



Academic Review Committee
Request Form: New Program

ARC Use Only:
ARC #:
Program ID:
Status:
Date rec'vd by ARC:

Please submit the ORIGINAL of this request form and supporting documents (along with an electronic version) to your unit ARC representative, who will deliver them to the Academic Review Committee.

SECTION A: Program Information

Program Title: Earth Science (minor)

Originator(s) of the Proposal: Emma Rainforth

Proposal Date: 10-6-14

School(s): TAS Convening Group(s): new (E Rainforth, C Brisson, H Horowitz)

Please attach a description of the proposed program, and all supporting documentation including the Provost's pre-approval.

SECTION B: Approvals

Reviewed and Approved by:

Table with 4 columns: Title, Print name, Sign, Date. Rows include Convener, Graduate Council Chair, School Curriculum Committee chair, and Dean.

ARC Disposition:

- Information item only - no ARC approval necessary
ARC recommends approval by the Faculty Assembly
ARC does NOT recommend approval by the Faculty Assembly

ARC Chair: print & sign Date:

The ARC recommends the following:

Office of the Provost Use Only:

Approved Not Approved Provost Signature Date:

1 Only applies to non-credit-bearing certificate programs

From: Beth E Barnett bbarnett@ramapo.edu 
Subject: Re: FW: proposal for Earth Science minor
Date: October 7, 2014 at 5:55 PM
To: Edward Saiff esaiff@ramapo.edu
Cc: Emma C. Rainforth erainfor@ramapo.edu, edafron@ramapo.edu

Eddie

I approve the feasibility proposal for the Earth Science minor.

I ask that the final proposal make clear whether this minor will qualify students for recommendation by Ramapo College to the state of New Jersey for teacher certification in Earth Science.

I look forward to the final proposal.

Beth

Beth E Barnett
Provost and Academic Vice President
Ramapo College of New Jersey
505 Ramapo Valley Road
Mahwah, NJ 04730
(201) 684-7529
bbarnett@ramapo.edu

---- Original message ----

Date: Fri, 3 Oct 2014 09:34:05 -0400
From: "Edward Saiff" <esaiff@ramapo.edu>
Subject: FW: proposal for Earth Science minor
To: "Beth E Barnett" <bbarnett@ramapo.edu>
Cc: "Emma C. Rainforth" <erainfor@ramapo.edu>

Beth,

Emma is proposing a minor in Earth Sciences. The relevant convening groups are on board. All the materials are here for your review. I give it my enthusiastic recommendation.

Eddie

[Earth Science minor proposal.doc \(356k bytes\)](#)

[EarthSci checklist.docx \(44k bytes\)](#)

Emma C. Rainforth, Ph.D.
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and Convener, Integrated Science Studies
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Checklist: Proposals for New Programs: Earth Science Minor

Submit the following items along with this checklist. If an item is subject to approval in *only* one phase (feasibility or curricular), that information is indicated in parentheses. If an item applies *only* to a particular type of program, that information is also indicated in parentheses. Certificates developed by or affiliated with CIPL use CIPL's forms and items, but if they are credit-bearing certificates they will also need an ARC form.

1. Feasibility Phase:

- Program proposal
 - Program summary, objectives, and cooperative arrangements (if any)
 - Program's impact on the College's other programs, including the undergraduate curriculum if the proposed program is a graduate program
 - Program's need
 - If the program is in the liberal arts/sciences, indicate student demand and opportunities for further education if appropriate; if the program is career-oriented/professional, indicate student demand and labor market need, provide employer surveys, and describe opportunities for employment and advanced/additional study.
 - Alignment with the Strategic Plan
 - Comparison with similar programs in the State and neighboring states
 - Program's anticipated enrollment from launch to optimal level
 - Additional resources needed for the first five years
- Program budget (graduate program only)

Feasibility approval: Provost's signature: _____ Date: _____

Upon approval by the Provost of the Feasibility Phase, include this signed form with the package for the Curricular Phase. Ensure all materials included in the Feasibility Phase are also included.

2. Curricular Phase

- Program proposal form with all signatures
- Program proposal –documents required in addition to those provided in the Feasibility Phase
 - Program assessment
 - learning goals/outcomes
 - direct and indirect measures
 - assessment process
 - alignment of program outcomes to all-college goals/outcomes (undergraduate programs only)
 - alignment of program outcomes to program courses
 - Program's relationship to:
 - College's mission (check those that apply)

<input checked="" type="checkbox"/> Interdisciplinary learning	<input type="checkbox"/> Diversity/Inclusiveness
<input checked="" type="checkbox"/> Experiential learning	<input checked="" type="checkbox"/> Sustainability
<input type="checkbox"/> International understanding	<input type="checkbox"/> Student engagement
<input type="checkbox"/> Intercultural understanding	<input type="checkbox"/> Community involvement
 - College's Strategic Plan
 - School's mission and/or goals
 - Degree requirements
 - Course titles, descriptions, and credits
 - Course sequencing
 - Distinction between required and elective courses
 - Number of credits for the entire program, including general education (undergraduate program only)
- Consultant's CV (for state review only) (majors and graduate programs only)

Curricular phase: Materials (checklist, ARC form, all proposal documents) received by ARC: _____ (date)

Earth Science minor

I. Program Summary

The proposed standalone minor in Earth Science consists of five courses (20 credits), three of which are required, whilst two are electives. The minor will provide students with a firm grounding in earth science, including both physical and historical geology (the basis of all earth science majors). Students will gain experience in geological cartographic techniques, be able to identify the major minerals and rocks, and gain practice in geological field techniques. The electives provide an opportunity to explore a wide range of aspects of earth science. Research opportunities in geology and paleontology are available.

Of the five courses, two (both of which are required) have laboratory sections, providing students plenty of hands-on experience in both laboratory and field settings. These courses are also writing intensive, giving students plenty of opportunity to practice and improve their written and oral communication skills.

There are no cooperative arrangements with other institutions or external agencies. The proposed program falls within the institutional mission.

II. Program Assessment

Program Goals, Measurable Student Learning Outcomes, Assessment

Program Goals (numbered) and Student Learning Outcomes (lettered). Assessment measures, and the courses in which assessment will take place, are indicated by the lower case roman numerals.

1. Graduates of the minor in Earth Science will have a foundational knowledge of historical and physical geology, and the Earth's context in the solar system. *SLOs:*
 - a. Demonstrate understanding of the formation and history of the Earth, life on Earth, and Earth's physical processes. *Assessment:*
 - i. Final exam questions (GEOL 105, 326, PHYS 103/345)
 - ii. Lab exercises (GEOL 105, 326)
2. Graduates of the minor will be able to use laboratory and field techniques to identify, analyze, and interpret geological materials. *SLOs:*
 - a. Identify common rocks, minerals, and fossils in the laboratory and field. *Assessment:*
 - i. lab exercises (GEOL 105, 326)
 - ii. lab final exams (GEOL 105, 326)
 - b. Read topographic and geological maps. *Assessment:*
 - i. lab exercises (GEOL 105)
 - c. Collect, record and analyze geological field observations including lithological and structural information. *Assessment:*
 - i. Field lab reports (GEOL 105, 326)
 - ii. Field notebooks (GEOL 105, 326)
3. Graduates of the minor will be able to communicate effectively with diverse audiences. *SLOs:*
 - a. Technical oral presentations
 - b. Technical written papers: synthesis reports (literature reviews), field reports.
 - c. Informal communications: communicating technical information to non-scientist stakeholders

- i. Assessment for all 3 outcomes will take place in the assignments (presentations, field reports, lit reviews, informal communication) in GEOL 105 and 326.

Assessment would take place within the 3 required courses (two of which – including the specific measures indicated - are already mined on a regular basis for assessment within the Environmental Science major). All of the measures indicated above are direct measures of assessment. For some students (those seeking Teacher Education certification), we may also be able to use Earth Science Content Praxis test scores as an indirect assessment measure.

As for all other programs at Ramapo, an Assessment Plan will be submitted early in the Fall semester, and reviewed by first the School Assessment Committee (SAC), and then College Wide Assessment Committee (CWAC), the Dean, and the Vice Provost for Curriculum and Assessment. Assessment will be conducted in the Fall and Spring semesters, with a final report being submitted to the SAC and then the CWAC, the Dean, and the Vice Provost.

Alignment of Program Goals to All-College Goals

This table shows the alignment of the nine all-college goals with the three programmatic goals.

<i>All-college goals</i>	<i>Goal 1 (geo-knowledge)</i>	<i>Goal 2 (geo-skills)</i>	<i>Goal 3 (communication)</i>
Interdisciplinary Analysis	x	X	
Experiential learning		x	
Intercultural/International			
Critical Inquiry	x	x	
Communication			x
In-depth knowledge	X	x	
Understanding the world	x	x	
Awareness			
Engagement			

III. Program's Institutional Context:

College's Mission:

Ramapo College has four pillars of learning, two of which are foundational to this minor: Interdisciplinary Education and Experiential Learning. Another value important to the College is Sustainability, which is a theme running through the minor.

Strategic Plan:

- Goal 1 of the Strategic Plan speaks to advancing academic excellence through (amongst other things) Minors. With lab courses and elective options based in experiential learning, this minor rests heavily on the Experiential Learning Pillar.
- Achievement Target 1.1.2 (extended experiential activity): although this target is for majors rather than minors, the program electives include a Research Project option for extended experiential activity.

School of Theoretical and Applied Science's Mission:

The minor addresses several of the goals embedded within TAS's mission, including science literacy, scientific understanding among non-science majors, and meeting the needs of the contemporary marketplace and community.

IV. Impact on Other Ramapo Undergraduate Programs

The minor will utilize existing courses; most are either required or elective courses in the Environmental Science major¹; the remainder are electives in the Environmental Studies² and Physics major. The required courses, and most of the electives, are offered once a year. Most of these courses usually have a couple of spare seats each time they are offered, which would accommodate students in the minor who are outside of these majors. These three majors have all indicated there would be no problem in accommodating a few extra students. Finally, as a minor, this program would not compete with any majors.

Currently, the Environmental Science major has two advisement tracks, the second of which was created for students seeking Earth Science content-area endorsement in teacher education. If this minor is approved, it will simplify the Environmental Science major by eliminating the “teaching” track. The Environmental Science faculty are eager to see this happen.

V. Program’s Need

Interest from Students

Every year for the past 10 years, a couple of students express interest in a geology / earth science minor. (These are usually Environmental Science or Environmental Studies students.) We have even, in the last 2 years, had 2 students leave Ramapo because we haven’t offered a geology program.

The Teacher Education program offers Content Certification in Earth Science (High School); but of all the content areas Ramapo offers, Earth Science is the only subject that we do not offer a major or minor in. Therefore, even though there are only a small number of students pursuing Earth Science endorsement, it is logical that we would have a stand-alone minor in this subject area.

College’s Strategic Plan:

Goal 1 of the Strategic Plan speaks to advancing academic excellence through (amongst other things) Minors. With lab courses and elective options based in experiential learning, this minor rests heavily on the Experiential Learning Pillar. This Goal also has a specific Target for experiential learning, which, whilst it is intended for majors rather than minors, the proposed minor’s electives include a research project option for extended experiential activity.

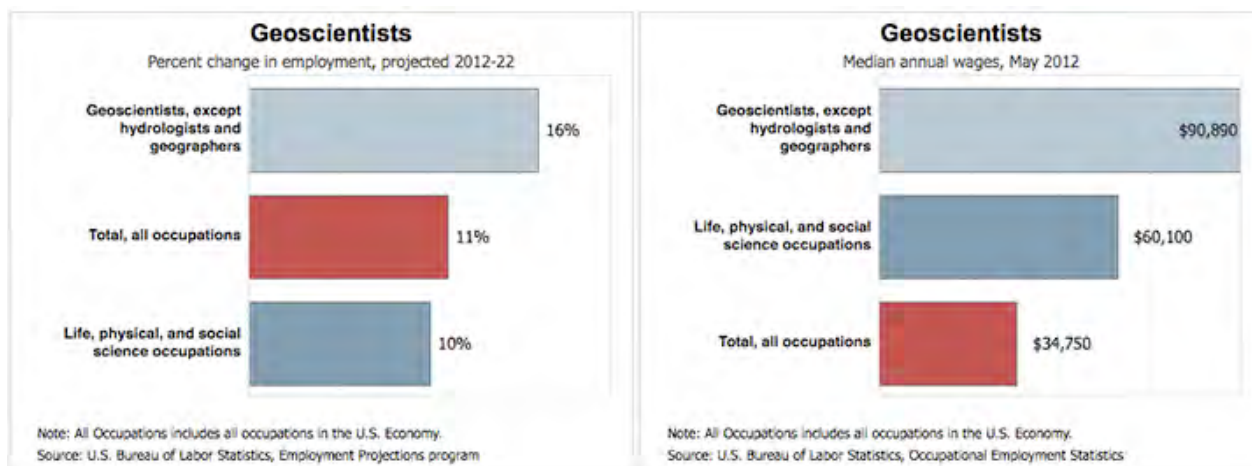
Employment opportunities

According to the BLS³, employment of geoscientists is projected to grow 16% from 2012 to 2022, which is faster than the average for all occupations (11%). Median annual wages for 2012 were \$90,890 (compared with \$34,750 for all occupations). Whilst an earth science *major* is not feasible at Ramapo, an earth science minor, particularly when combined with a science major, will open additional (and lucrative) doors for our students, and in addition, give students a better chance of getting into earth science graduate programs. Some local graduate programs (e.g. Rutgers Newark, Columbia) accept students into geology MS programs with such a background.

¹ GEOL courses are offered through the Environmental Science program

² GEOG courses

³ <http://www.bls.gov/ooh/life-physical-and-social-science/geoscientists.htm#tab-1> accessed 10/1/14



Other Programs in NJ

- NJCU, Montclair, Rider and Rutgers (New Brunswick) have minors in geology/geoscience/earth and environmental science. The only program similar in scope to the proposed minor is at Rider; the others are strictly geological.
- Majors are listed in the table below. Given the broad scope of the proposed minor, the majors to be compared with are entitled Earth Science, which are William Paterson and Kean.

4006 Geological and Earth Sciences/Geosciences			
A.S.	Earth Science	Middlesex County College	400601
B.A.	Earth Science	William Paterson University of NJ	400601
B.A.	Earth Sciences	Kean University	400601
B.A.	Geological & Geophysical Sciences	Princeton University	400699
B.A.	Geological Sciences	Fairleigh Dickinson University	400601
B.A.	Geology	Rutgers University / Newark	400601
B.A.	Geology	Richard Stockton College Of New Jersey	400601
B.A.	Geoscience	New Jersey City University	400601
B.S.	Earth Science	Kean University	400601
B.S.	Geological Sciences	Rutgers University / New Brunswick	400601
B.S.	Geology	Richard Stockton College Of New Jersey	400601
B.S.	Geology	Rutgers University / Newark	400601
B.S.	Geoscience	Montclair State University	400601
B.S.	Geoscience	New Jersey City University	400601
B.S.	Geosciences	Rider University	400601

VI. Anticipated Enrollment

Based upon unsolicited student interest expressed to date, we would expect 2-3 students per year enrolling in the minor, for a total of approximately 10-15 students at any one time.

VII. Additional Resources Needed, First Five Years

Organization:

- Home school: Theoretical and Applied Science
- In collaboration with: Environmental Science, Environmental Studies, Physics
- Proposed convening group: E. Rainforth (ENSC), C. Brisson (PHYS), H. Horowitz (ENST)

No additional faculty resources are expected to be needed. The required courses, and most of the electives, are all offered once a year, and typically have a small number (2-3) of spare seats which would accommodate the number of students who have expressed interest.

In terms of facilities, the new Geology Classroom in the renovated G-wing has ample space and facilities for the geology courses, and there is also a new geology faculty research laboratory, in the event that students opt to undertake a research project as one of their electives.

Therefore, it is not thought that any additional resources will be required.

VIII. Degree Requirements

Curriculum:

The minor will consist of 5 courses, 4 credits each (total: 20 credits). Course descriptions are appended on the last two pages.

Required courses

GEOL 105 Fundamentals of Geology (lec/lab) [writing intensive]

GEOL 326 Paleontology (lec/lab) [writing intensive]

Either: PHYS 103 Introduction to Astronomy

Or PHYS 345 Astronomy and Astrophysics I

Electives – select two from the following (one must be GEOL or ENSC)

GEOL 327 Geology of New Jersey

GEOL 333 Environmental Geology

ENSC 405 Global Climate Change⁴

GEOG 303 Water Resources

PHYS 105 Meteorology

PHYS 221 Environmental Physics

A 4-credit 2-semester geology research project

Sequencing:

- GEOL 105 is the prerequisite course for higher-level GEOL courses and ENSC 405.
- Fall courses: GEOL 326, PHYS 221
- Spring courses: GEOL 105, GEOG 303, GEOL 333, ENSC 405. (GEOL 333 and ENSC 405 offered in alternate years.)
- Summer courses: GEOL 327

Advisement information for the typical populations who have enquired about a minor:

1. ENSC majors seeking Earth Science certification:
Currently, we have an Earth Science advisement track within the Environmental Science major, which (in conjunction with the 4 year plan for the track) enables students to specialize in Earth Science at the upper level within the major. Because this advisement track was created solely for ENSC students wanting Earth Science certification, the track will be eliminated upon the creation of the minor, because it will no longer be needed. A benefit of the elimination of the Earth Science track in ENSC is that the catalog / degree audits will be simplified. (Note: for teaching, 30 credits of Earth Science are required.)
 - Currently, students seeking Earth Science certification by following the Teaching

⁴ ARC submission in progress to revise this course to become “ENSC 3xx Climate Change Science”.

Advisement Track have to take *two* additional earth science classes beyond the major in order to reach the 30 credits required for content certification. With the elimination of this track, students would choose appropriate Earth Science electives in the major, and would still need to take the two extra earth science classes to reach the 30 required credits for content certification.

- Students wishing to seek Earth Science certification with both the ENSC major and EarthSci minor would take *three* additional earth science classes beyond the major to complete the minor (because two of the required courses in the minor are also required in the major, and no more than two courses can double-count between the major and minor). Although this is one more course than if an ENSC student didn't want the minor, it gives the student the additional credential (the minor).
2. ENSC majors not seeking Earth Science certification:
 - a. Because two of the required courses in the minor are also required in the major, three additional courses are required to complete the minor.
 3. ENST majors seeking Earth Science certification:
 - b. Depending on how students fulfill distribution requirements for the ENST majors, they currently take 2-6 courses beyond the major to complete 30 credits for Content Certification. With the option to minor in Earth Science, they would need to take 3 courses, provided the distribution requirements are carefully chosen.
 4. ENST majors not seeking Earth Science certification:
 - c. Depending on how students fulfill their distribution requirements within the major, 3-5 courses are required to complete the minor.
 5. INSS majors:
 - d. Because two of the required courses in the minor are also required in the major, three additional courses are required to complete the major.

Course Descriptions

All courses are 4 credits.

1. Required Courses

GEOL 105 Fundamentals of Geology: lec/lab

This course will provide an introduction to the geological sciences. The course begins with the underlying geologic principles and the exploration of Plate Tectonics. Subsequent topics include: the formation of the major rock-forming minerals, and common igneous, sedimentary and metamorphic rocks; the major geophysical processes and the formation of resultant features (volcanoes, earthquakes, mountain belts, ocean basins, and structural geologic features); the major surface processes (weathering, erosion, water, ice, and wind); the structure and processes operating in the oceans and atmosphere; and the physical and biological history of the planet. This information will be presented in a plate tectonic framework. GEOL 105 is required for the Environmental Science and Integrated Science Studies majors, the Environmental Science minor, and can be used to fulfill requirements for the Environmental Studies major and minor as well as the 100-level introductory science category of General Education. It is the recommended foundation course for Earth Science teacher certification.

GEOL 326 Paleontology, Paleocology, and Paleoenvironments (lec/lab)

This is an interdisciplinary course in which students use paleontology and sedimentology to interpret ancient environments and the ecosystems they supported. Students begin with a brief review of aspects of geology required for paleontological studies: geologic time, plate tectonics, and sedimentary rocks and their depositional environments. There is also a review of evolutionary theory and ecological and paleoecological principles. Following this, the course is split into two sections. First, there is an overview of the major depositional environments, the typical fossil organisms that are found preserved in them, the process of fossilization, and how the ecosystems of particular environments have changed through time. This is followed by a survey of the history of settings, and use paleontological (biological) and sedimentological (geological) data to reconstruct the paleoecology and ancient physical environment. Lab sessions include fossil identification and analysis and several field visits to sites in New Jersey, Pennsylvania and Connecticut.

PHYS 103 – Introduction to Astronomy

A study of the motion and physical properties of bodies of the solar system and the nature and structure of galaxies. Areas covered will include: an historical background, the sun as a star, the properties of light, the apparent motion of celestial bodies, nebulae and pulsars, comets and meteors, astronomical instruments, quasars, and cosmology.

or

PHYS 345 – Astronomy and Astrophysics I

This course constitutes a quantitative introduction to the astronomy of the sun, earth, and solar system, with an emphasis on the physical principles involved. Includes celestial mechanics, planetary atmospheres and the physics of comets, asteroids and meteorites. NOTE: It is a 4-credit 300 level Ramapo course. It is an elective course for the Ramapo Engineering Physics Major. This course is taught by NJIT faculty at NJIT. Students will attend the lectures on the Ramapo campus through videoconferencing. Ramapo students will pay the regular Ramapo tuition and will register through the Ramapo website just like any other Ramapo course. Two mandatory observing sessions will be held at Rutgers-Newark's Boyden Observatory

2. Elective Courses (three required, one must have GEOL prefix)

ENSC 3xx – Climate Change Science

In this course, we will examine the scientific evidence for global climate change in the modern era, and the natural and human causes of climate change on various timescales. We will examine the probable effects of climate change through the 21st century and beyond, including temperature and precipitation changes, and the effects on terrestrial and aquatic ecosystems and natural resources such as soil and

water. We will look at the human dimension of climate change: the effects on settlements and infrastructure, and health. Finally we will explore the scientific and technological options available to us both now and in the near future that could enable us to begin to decrease the rate of climate change, as well as the policy and economic considerations that will be required in order for us to adapt to our new environment.

GEOG 303 – Water Resources

An overview of the physical and cultural geography of fresh water. Physical aspects include the hydrologic cycle, regional water budgets, stream flow processes, and groundwater aquifers. Resource management issues include examination of drinking water supplies, irrigation, flood control projects, multiple-use impoundments, floodplain zoning, water pollution, and fresh water fisheries. Case studies will be drawn from the local area and other parts of the world.

GEOL 327 – Geology of New Jersey

This field course explores New Jersey's 1.5 billion year geologic history through analysis and interpretation of clues left in the rocks. We will examine each of the four provinces of the state, from the bedrock to the surface, focusing on the geologic history of the state and its geologic resources; we will also look at environmental geology issues such as water resources, land use, and waste management. This course includes four full-day field trips and seminars before each trip (and a wrap-up session at the end). All trips are mandatory. This course fulfills the Field Studies requirement for the Environmental Studies major and can be used as an elective in the Environmental Science major and minor, Environmental Studies major, and for Earth Science Teacher Certification.

GEOL 333 – Environmental Geology

This course studies the interactions between geology and the surface and near-surface environment. First we will examine geologic resources such as water, soils, minerals, and energy; this section will include examination of current extraction including resource limits, alternative resources, and pollution. The second part of the course concerns geological hazards, both generated in the earth's interior (earthquakes and volcanoes) and those acting on the Earth's surface (mass movement, flooding, and coastal hazards), and the role of humans in both increasing their occurrence and damages and how to (try to) mitigate them. Third, we will examine the interplay between humans and the surface environment, in particular climate and hydrology. Finally we will study some applications of environmental geology in society, including land use planning, waste disposal, and environmental laws and regulations.

PHYS 105 - Meteorology

An exploration of the physical concepts involved in the weather processes of the earth. Topics will include solar radiation, the energy balance of the atmosphere, cloud formation, air masses, atmospheric disturbances, general wind circulation, weather forecasting, and weather instrumentation. Interaction of human society and weather processes will be analyzed through consideration of such topics as urban air pollution, acid rain, aircraft accidents, agriculture, the hydrologic cycle, and global weather modification.

PHYS 221 – Environmental Physics

Controversial environmental issues revolve around complicated scientific arguments. Therefore, we need to explore the concepts of mechanics, energy, thermodynamics, electromagnetic radiation, atmospheric processes and radioactivity to clarify these issues. The understanding of the fundamental concepts of physics is crucial to the study of natural processes such as global climate, greenhouse effect, ozone depletion, pollution, etc. This course also reviews the various alternative technologies that have been developed to produce energy and analyses their impact on the environment.