

# ENVIRONMENTAL SCIENCE

The environmental science program focuses on scientific approaches to solving environmental problems. Students can earn an environmental science minor that complements any major, or they can complete an environmental science major with a concentration in biology, chemistry, or geology.

## ABOUT THE PROGRAM

*The Environmental Science program is administered through the Department of Geological and Environmental Sciences. Descriptions of each of the GES courses are found under the heading of [Environmental Science Courses in the Geology section of the catalog](#).*

In the most basic terms, environmental science is the scientific study of the environment, particularly with regard to implications for humans. Environmental science therefore is broad in scope and interdisciplinary in nature. It draws on principles from throughout the sciences to understand and improve the ways that humans and the environment interact with one another. It uses systems thinking to help reduce complex natural phenomena into manageable subsets that can be studied and understood. It also incorporates ideas of sustainability as it considers the future of humans in the environment.

Our ability to modify our environment has increased dramatically over the last century, and we now recognize that many of those modifications have negative consequences. A growing number of scientists seek solutions to environmental problems as they work to improve our understanding of the causes, processes and consequences of environmental change. The "typical" environmental scientist is a specialist in one of the traditional disciplines such as biology, chemistry, geology, physics or engineering. However, he or she generally has a broad scientific understanding of environmental systems that goes beyond the confines of his or her discipline, including an understanding of how environmental issues affect and are affected by politics and economics. An environmental scientist will often work in a team with professionals from other fields to study and solve environmental problems.

At Hope College programs in environmental science are administered within the Department of Geological and Environmental Sciences. The department offers a **major in environmental science** as well as a **minor in environmental science** that is open to students with any major. Students with primary interests outside the sciences should compare the environmental science programs listed here with [the environmental studies minor](#), which has a greater focus on humanities and social science aspects of environmental issues.

## MAJORS

The Environmental Science major equips students to take a rigorous scientific approach when developing and evaluating effective solutions to environmental problems. It does this by combining four elements:

- a foundation in an environmentally-focused science discipline (biology, chemistry, or geology)
- broader interdisciplinary experiences and systems concepts that enable students to work and communicate across disciplines
- an understanding of political, economic, and regulatory aspects of environmental decision-making
- an outlook informed by tenets of sustainability.

The Environmental Science major supplies students with background knowledge, skills, and intellectual tools that are fundamental to addressing complex and multifaceted environmental problems. Solutions to these problems, however, demand both breadth and depth of knowledge, so students planning a profession in environmental science are strongly encouraged to take courses in one or more science disciplines beyond those required for an Environmental Science major, as well as to choose environmentally-related courses throughout the curriculum.

Students completing the environmental science major choose from one of three concentrations, in biology, chemistry, or geology. Students with interests in computer science, engineering, physics, or other fields in which there is not a designated concentration are strongly encouraged to combine a major in their field of interest with the environmental science minor. All environmental science major degrees are awarded as Bachelor of Science degrees.

### **Environmental Science Major with a Concentration in Biology (Bachelor of Science)**

#### Ancillary Science and Mathematics Courses (16 credits)

- One year of chemistry or accelerated chemistry and labs, 8 credits
- Math 311–Statistical Methods, 2 credits
- Math 312–Applied Statistical Models, 2 credits
- At least one semester of Calculus, 4 credits

#### Environmental Science Courses (20 credits)

- GES 130–Introduction to Environmental Science, 4 credits
- GES 211–Local Environmental Systems, 4 credits
- GES 213–Global Physical Systems, 2 credits
- GES 220–Environmental Laboratory Methods, 2 credits
- GES 225–Geographic Information Systems, 2 credits

- GES 310–Environmental Public Policy, 4 credits
- GES 401–Advanced Environmental Seminar, 2 credits

**biology courses (8 credits)**

- BIOL 105/107–General Biology I and lab
- BIOL 106/108–General Biology II and lab

**Organismal Biology (4 credits)**

Focus on familiarity with particular groups of organisms. At least one of the following:

- BIOL 301–Microbiology, 4 credits
- BIOL 330–Marine Biology and Biophysics, 4 credits
- BIOL 343–Plant Systematics, 4 credits
- BIOL 374–Biology of Insects, 4 credits
- BIOL 422–Invertebrate Zoology, 4 credits
- BIOL 432–Vertebrate Zoology, 4 credits

**Foundations of Ecology (8 credits)**

At least two of the following:

- BIOL 315–Principles of Ecology, 4 credits
- BIOL 315–Conservation Biology, 4 credits
- BIOL 315–Population and Community Ecology, 4 credits
- BIOL 315–Plant-animal Interactions, 4 credits
- BIOL 380–Field Studies in Biology, 4 credits
- Approved biology course from off-campus study programs, 4 credits

**Analytical/Modeling approaches to environmental biology (4 credits)**

At least one of the following:

- BIOL 318/MATH 318–Mathematical Biology, 4 credits
- CSCI 160–Scientific Computer Programming, 4 credits

Total Credits: 60

## **Environmental Science Major with a Concentration in Chemistry (Bachelor of Science)**

### **Ancillary science and mathematics (16 credits)**

- MATH 131–Calculus I, 4 credits
- MATH 311–Statistical Methods, 2 credits
- MATH 312–Applied Statistical Models, 2 credits
- PHYS 121/141–General Physics and lab, 4 credits
- At least one of the following:
  - PHYS 122/142–General Physics II and lab, 4 credits
  - BIOL 105/107–General Biology I and lab, 4 credits
  - GES 251–Surficial Geology and lab, 4 credits

### **Environmental science courses (26 credits)**

- GES 130–Introduction to Environmental Science, 4 credits
- GES 211–Local Environmental Systems, 4 credits
- GES 213–Global Physical Systems, 2 credits
- GES 215–Global Change-Humans & Biological Systems, 2 credits
- GES 220–Environmental Laboratory Methods, 2 credits
- GES 225–Geographic Information Systems, 2 credits
- GES 310–Environmental Public Policy, 4 credits
- GES 401–Advanced Environmental Seminar, 2 credits
- GES 430–Environmental Geochemistry, 4 credits

### **Chemistry courses (23 credits)**

#### **Introductory Chemistry (8 credits)**

- CHEM 125/127–General Chemistry I and lab, 4 credits and
  - CHEM 126/128–General Chemistry II and labs, 4 credits
- or
- CHEM 131/132–Accelerated General Chemistry and lab, 8 credits

#### **Advanced Chemistry (15 credits)**

- CHEM 221/255–Organic Chemistry I and lab, 5 credits
- CHEM 331/332–Analytical Chemistry and lab, 4 credits

At least 2 of the following:

- CHEM 321–Organic Chemistry II Lecture, 3 credits
- CHEM 311–Biochemistry Lecture, 3 credits
- CHEM 322–Inorganic Chemistry Lecture, 3 credits
- CHEM 343–Physical Chemistry I Lecture, 3 credits

Total Credits: 65

### **Environmental Science Major with a Concentration in Geology (Bachelor of Science)**

#### **Ancillary Science and Mathematics (16 credits)**

- CHEM 125/125–General Chemistry I and lab, 4 credits
- or
- CHEM 131/132–Accelerated General Chemistry and lab, 8 credits
- One semester of Chemistry, Biology or Physics, 4 credits
- Two semesters of Mathematics or Computer Science, 8 credits

#### **Environmental Science Courses (22 credits)**

- GES 130–Introduction to Environmental Science, 4 credits
- GES 211–Local Environmental Systems, 4 credits
- GES 213–Global Physical Systems, 2 credits
- GES 215–Global Change-Humans & Biological Systems, 2 credits
- GES 220–Environmental Laboratory Methods, 2 credits
- GES 225–Geographic Information Systems, 2 credits
- GES 310–Environmental Public Policy, 4 credits
- GES 401–Advanced Environmental Seminar, 2 credits

#### **Geology Courses (26 Credits)**

- GES 100/GEMS 157–Planet Earth and lab, 4 credits
- or
- GES 125–Michigan Field Geology, 4 credits
- GES 203–Historical Geology and lab, 4 credits
- GES 243–Mineralogy and lab, 4 credits
- GES 251–Surficial Geology and lab, 4 credits

- GES 341–Regional Field Study, 2 credits
- GES 430–Environmental Geochemistry, 4 credits
- GES 450–Hydrogeology and lab, 4 credits

Total Credits: 64

## MINORS

The Environmental Science Minor helps students acquire the background they need to be successful environmental scientists or, for those not majoring in science, to use skills learned in their own major to work closely with environmental scientists.

### Environmental Science Minor

The Environmental Science minor is open to all students regardless of their major, but it is best suited for those who have some interest in science or engineering. Students should complete a semester of chemistry before taking 200 or 400 level environmental science courses. Chemistry may be taken concurrently with permission of the instructor.

The Environmental Science Minor is designed to equip students with:

1. A solid preparation in one of the academic majors at Hope College.
2. A broad interdisciplinary understanding of environmental science. Students are required to take at least two interdisciplinary courses in environmental science, which may include GES 130-Intro to Environmental Science, GES 211-Local Environmental Systems, GES 213-Global Physical Systems, or GES 215-Global Change-Human and Biological Systems.
3. Knowledge of how environmental issues affect and are affected by politics and economics. Students meet this goal by taking GES 310 – Environmental Public Policy. This is an interdisciplinary course taught by faculty in the Natural Science Division, Department of Political Science Department and/or Department of Economics.
4. An ability to work in a team with scientists and non-science professionals from other disciplines. To obtain experience with technical aspects of environmental science, students may take GES 220 – Laboratory Methods in Environmental Science, and students are required to take GES 401 – Advanced Environmental Seminar. In this capstone course students work with colleagues from a number of disciplines to choose and study a local environmental problem.
5. An ability to use principles of sustainability when considering environmental problems and solutions. This is addressed formally in GES 130 and 213 and incorporated throughout the minor's other course offerings.

The Environmental Science Minor has two options:

**Option 1: Open to all students, consists of 18 credits**

- GES 130– Introduction to Environmental Science, 4 credits
- GES 211–Local Environmental Systems, 4 credits
- Four credits chosen from the following courses
  - GES 213–Global Physical Systems, 2 credits
  - GES 215–Global Change—Humans and Biological Systems, 2 credits
  - GES 220–Laboratory Methods in Environmental Science, 2 credits
- GES 310–Environmental Public Policy, 4 credits
- GES 401–Advanced Environmental Seminar, 2 credits

**Option 2: Available for students majoring in a natural science discipline or Engineering, consists of 22 credits**

- GES 130–Introduction to Environmental Science, 4 credits
- or
- Four credits chosen from the following courses
  - GES 213–Global Physical Systems, 2 credits
  - GES 215–Global Change—Humans and Biological Systems, 2 credits
  - GES 220–Laboratory Methods in Environmental Science, 2 credits
- GES 211–Local Environmental Systems, 4 credits
- GES 310–Environmental Public Policy, 4 credits
- GES 401–Advanced Environmental Seminar, 2 credits

- Two courses from the student's major flagged as environmentally relevant (8 credits)
  - BIOL 301–General Microbiology, 4 credits
  - BIOL 315–Advanced Topics in Ecology, 1-4 credits
  - BIOL 343–Vascular Plant Systematics, 4 credits
  - BIOL 356–Genetics, 3 credits
  - BIOL 422–Invertebrate Zoology, 4 credits
  - CHEM 331/332–Analytical Chemistry and Laboratory, 4 credits
  - Chemistry: Environmental Geochemistry or a second Chemistry course chosen in consultation with the Chemistry Department chairperson
  - ENGS 140–Introduction to Electric Circuits, 2 credits
  - ENGS 150–Conservation Principles, 2 credits
  - ENGS 346–Fluid Mechanics, 3 credits
  - GES 225–Geographic Information Systems, 2 credits
  - GES 430–Environmental Geochemistry, 4 credits
  - GES 450–Hydrogeology, 4 credits
  - PHYS 270–Modern Physics, 4 credits
  - PHYS 382–Advanced Laboratory: students must take a semester which involves radiation, 2 credits

## FACULTY & STAFF

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