ENVIRONMENTAL SCIENCES, MINOR

The environmental sciences minor has been developed to encourage and facilitate studies in environmental sciences by students completing degrees in the other science and engineering disciplines. The environmental sciences (ES) minor requires:

- completion of a set of courses in the core sciences,
- two introductory courses dealing with the environment, and
- three or more upper-level environmental sciences courses, as described.

Faculty Advising

A faculty advisor is assigned to each student in the environmental sciences minor program to assist in planning his/her academic program and to approve the choice of courses to satisfy the minor. Faculty advisors are available in the following areas:

- **Biological Processes**  
  Faculty advisor: Sarah Preheim
- **Physical Processes**  
  Faculty advisor: Ciaran Harman
- **Environmental Chemistry**  
  Faculty advisor: Alan Stone
- **Environmental Systems**  
  Faculty advisor: Ben Hobbs

Program Requirements

Core Sciences (ES Minor)

Because of the interdisciplinary nature of environmental science, it is important that professionals from various areas of expertise acquire a common language and set of core concepts to make discussion and cooperation possible. The following courses represent the minimum set of requirements:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics (12 credits)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS.110.108</td>
<td>Calculus I (Physical Sciences &amp; Engineering)</td>
<td>4</td>
</tr>
<tr>
<td>AS.110.109</td>
<td>Calculus II (For Physical Sciences and Engineering)</td>
<td>4</td>
</tr>
</tbody>
</table>

At least one of these four courses:

- AS.110.201  Linear Algebra  4
- AS.110.202  Calculus III  4
- AS.110.302  Differential Equations and Applications  4
- EN.553.291  Linear Algebra and Differential Equations  4

**Biology (3 credits)**

One course is needed, such as: AS.020.151 General Biology I  3

**Physics (10 credits)**

AS.171.101  General Physics: Physical Science Major I  4  
or AS.171.107  General Physics for Physical Sciences Majors (AL)  4

AS.171.102  General Physics: Physical Science Major II  4  
or AS.171.108  General Physics for Physical Science Majors (AL)  4

AS.173.111  General Physics Laboratory I  1

AS.173.112  General Physics Laboratory II  1

Chemistry (8 credits)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.030.101</td>
<td>Introductory Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>AS.030.102</td>
<td>Introductory Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>AS.030.105</td>
<td>Introductory Chemistry Laboratory I</td>
<td>1</td>
</tr>
<tr>
<td>AS.030.106</td>
<td>Introductory Chemistry Laboratory II</td>
<td>1</td>
</tr>
</tbody>
</table>

Environmental Sciences

Students must take two introductory courses dealing with the environment and three or more of the upper-level environmental science courses on the following lists, for a total of 15 credits:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN.570.110</td>
<td>Introduction to Engineering for Sustainable Development</td>
<td>6</td>
</tr>
<tr>
<td>EN.570.201</td>
<td>Environmental Biology and Ecology</td>
<td></td>
</tr>
<tr>
<td>EN.570.239</td>
<td>Environmental Engineering Chemistry - Current and Emerging Topics</td>
<td></td>
</tr>
<tr>
<td>AS.270.110</td>
<td>Freshman Seminar: Sustainable + Non-Sustainable Resources</td>
<td></td>
</tr>
<tr>
<td>AS.270.220</td>
<td>The Dynamic Earth: An Introduction to Geology</td>
<td></td>
</tr>
<tr>
<td>AS.270.221</td>
<td>The Dynamic Earth Laboratory</td>
<td></td>
</tr>
</tbody>
</table>

**Upper-Level Courses (9-10 credits)**

Select three of the following: 9-10

EN.570.303  Environmental Engineering Principles and Applications
EN.570.350  Environmental Hazards and Health Risks
EN.570.353  Hydrology
EN.570.411  Engineering Microbiology
EN.570.441  Environmental Inorganic Chemistry
EN.570.443  Aquatic and Biofluid Chemistry
EN.570.445  Physical and Chemical Processes I
EN.570.491  Hazardous Waste Engineering and Management
EN.575.706  Biological Processes for Water & Wastewater Treatment

AS.270.302  Aqueous Geochemistry
AS.270.350  Sedimentary Geology
AS.270.369  Geochem Earth/Environment

Total Credits 15-16

Pairing Your Major with the ES Minor

Many of the most creative and productive advances in environmental sciences in recent years have come from scientists trained in traditional disciplines (biology, chemistry, geology, physics, and engineering) who have devoted themselves to the study of environmental problems. Completion of the degree requirements of a traditional discipline provides depth and rigor that, when supplemented with additional academic training in environmental science, can be applied to professional work in a variety of environmental subjects, as the following examples show:

**Biological Processes**

Response of ecosystems to change, microbial degradation of pollutants, biogeochemical cycling of greenhouse gases. **Illustrative majors:** Biology, Biomedical Engineering, Biophysics, Biochemical Engineering.
Physical Processes
Erosion of hillslopes, rivers, and coastlines; sediment production, transport, and fate; groundwater, movement of contaminant plumes; oceanography; atmospheric physics; aerosol formation; global warming. 
**Illustrative majors:** Civil Engineering, Chemical and Biomolecular Engineering, Mechanical Engineering, Physics, Earth and Planetary Sciences.

Environmental Chemistry
Environmental fate of pollutants, water and waste water treatment, geochemistry, atmospheric chemistry, ozone depletion, acid rain. 
**Illustrative majors:** Chemistry, Chemical and Biomolecular Engineering, Earth and Planetary Sciences, Materials Science and Engineering.

Environmental Systems
Environmental modeling, risk assessment, environmental systems design, pollution control strategies. **Illustrative majors:** Civil Engineering, Applied Mathematics and Statistics.