Earth and Geographic Sciences – Environmental and Earth Science Objectives and Expected Student Outcomes

Students who earn a major in Environmental and Earth Science will demonstrate a scientific understanding of how the Earth operates as a system and how humans interact with their environment, including natural hazards and use of Earth's resources. They will be able to distinguish between science and non-science, back up arguments with quantitative evidence, communicate their ideas effectively, and explain the necessity and characteristics of an interdisciplinary approach to solving environmental issues.

Environmental and earth science students will:

- Communicate scientific information through written, oral, and graphical expression with clarity, logical organization, and use of scientific evidence to support their ideas.
- Use the scientific process, including experimental design, analysis and critical evaluation of information, and integration of evidence from relevant sources, in the context of environmental investigations.
- Apply an interdisciplinary approach to analyze and propose solutions to environmental science problems.
- Describe the complex interactions between humans and their environment, including geological hazards, air and water pollution, global environmental issues, and use and conservation of Earth's resources.

Students will achieve these objectives through developing essential skills and mastery of relevant content knowledge, as outlined below.

I. Skills

A. Communication

Students will communicate scientific information through written, oral, and graphical expression with clarity, logical organization, and use of scientific evidence to support their ideas.

Written communication – lab reports (2100, 2500, 4200, 4600), manuscripts/papers (3110, 4700)
Oral comm – presentations in 3110, 4200, 4600
Graphical/visual – graphs 2500, 3110; Maps in 4000; Images in 4500

B. Scientific Inquiry

Students will:

i. Gather, organize, interpret, and report scientific data in the context of environmental and earth science investigations. (Labs and reports, Intro level: Geology, Oceanography; Ecology; Papers and presentations, Upper level: Climatology; Hydrogeology; Geomorphology, GIS, Conservation)

ii. Critically and logically analyze competing ideas, and distinguish between scientific and non-scientific approaches to solving problems.
(All courses)

iii. Integrate principles of earth science, physics, chemistry, and biology to answer geoscience questions.
(4200, 4600)

iv. Describe ethical principles related to scientific inquiry and use of resources.
Position paper, Conservation

C. Quantitative, analytical, and mapping skills

i. Apply mathematical principles to quantitatively interpret geoscience data.
(Data interpretation assignments, labs, most courses)

ii. Use common software (e.g., Excel) to organize and graphically present data.
(in most labs, especially Ecology, Oceanography)

iii. Conduct spatial analysis in a GIS environment
(Final project, Intro to Geospatial; GIS)

iv. Analyze an environmental issue using and processing remotely acquired imagery
(Final project, Remote Sensing)

II. Content knowledge

A. Earth as a system

Students will:

i. describe relationships among lithosphere, atmosphere, hydrosphere, and biosphere (ESS; Conservation; Oceanography, Climatology)

ii. explain Earth-sun relationships, including reasons for seasons (ESS, Meteorology, Climatology)

iii. illustrate and discuss energy transfer and element cycling in the Earth system, such as Earth's energy budget, atmospheric composition and circulation, ocean circulation, and the carbon cycle. (ESS, Meteorology, Oceanography, Climatology, Ecology)

B. Earth Materials and Structure: Students will describe the structure and composition of Earth's interior, surface, and atmosphere, processes of mineral and rock formation, and characteristics of different types of minerals and rocks

Geology, Meteorology, Oceanography

C. Earth System Processes

Students will discuss constructional forces that have shaped Earth's surface (e.g., plate tectonics), theories and evidence of crustal movements, and the effects of crustal movements on Earth's landscape (Geology); erosional-depositional processes that change the earth's surface (e.g., weathering, erosion) (Geology, Geomorphology); and describe processes by which water moves on, above, and beneath Earth's surface (Oceanography, Hydrogeology)

D. Earth history

Students will describe Earth's physical evolution through geologic time (Historical Geology, Climatology)

E. Societal significance and human stewardship

Students will discuss society's dependence on Earth resources, such as mineral, rock resources, soil, and water resources; fossil fuels (Conservation), explain natural hazards related to earth system processes (Geology, Hydrogeology), and evaluate the effect of human activity on Earth's natural processes (e.g., global warming, ozone depletion, air pollution, water pollution)
Geographic Perspectives on Conservation; Climatology

The curriculum to achieve these objectives looks like this:

To gain content knowledge in the **physical environment**, students will take six courses (18 credits):
GEOG1000 *Earth Systems Science,* **OR** ENVS1000 *Introduction to Environmental Science* (3) OR GEOG2003 *Environmental Geology*
GEOG2100 *Geology* (3)
GEOG2500 *Oceanography* (3)
GEOG3110 *Climatology* (3)
GEOG4200 *Geomorphology* (3)
GEOG4600 *Environmental Hydrogeology*

To develop skills in **environmental spatial analysis**, students will take three courses (9 credits)
GEOG2400 *Introduction to Geospatial Technologies* OR GEOG3120 *Computer Cartography* (3)
GEOG4000 *GIS* (3)
GEOG4500 *Remote Sensing of the Environment* (3)

To understand **environmental interactions and applications** – students choose three courses (9 credits) from the following:
GEOG2200 *Meteorology*
GEOG2056 *Climate Change and Human History*
GEOG4220 *Structural Geology*
GEOG4700 *Geographic Perspectives on Conservation*
GEOG4900 Independent Study in Geo
GEOG4940/50/60 Internship in Geo
BIOL2100 *Flora of New England* OR BIOL3100 *Conservation Biology* OR BIOL3102 *Marine Biology*

ENSC2000 *Field Techniques in Environmental Science*
ENSC4050 *Internship in Environmental Science*

Required cognate courses allow students to integrate knowledge from various fields to address environmental problems:
Physics I and II
General Chemistry I and II
MATH1700
MATH1300 or 2300
BIOL2300 *Ecology*