geoscience Electives Pool** (Elective courses available for all Geoscience Options if not otherwise required in major/minor program requirements):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOS 240</td>
<td>Watershed Science (4)</td>
<td>GEOS 130</td>
</tr>
<tr>
<td>GEOS 315</td>
<td>Surficial Processes &amp; Soils (4)</td>
<td>GEOS 240</td>
</tr>
<tr>
<td>GEOS 320</td>
<td>Optical Mineralogy &amp; Petrology (4)</td>
<td>GEOS 220</td>
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<tr>
<td>GEOS 325</td>
<td>Environmental Geoscience (3)</td>
<td>any USP Natural Science course</td>
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<tr>
<td>GEOS 370</td>
<td>GIS &amp; Imaging Techniques (3)</td>
<td>GEOS 130, CMST 191 &amp; instructors permission</td>
</tr>
<tr>
<td>GEOS 385</td>
<td>Geology of North America (3)</td>
<td>GEOS 220</td>
</tr>
<tr>
<td>GEOS 399</td>
<td>Internship (1-3)</td>
<td>departmental approval</td>
</tr>
<tr>
<td>GEOS 400</td>
<td>Directed Research in Geoscience (1-3)</td>
<td>departmental approval</td>
</tr>
<tr>
<td>GEOS 405</td>
<td>Current Topics in Geoscience (1-3)</td>
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<tr>
<td>GEOS 420</td>
<td>Applied Hydrogeology (4)</td>
<td>GEOS 240</td>
</tr>
<tr>
<td>GEOS 425</td>
<td>Global Climate Change (3)</td>
<td>GEOS 325 or instructors permission</td>
</tr>
<tr>
<td>GEOS 430</td>
<td>Chemistry &amp; Physics of the Earth (3)</td>
<td>GEOS 330, 340; CHEM 212; PHYS 201</td>
</tr>
<tr>
<td>GEOS 440</td>
<td>Basin Analysis &amp; Tectonics (4)</td>
<td>GEOS 340</td>
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</table>

**Geoscience Introductory Course Pool** (A student choosing the BA Geology option may choose one of the following courses as an elective in the program.) [None of these courses carry prerequisites.]

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>GEOS 100</td>
<td>Minnesota’s Rocks &amp; Waters (3)</td>
</tr>
<tr>
<td>GEOS 102</td>
<td>Resources of the Earth (3)</td>
</tr>
<tr>
<td>GEOS 103</td>
<td>Natural Disasters (3)</td>
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<tr>
<td>GEOS 104</td>
<td>Catastrophes &amp; Extinctions (3)</td>
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<tr>
<td>GEOS 105</td>
<td>Astronomy with Laboratory (4)</td>
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<tr>
<td>GEOS 106</td>
<td>Astronomy (3)</td>
</tr>
<tr>
<td>GEOS 110</td>
<td>Oceanography with Laboratory (4)</td>
</tr>
<tr>
<td>GEOS 111</td>
<td>Oceanography (3)</td>
</tr>
<tr>
<td>GEOS 115</td>
<td>Meteorology with Laboratory (4)</td>
</tr>
<tr>
<td>GEOS 116</td>
<td>Meteorology (3)</td>
</tr>
</tbody>
</table>

2. **New catalog narrative.**

**B.A. Geoscience Major (Minor or second major required):** This program prepares students for graduate study or employment in geologic disciplines or in a variety of other disciplines, depending on the students chosen minor field. Students choose a minor (or double major) field that they must relate to their work in geoscience by completing an internship or research project. Students must obtain approval from the Geoscience department before engaging in this work. The topic of this project must integrate geoscience with the second discipline. The goal is to prepare students for success in an increasingly interdisciplinary world. Students are encouraged to speak with a Geoscience department advisor about their career goals so that this program can be tailored to best suit individual goals. The flexibility of this program enables students to pursue careers in diverse areas such as geochemistry and geophysics or environmental law and environmental justice, scientific illustration, scientific writing, etc. Professionals in many disciplines, including science, law, medicine, and politics, hold undergraduate B.A. degrees in Geoscience.
C. Description of Revisions:

1. A display of current program requirements next to proposed new requirements.

OLD PROGRAM:

B.S. MAJOR - GEOSCIENCE:
WATER RESOURCES MANAGEMENT OPTION
59-60 S.H. (No Minor Required)

CORE REQUIREMENTS (23 S.H.)
GEOS 120 Dynamic Earth (4)
GEOS 130 Earth and Life through Time (4)
GEOS 220 Minerals and Rocks (4)
GEOS 280 Field and Analytical Methods I (2)
GEOS 330 Structural Geology (4)
GEOS 340 Sedimentology and Stratigraphy (4)
GEOS 475 Geoscience Seminar (1)

Note: Majors in all options are urged to take a geology summer field course prior to graduation. This can satisfy the requirement GEOS 480 or an upper-division elective.

REQUIRED COURSES (34 S.H.)

Geoscience (15 S.H.)
110 Oceanography (4) OR
115 Meteorology (4)
325 Environmental Geoscience (3)
240 Watershed Science (4)
315 Surficial Processes and Soils (4)

Math (3 S.H.)
150 Math for Earth and Life Sciences I (3)

English/Administrative Information Systems (3 S.H.)
ENG 439 Technical Writing (3) OR
AIS 333 Business Communications (3)

Biology (4 S.H.)
415 Ecology of Large Rivers (4)

Political Science (3 S.H.)
340 Environmental Policy Analysis (3)

Philosophy (3 S.H.)
340 Philosophy of Science (3)

Economics (3 S.H.)
315 Environmental and Natural Resource Economics (3)

GEOSCIENCE ELECTIVES (2-3 S.H.)

Select from the "Electives Pool" list, except for geoscience courses listed as requirements for major.

PROPOSED NEW PROGRAM:

B.A. MAJOR—GEOSCIENCE OPTION
40-42 S.H. (Approved Minor or second major Required)

CORE REQUIREMENTS (19 S.H.)
GEOS 120 Dynamic Earth (4)
GEOS 130 Earth and Life through Time (4)
GEOS 220 Minerals and Rocks (4)
GEOS 240 Watershed Science (4)
GEOS 280 Field and Analytical Methods I (2)
GEOS 475 Geoscience Seminar (1)

Note: Majors in all options are urged to complete a geology summer field course prior to graduation. This can substitute for an upper-division elective.

REQUIRED COURSES (10-11 S.H.)

GEOSCIENCE (10-11 S.H.)
Choose one from each of the three pairs of courses listed below:

- GEOS 315—Surficial Processes & Soils (4) OR GEOS 420—Applied Hydrogeology (4)
- GEOS 330—Structural Geology (4) OR GEOS 340—Sedimentology & Stratigraphy (4)
- GEOS 399—Internship (2-3) OR GEOS 400—Directed Research (2-3)

§Internship or Research topic MUST integrate Geoscience and Minor field (see advisor for details).

**NOTE: A student may choose one of the options in each of the above pairs of courses to fulfill option requirements, and may also choose the other option in any or all of the above pairs of courses to fulfill elective requirements (below).

GEOSCIENCE ELECTIVES (11-13 S.H.)

Select from the “Electives Pool” list, except for geoscience courses listed as requirements for the major. Elective choices MUST include at least one laboratory course (4 S.H.) numbered 300 or above. Choices MAY include one additional course from Geoscience offerings at the 100-level (but may not include GEOS 120 or 130).
2. A clear identification of each proposed change.
Specific changes in the proposed program include:
A) A reduction in the total number of credits required for the major (from 59-60 S.H. to 40-42 S.H.)
B) The addition of a required minor or a second major. This minor/second major field would require approval by the
   Geoscience department, to ensure that students are able to connect their chosen minor field with geoscience to better
   prepare them for future careers.
C) The addition of an internship or supervised research requirement. This requirement is designed to ensure that the student
   demonstrates an ability to connect their chosen minor field with geoscience, and to help prepare the student for
   future interdisciplinary careers. The internship experience or research project must connect geoscience and the
   minor field.
D) Removal of the core requirements GEOS 330 (structural geology) and GEOS 340 (sedimentology and stratigraphy). The
   emphasis on these courses changes to require that students choose either GEOS 330 or GEOS 340. They may opt to
   enroll in the other as an elective.
E) Addition of GEOS 240 (watershed science) to the core requirements. This change reflects the increasing importance of a
   basic knowledge of surficial processes to the development of a competent geoscientist (and will be changed in our
   other options in the near future).
F) Reduction in the number and specificity of required courses. This change stems from increasing the flexibility of the
   program for students. By reducing the specified requirements, we enable students to tailor the program to better suit
   their career goals by choosing a minor or second major field that best suits their interests. The remaining required
   courses provide the student with advanced content and skills in each of two broad areas in geoscience, and further
   require that the student link his/her chosen minor/second major field with geoscience by the completion of a
   research project or internship. This project must integrate the students’ minor/second major field with geoscience.
G) Increase in the number of elective hours in the major. This change, coupled with the previous change, is designed to
   allow the student greater flexibility in the major curriculum. We have elected to require that students complete at
   least one additional upper-level laboratory course to ensure sufficient depth of content knowledge in the discipline.
   We have also allowed students to enroll in an additional introductory level course as part of the major because we
   find that many of our students have broad interests in earth science and are drawn to the discipline because they
   have an interest in topics that we are only able to cover at an introductory level. We believe that this allows the
   student to increase his/her breadth of knowledge in the discipline.

3. The following information for each required or elective course:
   a. Course number and name,
   b. A brief course description, and
   c. A brief statement explaining why the program should include the course.

CORE REQUIREMENTS (19 S.H.)
The following courses comprise the core geoscience courses in this and all other Geoscience options. These courses should
be included in this program because they provide students the fundamental content of the discipline and opportunities to
apply that content to the solution of real geologic problems. These courses are sequenced such that students deal with
progressively more complex topics and problems.
GEOS 120 Dynamic Earth (4): Fundamentals of physical geology, including earth surface processes, rocks and
minerals, and internal earth structure and mechanics of plate tectonics.
GEOS 130 Earth and Life through Time (4): Application of fundamental principles in a historical context, designed to
help students think about “deep time” and issues of temporal and spatial scale. Opportunities to learn basics of geologic
mapping and interpretation of earth history via cross-section and map analysis.
GEOS 220 Minerals and Rocks (4): In-depth study of minerals, mineral formation, and combination to form rocks
related to plate tectonic setting. Rocks record the history of earth events, and as such, are the fundamental tool by which
geoscientists interpret the earth.
GEOS 240 Watershed Science (4): Introduction to surficial processes that act to erode and sculpt the landscape. Water
is the primary catalyst in all geologic processes on Earth; this course provides students a framework by which to consider
water-rock interaction and the impact these processes have on geologic systems.
GEOS 280 Field and Analytical Methods I (2): Introduction to the basic field techniques required for data collection
and interpretation in geoscience. Includes basic surveying and mapping skills, field observation and proper note-taking
techniques, use of the geologic compass (brunton compass), and techniques by which geologist catalog and describe surficial
and bedrock geology.
GEOS 475 Geoscience Seminar (1): Capstone course in which students apply what they’ve learned in core and elective
courses. Focuses on reading primary geologic literature, synthesis of data from multiple sources, and oral and written
presentation skills.
REQUIRED COURSES (10-11 S.H.)
The following courses are included in this program because they provide students greater opportunities to apply introductory content from core courses in specific disciplines. Geoscience is traditionally divided into areas of specialization focusing on surficial processes (GEOS 315 or 420) and analysis of rocks (GEOS 330 or 340). We propose that students pursue more in-depth study of each of these areas by selecting one course from each pair. As a capstone experience, students will complete either an independent research project or an internship, depending on whether the student is interested in pursuing graduate study or a job upon graduation.

Students choose one from each of the three pairs of courses listed below:


OR GEOS 420 — Applied Hydrogeology (4): Application of hydrologic principles to ground-water flow problems, aqueous geochemistry, and contaminant studies. Techniques of water-well development, aquifer tests, determination of ground-water chemistry, using computer models and other analytical tools of the discipline.


OR GEOS 340 — Sedimentology & Stratigraphy (4): Physical, chemical and biological processes that affect sedimentation and depositional systems. Study of stratigraphic nomenclature and correlation, depositional models, causes of sea-level change, and relationship to plate tectonics.

C) GEOS 399 — Internship (2-3): Supervised governmental agency, business, industrial, or research institution experience designed by Geoscience faculty advisor, work supervisor and student.

OR GEOS 400 — Directed Research (2-3): Independent study of selected geologic field and/or laboratory problem with preparation of written report, poster, and oral presentation supervised by Geoscience faculty advisor.

ELECTIVE COURSES (11-13 S.H.)
(Catalog copy) Select from the “Electives Pool” list, except for geoscience courses listed as requirements for the major. Elective choices MUST include at least one laboratory course (4 S.H.) numbered 300 or above. Choices MAY include one additional course from Geoscience offerings at the 100-level (a student may not select any course already taken as part of the major program for any elective credit).

(Rationale) Electives courses are included in this program to give students a deeper and broader content and skill base in the discipline. Course selection is intentionally left broad, so that a student may elect courses that are most appropriately aligned with his/her interests (potentially as demonstrated by the minor/double major field selected). Because geoscience is such a broad discipline, we have chosen to allow our students to select an additional 100-level course as an elective in the program. This option allows the student to gain an introductory level understanding of one of the many subdisciplines in geoscience. However, the bulk of the elective courses must come from upper-division courses. Our intention is that the student will take an additional 3 or 4 courses, depending on the number of laboratory courses the student selects. Note that all students must select at least one additional laboratory course numbered 300 or above.

For purposes of space, courses that are detailed above (in the Core Requirements or Required Courses sections) are not reproduced here.

GEOS 100 - Minnesota’s Rocks and Waters — 3 S.H.: Introduction to Minnesota’s geological history focusing on such topics as: Minnesota’s rock record and history, fossils, mining, soils, lakes, rivers and ground water. This course provides students an overview of Minnesota’s geological setting.

GEOS 102 – Resources of the Earth – 3 S.H.: An investigative exploration of significant global resources with emphasis on fossil fuels, non-fossil fuels, water and other energy resources. Geologic processes governing each are explored. Prediction, impacts, economic and political scenarios are examined. This course provides students an introduction to economic geology.

GEOS 103 - Natural Disasters – 3 S.H.: An investigative exploration of significant geohazards impacting the earth with emphasis on volcanoes, earthquakes, landslides and other hill slope failures, hurricanes and tornadoes, pollution and floods. Geologic processes governing each type of disaster are explored. Prediction, impacts and mitigation potential for each hazard are examined. This course provides an introduction to issues of risk assessment and management in a geologic context.

GEOS 104 – Catastrophes and Extinctions – 3 S.H.: Over 99% of the animal species that once inhabited the Earth are now extinct. Remarkably, most of these extinctions have been associated through time with significant geologic events that are considered by many to be catastrophic. In this course, students will explore the major extinctions that have taken place through geologic history. These include the extinction of numerous marine invertebrate species, the extinction of the dinosaurs 65 million years ago, the extinction of large mammals during the last ice age, and many others. Weekend (overnight) field trip required. Lecture only. This course provides an introduction to topics in paleontology.

GEOS 105 (4 S.H.) or GEOS 106 (3 S.H.) - Astronomy: History of astronomy. Study of the planets, their moons, comets, asteroids, meteors and other planetary bodies. Origin of the universe, solar system, sun and other stars. This course provides
students an introduction to topics in planetary geology.

**GEOS 110 (4 S.H.) or GEOS 111 (3 S.H.) – Oceanography:** Introduction to oceans including the ocean floor, marine sediments, composition of sea water, ocean currents, waves and tides, marine biology and oceanic resources. This course provides students an introduction to topics in oceanography.

**GEOS 115 (4 S.H.) or GEOS 116 (S.H.) – Meteorology:** Study of earth’s dynamic weather system including atmospheric structure, composition, and processes; origin and development of storms and related phenomena. This course provides students an introduction to topics in meteorology.

**GEOS 320 - Optical Mineralogy and Petrology—4 S.H.:** Theory of optical mineralogy. Optical properties of minerals determined by petrographic microscope. Introduction to major sedimentary, igneous, and metamorphic rocks; mineral equilibria and stability, mineralogic phase rule and metamorphic facies. Rock identification by megascopic and petrographic techniques. Lecture and laboratory. Prerequisite: GEOS 220. This course provides more in-depth study of rocks in thin-section.

**GEOS 325 - Environmental Geoscience—3 S.H.:** Study of geologic and hydrologic processes operating in various terrestrial environments, including how these processes relate to land use, land-use planning and geologic hazards. Includes investigation of impact of human activity on natural systems. Prerequisite: Any University Studies Natural Science Laboratory course or instructor’s permission. This course will be popular with students interested in connecting their work in Geoscience with environmental issues.

**GEOS 370 - GIS and Imaging Techniques—3 S.H.:** Techniques of using aerial photographs, remote sensing, and GIS for geological applications. Prerequisite: CMST 191, GEOS 130, and instructor’s permission. This course will likely be a popular elective in this program because it teaches students a mapping tool that is useful in other courses, as well as in geologic careers.

**GEOS 385 - Geology of North America—3 S.H.:** Study of the physiographic provinces of the North American continent with emphasis on geomorphology, structural history, stratigraphy and mineral deposits of each province. Lecture and laboratory. Prerequisite: GEOS 220. This course provides a regional (North American) framework and greater detail of topics covered in GEOS 130 and GEOS 220.

**GEOS 405 - Current Topics in Geoscience—1-3 S.H.:** Analysis of current topics and issues relevant to Geosciences. Subject matter and prerequisites will be announced in advance by the department. May be repeated as topics change. This course provides students an option to study a variety of topics, depending on frequency of course availability.

**GEOS 430 - Chemistry and Physics of the Earth—3 S.H.:** Application of chemical and physical principles to geologic problems. Chemistry of formation of major rock groups. Isotopic and elemental distribution and abundance. Physics of Earth’s interior as determined from study of seismic activity. Application of seismic reflection and refraction principles. Lecture only. Prerequisite: CHEM 212, PHYS 201, GEOS 330 and GEOS 340. This course integrates aspects of physics and chemistry as applied to the study of the earth.

**GEOS 440 - Basin Analysis and Tectonics—4 S.H.:** Interpretation of the stratigraphic record to understand the development of sedimentary basins in a plate tectonic context. Study of sequence stratigraphy, eustatic changes in sea level, and fluid flow in basins. Lecture and laboratory. Prerequisite: GEOS 340. This course explores topics from GEOS 340 in greater depth and connects those topics in a plate-tectonic framework.

**GEOS 480 - Field and Analytical Methods II—1 S.H.:** Advanced geologic field techniques including mapping, correlation, and problem solving. Includes some laboratory sample preparation and analysis. Prerequisite: GEOS 280, GEOS 340 and instructor’s permission. This course provides greater field opportunities for students.