Morton K. Blaustein
Department of Earth and Planetary Sciences

The Department of Earth and Planetary Sciences offers programs of study and research in a wide range of disciplines including the atmosphere, biosphere, oceans, geochemistry, geology and geophysics, and planets. The undergraduate program in Earth and Planetary Sciences is flexible and lets the student, in consultation with a faculty advisor, devise a program that is challenging, individual, and rigorous. The graduate program develops skills in research through independent investigation under the general guidance of one or more members of the faculty, backed up by relevant course work. The department gives particular emphasis to the integration of experimental investigation, theoretical calculation, and quantitative field observations.

The Department also offers an interdepartmental undergraduate program in Global Environmental Change and Sustainability. This program introduces students to the science of the Earth and its living and nonliving systems as well as how humans interact with Earth and its natural systems and how humans can use a variety of tools, such as policy, communication, individual and societal behavior change, and law to harm or help those systems. Students are exposed to theory, research, and the practical applications of both throughout their course work.

Facilities

The Department of Earth and Planetary Sciences is housed in Olin Hall, a modern building dedicated to the Earth sciences, nestled on a wooded knoll on the western edge of campus. Its facilities include state-of-the-art instrumentation, a departmental library, and modern computer equipment. There are laboratories for crystallography, evolutionary biology/ecology, stable isotope geochemistry, materials science, and fluid and solid mechanics. Olin Hall also contains equipment for modern petrographic work (including a computer-controlled image analysis system), darkroom facilities, and a laboratory for sectioning rocks. There is also a substantial collection of rocks, minerals, and fossils. Facilities are available for a wide spectrum of fluid mechanical experiments, including thermal convection and solidification.

A JEOL 8600 electron microprobe in Olin Hall is available to all members of the department. Crystallographic facilities include a modern specimen preparation laboratory for transmission electron microscopy and single-crystal X-ray diffraction studies. The transmission electron microscopy laboratory houses state-of-the-art instruments capable of both high-resolution imaging at the atomic scale and microanalysis at the nanometer scale.

A field station for geological research, Camp Singewald, in the Bear Pond Mountains of Washington County, Maryland, and a vehicle for field use.

Supporting facilities on campus include the Milton S. Eisenhower Library, the Space Telescope Science Institute, and the Homewood High-Performance Computing Center. In addition, the JHU Applied Physics Laboratory, the facilities of the Smithsonian Institution and the Geophysical Laboratory and the Department of Terrestrial Magnetism of the Carnegie Institution of Washington are available by special arrangement for students qualified to use them. For students whose research requires substantial computation, special arrangements can be made to use the supercomputers at the NASA Goddard Space Flight Center and the National Center for Atmospheric Research.

The Department of Earth and Planetary Sciences offers programs of study for majors, joint majors, and minors in Earth and Planetary sciences (EPS) and in Global Environmental Change and Sustainability (GECS). The EPS major focuses on the study of the physical, chemical, and biological processes that shape the Earth and the other planets. It is designed primarily for students who wish to have careers researching the science of the Earth and planets, although it is also suitable for students planning careers in the health professions. The GECS major is an interdepartmental program introducing students to the science of the Earth and its living and nonliving systems, as well as how humans interact with Earth and its natural systems, and how humans can use a variety of tools, such as policy, communication, individual and societal behavior change, and law to harm or help those systems.

Earth and Planetary Sciences (EPS) Major

The EPS major is for undergraduates interested in the study of the physical, chemical, and biological processes that shape the Earth and the other planets, drawing on the disciplines of geology, geochemistry, hydrology, ecology, geobiology, oceanoigraphy, and atmospheric science.

The student can design a specific plan of appropriate courses in consultation with the coordinator for undergraduate programs in the department. Depending on the student’s background, it may be appropriate initially to take a freshman seminar or 100-level course designed for the non-major. Those who wish to be majors may proceed directly to courses at the 200- and, in many cases, the 300-level. Our courses provide a broad educational base in the Earth and planetary, and the environmental earth sciences, and enable exploration of a set of electives at the 300-level, depending on the area of interest.

Undergraduates majoring in the department must satisfy the general university requirements for the B.A. degree (see General Requirements for Departmental Majors (http://e-catalog.jhu.edu/archive/2013-14/undergrad-students/academic-policies/requirements-for-a-bachelors-degree)). The department required a total of 9 credits at the 100- or 200-levels and a total of 12 credits at the 300-level within the department. Courses should be selected to reflect an Earth and Planetary Sciences emphasis and should include the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.270.108</td>
<td>Oceans + Atmospheres</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.220</td>
<td>The Dynamic Earth: An Introduction to Geology</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.221</td>
<td>Lab Dynamic Earth</td>
<td>2</td>
</tr>
</tbody>
</table>

In addition the following courses outside the Department of Earth and Planetary Sciences are required:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.030.101</td>
<td>Introductory Chemistry I</td>
<td>3</td>
</tr>
</tbody>
</table>
The major in GECS is an interdepartmental program designed to provide students with a solid knowledge base of the science of the Earth and its living and nonliving systems, as well as how humans interact with Earth and its natural systems, including social science tools of change, such as policy, communication, individual and societal behavior change, and law. Students will be exposed to theory, research, and the practical applications of both throughout their course work. Requirements for the major will include a total of 23 courses (78 credits) if the Science Concentration is chosen and 24 courses (75 credits) for the Social Science Concentration. Because the GECS major is inherently interdisciplinary, students in the GECS major are exempt from the University’s distribution requirements.

All GECS majors must complete 12 “core” courses listed in Table 1 below. Additionally, students will choose either the “Science Concentration” or the “Social Science Concentration” to determine their additional course requirements. For the Science Concentration, majors complete the additional science core courses listed in Table 2 below, 2 additional upper-level courses from Table 3 (Major Electives in Earth and Environmental Science), and 4 courses from Table 4 (Major Electives in Social Sciences), 2 of which must be upper-level. For the Social Science Concentration, majors complete an additional 2 courses from Table 3 (Major Electives in Earth and Environmental Science), at least 1 of which must be upper-level, and 10 courses from Table 4 (Major Electives in Social Sciences), at least 6 of which must be upper level.

All GECS majors must also complete a capstone experience in conjunction with the program director and relevant faculty. The capstone could consist of a research or internship-type project and will be a demonstration of integration and synthesis of knowledge and skills obtained during the 4-year program. Majors are encouraged to begin planning their capstone project during their junior year and must submit a proposal by the end of spring semester of their junior year. Subsequent milestones will be designated throughout the senior year to ensure that all majors are making satisfactory progress on their projects. All majors will make an oral presentation about their project to interested faculty and advisors during spring semester of their senior year and create a poster presentation prior to graduation.

**Honors in EPS Major**

To receive honors in Earth and Planetary Sciences, you must have met the following criteria:

- Have taken a challenging set of courses during the four years of study.
- Have a GPA in your major requirements of a 3.5 or higher.
- Complete a senior thesis at a level judged to be sufficiently high by the faculty of the Department of Earth and Planetary Sciences.
- Present the results of the thesis orally in the Department of Earth and Planetary Sciences.

To notify us that you are eligible for honors you must:

1. Obtain an honors checklist by either downloading it from [www.advising.jhu.edu](http://www.advising.jhu.edu) or by picking one up in the Office of Academic Advising.
2. Complete the checklist after February 1 of your senior year and take it to Dr. Naomi E. Levin.
3. Return the signed checklist to the Office of Academic Advising by April 1. You do not need to make an appointment to return the checklist, but it must be signed by the correct representative from your department or it will not be processed.

**Minor in EPS**

The Earth and Planetary Sciences minor is for science undergraduates interested in applying their major discipline to Earth’s environment through geology, geochemistry, ecology, geobiology, oceanography, and atmospheric science. Students are expected to have at least 16 credits in Natural Sciences, Quantitative Studies, or Engineering courses. Students will take 12 credits in the department, at least six of which are at the 300-level.

**Global Environmental Change and Sustainability (GECS) Major**

The major in GECS is an interdepartmental program designed to provide students with a solid knowledge base of the science of the Earth and its living and nonliving systems, as well as how humans interact with Earth and its natural systems, including social science tools of change, such as policy, communication, individual and societal behavior change, and law. Students will be exposed to theory, research, and the practical applications of both throughout their course work. Requirements for the major will include a total of 23 courses (78 credits) if the Science Concentration is chosen and 24 courses (75 credits) for the Social Science Concentration. Because the GECS major is inherently interdisciplinary, students in the GECS major are exempt from the University’s distribution requirements.

All GECS majors must complete 12 “core” courses listed in Table 1 below. Additionally, students will choose either the “Science Concentration” or the “Social Science Concentration” to determine their additional course requirements. For the Science Concentration, majors complete the additional science core courses listed in Table 2 below, 2 additional upper-level courses from Table 3 (Major Electives in Earth and Environmental Science), and 4 courses from Table 4 (Major Electives in Social Sciences), 2 of which must be upper-level. For the Social Science Concentration, majors complete an additional 2 courses from Table 3 (Major Electives in Earth and Environmental Science), at least 1 of which must be upper-level, and 10 courses from Table 4 (Major Electives in Social Sciences), at least 6 of which must be upper level.

All GECS majors must also complete a capstone experience in conjunction with the program director and relevant faculty. The capstone could consist of a research or internship-type project and will be a demonstration of integration and synthesis of knowledge and skills obtained during the 4-year program. Majors are encouraged to begin planning their capstone project during their junior year and must submit a proposal by the end of spring semester of their junior year. Subsequent milestones will be designated throughout the senior year to ensure that all majors are making satisfactory progress on their projects. All majors will make an oral presentation about their project to interested faculty and advisors during spring semester of their senior year and create a poster presentation prior to graduation.

**Honors in GECS Major**

To receive honors in GECS, you must have met the following criteria:

- Have a GPA of a 3.5 or higher in GECS courses.
- Receive an A on your capstone project.

To notify us that you are eligible for honors you must:

1. Obtain an honors checklist by either downloading it from [www.advising.jhu.edu](http://www.advising.jhu.edu) or by picking one up in the Office of Academic Advising.
2. Complete the checklist between February 1 and March 1 of your senior year and take it to Dr. Cindy Parker.
3. Return the signed checklist to the Office of Academic Advising by April 1. You do not need to make an appointment to return the checklist, but it must be signed by the correct representative from your department or it will not be processed.

**Minor in GECS**

The GECS minor consists of seven courses. All minors are required to take two core courses: Intro to Global Environmental Change provides the necessary content about the science of the Earth and its environments and Intro to Sustainability covers a thorough overview of the interactions between humans and the Earth’s systems and how those interactions could become sustainable. Students then have a choice of one of four other science courses that further explore a subset
of interactions of humans with Earth’s living and nonliving systems, depending on the student’s area of interest. Students must choose two more courses from the list of Earth and Environmental Science Electives (Table 3) and two more courses from the list of Social Science Electives (Table 4). At least one course from each elective list must be upper level. A total of five Earth and Environmental Science courses provide the science basis of the minor, which is then rounded out with two relevant Social Science courses. Because students will be acquiring the methodological tools of their major discipline, this curriculum removes the science methodology required in the GECS major, while keeping the most important core content.

Check the GECS major/minor web pages for latest information.

**Table 1: Required Courses for all GECS Majors**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.270.103</td>
<td>Introduction to Global Environmental Change</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.107</td>
<td>Introduction to Sustainability</td>
<td>3</td>
</tr>
<tr>
<td>AS.030.101</td>
<td>Introductory Chemistry I &amp; Introductory Chemistry Lab I</td>
<td>4</td>
</tr>
<tr>
<td>AS.110.106</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>or AS.110.108</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>AS.180.102</td>
<td>Elements of Microeconomics</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.501</td>
<td>Independent Study</td>
<td>3</td>
</tr>
</tbody>
</table>

Select one of the following:

- EN.550.111 Statistical Analysis I
- EN.550.113 Statistics Through Case Study
- AS.280.345 Public Health Biostatistics
- AS.230.205 Introduction to Social Statistics

Select two of the following:

- AS.190.102 Introduction To Comparative Politics
- AS.190.209 Contemp Int’l Politics
- AS.190.211 Intro Political Econ I
- AS.190.213 International Politics

Select two of the following:

- AS.270.305 Energy Resources in the Modern World
- AS.270.308 Population/Community Ecology
- AS.270.360 Climate Change: Science & Policy
- AS.270.335 Planets, Life and the Universe

Select one of the following:

- AS.200.101 Introduction to Psychology
- AS.200.133 Introduction to Social Psychology
- AS.230.101 Introduction Sociology
- AS.230.150 Issues in International Development

**Table 2: Science Track Core Course**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.110.107</td>
<td>Calculus II (For Biological and Social Science)</td>
<td>4</td>
</tr>
<tr>
<td>or AS.110.109</td>
<td>Calculus II (For Physical Sciences and Engineering)</td>
<td>3</td>
</tr>
<tr>
<td>AS.030.102</td>
<td>Introductory Chemistry II &amp; Introductory Chemistry Laboratory II</td>
<td>3</td>
</tr>
</tbody>
</table>

Select one of the following:

- AS.250.205 Introduction to Computing
- AS.270.205 Introduction to Geographic Information Systems and Geospatial Analysis
- AS.270.307 Geoscience Modelling

**Table 3: GECS Electives in Earth and Environmental Science**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.250.205</td>
<td>Introduction to Computing</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.104</td>
<td>History of the Earth and its Biota</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.205</td>
<td>Introduction to Geographic Information Systems and Geospatial Analysis</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.210</td>
<td>Environmental Field Methods</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.220</td>
<td>The Dynamic Earth: An Introduction to Geology</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.221</td>
<td>Lab Dynamic Earth</td>
<td>2</td>
</tr>
<tr>
<td>AS.270.305</td>
<td>Energy Resources in the Modern World</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.108</td>
<td>Oceans + Atmospheres</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.307</td>
<td>Geoscience Modelling</td>
<td>4</td>
</tr>
<tr>
<td>AS.270.308</td>
<td>Population/Community Ecology</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.311</td>
<td>Geobiology</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.315</td>
<td>Natural Catastrophes</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.318</td>
<td>Remote Sensing of the Environment</td>
<td>4</td>
</tr>
<tr>
<td>AS.270.322</td>
<td>GECS Fieldwork in Ecuador</td>
<td>4</td>
</tr>
<tr>
<td>AS.270.332</td>
<td>Soil Ecology</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.360</td>
<td>Climate Change: Science &amp; Policy</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.369</td>
<td>Geochem Earth/Environment</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.377</td>
<td>Climates Of The Past</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.378</td>
<td>Present &amp; Future Climate</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.405</td>
<td>Modeling the Hydrological Cycle</td>
<td>3</td>
</tr>
<tr>
<td>AS.280.335</td>
<td>The Environment and Your Health</td>
<td>3</td>
</tr>
<tr>
<td>AS.360.236</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>AS.420.633</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>EN.570.108</td>
<td>Introduction Environmental Engineering</td>
<td>3</td>
</tr>
<tr>
<td>EN.570.239</td>
<td>Emerging Environmental Issues</td>
<td>3</td>
</tr>
<tr>
<td>EN.570.328</td>
<td>Geography &amp; Ecology of Plants</td>
<td>3</td>
</tr>
<tr>
<td>EN.570.353</td>
<td>Hydrology</td>
<td>3</td>
</tr>
<tr>
<td>EN.570.395</td>
<td>Principles of Estuarine Environment: Chesapeake Bay</td>
<td>3</td>
</tr>
<tr>
<td>EN.570.403</td>
<td>Ecology</td>
<td>3</td>
</tr>
<tr>
<td>EN.570.411</td>
<td>Engineering Microbiology</td>
<td>4</td>
</tr>
<tr>
<td>EN.570.423</td>
<td>Principles of Geomorphology</td>
<td>4</td>
</tr>
<tr>
<td>EN.570.443</td>
<td>Aquatic Chemistry</td>
<td>3</td>
</tr>
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</table>
Table 4: GECS Electives in Social Sciences

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.070.132</td>
<td>Invitation to Anthropology</td>
<td>3</td>
</tr>
<tr>
<td>AS.070.219</td>
<td>Anthropology &amp; Public Action</td>
<td>3</td>
</tr>
<tr>
<td>AS.070.265</td>
<td>Anthropology of Media</td>
<td>3</td>
</tr>
<tr>
<td>AS.070.285</td>
<td>Understanding Aid: Anthropological Perspectives</td>
<td>3</td>
</tr>
<tr>
<td>AS.070.327</td>
<td>Poverty’s Life: Anthropology of Health &amp; Economy</td>
<td>3</td>
</tr>
<tr>
<td>AS.130.177</td>
<td>World Prehistory</td>
<td>3</td>
</tr>
<tr>
<td>AS.140.302</td>
<td>Rise of Modern Science</td>
<td>3</td>
</tr>
<tr>
<td>AS.140.311</td>
<td>Ecology, Health, and the Environment</td>
<td>3</td>
</tr>
<tr>
<td>AS.180.101</td>
<td>Elements of Macroeconomics</td>
<td>3</td>
</tr>
<tr>
<td>AS.180.215</td>
<td>Game Theory and the Social Sciences</td>
<td>3</td>
</tr>
<tr>
<td>AS.180.228</td>
<td>Economic Development</td>
<td>3</td>
</tr>
<tr>
<td>AS.180.241</td>
<td>International Trade</td>
<td>3</td>
</tr>
<tr>
<td>AS.180.252</td>
<td>Economics of Discrimination</td>
<td>3</td>
</tr>
<tr>
<td>AS.180.266</td>
<td>Financial Markets and Institutions</td>
<td>3</td>
</tr>
<tr>
<td>AS.180.301</td>
<td>Microeconomic Theory</td>
<td>4</td>
</tr>
<tr>
<td>AS.180.302</td>
<td>Macroeconomic Theory</td>
<td>4</td>
</tr>
<tr>
<td>AS.180.355</td>
<td>Economics of Poverty and Inequality</td>
<td>3</td>
</tr>
<tr>
<td>AS.180.365</td>
<td>Public Finance</td>
<td>3</td>
</tr>
<tr>
<td>AS.190.102</td>
<td>Introduction To Comparative Politics</td>
<td>3</td>
</tr>
<tr>
<td>AS.190.209</td>
<td>Contemp Int'l Politics</td>
<td>3</td>
</tr>
<tr>
<td>AS.190.211</td>
<td>Intro Political Econ I</td>
<td>3</td>
</tr>
<tr>
<td>AS.190.213</td>
<td>International Politics</td>
<td>3</td>
</tr>
<tr>
<td>AS.190.301</td>
<td>Global Political Economy</td>
<td>3</td>
</tr>
<tr>
<td>AS.190.323</td>
<td>Introduction to International Law</td>
<td>3</td>
</tr>
<tr>
<td>AS.190.328</td>
<td>Black Visual Politics</td>
<td>3</td>
</tr>
<tr>
<td>AS.190.405</td>
<td>Food Politics</td>
<td>3</td>
</tr>
<tr>
<td>AS.190.409</td>
<td>Comp/Politics/Social Mov</td>
<td>3</td>
</tr>
<tr>
<td>AS.190.411</td>
<td>Environment and Development in the Third World</td>
<td>3</td>
</tr>
<tr>
<td>AS.190.421</td>
<td>&amp; AS.195.477 Intro To Urban Policy &amp; Urban Policy Internship</td>
<td>6</td>
</tr>
<tr>
<td>AS.200.133</td>
<td>Introduction to Social Psychology</td>
<td>3</td>
</tr>
<tr>
<td>AS.200.205</td>
<td>Motivation</td>
<td>3</td>
</tr>
<tr>
<td>AS.200.343</td>
<td>Psych of Decision Making</td>
<td>3</td>
</tr>
<tr>
<td>AS.220.203</td>
<td>Introduction to Science Writing</td>
<td>3</td>
</tr>
<tr>
<td>AS.230.101</td>
<td>Introduction Sociology</td>
<td>3</td>
</tr>
<tr>
<td>AS.230.150</td>
<td>Issues in International Development</td>
<td>3</td>
</tr>
<tr>
<td>AS.230.213</td>
<td>Social Theory</td>
<td>3</td>
</tr>
<tr>
<td>AS.230.225</td>
<td>Population, Health and Development</td>
<td>3</td>
</tr>
<tr>
<td>AS.230.313</td>
<td>Space, Place, Poverty &amp; Race: Sociological Perspectives on Neighborhoods &amp; Public Housing</td>
<td>3</td>
</tr>
<tr>
<td>AS.230.314</td>
<td>International Development</td>
<td>3</td>
</tr>
<tr>
<td>AS.230.324</td>
<td>Gender and International Development</td>
<td>3</td>
</tr>
<tr>
<td>AS.230.353</td>
<td>Global Social Change</td>
<td>3</td>
</tr>
<tr>
<td>AS.230.354</td>
<td>Trust &amp; Collective Efficacy: Fragile Resources</td>
<td>3</td>
</tr>
<tr>
<td>AS.230.365</td>
<td>Labor and Globalization</td>
<td>3</td>
</tr>
<tr>
<td>AS.420.656</td>
<td>Engineering Microeconomics</td>
<td>3</td>
</tr>
<tr>
<td>EN.570.109</td>
<td>Environment &amp; Society: Towards Sustainability</td>
<td>3</td>
</tr>
<tr>
<td>EN.570.334</td>
<td>Political Ecology</td>
<td>3</td>
</tr>
</tbody>
</table>

** The lists of acceptable Earth and Environmental Science and Social Science Electives will be reviewed and updated annually by the Director, with guidance from the Advisory Committee. Courses no longer taught will be removed, although credit earned for courses that are removed will still count toward GECS major requirements as long as the course was on the list when it was taken, and new courses will be added. Relevant courses not included in the elective list may be able to be substituted for an elective with approval of the Director. Students wishing to make such a substitution should follow the procedure outlined on the major’s website.

B.A./M.S. Option for Johns Hopkins GECS Majors

Undergraduates majoring in Global Environmental Change and Sustainability (GECS) may apply for accelerated status toward an M.S. in Environmental Science and Policy (ESP). These students should declare their intention to pursue the M.S. during their junior year or early in their senior year of undergraduate study by contacting either the undergraduate GECS Director, Cindy Parker (ciparker@jhsph.edu ) or the Associate Director of the ESP Program, David Elbert (elbert@jhu.edu ). GECS students may apply up to three courses taken as undergraduates toward the M.S. in Environmental Science and Policy thereby leaving only seven more courses to complete the M.S. following receipt of their B.A.

Application

GECS students may apply for the B.A./M.S. anytime during the senior year or up to one year following the conferral of their B.A. The application procedure is the same as that of other AAP applicants and details are found online at: http://advanced.jhu.edu/admissions/index.html . Students admitted to the B.A./M.S. program will be assigned a graduate advisor, but will continue to be advised by their GECS advisor for all matters concerning the B.A. degree.

Course Requirements For B.A./M.S.

GECS students will receive two separate degrees and so the requirements of both degrees must be fulfilled. Students may not earn the M.S. degree without completion of the B.A., however, students who do not complete the M.S. retain their B.A. GECS B.A./M.S. students must complete all the requirements of the M.S. in ESP and may opt for either the general ESP degree or a concentration. Up to three courses completed while an undergraduate can count toward the ten courses required for the M.S. Specifically, up to two of the following courses can be used to satisfy the corresponding core course requirements for the M.S. in Environmental Science and Policy.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.270.224</td>
<td>Oceans &amp; Atmospheres</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.308</td>
<td>Population/Community Ecology</td>
<td>3</td>
</tr>
<tr>
<td>AS.270.403</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

(Note that the Environmental Policymaking and Policy Analysis course will be a combined GECS undergraduate and ESP masters class.)

If a student wishes to apply a third course to both their GECS B.A. and their ESP M.S., the course must be approved by the graduate.
advisors and must be at the 300- to 600- level with content germane to environmental science and policy.

**Requirements for Admission**

Applicants must submit transcripts, Graduate Record Examination scores (aptitude exam only), and supporting letters to show their ability to do advanced study. The applicant should have his/her GRE scores, verbal and quantitative aptitude, sent to the department before the January 15 deadline for filing applications for admission.

The department expects applicants for advanced degrees to have completed undergraduate training in the basic sciences and mathematics. Normally this includes mathematics through at least integral calculus and a year’s course each in physics, chemistry, and biology. Further undergraduate study in one or more of these subjects or in mathematics is highly desirable for all programs in the Earth sciences; additional mathematics is essential for geophysics, atmospheric sciences, and dynamical oceanography. Extensive undergraduate work in Earth sciences is not a requirement for admission. If students lack formal training in this area or have deficiencies in the other related sciences, they may be admitted but will have to allow additional time in the graduate program to make up for deficiencies in their preparation.

**Requirements for Advanced Degrees**

Candidates for the Ph.D. must take courses and meet requirements specified by their advisory committee; must pass a comprehensive examination before a departmental committee and an oral examination administered by the Graduate Board of the university; and must submit an acceptable dissertation involving significant original research. A minimum of two consecutive terms registered as a full-time student is required.

The department rarely accepts candidates for the M.A. degree alone, but Ph.D. students can, with the consent of their advisors, complete a program that will qualify them for the M.A. degree at the end of the second year. Candidates for this degree must pass a comprehensive examination before a departmental committee, and must satisfy the residency requirement specified above for the Ph.D. degree. A student’s advisor may require an essay demonstrating research capability.

For further information about graduate study in the Earth and planetary sciences contact the Chair, Department of Earth and Planetary Sciences.

**Fields of Graduate Study and Research**

The department offers numerous graduate fields: sedimentology, geochemistry and petrology, mineralogy and crystallography, paleobiology, solid Earth geophysics, oceanography, atmospheric sciences, and planetary astrophysics. Descriptions of these fields and their various programs are given below.

**Petrology**

Modern research in petrology requires a flexible approach combining thermodynamics, solution chemistry, experimental petrology, and careful field observation. The department offers a broad range of courses that provide a thorough background in these areas and a detailed review of research to date. In addition to the facilities available on campus, those at the Geophysical Laboratory and the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, the Smithsonian Institution, the University of Maryland, and the U.S. Geological Survey in Reston are available to students and faculty through a cooperative arrangement.

The program in mineral igneous-petrology is concerned with the chemistry and physics of the origin and evolution of magma. All aspects of the generation, extraction, ascension, cooling, kinetics of crystallization, convection, differentiation, eruption, and flow are considered in detail. The results of high temperature melting experiments as well as detailed chemical analysis are applied to these problems. A nontraditional approach to petrological problems is emphasized through an analytical treatment of volcanological field work. Students are encouraged to take thermodynamics, fluid mechanics, and heat transfer, in addition to AS.270.690 Igneous Petrology, AS.270.395 Planetary Physics & Chem, AS.270.652 Physics Of Magma, and AS.270.604 Sem:Geophysical Petrology.

The program in metamorphic petrology emphasizes studies of petrogenesis involving field work, chemical, and stable isotope analysis of rocks and minerals, fluid inclusion studies, interpretation of textures and structures, laboratory phase equilibrium studies, and computer modeling of metamorphic processes. Analytical data from mineral assemblages are rigorously interpreted within the framework of chemical thermodynamics and transport theory. All chemical aspects of metamorphism are of concern, including mineral-fluid reactions and reaction mechanisms; the role of heat-rock vs. fluid-rock interaction in driving metamorphism; the scale and mechanism of fluid-rock interaction; major and minor element mobility; pressure-temperature paths followed by rocks during metamorphism; and the interplay between metamorphism and deformation.

**Mineralogy and Crystallography**

An understanding of crystal structure and the subsolidus behavior of minerals is fundamental to the interpretation of many geological phenomena. The program in mineralogy and crystallography stresses the application of crystallographic theory and experimental approaches to petrologically, environmentally, and geophysically relevant mineral systems.

Research in crystal chemistry utilizes X-ray techniques but more strongly emphasizes the application of high-resolution transmission electron microscopy, electron diffraction, and analytical transmission electron microscopy. The electron microscopy laboratory in the Department of Earth and Planetary Sciences is used to investigate the defects and mechanisms of solid-state reactions in minerals, mechanisms of crystal growth, the structures of fine-grained and disordered geological materials, the chemical and structural variations in synthetic run products and the structures of grain boundaries in rocks.

**Geochemistry**

The program in molecular surface geochemistry emphasizes fundamental research in how the Earth’s environment changes because of interactions between natural waters, minerals and rocks, and living organisms. It emphasizes understanding of the chemical reactions at water-electrolyte-mineral-biomolecule interfaces. Students are encouraged to undertake quantitative studies integrating field, laboratory, and theoretical methods that permit a predictive approach to a wide variety of geochemical and biogeochemical processes including weathering and soil formation, life in the oceans, the migration of toxic species in the environment, the binding of medical implants in the human body, and the role of mineral surface reactions in the origin of life.
of life. Collaborative research possibilities are available through joint projects with the geobiology program in the department, and at the Geophysical Laboratory of the Carnegie Institution of Washington.

The program in stable isotope geochemistry focuses on development and application of geochemical tools that allow for reconstruction and understanding of phenomena such as climate, ecology, biogeochemical cycling, tectonics, sedimentation, and metamorphism. Group members work on questions ranging from paleoenvironments of human evolution, history of the Tibetan Plateau and East Asian monsoons, global expansion of savanna grasslands, niche partitioning among fossil mammals, and temperatures of dolomite formation. Students may pursue their own research interests, and are encouraged to become proficient in all aspects of the science, including instrumentation and laboratory methods, fieldwork, theory, and modeling.

Sedimentology Systems

The teaching and research program in sedimentary systems is dedicated to understanding interactions between sediments, organisms, climate and tectonics in the Earth’s past. This program combines sedimentology, paleontology, geochronology, and geochemistry to study Earth history from sedimentary archives. Field and laboratory observations are equally essential to this kind of research, and students are expected to become proficient in both. Through course work and research students should develop literacy in a combination of disciplines, which may include but are not limited to stratigraphy, geochemistry, paleontology, ecology, geomorphology, geochronology, soil science, and meteorology. Interdisciplinary interactions are encouraged within the Earth and Planetary Science department and with members of other departments at Hopkins, such as the Department of Geography and Environmental Engineering in the School of Engineering and the Center for Functional Anatomy and Evolution in the Medical School.

Geobiology and Paleoclimatology

Research emphases within this discipline include soil ecology, soil formation, biophysics, plant-soil-animal interactions, biogeochemical cycling, paleoecology, and paleoclimatology. Methods of stable isotope geochemistry are used to investigate changes in the cycling of C, H, N, and O through Earth history. Students are invited to participate in ongoing collaborations with the Baltimore Ecosystem Study (Long-Term Ecological Research Site), Smithsonian Environmental Research Center, or to design an original research project under the advisement of our faculty. Instrumentation in the Department of Earth and Planetary Sciences includes stable isotope mass spectrometry, scanning electron microscopy, microprobe and transmission electron microscopy; fieldwork is ongoing at several international sites.

All Ph.D. students are expected to have a background of physics, chemistry, calculus, general biology, and sedimentary geology. Deficiencies can be made up in the first semesters at Hopkins. Students take a core program of statistics, Earth history, stable isotope geochemistry, and ecology. In conjunction with the Department of Geography and Environmental Engineering, Earth and Planetary Sciences offers course work opportunities in Aquatic Chemistry, Plant and Animal Ecology, Geobiology, Analytical Environmental Chemistry, and Sedimentary Geochemistry.

Oceans, Atmospheres, and Climate Dynamics

The oceans, atmospheres, and climate dynamics program focuses on the study of physical processes in the oceans and atmosphere, the interaction between the ocean, atmosphere and land surface, and their role in climate. The philosophy underlying the department’s program is a rigorous and thorough background in the physics of fluids and radiation, and their applications to climate and environmental problems, applied mathematics, laboratory experiments, and observations. Problems in radiative transfer and the dynamics of atmospheres and oceans are attacked by theory, laboratory or numerical experiments, and field observations. Johns Hopkins is a member of the University Corporation for Atmospheric Research.

The best preparation for graduate study in this program is an undergraduate degree in physics, applied mathematics, mechanical engineering, or another parent science such as chemistry or geology/geochemistry. Prior course work in fluid dynamics, while highly desirable, is not mandatory to pursue graduate study in this area. It is essential to have a broad background in the parent sciences, specialization in one of them, and at least three years of undergraduate mathematics.

Research in physical oceanography focuses on the processes that maintain the global ocean circulation and the ocean’s role in climate and global biogeochemical cycling. In particular, attention is on the role of waves, eddies, and small-scale mixing in controlling the ocean’s part in Earth’s heat balance. We also study advection, stirring, and mixing processes in the interior ocean and their roles in dispersing atmospheric trace gases and nutrients.

Research in atmospheric dynamics focuses on large-scale dynamics, the transport of trace constituents, and understanding the composition of the global atmosphere (e.g., distributions of stratospheric ozone and tropospheric water vapor). Current interests include stratospheric vortex dynamics, troposphere-stratosphere couplings, transport and mixing processes, and global modeling of chemical constituents.

Research on climate and radiation includes study of the global climate system and its response to radiative forcing due to changes in greenhouse gases and solar luminosity, the feedback effects of water vapor and clouds, and the radiative and hydrological effects of aerosols. These studies involve global and regional scale modeling, and the analysis and interpretation of satellite observations.

Research on climate also includes studies on the interplay between atmospheric variability and surface processes, including hydrological states and fluxes, human modification of the landscape, and ecosystem activities. This research employs satellite image analysis, numerical modeling, and field observation to build a process-based understanding of the ways in which climate shapes landscape and vice versa. Particular emphasis is devoted to the impact of climate variability on fresh water resources.

A new program of research, combining physical oceanography and atmospheric science, focuses on the role of ocean-atmosphere interactions in the climate of the North Atlantic region. The task is to isolate and understand the predictable mechanisms that govern mid-latitude climate oscillations lasting several years.

A new program of research in global biogeochemical cycling, focuses on applying and developing large-scale computational models that can be combined with observations remotely sensed data to characterize cycling of key elements (including carbon, nitrogen, and oxygen) in the earth system. Opportunities exist to link this work to the observational geochemistry work done in the department as well as to stimulate key periods and transitions in Earth History.
Solid Earth Geophysics

Solid Earth geophysics is the study of our planet’s interior. Our overarching goals are to understand the formation, structure, composition, and dynamics of the Earth as a whole, and their relationship to geological and surface environmental processes today, in the past, and in the future.

Modern geophysics requires an integrated approach that combines geology, solid and fluid mechanics, seismology, gravity, magnetism, and planetology. Students following the geophysics program are therefore encouraged to take advanced mathematics (including numerical modeling), classical physics, solid and fluid mechanics, as well as a broad range of EPS course work that includes geology, geochemistry, geophysics, and planetary science.

Some examples of broad-based geophysics research topics in EPS include study of Earth’s magnetic field, the surface expression of Earth’s “geodynamo,” which is powered by fluid flow in the Earth’s metallic core. Similarly, earthquakes arise from tectonic forces that are ultimately produced by large-scale motions of the Earth’s rocky interior, which moves at rates of a few cm per year. Much of earth’s surface topography, the presence of Earth’s ocean basins, and several physical and geochemical aspects of Earth’s surface environment, are a direct consequence of plate tectonics, which governs the internal dynamics of our planet. Volcanism and magma dynamics are other examples of fundamental processes that shape the Earth and its environment, a study that integrates geology, solid and fluid mechanics, and geochemistry.

Professors Olson and Marsh specialize in study of Earth’s interior and its influence on the surface environment, and Professor Strobel specializes in the study of the other planets, with emphasis on their atmospheres and magnetospheres.

Planetary Atmospheres/Astrophysics

The program in planetary astrophysics emphasizes the study of planetary atmospheres and magnetospheres. A broad range of fundamental problems in atmospheric chemistry, dynamics, physics, and radiation pertinent to the atmospheres of the giant planets and their satellites is addressed with the goal to understand the global structure of composition, pressure, temperature, and winds. The study of magnetospheric plasma interactions with extended satellite atmospheres is focused on the energy balance, ionospheric structure, and radiative output of their upper atmospheres, and the mass loading rates of the parent planets’ magnetospheres. The atmospheres and magnetospheres of the planets are investigated with the aid of theoretical models and the analysis and interpretation of data acquired by ground-based, Hubble Space Telescope, and satellite observations. Professor Strobel is an interdisciplinary scientist on the Cassini/Huygens Mission. An in-depth study of the Saturnian system is being conducted with the Cassini spacecraft and Huygens Probe. He is also a co-investigator on the New Horizons Pluto Kuiper-belt mission, which was successfully launched on January 19, 2006, and will arrive at Pluto in July 2015, after flying by Jupiter during February 2007 and performing observations of the Jovian system.

This research program is closely coordinated with the astrophysics program in the Department of Physics and Astronomy. Students are encouraged to take courses in astrophysics, chemistry, physics, and applied mathematics to gain the comprehensive background necessary for interdisciplinary research. The best undergraduate preparation is a broad background in physics, applied mathematics, and physical chemistry with a minimum of three years of course work in two of these fields. Advanced undergraduate courses in classical mechanics, fluid mechanics, electricity and magnetism, thermodynamics, and quantum mechanics are strongly recommended. The facilities of the Center for Astrophysical Sciences and the Space Telescope Science Institute are available for thesis research.

Financial Aid

The university makes available to the department a number of Gilman Fellowships, which provide for complete payment of tuition, together with Johns Hopkins’ fellowships and graduate assistantships that carry a nine-month stipend. Graduate assistantships cannot require more than 10 hours a week of service to the department, and all recipients of financial aid carry a full program of study. In addition, a number of special and endowed fellowships pay as much or more. In many areas of study, summer support is also available.

Applications for admission to graduate study and financial aid (including all supporting documents and GRE scores) should be submitted to the department before January 15.

For current faculty and contact information go to http://eps.jhu.edu/directory/

Faculty

Chair
Thomas W. N. Haine
physical oceanography.

Professors
John M. Ferry
metamorphic geology.

Bruce D. Marsh
igneous petrology and geophysics.

Peter L. Olson
geophysical fluid dynamics.

Darrell F. Strobel
planetary atmospheres and astrophysics.

Dimitri Sverjensky
molecular surface geochemistry and environmental geochemistry.

David R. Veblen
crystallography.

Darryn W. Waugh
Morton K. Blaustein Professor: atmospheric dynamics.

Associate Professor
Anand Gnanadesikan
biogeochemical oceanography.

Assistant Professors
Naomi Levin
sedimentary geology, stable isotope ecology.

Benjamin H. Passey
geochemistry, paleoecology, paleoclimate.
Benjamin Zaitchik  
climate dynamics, surface hydrology.

Professors Emeriti  
George W. Fisher  
global earth systems and religious ethics.

Lawrence A. Hardie  
geology, geochemistry and sedimentation.

Research/Teaching Faculty  
Albert Arking  
Principal Research Scientist: atmospheric sciences.

Linda Hinnov  
Associate Research Professor: quantitative stratigraphy and paleoclimatology.

Sakiko Olsen  
Senior Lecturer: metamorphic petrology.

Richard Stolarski  
Research Professor: atmospheric chemistry.

Katalin Szlavecz  
Associate Research Professor: soil ecology.

Joint Appointments  
Olivier Barnouin  
Assistant Research Professor: Applied Physics Laboratory.

Carlos E. Del Castillo  
Assistant Research Professor: Applied Physics Laboratory.

Robert A. Dalrymple  
Professor, Civil Engineering.

Jocelyne DiRuggiero  
Associate Research Professor, Biology.

Seth Guikema  
Assistant Professor, Geography and Environmental Engineering.

Michael Harrower  
Assistant Professor, Near Eastern Studies.

Kevin J. Hemker  
Professor, Mechanical Engineering.

Takeru Igusa  
Professor, Civil Engineering.

Cindy L. Parker  
Assistant Professor: Environmental Health Sciences.

James Roberts  
Assistant Research Professor: Applied Physics Laboratory.

Kenneth Rose  
Professor, Functional Anatomy and Evolution.

David Weishampel  
Professor, Functional Anatomy and Evolution.

Peter Wilcock  
Professor, Geography and Environmental Engineering.

For current course information and registration go to https://isis.jhu.edu/classes/

Courses  

AS.270.102. Conversations with the Earth. 2 Credits.  
A discussion of current topics on Earth’s origin, evolution, and habitability. Topics will include extinction of life from meteorite impact, global warming, ozone depletion, volcanism, ice ages, and catastrophic floods, among others. Freshmen only. Sec. 01: 2 credits (normal participation) Sec. 02: 3 credits (requires term paper)  
Instructor(s): B. Marsh  
Area: Natural Sciences.

AS.270.103. Introduction to Global Environmental Change. 3 Credits.  
A broad survey of the Earth as a planet, with emphasis on the processes that control global changes. Topics include: the structure, formation, and evolution of the Earth, the atmosphere, oceans, continents, and biosphere. Special attention is given to present-day issues, such as global climate change, natural hazards, air pollution, resource depletion, human population growth, habitat destruction, and loss of biodiversity. Open to all undergraduates.  
Instructor(s): B. Passey; D. Waugh  
Area: Natural Sciences.

AS.270.104. History of the Earth and its Biota. 3 Credits.  
Instructor(s): L. Hinnov  
Area: Natural Sciences.

AS.270.107. Introduction to Sustainability. 3 Credits.  
Will introduce interactions between global environment and humans, discuss meaning of sustainability, and introduce use of tools to attain sustainability such as policy, law, communication, marketing, research, advocacy, international treaties.  
Instructor(s): C. Parker  
Area: Natural Sciences.

AS.270.108. Oceans + Atmospheres. 3 Credits.  
This course is a broad survey of the Earth’s atmosphere and oceans, and their role in the environment and climate. Topics include: weather systems, atmosphere and ocean circulation, hurricanes and tornadoes, and global warming.  
Instructor(s): A. Gnanadesikan; T. Haine  
Area: Natural Sciences.

AS.270.110. Freshman Seminar: Sustainable + Non-Sustainable Resources. 1 Credit.  
An introduction to the important resources involved in the origin and production of oil, natural gas, coal, cement, metals and geothermal fluids.  
Instructor(s): D. Sverjensky  
Area: Natural Sciences.

AS.270.113. Freshman Seminar: Environmental Poisons. 1 Credit.  
An exploration of the occurrence and potential effects of poisons in the environment, from naturally occurring ones such as arsenic to those that may be introduced by mankind such as nuclear waste.  
Instructor(s): D. Sverjensky  
Area: Natural Sciences.
AS.270.114. Guided Tour: The Planets. 3 Credits.
An introduction to planetary science and planetary exploration primarily for non-science majors. A survey of concepts from astronomy, chemistry, geology, and physics applied to the study of the solar system.
Instructor(s): B. Marsh; D. Strobel
Area: Natural Sciences.

AS.270.201. Dinosaurs. 3 Credits.
This course covers all of the major groups of dinosaurs, from Triceratops to T. Rex and their relatives living, today birds. It will also cover the origins of the group, their near demise 65 million years ago, their behavior, growth and development, and a history of their study.
Instructor(s): D. Weishampel
Area: Natural Sciences.

AS.270.220. The Dynamic Earth: An Introduction to Geology. 3 Credits.
Basic concepts in geology, including plate tectonics; Earth’s internal structure; geologic time; minerals; formation of igneous, sedimentary, and metamorphic rocks; development of faults, folds and earthquakes; geomagnetism. Corequisite (for EPS Majors): AS.270.221; optional for others.
Prerequisites: AS.030.101 OR ( AS.171.101 AND AS.171.102 ) or equivalent
Instructor(s): D. Veblen; J. Ferry
Area: Natural Sciences.

AS.270.221. Lab Dynamic Earth. 2 Credits.
This course is a hands-on learning experience for introductory geological concepts and techniques using geological tools, such as mineral/rock samples, microscopes, and maps. Field trips are its essential part. Corequisite: AS.270.220
Instructor(s): S. Olsen
Area: Natural Sciences.

AS.270.222. Earth Materials. 4 Credits.
An introduction to the properties, occurrence, and origin of the basic constituents of the Earth, including minerals and rocks. Introductory training in the recognition of minerals and rocks in the laboratory and the field.
Instructor(s): D. Veblen; J. Ferry
Area: Natural Sciences.

AS.270.223. Intro To Oceanography. 3 Credits.
Area: Natural Sciences.

AS.270.224. Oceans & Atmospheres. 3 Credits.
In the environment and climate. Topics covered include waves, tides, ocean and atmosphere circulation, weather systems, tornadoes and hurricanes, El Niño, and climate change. For science and engineering majors
Instructor(s): A. Gnanadesikan; T. Haine
Area: Natural Sciences.

AS.270.251. Introduction to Geographic Information Systems and Geospatial Analysis. 3 Credits.
The course provides a broad introduction to the principles and practice of Geographic Information Systems (GIS) and related tools of Geospatial Analysis. Topics will include history of GIS, GIS data structures, data acquisition and merging, database management, spatial analysis, and GIS applications. In addition, students will get hands-on experience working with GIS software.
Instructor(s): X. Chen
Area: Engineering, Natural Sciences.

AS.270.270. Environmental Field Methods. 3 Credits.
This course is designed to introduce students to field based environmental research with a focus on the ecology and geochemistry of the surface and sub-surface environment. Field activities will center around soils and the carbon cycle in the riparian ecosystem adjacent to the Homewood campus and on the urban ecology of the greater Baltimore region. Students will build skills in data collection, analysis and synthesis. Outdoor fieldwork is an essential part of the course.
Prerequisites: AS.270.103 OR AS.270.220.
Instructor(s): K. Szlavecz; N. Levin
Area: Natural Sciences.
AS.270.307. Geoscience Modelling. 4 Credits.
An introduction to modern ways to interpret observations in the context of a conceptual model. Topics include model building, hypothesis testing, and inverse methods. Practical examples from geophysics, engineering, and medical physics will be featured.
Instructor(s): T. Haine
Area: Natural Sciences.

AS.270.308. Population/Community Ecology. 3 Credits.
This course explores the distribution and abundance of organisms and their interactions. Topics include dynamics and regulation of populations, population interactions (competition, predation, mutualism, parasitism, herbivory), biodiversity, organization of equilibrium and non-equilibrium communities, energy flow, and nutrient cycles in ecosystems. Field trip included.
Prerequisites: AS.270.103 or permission of instructor
Instructor(s): K. Szlavecz
Area: Natural Sciences.

AS.270.309. Designing Sustainable Wellness. 3 Credits.
Limited to juniors, seniors and graduate students. Otherwise permission of instructor. This project-based course will explore and re-imagine interdisciplinary conceptual frameworks aimed at promoting “sustainable wellness” (the convergence of social and ecological sustainability) within the built environment (the space, structures and systems humans generate for living, working and playing). Beginning with a conceptual overview of sustainability, the science of happiness, and design/planning principles, students will review relevant case studies and complete a final, hands-on, community-based studio project.
Instructor(s): A. Monopolis; C. Parker
Area: Social and Behavioral Sciences.

AS.270.310. Global Environmental Changes & Sustainability Seminar. 3 Credits.
By using guest speakers and published literature, students will investigate sustainability topics in greater depth, taking turns presenting relevant papers and leading a focused discussion about the topic.
Prerequisites: AS.270.103 AND AS.270.107 OR Instructor Permission
Instructor(s): C. Parker
Area: Natural Sciences.

AS.270.311. Geobiology. 3 Credits.
A survey of the interactions between geological and biological processes at and near the Earth’s surface, covering topics such as biogeochemistry and nutrient cycles, soil chemistry, biomarkers, archives of paleobiology, and the evolution of life, with an emphasis on terrestrial systems. Recommended Course Background: AS.270.220
Instructor(s): N. Levin
Area: Natural Sciences.

AS.270.312. Mammalian Evolution. 3 Credits.
An introduction to the evolutionary history and diversity of mammals, with emphasis on the first half of the Cenozoic - the beginning of the Age of Mammals. The course will focus primarily on the adaptive radiation of mammals (including our own order primates) that followed the extinction of the dinosaurs, exploring the origins and relationships of the major groups of mammals as well as the anatomical and ecological reasons for their success. Lectures will be supplemented with relevant fossils and recent specimens.
Instructor(s): K. Rose
Area: Natural Sciences.

AS.270.313. Isotope Geochemistry. 3 Credits.
Instructor(s): B. Passey
Area: Natural Sciences.

AS.270.314. Planetary Tectonics and Geodynamics. 3 Credits.
Fundamental physical processes relevant to interiors of terrestrial planets and icy satellites. Topics include: stress and strain; elasticity and flexure; rheology; internal structure; thermal evolution; fluid mechanics; tectonics; and faulting. Recommended Course Background: AS.110.108-AS.110.109 or equivalent; AS.171.101 or AS.171.105 or equivalent; AS.110.202 or equivalent.
Instructor(s): J. Roberts; O. Barnouin
Area: Natural Sciences.

AS.270.315. Natural Catastrophes. 3 Credits.
A survey of naturally occurring catastrophic phenomena, with emphasis on the underlying physical processes. Topics include hurricanes, tornadoes, lightning, earthquakes, tsunamis, landslides, and volcanic eruptions and climate change. Intended for students in science and engineering.
Instructor(s): P. Olson
Area: Natural Sciences.

AS.270.318. Remote Sensing of the Environment. 4 Credits.
This course is an introduction to the use of remote sensing technology to study Earth’s physical and biochemical processes. Topics covered include remote sensing of the atmosphere, land and oceans, as well as remote sensing as a tool for policy makers. Also offered as 270.618
Instructor(s): B. Zaitchik
Area: Natural Sciences.

AS.270.320. The Environment and Your Health. 3 Credits.
This course surveys the basic environmental health sciences (toxicology, risk assessment), current public health issues (hazardous waste, radon, water-borne diseases) and emerging global health threats (global warming, ozone depletion, sustainability).
Instructor(s): M. Trush
Area: Natural Sciences.

AS.270.322. GECS Fieldwork in Ecuador. 4 Credits.
Course will provide theory and hands-on practice of environmental science and social science fieldwork.
Prerequisites: AS.270.103 and AS.270.107 AND consent of instructor. GECS majors only.
Instructor(s): C. Parker
Area: Natural Sciences.

AS.270.323. Ocean Biogeochemical Cycles. 3 Credits.
This course will examine the cycling of trace chemicals in the ocean, consider what we can learn from the distributions of these chemicals about the ocean circulation, and ocean ecosystems. Topics covered will include oceanic biological productivity, open water cycling of nutrients and oxygen, ocean acidification and sediment cycling.
Instructor(s): A. Gnanadesikan
Area: Natural Sciences.
AS.270.325. Introductory Oceanography. 3 Credits.
This class is an introduction to a wide range of physical, chemical, and biological phenomena in the world's oceans. Underlying basic principles are exposed wherever possible. Topics covered include: seawater, waves, tides, ocean circulation, chemical oceanography, biogeochemical ocean processes, and remote sensing of the oceans. Recommended Course Background: freshman Physics, Chemistry, Calculus through ordinary differential equations.
Instructor(s): A. Ganadesikan; T. Haine
Area: Natural Sciences.

AS.270.330. Atmospheric Chemistry. 3 Credits.
This course will examine the structure and composition of the atmosphere and the processes that determine how the composition has changed in the past and might change in the future. Emphasis will be on the chemistry of the stratospheric ozone layer. The chemistry of the troposphere and air pollution will also be covered. Prerequisites: AS.110.106 Calculus I and AS.110.109 Calculus II
Instructor(s): R. Stolarski
Area: Natural Sciences.

AS.270.332. Soil Ecology. 3 Credits.
The course introduces basic aspects of cycles and flows in the soil ecosystem, and provides students with an overview of the higher groups of soil organisms. Laboratory and field surveying methods are also covered.
Instructor(s): K. Szlavecz
Area: Natural Sciences.

AS.270.335. Planets, Life and the Universe. 3 Credits.
This multidisciplinary course explores the origins of life, planets' formation, Earth's evolution, extrasolar planets, habitable zones, life in extreme environments, the search for life in the Universe, space missions, and planetary protection.
Prerequisites: Students may not register for this class if they have already received credit for AS.171.333 or AS.020.334.
Instructor(s): C. Norman; J. Diruggiero; N. Levin
Area: Natural Sciences.

AS.270.340. Nature of the Solid Planets. 3 Credits.
The overall origin and evolution of the terrestrial-like planets in the Solar System is discussed and analyzed. As a starting point the detailed structure and dynamics of Earth is presented from the perspectives of seismology, gravity, geomagnetism, and volcanism. Extensions are also made to the origin, structure, and present state of the moons of Jupiter and Saturn and other icy bodies. Recommended Course Background: calculus through differential equations, physics, and chemistry, some grounding in Earth and/or Planetary Sciences.
Instructor(s): B. Marsh
Area: Natural Sciences.

AS.270.350. Sedimentary Geology. 4 Credits.
Introduction to sedimentary processes and sedimentary rocks. Focus is placed on linking physical observations to earth surface processes. Fundamental tools for interpreting the sedimentary rock record, such as depositional models, geochronology, and chemostratigraphy are reviewed. Weekend field trips. Graduate and advanced undergraduate level. Recommended Course Background: AS.270.220 or instructor permission.
Instructor(s): N. Levin
Area: Natural Sciences.

AS.270.360. Climate Change: Science & Policy. 3 Credits.
This course will investigate the policy and scientific debate over global warming. It will review the current state of scientific knowledge about climate change, examine the potential impacts and implications of climate change, explore our options for responding to climate change, and discuss the present political debate over global warming.
Prerequisites: AS.270.103 or permission
Instructor(s): B. Zaitchik
Area: Natural Sciences.

AS.270.369. Geochem Earth/Environment. 3 Credits.
An introduction to all aspects of Geochemistry: theoretical, experimental, and observational, including the application of geochemistry to issues such as the migration of toxic metals and nuclear waste.
Instructor(s): D. Sverjensky
Area: Natural Sciences.

AS.270.377. Climates Of The Past. 3 Credits.
Earth's climate history through study of forcing mechanisms, climate proxies, and paleoclimate modeling. Presentation of climate-sensitive archives will be followed by discussion of geochemical principles, climates through time, recent advances and emerging problems. For upper-level undergraduate and graduate students in the natural sciences. Recommended Courses Background: AS.270.220 or instructor permission.
Instructor(s): L. Hinno
Area: Natural Sciences.

AS.270.378. Present & Future Climate. 3 Credits.
Intended for majors who are interested in the science that underlies the current debate on global warming, the focus is on recent observations one can glean from model simulations. Meets with AS.270.641.
Recommended Course Background: AS.110.108-AS.110.109 and AS.171.101-AS.171.102
Instructor(s): B. Zaitchik; D. Waugh
Area: Natural Sciences.

AS.270.395. Planetary Physics & Chem. 3 Credits.
The fundamental principles governing the dynamic processes within and around the planets are treated in some detail. Core equations are developed and used to analyze nebula condensation, planetary accretion, convection in mantles and atmospheres, radiative and conductive heat transport, seismic waves, hurricanes, volcanism, and meteorite impacts, among others. Emphasis is on fundamentals and problem solving.
Prerequisites: AS.030.101; AS.171.101-102 or 103-104 or 105-106.
Instructor(s): B. Marsh; D. Strobel
Area: Natural Sciences.

AS.270.402. Scientific Survival Skills. 1 Credit.
Transitioning from graduate school to a postdoc to a "permanent" job in the natural sciences requires a set of essential skills that are not covered as a formal component of most Ph.D. programs. This seminar will be a weekly discussion of career issues relevant to new scientists. Topics will include elements of good presentations, conferences, scientific writing and peer-review, employment trends, job interviews, and grant proposals. The class will conclude with a mock grant proposal review panel, conducted by the students. This seminar is aimed at graduate and advanced undergraduate students in the natural sciences planning careers in academia or industry.
Instructor(s): J. Roberts
Area: Natural Sciences.
AS.270.405. Modeling the Hydrological Cycle. 3 Credits.
Survey of modeling techniques for hydrological monitoring, analysis and prediction, including applied exercises with commonly used models. Topics include the terrestrial water balance, rivers and floods, groundwater, atmospheric transport, and precipitation processes. Focus is on numerical methods applicable at the large watershed to global scale.
Instructor(s): B. Zaitchik.

AS.270.407. Seminar in Planetary Sciences. 1 Credit.
Instructor(s): B. Marsh; O. Barnouin
Area: Natural Sciences.

AS.270.410. Planetary Surface Processes. 3 Credits.
Instructor(s): J. Roberts; O. Barnouin
Area: Natural Sciences.

AS.270.415. Climate Change Discussions. 2 Credits.
Discussion of current topics in climate change science. Open to Graduate students & Advanced Undergraduates. Instructor Permission.
Instructor(s): B. Zaitchik
Area: Natural Sciences.

AS.270.425. Earth & Planetary Fluids. 3 Credits.
An introductory course on the properties, flow, and transport characteristics of fluids throughout the Earth and planets. Topics covered include: constitutive relationships, fluid rheology, hydrostatics, dimensional analysis, low Reynolds number flow, porous media, waves, stratified and rotating fluids, plus heat, mass, and tracer transport. Illustrative examples and problems are drawn from the atmosphere, ocean, crust, mantle, and core of the Earth and other Planets. Open to graduate and advanced undergraduate students. Recommended Course Background: Basic Physics, Calculus, and familiarity with ordinary differential equations.
Instructor(s): P. Olson
Area: Natural Sciences.

AS.270.495. Senior Thesis.
Preparation of a substantial thesis based upon independent student research, supervised by at least one faculty member in Earth and Planetary Sciences. Open to Sr. departmental majors only. Required for department honors.
Instructor(s): B. Passey; D. Waugh
Area: Natural Sciences
Writing Intensive.

AS.270.496. Senior Thesis. 4 Credits.
Preparation of a substantial thesis based upon independent student research, supervised by at least one faculty member in Earth and Planetary Sciences. Open to Sr. departmental majors only. Required for department honors.
Instructor(s): B. Passey; T. Haine
Writing Intensive.

AS.270.501. Independent Study. 3 Credits.
An independent course of study may be pursued under the direction of an adviser on those topics not specifically listed in the form of regular courses.
Instructor(s): B. Marsh; C. Parker; D. Waugh; K. Szlavecz; Staff.

AS.270.502. Independent Study. 0 - 3 Credit.
Instructor(s): B. Marsh; C. Parker; D. Sverjensky; Staff.

AS.270.503. Independent Research. 3 Credits.
Instructor(s): B. Marsh; B. Zaitchik; G. Ball.

AS.270.504. Independent Research. 0 - 3 Credit.
Research under the direction of members of the Earth & Planetary Sciences Faculty.
Instructor(s): B. Passey; B. Zaitchik; L. Hinnoy.

AS.270.505. GECS Senior Capstone Seminar. 3 Credits.
The GECS Senior Capstone Seminar will provide the intellectual time and space to bring together the knowledge and tools acquired during the four years of interdisciplinary work on the GECS curriculum into a coherent framework in preparation for careers, and/or graduate work. In addition to the culmination of the capstone project, final paper, and presentations, students will look at relevant current events through the lenses of science, social science and the humanities, and engage in in-depth readings and discussion of these issues.
Instructor(s): C. Parker.

AS.270.507. Internship. 1 Credit.
Instructor(s): C. Parker.

AS.270.508. Internship. 0 - 3 Credit.
Instructor(s): A. Monopolis; C. Parker; Staff.

AS.270.595. Internship. 1 Credit.
Instructor(s): C. Parker; D. Sverjensky; D. Veblen.

AS.270.599. Independent Study. 3 Credits.
Instructor(s): A. Monopolis; B. Marsh; D. Sverjensky; K. Szlavecz; S. Stanley.

AS.270.601. Fluids Seminar.
Graduate discussion group ranging over all aspects of fluids in Earth and planetary sciences. Area: Natural Sciences.

AS.270.602. Graduate Independent Study.
Instructor(s): B. Marsh.

AS.270.603. Geochemistry Seminar.
A variety of topics of current interest involving mineral-fluid interactions will be reviewed.
Instructor(s): D. Sverjensky.

AS.270.604. Sem:Geophysical Petrology.
Discussion of present research topics in geophysics and igneous petrology.
Instructor(s): B. Marsh.

AS.270.605. EPS Colloquium.
A weekly seminar series in which graduate students present their latest research results and attend Departmental seminars. This course is required for all graduate students in the Department of Earth and Planetary Sciences.
Instructor(s): T. Wright.

AS.270.606. EPS Colloquium.
A weekly seminar series in which graduate students present their latest research results and attend Departmental seminars. This course is required for all graduate students in the Department of Earth and Planetary Sciences.
Instructor(s): T. Wright.

AS.270.607. Topics in African Climate.
Advanced research seminar on atmospheric dynamics, climate processes, and hydrology of the African continent.
Instructor(s): B. Zaitchik; N. Levin.

AS.270.608. Sem Atmospheric Sciences.
Discussion of current research topics in atmospheric science. Area: Natural Sciences.
AS.270.610. Climate Modeling and Analysis.
Instructor(s): A. Arking
Area: Natural Sciences.

AS.270.611. Global Atmospheric Dynamics.
This course will examine the fluid dynamics that determine large-scale atmospheric circulation and variability using Ian James’ “Introduction to Circulating Atmospheres.” Topics covered will include the dynamics of Hadley cells, mid-latitude jets, baroclinic instability, monsoon circulations, and low-frequency variability of the circulation.
Instructor(s): A. Gnanadesikan.

Transitioning from graduate school to a postdoc to a “permanent” job in the natural sciences requires a set of essential skills that are not covered as a formal component of most Ph.D. programs. This seminar will be a weekly discussion of career issues relevant to new scientists. Topics will include elements of good presentations, conferences, scientific writing and peer-review, employment trends, job interviews, and grant proposals. The class will conclude with a mock grant proposal review panel, conducted by the students. This seminar is aimed at graduate and advanced undergraduate students in the natural sciences planning careers in academia or industry.
Instructor(s): J. Roberts.

AS.270.615. Inversion Modeling & Data Assimilation.
This graduate class will introduce modern inverse modeling and data assimilation techniques. These powerful methods are used in atmospheric science, oceanography, and geophysics and are growing more widespread. Topics will include: singular value decomposition, Green’s function inversions, Kalman filtering, and variational data assimilation. The class will include lectures on concepts and theory, and practical experience in the computer laboratory. Permission of Instructor Required
Instructor(s): T. Haine.

AS.270.616. Geodesy, Gravity, and Tides.
Introduces physical geodesy problems, and the interpretation of geoid and gravity anomalies on Earth and other planets. Covers potential theory, measurement techniques from surface and spacecraft, planetary rotation, and tides. Recommended: AS.110.301 or EN.550.291 (or equivalent)
Prerequisites: (AS.110.202 OR AS.110.211 or equivalent) AND (AS.171.101 OR AS.171.105 or equivalent)
Instructor(s): J. Roberts
Area: Natural Sciences.

Also offered as 270.318
Instructor(s): B. Zaitchik
Area: Natural Sciences.

AS.270.620. Seminar in Geophysical Turbulence and Transport.
This course introduces students to the concept of geophysical turbulence and its ability to describe certain aspects of ocean and atmosphere dynamics and associated transport processes. It covers the phenomenology of turbulence, Kolmogorov scaling, 2d turbulence, stratified geostrophic turbulence, coherent structures, as well as the dispersion theory and its application to the study and parametrization of turbulent transport processes. Students are given 3 assignments involving simple calculations based on theoretical exercises as well as processing of real ocean data and ocean model output (drifter data for dispersion, analysis of model fields for identification of vortices by OW and associated fluxes). Interested students should be familiar with the Navier-Stokes equations for fluid flow.
Instructor(s): A. Gnanadesikan; I. Koszaika.

AS.270.621. TEM: Practice and Applications.
A lab and lecture course covering the practical aspects of transmission electron microscopy. Electron diffraction, image formation, and analytical techniques are explained, and students are given an opportunity to gain hands-on microscopy experience. The detailed theory for these experiments is developed in 270.622.
Instructor(s): D. Veblen; K. Hemker.

AS.270.622. TEM: Theory/Understanding.
This course, which follows and complements 270.621, introduces the student to more detailed aspects of kinematical and dynamical theories of electron diffraction. Theory of conventional TEM imaging, phase-contrast imaging (high-resolution electron microscopy), X-ray and energy loss analytical TEM, and computer-based image simulation are included.

AS.270.623. Planetary Atmospheres.
Instructor(s): D. Strobel
Area: Natural Sciences.

Discussion of the physical principles that underlie earth remote sensing. Topics to include radiative transfer in Earth’s atmosphere, operating principles of active and passive remote sensing systems, and advanced methods for image analysis.
Prerequisites: AS.270.318 OR AS.270.618 or permission of instructors.
Instructor(s): B. Zaitchik; C. Del Castillo.

AS.270.625. Seminar in Biogeochemistry.
In-depth exploration of emerging topics in biogeochemistry, including themes relevant to the evolution of Earth’s biogeochemical cycles, global change, paleoecology, and paleoclimate.
Instructor(s): B. Passey
Area: Natural Sciences.

AS.270.626. Ocean General Circulation.
The aim of this course is to achieve conceptual understanding of the large scale low frequency ocean general circulation. The role of the ocean circulation in earth’s climate is emphasized throughout.
Instructor(s): T. Haine.
Discussion of current research topics in soil ecology and biogeochemistry.
Instructor(s): K. Szlavecz; Staff.

Instructor(s): D. Veblen.

AS.270.633. Advanced Topics in Isotopic Geochemistry.
Consent of instructor required in depth exploration of selected systems in stable isotope geochemistry, and examination of the physical basis of stable isotope fractionation. Topics vary annually.
Instructor(s): B. Passey; N. Levin
Area: Natural Sciences.

Instructor(s): D. Veblen.

AS.270.641. Present and Future Climate.
Meets with AS.270.378.
Prerequisites: (AS.110.108 AND AS.110.109) AND (AS.171.101 AND AS.171.102)
Instructor(s): B. Zaitchik; D. Waugh
Area: Natural Sciences.

AS.270.642. Surface Geochemistry.
Instructor(s): D. Sverjensky.

AS.270.644. Physics of Climate Variability.
This course is an advanced-level review of the ways in which climate varies on time scales of seasons to decades, including El Nino, the Pacific Decadal Oscillation, the Indian Ocean Dipole Mode, the North Atlantic Oscillation and others. Topics covered will include, depending on class's interest: 1) Methods for isolating climate modes. (2) Key dynamic and thermodynamic processes involved in causing such fluctuations, including atmospheric and oceanic wave propagation, air-sea interaction and changes in the thermohaline circulation. (3) Impacts of climate modes on biogeochemical cycling, including some that are used by paleoclimatologists to reconstruct past variability. Geophysical understanding and links to fundamental mechanisms are emphasized. Format will consist of a mix of lectures and paper discussions.
Instructor(s): A. Gnanadesikan; N. Levin
Area: Natural Sciences.

AS.270.645. Earth System Modeling.
Introduces students to using comprehensive Earth System Models. Students will learn about how such models are structured and configure experiments with such a model, based on their interests.
Instructor(s): A. Gnanadesikan.

AS.270.647. Earth's Interior.
Mechanical processes in Earth's core and mantle with applications to plate tectonics, the thermal and chemical evolution of the Earth, and generation of Earth's magnetic field.
Instructor(s): P. Olson; Staff.

AS.270.652. Physics Of Magma.
The principles of viscous fluid flow, heat conduction and convection are treated in reference to all aspects of the mechanics of magma. Emphasis is placed on understanding petrologic processes as observed in rocks and rock sequences.
Instructor(s): B. Marsh
Area: Natural Sciences.

AS.270.653. Earth and Planetary Fluids II.
A sequel to AS.270.425 concentrating on planetary-scale atmospheric and oceanic circulation. Physical understanding of the underlying fluid dynamics will be emphasized.
Instructor(s): N. Paldor.

AS.270.661. Planetary Fluid Dynamics.
Recommended Course Background: AS.270.646 or equivalent.
Instructor(s): D. Strobel
Area: Natural Sciences.

Permission of instructor required
Instructor(s): D. Strobel.

Instructor(s): K. Szlavecz
Area: Natural Sciences.

AS.270.673. Time Series-Data Analysis.
Spectral analysis, digital filtering, convolutions, and other techniques for processing data will be covered.

AS.270.681. Advanced Metamorphic Petrology.
The interpretation of metamorphic processes based on mineral assemblages, mineral chemistry, chemical thermodynamics, transport theory, experimental petrology, and field studies. Geothermometry and geobarometry; mineral reactions and reaction mechanisms; heat transfer and fluid transfer; element and isotope mobility; thermal models for orogenic belts.
Prerequisites: AS.270.301
Instructor(s): J. Ferry
Area: Natural Sciences.

AS.270.690. Igneous Petrology.

AS.270.692. Igneous Petrology Lab.
Corequisites : AS.270.690[C]
Instructor(s): B. Marsh.

AS.270.807. Research.
Instructor(s): T. Haine.

AS.270.808. Research.
Instructor(s): T. Haine.

AS.271.107. Introduction to Sustainability. 3 Credits.
Will introduce interactions between global environment and humans, discuss meaning of sustainability, and introduce use of tools to attain sustainability such as policy, law, communication, marketing, research, advocacy, international treaties.
Instructor(s): C. Parker
Area: Natural Sciences.
AS.271.120. Environmental Photojournalism. 3 Credits.

Environmental cognition, consciousness, and communication are produced, reproduced, interpreted, and remembered with the support of visual representations and, in particular, photography. Images increasingly structure our experience of nature, environmental problems, human-environmental relations, and ecological awareness. Students will review critical literature focusing on visual representation theory, the relationship between images and social change, and the history and typology of environmental photography. A basic understanding of modern environmental history, sustainability issues, and environmental problems is required. Students will identify environmental narratives in Baltimore, document their stories through photojournalism, have their images critiqued in class every two weeks, and develop a final documentary project focusing on one particular environmental narrative. This project, active class participation, and a final paper analyzing the images and communication strategies used will make up the final grade for the course. The class is designed with an emphasis on independent research and practice, interdisciplinary analysis, and application. It is geared towards Global Environmental Change and Sustainability, Film & Media Studies, and Writing Seminars majors, in addition to students interested or experienced in photography, film, journalism, psychology, and public health.

Instructor(s): A. Monopolis.

AS.271.309. Designing Sustainable Wellness: the Convergence of Social and Environmental Sustainability within the Built Environment. 3 Credits.

The "built environment" refers to the space, structures, and systems humans generate for living, working, and playing. This includes everything from homes and office buildings, to neighborhoods and cities, to green spaces and parks. It also includes hard infrastructure, such as energy, transportation, and water systems, and soft infrastructure, such as formal human services (e.g. health, education, recreation). More recently, the term has expanded to include conditions related to public health, such as walkability, bikability, and access to healthy foods. This course will examine the conceptual frameworks that support the creation of built environments, assess their impact on environmental and social well-being, and re-imagine methodologies and designs that may better promote "sustainable wellness," or socio-ecological sustainability, in the future. Through case studies and a final design-based project, students will learn and apply the fundamental principles behind socio-ecologically sustainable design. The course is designed with an emphasis on interdisciplinary analysis and systems thinking. The course is geared towards Global Environmental Change and Sustainability majors, in addition to students interested in design, architecture, and urban planning.

Instructor(s): A. Monopolis.

AS.271.360. Climate Change: Science & Policy. 3 Credits.

Prereq: 270.103 or permission of instructor. This course will investigate the policy and scientific debate over global warming. It will review the current state of scientific knowledge about climate change, examine the potential impacts and implications of climate change, explore our options for responding to climate change, and discuss the present political debate over global warming.

Instructor(s): D. Waugh
Area: Natural Sciences.

AS.271.401. Environmental Ethics. 3 Credits.

Environmental Ethics is a philosophical discipline that examines the moral relationship between human beings and the natural environment. Beginning with an analysis of their own values, students will explore complex ethical questions, philosophical paradigms and real-life case studies. Through readings, films, seminar discussions and debates, this course will help students strengthen their ability to communicate viewpoints rooted in ethical principles. Afterwards, students will apply these tools to an examination of contemporary environmental issues, ranging from natural resource depletion, pollution, species extinction, environmental justice, climate change, and overpopulation. This course is geared towards Global Environmental Change & Sustainability and Philosophy majors.

Instructor(s): A. Monopolis.

AS.271.403. Environmental Policymaking and Policy Analysis. 3 Credits.

This course provides students with a broad introduction to US environmental policymaking and policy analysis. Included are a historical perspective as well as an analysis of future policymaking strategies. Students examine the political and legal framework, become familiar with precedent-setting statutes such as NEPA, RCRA, and the Clean Air and Clean Water Acts, and study models for environmental policy analysis. Cost benefit studies, the limits of science in policymaking, and the impact of environmental policies on society are important aspects of this course. A comparison of national and international policymaking is designed to provide students with the proper perspective. This course is taught in conjunction with an identical graduate course. All students will be expected to perform at a graduate level.

Instructor(s): C. Bausch; R. Solomon
Area: Social and Behavioral Sciences.

AS.271.501. Independent Study. 3 Credits.

Instructor(s): A. Monopolis.

AS.271.505. GECS Senior Capstone Seminar. 3 Credits.

The GECS Senior Capstone Seminar will provide the intellectual time and space to bring together the knowledge and tools acquired during the four years of interdisciplinary work on the GECS curriculum into a coherent framework in preparation for careers, and/or graduate work. In addition to the culmination of the capstone project, final paper, and presentations, students will look at relevant current events through the lenses of science, social science and the humanities, and engage in in-depth readings and discussion of these issues.

Instructor(s): A. Monopolis; C. Parker.

Cross Listed Courses

History of Science Technology

AS.140.322. The Heavens and Earth in the History of Astronomy. 3 Credits.

How do we study the stars, and what do they tell us about the earth? In this course, we explore views of the heavens across history, from ancient Greece to international astrophysics. Special emphasis will be given to the ‘new stars’ of 1572 and 1604, whose remnants astronomers at Johns Hopkins University continue to study today. Cross-listed with Earth and Planetary Science, Physics and Astronomy

Instructor(s): P. Boner
Area: Humanities, Social and Behavioral Sciences.
Physics Astronomy

**AS.171.321. Introduction to Space, Science, and Technology. 3 Credits.**
Topics include space astronomy, remote observing of the earth, space physics, planetary exploration, human space flight, space environment, orbits, propulsion, spacecraft design, attitude control and communication. Crosslisted by Departments of Earth and Planetary Sciences, Materials Science and Engineering and Mechanical Engineering. Recommended Course Background: AS.171.101-AS.171.102 or similar; AS.110.108-AS.110.109.
Instructor(s): H. Moos; S. Murray
Area: Engineering, Natural Sciences.

Public Health Studies

**AS.280.335. The Environment and Your Health. 3 Credits.**
This course surveys the basic concepts underlying environmental health sciences (toxicology, exposure assessment, risk assessment), current public health issues (hazardous waste, water- and food-borne diseases), and emerging global health threats (global warming, built environment, ozone depletion, sustainability). Public Health Studies, Global Environmental Change and Stability, and Earth and Planetary Science majors have 1st priority for enrollment. Your enrollment may be withdrawn at the discretion of the instructor if you are not a GECS, PHS, or EPS major.
**Prerequisites:** (Students may not have taken AS.270.320)
Instructor(s): M. Trush
Area: Natural Sciences.