Department of Earth System Science

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949-824-8794
http://www.ess.uci.edu/

Overview
Understanding global environmental issues such as global warming, stratospheric ozone depletion, and worldwide air pollution requires the cooperation of scientists across many fields. Global change is projected to accelerate through the 21st century and will impact the ecosystems that preserve the habitability of the planet. The Department of Earth System Science focuses on the atmosphere, land, and oceans, how these interact as a system, and how the Earth will change over a human lifetime. Earth System Science (ESS) is inherently interdisciplinary in scope, linking oceanography, atmospheric and terrestrial sciences, climatology, hydrology, biology, physics, and chemistry to understand the environment. ESS faculty includes chemists, biologists, ecologists, physicists, hydrologists, geologists, meteorologists, engineers, applied mathematicians, and oceanographers. The wide-ranging expertise of ESS faculty and teaching assistants allows students to learn valuable scientific skills in the classroom, laboratory, and field experiences.

Bachelor of Science in Earth System Science
http://ess.uci.edu/undergrad/bs

Earth System Science is an interdisciplinary field of study that combines oceanography, atmospheric science, meteorology, geography, geology, hydrology, and environmental science. ESS students gain an understanding of how individual aspects of the environment interact, including the influence of humans on this complex system.

Examples of important questions in Earth System Science include, but are not limited to, the influence of atmospheric chemistry on climate and air quality, biological controls on the chemistry of the oceans, and physical controls on atmosphere and ocean circulation.

The Earth System Science (B.S.) program provides students with a fundamental understanding of the oceanographic, atmospheric, and terrestrial sciences. This program of study prepares students for careers in science, research, or technical fields. Students learn to apply basic sciences (physics, chemistry, mathematics, and biology) to understand the major processes and systems governing the Earth’s climate, biogeochemical cycles, and global change. Central to the B.S. program is an understanding of relevant scientific literature, methods to collect/analyze data, and interpret results in the context of scientific theory. Students will learn to work collaboratively to understand and address complex problems and communicate scientific knowledge.

Through the core course work, students will learn to explain the current and projected future state of the Earth system in the context of past climate change and current human activities. Once the core course work is complete, students are encouraged to focus on a particular area within Earth System Science and to choose electives that build a coherent core of knowledge. Focus areas include but are not limited to climatology, biogeochemical cycles, oceanography, hydrology, terrestrial sciences, and atmospheric sciences. Optional specializations are available in Atmospheric Science, Hydrology and Terrestrial Ecosystems, and Oceanography.

Earth System Science students are encouraged to become directly involved in research. The Department provides excellent opportunities to learn from and work with recognized experts in the field, while fulfilling degree requirements. EARTHSS 198W may satisfy Department and UCI upper-division writing requirements.

Careers for the Earth System Science Major
Some students go on to graduate school in physical sciences, engineering, or related areas. Others begin careers as research scientists in academic, public, or private institutions (may require a graduate-level degree). Options that may be available are scientist positions in the following roles: environmental policy and planning, environmental consulting, air quality monitoring and assessment, laboratory analysis, scientific research, science education, natural resource management, wildlife management, conservation and environmental protection, and water resource management.

Special Programs
Earth System Science Honors Program. In the year-long honors course sequence, students admitted into the ESS Honors Program pursue research with faculty in the Department, and prepare a written thesis of their work. Visit the Earth System Science Honors Program website (http://www.ess.uci.edu) for more information.

Teaching Certification. Earth System Science students interested in teaching careers can earn a bachelor’s degree concurrently with a California Preliminary Single Subject Teaching Credential. See the Concentration in Geosciences Education with Secondary Teaching Certification section below for more information.
**Admission to the Earth System Science Major**

Students may be admitted to the Earth System Science major upon entering the University as freshmen, via change of major, or as transfer students from other colleges and universities. Information about change of major policies is available in the Physical Sciences Student Affairs Office and at the UCI Change of Major Criteria website (http://www.changeofmajor.uci.edu). For transfer student admission, preference will be given to junior-level applicants with the highest grades overall and who have satisfactorily completed the following required courses: one year of approved calculus and one year of *either* general chemistry with laboratory (preferred) or one-year of calculus-based physics with laboratory.

**NOTE:** The major is open to all students except Environmental Science majors and Earth and Atmospheric Sciences minors.

**Requirements for the B.S. in Earth System Science (including optional Specializations and a Concentration)**

All students must meet the University Requirements.

**School Requirements:** None.

**Major Requirements**

**A. Complete:**

- EARTHSS 1
  - or EARTHSS 3
  - or EARTHSS 5
- EARTHSS 51
- EARTHSS 53
- EARTHSS 55
- EARTHSS 114
- EARTHSS 116
- EARTHSS 191
- EARTHSS 192
- MATH 2A-2B
  - or MATH 3A
- MATH 2D
  - or MATH 3A

Select one of the following sequences and accompanying labs:

- CHEM 1A-1B-1C
  - General Chemistry
  - and General Chemistry
  - and General Chemistry
- CHEM 1LC-1LD
  - General Chemistry Laboratory
  - and General Chemistry Laboratory
  - or
- CHEM H2A-H2B-H2C
  - Honors General Chemistry
  - and Honors General Chemistry
  - and Honors General Chemistry
- CHEM H2LA-H2LB-H2LC
  - Honors General Chemistry Laboratory
  - and Honors General Chemistry Laboratory
  - and Honors General Chemistry Laboratory

Select one of the following sequences and accompanying labs:

- PHYSICS 3A-3B-3C
  - Basic Physics I
  - and Basic Physics II
  - and Basic Physics III
- PHYSICS 3LB-3LC
  - Basic Physics Laboratory
  - and Basic Physics Laboratory
  - or
- PHYSICS 7C-7E
  - Classical Physics
  - and Classical Physics
- PHYSICS 7LC
  - Classical Physics Laboratory

**B. Select seven electives from the following (at least four must be Earth System Science courses):**

All 4-unit upper-division EARTHSS courses except EARTHSS 114, EARTHSS 116, EARTHSS 190C, and EARTHSS 198 or EARTHSS H198 (EARTHSS 199 or one quarter of H199A-B-C may count only once toward the elective requirement)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI 93</td>
<td>From DNA to Organisms</td>
</tr>
<tr>
<td>BIO SCI 94</td>
<td>From Organisms to Ecosystems</td>
</tr>
<tr>
<td>BIO SCI 98</td>
<td>Biochemistry</td>
</tr>
<tr>
<td>BIO SCI D105</td>
<td>Cell, Developmental, and Molecular Biology of Plants</td>
</tr>
<tr>
<td>BIO SCI E106</td>
<td>Processes in Ecology and Evolution</td>
</tr>
<tr>
<td>BIO SCI E179</td>
<td>Limnology and Freshwater Biology</td>
</tr>
<tr>
<td>BIO SCI E179L</td>
<td>Field Freshwater Ecology</td>
</tr>
<tr>
<td>BIO SCI E186</td>
<td>Population and Community Ecology</td>
</tr>
<tr>
<td>BIO SCI E189</td>
<td>Environmental Ethics</td>
</tr>
<tr>
<td>BIO SCI M133</td>
<td>High-Resolution Structures: NMR and X-ray</td>
</tr>
<tr>
<td>CHEM 51A</td>
<td>Organic Chemistry</td>
</tr>
<tr>
<td>CHEM 51B- 51LB</td>
<td>Organic Chemistry and Organic Chemistry Laboratory</td>
</tr>
<tr>
<td>CHEM 51C- 51LC</td>
<td>Organic Chemistry and Organic Chemistry Laboratory</td>
</tr>
<tr>
<td>CHEM H52A- H52LA</td>
<td>Honors Organic Chemistry and Honors Organic Chemistry Laboratory</td>
</tr>
<tr>
<td>CHEM H52B- H52LB</td>
<td>Honors Organic Chemistry and Honors Organic Chemistry Laboratory</td>
</tr>
<tr>
<td>CHEM H52C</td>
<td>Honors Organic Chemistry</td>
</tr>
<tr>
<td>CHEM 132A</td>
<td>Chemical Thermodynamics, Kinetics, and Dynamics</td>
</tr>
<tr>
<td>CHEM 132B</td>
<td>Quantum Principles, Spectroscopy, and Bonding</td>
</tr>
<tr>
<td>CHEM 132C</td>
<td>Molecular Structure and Elementary Statistical Mechanics</td>
</tr>
<tr>
<td>ENGRCEE 156</td>
<td>Foundation Design</td>
</tr>
<tr>
<td>ENGRCEE 162</td>
<td>Introduction to Environmental Chemistry</td>
</tr>
<tr>
<td>ENGRCEE 171</td>
<td>Water Resources Engineering</td>
</tr>
<tr>
<td>ENGRCEE 172</td>
<td>Groundwater Hydrology</td>
</tr>
<tr>
<td>ENGRCEE 176</td>
<td>Hydrology</td>
</tr>
<tr>
<td>ENGRCEE 178</td>
<td>Fluid Mechanics of Open Channels</td>
</tr>
<tr>
<td>ENGRMAE 60</td>
<td>Electric Circuits</td>
</tr>
<tr>
<td>ENGRMAE 91</td>
<td>Introduction to Thermodynamics</td>
</tr>
<tr>
<td>ENGRMAE 130A</td>
<td>Introduction to Fluid Mechanics</td>
</tr>
<tr>
<td>ENGRMAE 164</td>
<td>Air Pollution and Control</td>
</tr>
<tr>
<td>ENGRMAE 185</td>
<td>Numerical Analysis in Mechanical Engineering</td>
</tr>
<tr>
<td>MATH 2D</td>
<td>Multivariable Calculus (may be counted only once; or MATH 3A, may be counted only once)</td>
</tr>
<tr>
<td>MATH 3D</td>
<td>Elementary Differential Equations</td>
</tr>
<tr>
<td>MATH 105A</td>
<td>Numerical Analysis</td>
</tr>
<tr>
<td>MATH 112A</td>
<td>Introduction to Partial Differential Equations and Applications</td>
</tr>
<tr>
<td>MATH 115</td>
<td>Mathematical Modeling</td>
</tr>
<tr>
<td>PHYSICS 51A</td>
<td>Modern Physics</td>
</tr>
<tr>
<td>PHYSICS 51B</td>
<td>Modern Physics</td>
</tr>
<tr>
<td>PHYSICS 115A</td>
<td>Statistical Physics</td>
</tr>
<tr>
<td>PHYSICS 120</td>
<td>Electronics for Scientists</td>
</tr>
<tr>
<td>PHYSICS 134A</td>
<td>Physical and Geometrical Optics</td>
</tr>
<tr>
<td>PHYSICS 137</td>
<td>Introduction to Cosmology</td>
</tr>
<tr>
<td>PHYSICS 144</td>
<td>Stellar Astrophysics</td>
</tr>
<tr>
<td>PHYSICS 145</td>
<td>High-Energy Astrophysics</td>
</tr>
<tr>
<td>UPPP 139</td>
<td>Water Resource Policy</td>
</tr>
<tr>
<td>PUBHLTH 161</td>
<td>Environmental Geology</td>
</tr>
</tbody>
</table>

Computing Skills (one of the following may be counted toward degree): EECS 10, ENGRMAE 10, I&C SCI 31, PHYSICS 53, or an approved programming course.
**Optional Specializations**

Three optional specializations are available: Atmospheric Science, Hydrology and Terrestrial Ecosystems, and Oceanography. The specializations require the completion of at least five courses from the following lists (four science courses plus one advanced tools course).

**Specialization in Atmospheric Science**

**Requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTHSS 101</td>
<td>Paleoclimatology</td>
</tr>
<tr>
<td>EARTHSS 112</td>
<td>Global Climate Change and Impacts</td>
</tr>
<tr>
<td>EARTHSS 124</td>
<td>Weather Analysis</td>
</tr>
<tr>
<td>EARTHSS 142</td>
<td>Atmospheric Chemistry</td>
</tr>
<tr>
<td>EARTHSS 199</td>
<td>Undergraduate Research (one 4-unit course focused on atmospheric research selected from EARTHSS 199, 198, H198, H199A-H199B-H199C)</td>
</tr>
</tbody>
</table>

One advanced tools course selected from the following:

- EARTHSS 118  | Programming for Earth System Science and Ecology         |
- EARTHSS 138  | Satellite Remote Sensing for Earth System Science        |

(These courses may overlap in Major Requirements, Section B.)

**Specialization in Hydrology and Terrestrial Ecosystems**

**Requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTHSS 132</td>
<td>Terrestrial Hydrology</td>
</tr>
<tr>
<td>EARTHSS 140</td>
<td>Advanced Geology</td>
</tr>
<tr>
<td>EARTHSS 164</td>
<td>Ecosystem Ecology</td>
</tr>
<tr>
<td>EARTHSS 168</td>
<td>Physiological Plant Ecology</td>
</tr>
<tr>
<td>EARTHSS 174</td>
<td>Ice in the Climate System</td>
</tr>
<tr>
<td>EARTHSS 199</td>
<td>Undergraduate Research (one 4-unit course focused on terrestrial research selected from EARTHSS 199, 198, H198, H199A-H199B-H199C)</td>
</tr>
</tbody>
</table>

One advanced tools course selected from the following:

- EARTHSS 118  | Programming for Earth System Science and Ecology         |
- EARTHSS 134  | Fundamentals of GIS for Environmental Science            |
- EARTHSS 138  | Satellite Remote Sensing for Earth System Science        |

(These courses may overlap in Major Requirements, Section B.)

**Specialization in Oceanography**

**Requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTHSS 101</td>
<td>Paleoclimatology</td>
</tr>
<tr>
<td>EARTHSS 112</td>
<td>Global Climate Change and Impacts</td>
</tr>
<tr>
<td>EARTHSS 130</td>
<td>Physical Oceanography</td>
</tr>
<tr>
<td>EARTHSS 144</td>
<td>Marine Geochemistry and Biogeochemistry</td>
</tr>
<tr>
<td>EARTHSS 148</td>
<td>Marine Ecosystems and Global Change</td>
</tr>
<tr>
<td>EARTHSS 170</td>
<td>Environmental Microbiology</td>
</tr>
<tr>
<td>EARTHSS 199</td>
<td>Undergraduate Research (one 4-unit course focused on oceanographic research selected from EARTHSS 199, 198, H198, H199A-H199B-H199C)</td>
</tr>
</tbody>
</table>

One advanced tools course selected from the following:

- EARTHSS 118  | Programming for Earth System Science and Ecology         |
- EARTHSS 138  | Satellite Remote Sensing for Earth System Science        |

(These courses may overlap in Major Requirements, Section B.)

**Sample Program — Earth System Science**

**Freshman**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 2A</td>
<td>MATH 2B</td>
<td>MATH 2D or 3A</td>
</tr>
</tbody>
</table>
Some students (particularly transfer students) take EARTHSS 51, EARTHSS 53, and EARTHSS 55 in the junior year.

### Concentration in Geosciences Education with Secondary Teaching Certification

This concentration allows students pursuing the B.S. in Earth System Science to earn a bachelor's degree and complete the required course work and field experience for a California Preliminary Single Subject Teaching Credential at the same time. In addition to the requirements listed above, students must complete the following courses:

<table>
<thead>
<tr>
<th>CHEM 193</th>
<th>PHYSICS 193</th>
<th>Research Methods</th>
<th>Research Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTHSS 7</td>
<td>or EARTHSS 140</td>
<td>Physical Geology 1</td>
<td>Advanced Geology</td>
</tr>
<tr>
<td>EDUC 55</td>
<td></td>
<td>Knowing and Learning in Mathematics and Science</td>
<td></td>
</tr>
<tr>
<td>EDUC 109</td>
<td></td>
<td>Reading and Writing in Secondary Mathematics and Science Classrooms</td>
<td></td>
</tr>
<tr>
<td>EDUC 143AW</td>
<td></td>
<td>Classroom Interactions I</td>
<td></td>
</tr>
<tr>
<td>EDUC 143BW</td>
<td></td>
<td>Classroom Interactions II</td>
<td></td>
</tr>
<tr>
<td>EDUC 148</td>
<td></td>
<td>Complex Pedagogical Design</td>
<td></td>
</tr>
<tr>
<td>EDUC 158</td>
<td></td>
<td>Student Teaching Mathematics and Science in Middle/High School (two quarters)</td>
<td></td>
</tr>
<tr>
<td>LPS 60</td>
<td></td>
<td>The Making of Modern Science</td>
<td></td>
</tr>
<tr>
<td>PHY SCI 5</td>
<td></td>
<td>California Teach 1: Introduction to Science and Mathematics Teaching</td>
<td></td>
</tr>
<tr>
<td>PHY SCI 105</td>
<td></td>
<td>California Teach 2: Middle School Science and Mathematics Teaching</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 20A</td>
<td>or PHYSICS 20B</td>
<td>Introduction to Astronomy</td>
<td>Cosmology: Humanity's Place in the Universe</td>
</tr>
</tbody>
</table>

1  EARTHSS 140 may overlap with the major requirement in section B.

With careful, early planning, it is possible for students to complete the bachelor's degree and the secondary teaching certification in four years.

For additional information about teacher certification requirements and enrollment procedures, visit the Cal Teach website (http://www.education.uci.edu/calteach). Interested students are strongly encouraged to contact the Cal Teach Resource and Advising Center or the Physical Sciences Student Affairs Office.

### Sample Program – Concentration in Geosciences Education with Secondary Teaching Certification

<table>
<thead>
<tr>
<th>Freshman</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 2A</td>
<td>MATH 2B</td>
<td>MATH 2D or 3A</td>
</tr>
<tr>
<td>CHEM 1A</td>
<td>CHEM 1B</td>
<td>CHEM 1C-1LC</td>
</tr>
<tr>
<td>EARTHSS 1</td>
<td>PHYSICS 20A</td>
<td>General Education</td>
</tr>
</tbody>
</table>
Bachelor of Arts in Environmental Science

http://ess.uci.edu/undergrad/ba

The Environmental Science B.A. program prepares students interested in environmental problem solving by linking an understanding of natural science with socioeconomic factors and public policy. The curriculum combines a quantitative understanding of environmental science, chemistry, and biology with studies of social science, policy, and macro- and microeconomics to provide a foundation for careers in environmental policy, resource management, education, environmental law, and related fields.

The Environmental Science program provides students with a solid foundation to recognize the impacts of human activities on the environment, and in turn the impacts of environmental change on society. Students will understand the mechanisms by which key institutions, policies, and regulations impact ecosystems and the physical environment. Once the core course work is complete, students are encouraged to focus on a particular area within Environmental Science and to choose electives that build a coherent core of knowledge. Focus areas include, but are not limited to planning, policy and design, sociology, economics, climatology, water resources, water quality, air pollution, resource management, and atmospheric sciences.

Careers for the Environmental Science Major

Some students may find career opportunities in roles such as policy advisor, data analyst (may require a graduate-level degree), scientific journalist, or technical writer. Other options that may be available are scientist positions in the following roles: environmental policy and planning, environmental consulting, air quality monitoring and assessment, natural resource management, wildlife management, conservation and environmental protection.

Special Programs

Environmental Science Honors Program. In the year-long honors course sequence, Environmental Science students admitted into the ESS Honors Program pursue research with faculty in the Department, and prepare a written thesis of their work. Visit the Environmental Science Honors Program website (http://www.ess.uci.edu) for more information.

Teaching Certification. Environmental Science students interested in teaching careers can earn a bachelor’s degree concurrently with a California Preliminary Single Subject Teaching Credential. See the Concentration in Geosciences Education with Secondary Teaching Certification section below for more information.

Admission to the Environmental Science Major

Students may be admitted to the Environmental Science major upon entering the University as freshmen, via change of major, or as transfer students from other colleges and universities. Information about change of major policies is available in the Physical Sciences Student Affairs Office and at the UCI Change of Major Criteria website (http://www.changeofmajor.uci.edu). For transfer student admission, preference will be given to junior-level applicants with the highest grades overall and who have satisfactorily completed either one year of general chemistry with laboratory (preferred) or one year of biology with laboratory. One year of economics or sociology is recommended.

NOTE: The major is open to all students except Earth System Science B.S. majors and Earth and Atmospheric Sciences minors.

Requirements for the B.A. in Environmental Science (including a Concentration)

All students must meet the University Requirements.

School Requirements: None.

Major Requirements

A. Select one of the following:
EARTHSS 1 | Introduction to Earth System Science
---|---
EARTHSS 3 | Oceanography
EARTHSS 5 | The Atmosphere
EARTHSS 7 | Physical Geology
EARTHSS 15 | Introduction to Global Climate Change
EARTHSS 17 | Hurricanes, Tsunamis, and Other Catastrophes
EARTHSS 21 | On Thin Ice: Climate Change and the Cryosphere
EARTHSS 23 | Air Pollution: From Urban Smog to Global Change

**Complete:**

EARTHSS 60A-60B-60C | Fundamental Processes in Earth and Environmental Studies and Local and Regional Environmental Issues and Global Environmental Issues
---|---
EARTHSS 114 | Earth System Science Laboratory and Field Methods
EARTHSS 180 | Environmental Sustainability I
EARTHSS 182 | Environmental Sustainability II
EARTHSS 192 | Careers in Earth System Science

**B. Select one of the following sequences and accompanying labs:**

CHEM 1A-1B-1C | General Chemistry and General Chemistry and General Chemistry
---|---
CHEM 1LC-1LD | General Chemistry Laboratory and General Chemistry Laboratory

or

CHEM H2A-H2B-H2C | Honors General Chemistry and Honors General Chemistry and Honors General Chemistry
---|---
CHEM H2LA-H2LB-H2LC | Honors General Chemistry Laboratory and Honors General Chemistry Laboratory and Honors General Chemistry Laboratory

**Complete:**

BIO SCI 93 | From DNA to Organisms
BIO SCI 94 | From Organisms to Ecosystems

**C. Select three courses from the following:**

EARTHSS 19 | Introduction to Modeling the Earth System
---|---
EARTHSS 116 | Data Analysis for Earth Sciences
EARTHSS 134 | Fundamentals of GIS for Environmental Science
MATH 2A-2B | Single-Variable Calculus and Single-Variable Calculus
MATH 4 | Mathematics for Economists
STATS 7 | Basic Statistics

**D. Select four courses from the following:**

BIO SCI E189 | Environmental Ethics
---|---
EARTHSS 110 | Environmental Controversies
EARTHSS 178 | Solving the Energy-Carbon-Climate Problem
ECON 13 | Global Economy
LPS 60 | The Making of Modern Science
ECON 20A-20B | Basic Economics I and Basic Economics II
UPPP 4 | Introduction to Urban Studies
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPPP 139</td>
<td>Water Resource Policy</td>
</tr>
<tr>
<td>SOCIOL 1</td>
<td>Introduction to Sociology</td>
</tr>
<tr>
<td>SOCIOL 2</td>
<td>Globalization and Transnational Sociology</td>
</tr>
<tr>
<td>SOCIOL 3</td>
<td>Social Problems</td>
</tr>
</tbody>
</table>

**E. Select two electives each from the following three categories:**

1. Select any upper-division, 4-unit course in EARTHSS (199/H199 may count only once; the combination of EARTHSS 190A and EARTHSS 190B may be used as one elective requirement); courses may not be used as electives if counted toward degree requirements.

2. BIO SCI 55 Introduction to Ecology
   BIO SCI 97 Genetics
   BIO SCI 98 Biochemistry
   BIO SCI 99 Molecular Biology
   BIO SCI E106 Processes in Ecology and Evolution
   BIO SCI E138 Comparative Animal Physiology
   BIO SCI E150 Conservation Biology
   BIO SCI E151 Evolutionary and Ecological Principles in Medicine
   BIO SCI E160 Biology of Birds
   BIO SCI E160L Biology of Birds Lab
   BIO SCI E172 Plant Diversity in a Changing World
   BIO SCI E175 Restoration Ecology
   BIO SCI E179 Limnology and Freshwater Biology
   BIO SCI E179L Field Freshwater Ecology
   BIO SCI E182 Mediterranean Ecosystems: Biodiversity and Conservation
   BIO SCI E184 Ecology and Diversity of Insects
   BIO SCI E186 Population and Community Ecology
   BIO SCI E189 Environmental Ethics
   CHEM 51A Organic Chemistry
   CHEM 51B-51LB Organic Chemistry and Organic Chemistry Laboratory
   CHEM 51C-51LC Organic Chemistry and Organic Chemistry Laboratory
   CHEM H52A-H52LA Honors Organic Chemistry and Honors Organic Chemistry Laboratory
   CHEM H52B-H52LB Honors Organic Chemistry and Honors Organic Chemistry Laboratory
   CHEM H52C Honors Organic Chemistry
   PHYSICS 3A Basic Physics I
   PHYSICS 3B Basic Physics II
   PHYSICS 3C Basic Physics III
   PHYSICS 7C Classical Physics
   PHYSICS 14 Energy and the Environment
   PHYSICS 20A Introduction to Astronomy
   PHYSICS 20B Cosmology: Humanity’s Place in the Universe
   PHYSICS 20D Space Science

3. ECON 100A-100B-100C Intermediate Economics I and Intermediate Economics II and Intermediate Economics III
   ECON 142A-142CW Industrial Organization I and Industrial Organization II
   ECON 144A-144B Urban Economics I and Urban Economics II
   ECON 145E Economics of the Environment
   SOCIOL 31 Self-Identity and Society
SOCIOL 43  City and Community
SOCIOL 44  Births, Deaths, and Migration
SOCIOL 110  Research Methods
SOCIOL 141  Organizations
SOCIOL 171  Environment and Society

Other courses may be substituted for approved electives by petition.

Sample Program – Environmental Science

**Freshman**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTHSS 1</td>
<td>MATH 2A</td>
<td>STATS 7</td>
</tr>
<tr>
<td>CHEM 1A</td>
<td>CHEM 1B</td>
<td>CHEM 1C-1LC</td>
</tr>
<tr>
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**Sophomore**

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**Junior**

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<tbody>
<tr>
<td>BIO SCI 93</td>
<td>BIO SCI 94</td>
<td>EARTHSS 114</td>
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<td>Approved Elective</td>
<td>EARTHSS 180</td>
<td>Approved Elective</td>
</tr>
<tr>
<td>EARTHSS 116</td>
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<tr>
<td>EARTHSS 192</td>
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**Senior**

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<tr>
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Concentration in Geosciences Education with Secondary Teaching Certification

This concentration allows students pursuing the B.A. in Environmental Science to earn a bachelor’s degree and complete the required course work and field experience for a California Preliminary Single Subject Teaching Credential at the same time. With careful, early planning, it is possible for students to complete the bachelor’s degree and the secondary teaching certification in four years.

For additional information about teacher certification requirements and enrollment procedures, visit the Cal Teach website (http://www.education.uci.edu/calteach). Interested students are strongly encouraged to contact the Cal Teach Resource and Advising Center or the Physical Sciences Student Affairs Office.

Departmental Requirements

A. Select one of the following:

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>EARTHSS 1</td>
<td>Introduction to Earth System Science</td>
</tr>
<tr>
<td>EARTHSS 3</td>
<td>Oceanography</td>
</tr>
<tr>
<td>EARTHSS 5</td>
<td>The Atmosphere</td>
</tr>
<tr>
<td>EARTHSS 7</td>
<td>Physical Geology</td>
</tr>
<tr>
<td>EARTHSS 15</td>
<td>Introduction to Global Climate Change</td>
</tr>
<tr>
<td>EARTHSS 17</td>
<td>Hurricanes, Tsunamis, and Other Catastrophes</td>
</tr>
<tr>
<td>EARTHSS 21</td>
<td>On Thin Ice: Climate Change and the Cryosphere</td>
</tr>
<tr>
<td>EARTHSS 23</td>
<td>Air Pollution: From Urban Smog to Global Change</td>
</tr>
</tbody>
</table>

Complete:

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<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>EARTHSS 7</td>
<td>Physical Geology 1</td>
</tr>
<tr>
<td>or EARTHSS 140</td>
<td>Advanced Geology</td>
</tr>
<tr>
<td>EARTHSS 60A-60B-60C</td>
<td>Fundamental Processes in Earth and Environmental Studies and Local and Regional Environmental Issues and Global Environmental Issues</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
</tr>
<tr>
<td>-------------</td>
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</tr>
<tr>
<td>EARTHSS 114</td>
<td>Earth System Science Laboratory and Field Methods</td>
</tr>
<tr>
<td>EARTHSS 180</td>
<td>Environmental Sustainability I</td>
</tr>
<tr>
<td>EARTHSS 182</td>
<td>Environmental Sustainability II</td>
</tr>
<tr>
<td>EARTHSS 192</td>
<td>Careers in Earth System Science</td>
</tr>
<tr>
<td>PHYSICS 20A</td>
<td>Introduction to Astronomy 2</td>
</tr>
<tr>
<td>or PHYSICS 20B</td>
<td>Cosmology: Humanity’s Place in the Universe</td>
</tr>
</tbody>
</table>

**B. Select one of the following sequences and accompanying labs:**

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 1A- 1B- 1C</td>
<td>General Chemistry and General Chemistry</td>
</tr>
<tr>
<td>or CHEM 1LC- 1LD</td>
<td>General Chemistry Laboratory and General Chemistry Laboratory</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM H2A- H2B- H2C</td>
<td>Honors General Chemistry and Honors General Chemistry</td>
</tr>
<tr>
<td>CHEM H2LA- H2LB- H2LC</td>
<td>Honors General Chemistry Laboratory and Honors General Chemistry Laboratory</td>
</tr>
</tbody>
</table>

**Complete:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI 93</td>
<td>From DNA to Organisms</td>
</tr>
<tr>
<td>BIO SCI 94</td>
<td>From Organisms to Ecosystems</td>
</tr>
</tbody>
</table>

**C. Select three courses from the following:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTHSS 19</td>
<td>Introduction to Modeling the Earth System</td>
</tr>
<tr>
<td>EARTHSS 116</td>
<td>Data Analysis for Earth Sciences</td>
</tr>
<tr>
<td>EARTHSS 134</td>
<td>Fundamentals of GIS for Environmental Science</td>
</tr>
<tr>
<td>MATH 2A- 2B</td>
<td>Single-Variable Calculus and Single-Variable Calculus</td>
</tr>
<tr>
<td>MATH 4</td>
<td>Mathematics for Economists</td>
</tr>
<tr>
<td>STATS 7</td>
<td>Basic Statistics</td>
</tr>
</tbody>
</table>

**D. Select two courses from the following:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI E189</td>
<td>Environmental Ethics</td>
</tr>
<tr>
<td>EARTHSS 110</td>
<td>Environmental Controversies</td>
</tr>
<tr>
<td>EARTHSS 178</td>
<td>Solving the Energy-Carbon-Climate Problem</td>
</tr>
<tr>
<td>ECON 13</td>
<td>Global Economy</td>
</tr>
<tr>
<td>ECON 20A- 20B</td>
<td>Basic Economics I and Basic Economics II</td>
</tr>
<tr>
<td>LPS 60</td>
<td>The Making of Modern Science</td>
</tr>
<tr>
<td>UPPP 4</td>
<td>Introduction to Urban Studies</td>
</tr>
<tr>
<td>UPPP 139</td>
<td>Water Resource Policy</td>
</tr>
<tr>
<td>SOCIOL 1</td>
<td>Introduction to Sociology</td>
</tr>
<tr>
<td>SOCIOL 2</td>
<td>Globalization and Transnational Sociology</td>
</tr>
<tr>
<td>SOCIOL 3</td>
<td>Social Problems</td>
</tr>
</tbody>
</table>

**E. Select two electives each from the following three categories:**

1. Any upper-division, 4-unit course in EARTHSS or 190A-B (199/H199 may count only once; the combination of 190A and 190B may be used as one elective requirement); courses may not be used as electives if counted toward degree requirements.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>BIO SCI 55</td>
<td>Introduction to Ecology</td>
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<tr>
<td>BIO SCI 97</td>
<td>Genetics</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
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<td>--------------------------------------------------</td>
</tr>
<tr>
<td>BIO SCI 98</td>
<td>Biochemistry</td>
</tr>
<tr>
<td>BIO SCI 99</td>
<td>Molecular Biology</td>
</tr>
<tr>
<td>BIO SCI E106</td>
<td>Processes in Ecology and Evolution</td>
</tr>
<tr>
<td>BIO SCI E138</td>
<td>Comparative Animal Physiology</td>
</tr>
<tr>
<td>BIO SCI E150</td>
<td>Conservation Biology</td>
</tr>
<tr>
<td>BIO SCI E151</td>
<td>Evolutionary and Ecological Principles in Medicine</td>
</tr>
<tr>
<td>BIO SCI E160</td>
<td>Biology of Birds</td>
</tr>
<tr>
<td>BIO SCI E160L</td>
<td>Biology of Birds Lab</td>
</tr>
<tr>
<td>BIO SCI E172</td>
<td>Plant Diversity in a Changing World</td>
</tr>
<tr>
<td>BIO SCI E175</td>
<td>Restoration Ecology</td>
</tr>
<tr>
<td>BIO SCI E179</td>
<td>Limnology and Freshwater Biology</td>
</tr>
<tr>
<td>BIO SCI E179L</td>
<td>Field Freshwater Ecology</td>
</tr>
<tr>
<td>BIO SCI E182</td>
<td>Mediterranean Ecosystems: Biodiversity and Conservation</td>
</tr>
<tr>
<td>BIO SCI E184</td>
<td>Ecology and Diversity of Insects</td>
</tr>
<tr>
<td>BIO SCI E186</td>
<td>Population and Community Ecology</td>
</tr>
<tr>
<td>BIO SCI E189</td>
<td>Environmental Ethics</td>
</tr>
<tr>
<td>CHEM 51A</td>
<td>Organic Chemistry</td>
</tr>
<tr>
<td>CHEM 51B-51LB</td>
<td>Organic Chemistry and Organic Chemistry Laboratory</td>
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<tr>
<td>CHEM 51C-51LC</td>
<td>Organic Chemistry and Organic Chemistry Laboratory</td>
</tr>
<tr>
<td>CHEM H52A-H52LA</td>
<td>Honors Organic Chemistry and Honors Organic Chemistry Laboratory</td>
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<tr>
<td>CHEM H52B-H52LB</td>
<td>Honors Organic Chemistry and Honors Organic Chemistry Laboratory</td>
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<tr>
<td>CHEM H52C</td>
<td>Honors Organic Chemistry</td>
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<tr>
<td>PHYSICS 3A</td>
<td>Basic Physics I</td>
</tr>
<tr>
<td>PHYSICS 3B</td>
<td>Basic Physics II</td>
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<td>PHYSICS 3C</td>
<td>Basic Physics III</td>
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<td>PHYSICS 7C</td>
<td>Classical Physics</td>
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<tr>
<td>PHYSICS 14</td>
<td>Energy and the Environment</td>
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<tr>
<td>PHYSICS 20A</td>
<td>Introduction to Astronomy</td>
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<tr>
<td>PHYSICS 20B</td>
<td>Cosmology: Humanity’s Place in the Universe</td>
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<td>PHYSICS 20D</td>
<td>Space Science</td>
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<td>Intermediate Economics I and Intermediate Economic II and Intermediate Economic III</td>
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<tr>
<td>ECON 142A-142CW</td>
<td>Industrial Organization I and Industrial Organization III</td>
</tr>
<tr>
<td>ECON 144A-144B</td>
<td>Urban Economics I and Urban Economics II</td>
</tr>
<tr>
<td>ECON 145E</td>
<td>Economics of the Environment</td>
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<tr>
<td>SOCIOL 31</td>
<td>Self-Identity and Society</td>
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<tr>
<td>SOCIOL 43</td>
<td>City and Community</td>
</tr>
<tr>
<td>SOCIOL 44</td>
<td>Births, Deaths, and Migration</td>
</tr>
<tr>
<td>SOCIOL 110</td>
<td>Research Methods</td>
</tr>
<tr>
<td>SOCIOL 141</td>
<td>Organizations</td>
</tr>
<tr>
<td>SOCIOL 171</td>
<td>Environment and Society</td>
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</tbody>
</table>

**F. Complete:**
- CHEM/PHYSICS 193 Research Methods
- EDUC 55 Knowing and Learning in Mathematics and Science
- EDUC 109 Reading and Writing in Secondary Mathematics and Science Classrooms
EDUC 143AW  Classroom Interactions I
EDUC 143BW  Classroom Interactions II
EDUC 148  Complex Pedagogical Design
EDUC 158  Student Teaching Mathematics and Science in Middle/High School (two quarters)
LPS 60  The Making of Modern Science
PHY SCI 5-105  California Teach 1: Introduction to Science and Mathematics Teaching and California Teach 2: Middle School Science and Mathematics Teaching

1 EARTHSS 140 may overlap with the major requirement in section E1.
2 PHYSICS 20A and PHYSICS 20B may overlap with the major requirement in section E2.

Sample Program — Concentration in Geosciences Education with Secondary Teaching Certification

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<td>CHEM 1B</td>
<td>CHEM 1C-1LC</td>
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<td>MATH 2A</td>
<td>STATS 7</td>
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<td>PHYSICS 20A</td>
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<tr>
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<td>EARTHSS 60B</td>
<td>EARTHSS 60C</td>
</tr>
<tr>
<td>EARTHSS 60A</td>
<td>CHEM 193 or PHYSICS 193</td>
<td>LPS 60</td>
</tr>
<tr>
<td>PHYS SCI 105</td>
<td>General Education</td>
<td>Approved Elective</td>
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<td>SOCIOL 1</td>
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<td>BIO SCI 93</td>
<td>BIO SCI 94</td>
<td>EARTHSS 114</td>
</tr>
<tr>
<td>EARTHSS 116</td>
<td>EDUC 143AW</td>
<td>EARTHSS 182</td>
</tr>
<tr>
<td>EARTHSS 140</td>
<td>EARTHSS 180</td>
<td>EDUC 148</td>
</tr>
<tr>
<td>EDUC 55</td>
<td>Approved Elective</td>
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<tr>
<td>EARTHSS 192</td>
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<table>
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</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Winter</td>
<td>Spring</td>
</tr>
<tr>
<td>EDUC 143BW</td>
<td>EDUC 109</td>
<td>EDUC 158</td>
</tr>
<tr>
<td>Approved Elective</td>
<td>EDUC 158</td>
<td>Approved Elective</td>
</tr>
<tr>
<td>Approved Elective</td>
<td>General Education</td>
<td>General Education</td>
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</table>

Bachelor of Arts in Environmental Science and Policy

The Environmental Science and Policy B.A. prepares students interested in environmental problem solving by linking an understanding of natural science with socioeconomic factors and public policy.

The curriculum combines a quantitative understanding of environmental science, chemistry, and biology with law, policy, and economics to provide a foundation for careers in environmental policy, resource management, education, environmental law, urban and environmental design, and related fields.

Administered jointly by the School of Social Ecology and the School of the Physical Sciences, the Environmental Science and Policy major provides students with a solid foundation to recognize the impacts of human activities on the environment, and in turn, the impacts of environmental change on society. Students are taught the mechanisms by which key institutions, policies, and regulations impact ecosystems and the physical environment. Once the core course work is complete, students are encouraged to focus on a particular area within Environmental Science and Policy, and to choose electives that build a coherent core of knowledge. Focus areas include, but are not limited to, urban planning, public policy, sociology, economics, climatology, water resources, water quality, agriculture, air pollution, resource management, and atmospheric sciences.
Requirements for the B.A. in Environmental Science and Policy

Major Requirements: Visit the Interdisciplinary Studies section of the Catalogue.

Additional Information

Honors Program in Earth System Science

The Department of Earth System Science awards honors to students who have completed a customized year-long research program in their senior year. ESS honors students engage in advanced research, alongside faculty, research staff, and graduate students within well-equipped laboratories in Earth System Science. The program involves both conducting original research and communicating scientific findings.

The Honors Program in Earth System Science provides an opportunity for selected students majoring in Earth System Science or Environmental Science to pursue research with faculty in the Department during their senior year. Admission to the program is based on an application normally submitted by the sixth week of the spring quarter during the junior year.

To be considered for Departmental Honors, a student must have satisfied the following requirements:

1. Completion of all mathematics, chemistry, and physics requirements for the major;
2. Completion of EARTHSS 51- EARTHSS 53- EARTHSS 55 or EARTHSS 60A- EARTHSS 60B- EARTHSS 60C.
3. Achievement of an overall GPA at UCI of at least 3.3; and

Students must also demonstrate potential for carrying out research of honors quality, as judged by the Earth System Science faculty member who will supervise their research. Application materials are available at the Environmental Science Honors Program website (http://www.ess.uci.edu/undergrad/ess/honors).

Once admitted to the program, students will enroll in:

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<tbody>
<tr>
<td>EARTHSS H198</td>
<td>Honors Thesis in Earth System Science</td>
</tr>
</tbody>
</table>

In the Honors Research series, students will commit 10–15 hours a week to conduct research with an ESS faculty. At the end of each quarter, a written report is required.

In the Honors Thesis course, students will prepare and submit a seminar, poster, and written thesis describing their research. The thesis will be written in the style of a scientific manuscript, with separate abstract, introduction, methods, results and discussion sections. If the thesis is deemed honors quality by the ESS faculty and the student’s final accumulative GPA is above 3.3, the student will graduate with Departmental Honors.

Requirements for the Minor in Earth and Atmospheric Sciences

The science of the Earth as a system has implications for many fields of study. Students interested in understanding how the Earth’s systems work can complete the requirements for a minor in Earth and Atmospheric Sciences. The program is primarily designed for students in the natural sciences and engineering who wish to explore interdisciplinary problems and broaden their studies to include the application of their fields to understanding the Earth system.

NOTE: This minor is not available to students in the Earth System Science (B.S.) or Environmental Science (B.A.) majors.

Requirements for the Minor

Select one of the following series:

<table>
<thead>
<tr>
<th>EARTHSS 51- 53- 55</th>
<th>Land Interactions and Ocean Biogeochemistry and Earth’s Atmosphere</th>
</tr>
</thead>
<tbody>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>EARTHSS 60A- 60B- 60C</td>
<td>Fundamental Processes in Earth and Environmental Studies and Local and Regional Environmental Issues and Global Environmental Issues</td>
</tr>
</tbody>
</table>

and select four electives from the approved elective list for the B.S. in Earth System Science major, at least two of which must be Earth System Science courses.

Graduate Program

The Earth, as a coupled system of atmosphere, ocean, land, and cryosphere, has changed in our lifetime. The observed depletion of stratospheric ozone at high latitudes has been attributed directly to industrial use of halocarbons. Global warming a result of increases in the atmospheric
concentrations of greenhouse gases, such as carbon dioxide and methane, which are released by the use of fossil fuel and agricultural practices. These examples illustrate the ability of humans to alter the global environment. Understanding the sensitivity of the Earth’s climate system requires a broad base of scientific knowledge, which includes detection, quantification, and prediction of the rates of change of chemical, physical, and biological variables. Our program is built around this interdisciplinary and holistic approach to the Earth System.

The Department’s doctoral program is aimed at training new research scientists in the field of Earth System Science. The graduate education provides a comprehensive curriculum, along with opportunities to conduct groundbreaking research. The Department’s doctoral-level students are expected to become researchers with a global perspective and broad research skills as well as a high level of expertise in specific areas. Active programs of research are underway studying the influence of human activities in the Earth System, biogeochemistry, and physical climate.

NOTE: Students are admitted to the Ph.D. program only; the master’s degree is awarded upon progress to the Ph.D.

**Course Requirements**

Students must complete a minimum of nine 4-unit approved graduate-level courses, including the core curriculum, with an average grade of B or better. All courses must be approved by the student’s advisor.

A. Complete:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTHSS 200</td>
<td>Global Physical Climatology</td>
</tr>
<tr>
<td>EARTHSS 204</td>
<td>Humans in the Earth System</td>
</tr>
<tr>
<td>EARTHSS 266</td>
<td>Global Biogeochemical Cycles</td>
</tr>
<tr>
<td>EARTHSS 298</td>
<td>Practicum in Earth System Science</td>
</tr>
</tbody>
</table>

B. Select at least five additional graduate-level courses, two of which must be offered by the Earth System Science Department.

**Residency**

Academic Senate regulations specify a minimum period of residence of six quarters for Ph.D. candidates. Enrollment in a minimum of 12 units of graduate/upper-division course work per quarter is required. Registration in every regular academic session is necessary until all requirements for the degree have been completed, unless a formal Leave of Absence is granted by the Graduate Division. All Ph.D. requirements must be completed within 15 quarters in residence (five years), excluding summer quarters. Exceptions must be put to a vote of the Earth System Science faculty. The maximum time permitted is seven years.

**Comprehensive Examination**

Progress toward the degree and readiness to begin research is assessed by a comprehensive examination covering breadth, general knowledge, and the ability to integrate and use information covered in the core curriculum and other course work. At the end of the spring quarter, the ESS Comprehensive Examination Committee administers the written and oral examinations.

**Teaching and Seminar**

Students are required to complete a teaching assistant training program and to have a minimum of two quarters of experience as a teaching assistant, provided opportunities are available. Students can enroll in EARTHSS 399 while serving as a teaching assistant. Students are also expected to participate in the Earth System Science seminar.

**Advance to Ph.D. Candidacy**

Following completion of the Comprehensive Examination, those students who receive a recommendation to continue Ph.D. work will pursue research on a potential dissertation topic and then take the Advancement to Candidacy Examination. This oral examination is given by a faculty committee, including extra-departmental faculty. The normative time for advancement for candidacy is two years.

**Dissertation**

After advancing to candidacy, students are expected to be fully involved in research toward writing their Ph.D. dissertation. Students should keep in steady contact/interaction with their Doctoral Committee. A dissertation based on original research and demonstrating critical judgment, intellectual synthesis, creativity, and clarity in written communication is required for the Ph.D. degree. The dissertation must summarize the results of original research performed by the student under the supervision of a faculty member of the Department. The dissertation will be evaluated by the Dissertation Committee, based on suitability for publication in a peer-reviewed journal of high editorial standards. The dissertation may be a compilation of published papers or manuscripts accepted for publication, so long as the candidate has produced a major proportion of the material independently. The Dissertation Committee approves the format and content, which must meet University requirements for style, format, and appearance.

**Doctor of Philosophy in Earth System Science**

1. Completion of course work (9 courses, including core courses)
2. Six quarters in residence at UCI
3. Completion of the Comprehensive Examination, with recommendation to continue for the Ph.D.
4. Completion of the teaching and seminar requirements
5. Pass the Advancement to Candidacy Examination
6. Presentation of an open research seminar
7. Submission of an acceptable doctoral dissertation and formal defense.

Master of Science in Earth System Science
1. Completion of course work (8 courses, including core courses)
2. Three quarters in residence at UCI
3. Completion of the Comprehensive Examination.

Faculty
Steven D. Allison, Ph.D. Stanford University, Associate Professor of Ecology and Evolutionary Biology; Earth System Science
Elizabeth D. Crook, Ph.D. University of California, Santa Cruz, Lecturer with Potential Security of Employment of Earth System Science
Kristen A. Davis, Ph.D. Stanford University, Assistant Professor of Civil and Environmental Engineering; Earth System Science (coastal oceanography, fluid mechanics, turbulent flows)
Steven J. Davis, Ph.D. Stanford University, Department Vice Chair and Associate Professor of Earth System Science
Ellen R. Druffel, Ph.D. University of California, San Diego, Fred Kavli Chair in Earth System Science and Professor of Earth System Science
Julie E. Ferguson, Ph.D. Oxford University, Lecturer with Potential Security of Employment of Earth System Science
Michael L. Goulden, Ph.D. Stanford University, Professor of Earth System Science; Ecology and Evolutionary Biology
Claudia I. Green, Ph.D. Max Planck Institute, Associate Professor of Earth System Science
Alex Guenther, Ph.D. Washington State University, Professor of Earth System Science
Kathleen Johnson, Ph.D. University of California, Berkeley, Associate Professor of Earth System Science
Saewung Kim, Ph.D. Georgia Institute of Technology, Assistant Professor of Earth System Science
Katherine Mackey, Ph.D. Stanford University, Clare Booth Luce Assistant Professor of Earth System Science
Gudrun Magnusdottir, Ph.D. Colorado State University, Professor of Earth System Science
Adam Martiny, Ph.D. Technical University of Denmark, Associate Professor of Earth System Science; Ecology and Evolutionary Biology
Jefferson Moore, Ph.D. Oregon State University, Department Vice Chair and Professor of Earth System Science
Mathieu Morlighem, Ph.D. Ecole Centrale de Lyon, Assistant Professor of Earth System Science
Nathan Mueller, Ph.D. University of Minnesota, Assistant Professor of Earth System Science
Michael J. Prather, Ph.D. Yale University, UCI Distinguished Professor of Earth System Science
François W. Primeau, Ph.D. Massachusetts Institute of Technology, Professor of Earth System Science
Michael S. Pritchard, Ph.D. University of California, San Diego, Assistant Professor of Earth System Science
James T. Randerson, Ph.D. Stanford University, UCI Chancellor's Professor of Earth System Science; Ecology and Evolutionary Biology
William S. Reeburgh, Ph.D. Johns Hopkins University, Professor Emeritus of Earth System Science
Eric Rignot, Ph.D. University of Southern California, Department Chair and Donald Bren Professor of Earth System Science
Eric S. Saltzman, Ph.D. University of Miami, Professor of Earth System Science; Chemistry
Soroosh Sorooshian, Ph.D. University of California, Los Angeles, Director of the Center for Hydrometeorology and Remote Sensing (CHRS) and UCI Distinguished Professor of Civil and Environmental Engineering; Earth System Science (hydrology, hydrometeorology and hydroclimate modeling, remote sensing, water sources management)
Susan E. Trumbore, Ph.D. Columbia University, Professor of Earth System Science
Isabella Velicogna, Ph.D. Università degli Studi di Trieste, UCI Chancellor's Fellow and Professor of Earth System Science
Jasper A. Vrugt, Ph.D. University of Amsterdam, Associate Professor of Civil and Environmental Engineering; Earth System Science (complex systems, modeling, statistics, hydrology, geophysics, ecology, data, optimization, hydropower, data assimilation)

Laurel L. Wilkening, Ph.D. University of California, San Diego, Professor Emerita of Earth System Science

Jin Yi Yu, Ph.D. University of Washington, Professor of Earth System Science

Charles S. Zender, Ph.D. University of Colorado Boulder, Professor of Earth System Science; Computer Science

Courses

EARTHSS 1. Introduction to Earth System Science. 4 Units.
Covers the origin and evolution of the Earth, its atmosphere, and oceans, from the perspective of biogeochemical cycles, energy use, and human impacts on the Earth system.

(II and VA ).

EARTHSS 3. Oceanography. 4 Units.
Examines circulation of the world oceans and ocean chemistry as it relates to river, hydrothermal vent, and atmospheric inputs. Geological features, the wide variety of biological organisms, and global climate changes, such as greenhouse warming, are also studied.

(II, Va)

EARTHSS 5. The Atmosphere. 4 Units.
The composition and circulation of the atmosphere with a focus on explaining the fundamentals of weather and climate. Topics include solar and terrestrial radiation, clouds, and weather patterns.

(II, Va)

EARTHSS 7. Physical Geology. 4 Units.
Introduction to Earth materials and processes. Topics include rocks and minerals, plate tectonics, volcanoes, earthquakes, Earth surface processes, Earth resources, geologic time, and Earth history. Laboratory work involves hands-on study of geologic materials, maps, and exercises pertaining to geologic processes. Materials fee.

(II, Va)

EARTHSS 15. Introduction to Global Climate Change. 4 Units.
Introduction of scientific, technological, environmental, economic, and social aspects underlying the threat and understanding of global climate change. Human and natural drivers of climate. Impacts of climate on natural, managed, and human systems, including their vulnerability and ability to adapt.

(II and (VA or VIII )).

EARTHSS 17. Hurricanes, Tsunamis, and Other Catastrophes. 4 Units.
Introduction to the basic science and state of predictability of various natural catastrophic events including earthquakes, volcanic eruptions, tsunamis, landslides, floods, hurricanes, fires, and asteroid impacts and their interactions and implications with human society in the U.S. and globally.
Overlaps with PUBHLTH 90.

(II and (VA or VIII )).

EARTHSS 19. Introduction to Modeling the Earth System. 4 Units.
Simulate the Earth's system using computer models. Covers the interaction of the air, land, and ocean, and explores how changes to one part of the environment affect the complete Earth system. Utilizes technological tools to understand scientific principles.

(II, Vb)

EARTHSS 21. On Thin Ice: Climate Change and the Cryosphere. 4 Units.
Introduction of the basic science that governs the cryosphere and its interaction with the climate system. Covers some of the significant economic, sociological, and political consequences of the recent melting of the cryosphere driven by anthropogenic climate change.

(II and (VA or VIII )).

EARTHSS 23. Air Pollution: From Urban Smog to Global Change . 4 Units.
Air pollution occurs on regional to global scales. A wide range of air pollution sources and physical, chemical, and meteorological sciences behind air pollution are introduced. The consequences of air pollution to our society are also discussed.

(II and (VA or VIII )).
EARTHSS 27. The Sustainable Ocean. 4 Units.
An introduction to sustainability as it relates to marine resources and conservation. Topics include the scientific basis of our understanding of marine ecosystems, and the political, social, and cultural principles that govern resource protection.

(II and VIII).

EARTHSS H30B. Environmental Issues Affecting the Sustainability of Societies I. 4 Units.
Focuses on several environmental challenges facing the world today, and explores the problem, possible solutions, and their scientific, technical, and social constraints. Models for systems, their assumptions, predictive uncertainty, and interpretation, play a large role.

Prerequisite: CHEM H30A. CHEM H30A with a grade of C or better
Overlaps with EARTHSS 15.
Restriction: Campuswide Honors Program students only.

(II and Vb).

EARTHSS H30C. Environmental Issues Affecting the Sustainability of Societies II. 4 Units.
Focuses on how we can use Earth's resources, e.g., food and water, in a more sustainable way, exploring their scientific, technical, and social constraints.

Prerequisite: EARTHSS H30B. EARTHSS H30B with a grade of C or better
Restriction: Campuswide Honors Program students only.

(III)

EARTHSS 40A. Earth System Chemistry. 4 Units.
To understand the cycling of matter on Earth, we need to learn about the chemistry of elements and molecules in the environment. Introduces students to the understanding of how chemical principles apply in context to their everyday lives.

Restriction: Environmental Science and Policy Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment.

(II and VA).

EARTHSS 40B. Earth System Biology. 4 Units.
Earth System Science is a highly interdisciplinary field that requires knowledge of various components of the Earth as a system, including the biosphere. Students are introduced to several fundamental principles of biology, from the smallest cells to the largest ecosystems.

Prerequisite: EARTHSS 40A or CHEM 1C or CHEM H2C or CHEM M3C
Restriction: Environmental Science and Policy Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment.

(II)

EARTHSS 40C. Earth System Physics. 4 Units.
Covers the fundamental physical forces and laws that affect the Earth system, such as electromagnetic radiation and energy transfer, atmospheric and ocean dynamics. Also covers aspects of physics related to environmental issues, such as electricity generation and transmission.

Prerequisite: EARTHSS 40A or CHEM 1C or CHEM H2C or CHEM M3C
Restriction: Environmental Science and Policy Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment.

(II and VA).

EARTHSS 45. New Student Seminar. 1 Unit.
Weekly meetings led by faculty, current students, and staff, to provide information on the Department of Earth System Science, campus resources, and special programs and opportunities. Designed for students who recently joined the Earth System Science and Environmental Science majors.

Grading Option: Pass/no pass only.
Restriction: Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.
New students only (freshman, transfer, and change of major).
EARTHSS 51. Land Interactions. 4 Units.
The role of terrestrial processes in the Earth system. Provides an introduction to ecosystem processes that regulate the cycling of energy, water, carbon, and nutrients. Analysis of the impact of human activities. Materials fee.
Corequisite: CHEM 1C
Restriction: Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.

EARTHSS 53. Ocean Biogeochemistry. 4 Units.
Overview of oceanography for those interested in Earth System Science. Focus is on physical, chemical, and biological processes that drive biogeochemical cycling in the oceans. Coastal systems are also reviewed, with an emphasis on California waters.
Prerequisite: CHEM 1C
Restriction: Earth System Science Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment.

EARTHSS 55. Earth's Atmosphere. 4 Units.
Composition, physics, and circulation of Earth's atmosphere with an emphasis on explaining the role of atmospheric processes in shaping the climate system. Topics include atmospheric composition, the global energy balance, radiative transfer and climate, atmospheric circulation, and climate sensitivity.
Prerequisite: (MATH 2B or MATH 5B or AP Calculus BC) and (PHYSICS 3B or PHYSICS 7C or AP Physics C: Electricity and Magnetism). AP Calculus BC with a minimum score of 4. AP Physics C: Electricity and Magnetism with a minimum score of 5
Restriction: Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.

EARTHSS 60A. Fundamental Processes in Earth and Environmental Studies. 4 Units.
An introduction to the physical environment, biological systems, and human-environment interactions. Explores physical principles such as fluid transport and reaction rates using environmental examples as well as principles of populations, ecosystems, carrying capacity, and sustainable use of resources.
Prerequisite: CHEM 1B
Restriction: Earth System Science Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment.

EARTHSS 60B. Local and Regional Environmental Issues. 4 Units.
An introduction to common environmental issues using case studies from Orange County and California. Studies natural hazards as well as human-caused problems with air quality, water quality, coastal pollution, ecosystem degradation, and urban climate.
Prerequisite: EARTHSS 60A and (CHEM 1B or CHEM H2B)
Restriction: Earth System Science Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment.

EARTHSS 60C. Global Environmental Issues. 4 Units.
An overview of global environmental changes including climate change, sea level rise, biodiversity loss, land and ocean degradation, and resource depletion. Discusses scientific, cultural, historical, and policy dimensions of these issues as well as possible solutions.
Prerequisite: EARTHSS 60A and (CHEM 1B or CHEM H2B)

EARTHSS 70A. Sustainable Energy Systems. 4 Units.
Addresses how modern energy services can be provided sustainably and the challenges and barriers that must be overcome. Major environmental issues are discussed, such as climate change, air pollution, and resource demands.
Prerequisite: EARTHSS 40C or PHYSICS 3C or PHYSICS 7E
Restriction: Environmental Science and Policy Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.

EARTHSS 70B. Sustainable Food and Water Systems. 4 Units.
Explores the biophysical underpinnings of food production, the history of agricultural development, and a range of environmental issues facing agricultural systems, including water management, climate change, and land use.
Prerequisite: EARTHSS 40C or PHYSICS 3C or PHYSICS 7E
Restriction: Environmental Science and Policy Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.
EARTHSS 100. Special Topics in Earth System Science. 1-4 Units.
Devoted to current topics in the field of Earth System Science. Topics addressed vary each quarter.
Prerequisite: (EARTHSS 51 and EARTHSS 53 and EARTHSS 55) or (EARTHSS 60A and EARTHSS 60B and EARTHSS 60C)
Repeatability: May be taken for credit for 12 units as topics vary.
Restriction: Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.

EARTHSS 101. Paleoclimatology. 4 Units.
Explores past changes in Earth's climate. Topics include tools and techniques used to reconstruct past climate from natural archives; records and mechanisms of past climate changes throughout Earth history; and lessons learned from the paleo-record for prediction of future climate.
Prerequisite: (EARTHSS 60A and EARTHSS 60B and EARTHSS 60C) or (EARTHSS 51 and EARTHSS 53 and EARTHSS 55)
Restriction: Earth System Science Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment.
Concurrent with EARTHSS 201.

EARTHSS 110. Environmental Controversies. 4 Units.
Examines the roles and strategies of advocacy groups, scientists, lobbyists, celebrities, pundits, politicians, and other opinion-makers in creating and shaping public opinion on controversial environmental issues. Use and misuse of science to influence public opinion is elicited.
Prerequisite: (EARTHSS 60A and EARTHSS 60B and EARTHSS 60C) or EARTHSS 51 or EARTHSS 53 or EARTHSS 55
Restriction: Earth System Science Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment.

EARTHSS 112. Global Climate Change and Impacts. 4 Units.
Observations over the 20th century show extensive changes in atmospheric composition, climate and weather, and biological systems that have paralleled industrial growth. Evidence of globally driven changes in these biogeochemical systems is studied, including projected impacts over the 21st century.
Prerequisite: (EARTHSS 51 and EARTHSS 53 and EARTHSS 55) or (EARTHSS 60A and EARTHSS 60B and EARTHSS 60C) or (EARTHSS 70A and EARTHSS 70B)
Restriction: Environmental Science and Policy Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.
Concurrent with EARTHSS 222.

EARTHSS 114. Earth System Science Laboratory and Field Methods. 4 Units.
Introduction to methods used to measure exchange of gases and energy between the atmosphere and terrestrial ecosystems. Laboratories include data acquisition and isotopic and chromatographic analysis. Field measurements at UCI's Marsh Reserve include microclimate, hydrology, trace-gas exchange, and plant growth. Materials fee.
Prerequisite: (EARTHSS 51 and EARTHSS 53 and EARTHSS 55) or (EARTHSS 60A and EARTHSS 60B and EARTHSS 60C)
Restriction: Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.

EARTHSS 115. Aquatic Field Methods. 4 Units.
Students design sampling plans, conduct field research techniques, and carry out data analyses that are relevant to aquatic field research. Aquatic field sites covered in the course include marine, estuarine, and fluvial systems. Materials fee.
Prerequisite: (EARTHSS 51 and EARTHSS 53 and EARTHSS 55) or (EARTHSS 60A and EARTHSS 60B and EARTHSS 60C)
Restriction: Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.

EARTHSS 116. Data Analysis for Earth Sciences. 4 Units.
Analysis and interpretation of geophysical data, including functional fitting, probability density functions, and multidimensional time-series methods, with applications in atmospheric, oceanic, and biogeochemical sciences.
Prerequisite: (EARTHSS 51 and EARTHSS 53 and EARTHSS 55) or (EARTHSS 60A and EARTHSS 60B and EARTHSS 60C) or (EARTHSS 70A and EARTHSS 70B)
Restriction: Environmental Science and Policy Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.
EARTHSS 118. Programming for Earth System Science and Ecology. 4 Units.
Students learn programming and numerical methods in Python with applications in Earth System Science and ecology. Topics include regression, uncertainty and significance, the development of simple box models, and the visualization of multi-dimensional climate and satellite datasets.

Prerequisite: IN4MATX 41 or I&C SCI 31 or (EARTHSS 51 and EARTHSS 53 and EARTHSS 55) or (EARTHSS 60A and EARTHSS 60B and EARTHSS 60C)

Restriction: Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.

EARTHSS 122. Atmospheric Dynamics. 4 Units.
Fluid dynamical processes that determine the large-scale flow of the atmosphere and ocean. Most important are interactions between the density stratification and the Coriolis force associated with Earth's rotation. Topics include circulation, vorticity, planetary waves, and their role in climate.

Prerequisite: EARTHSS 55 and MATH 2D and PHYSICS 7C

Restriction: Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.

EARTHSS 124. Weather Analysis. 4 Units.
Provides an overview of weather systems in midlatitudes and tropics. The fundamental dynamics possible for these weather systems are described. Elementary weather analysis and forecasting techniques are introduced.

Prerequisite: EARTHSS 55 or EARTHSS 60A

Restriction: Earth System Science Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment.

EARTHSS 130. Physical Oceanography. 4 Units.
Physical processes that determine the distribution of water properties such as salt and temperature. Fluid-dynamical underpinnings of physical oceanography. Wave motions. The wind-driven and thermohaline circulation. Similarities and differences between ocean and atmosphere dynamics.

Prerequisite: MATH 2D and PHYSICS 7C and (EARTHSS 53 or EARTHSS 60A)

Restriction: Earth System Science Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment.

EARTHSS 132. Terrestrial Hydrology. 4 Units.
Comprehensive treatment of modern conceptual and methodological approaches to hydrological science. Combines qualitative understanding of hydrological processes with quantitative representation, approaches to measurement, and treatment of uncertainty. Components of the hydrological cycle and their linkages within the coupled Earth system.

Prerequisite: EARTHSS 60A or (EARTHSS 51 and EARTHSS 55) or (EARTHSS 40C and EARTHSS 70B)

Restriction: Environmental Science and Policy Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.

EARTHSS 134. Fundamentals of GIS for Environmental Science. 4 Units.
Introduction to Geographic Information Systems (GIS). Topics include fundamentals of cartography, creating/editing GIS data, linking spatial and tabular data, georeferencing, map projections, geospatial analysis, spatial statistics, and the development of GIS models. Examples from hydrology, ecology, and geology.

Prerequisite: (EARTHSS 60A and EARTHSS 60B) or (EARTHSS 51 and EARTHSS 53) or (EARTHSS 70A and EARTHSS 70B)

Overlaps with CRM/LAW C148.

Restriction: Environmental Science and Policy Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.

EARTHSS 138. Satellite Remote Sensing for Earth System Science. 4 Units.
Satellite remote sensing data are increasingly used to study the Earth system. Provides an overview of the principles behind remote sensing, and the types of satellite data available for study of the oceans, land, and atmosphere.

Prerequisite: EARTHSS 51 or EARTHSS 53 or EARTHSS 60A or EARTHSS 60C

Restriction: Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.
EARTHSS 140. Advanced Geology. 4 Units.
Introduces students to the geological processes which have formed and continue to shape the Earth. Topics will include geological time, minerals and the rock cycle, plate tectonics and associated geological hazards, earth resources, and earth surface processes. Materials fee.
Prerequisite: EARTHSS 51 or EARTHSS 60A
Overlaps with EARTHSS 7.
Restriction: Earth System Science Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment.

EARTHSS 142. Atmospheric Chemistry. 4 Units.
Chemistry of the troposphere and stratosphere. Topics include processes controlling the lifetime and reaction pathways of chemicals in the atmosphere, the role of the atmosphere in biogeochemical cycles, and interactions between atmospheric chemistry and the physical climate system.
Prerequisite: (CHEM 1C or CHEM H2C or CHEM M3C) and (PHYSICS 3C or PHYSICS 7E) and (MATH 2B or MATH 5B or AP Calculus BC). AP Calculus BC with a minimum score of 4
Restriction: Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.

EARTHSS 144. Marine Geochemistry and Biogeochemistry. 4 Units.
Processes controlling the major and minor element composition of seawater and element distributions in the ocean. Gas exchange, carbon dioxide system, stable isotopes, radionuclides as tracers and chronometers, particle fluxes, organic geochemistry, sediment geochemistry, global cycles of biogeochemically important elements.
Prerequisite: (EARTHSS 53 or EARTHSS 60A or CHEM 51C) and (CHEM 1C or CHEM H2C or CHEM M3C)
Restriction: School of Physical Sciences students have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.

EARTHSS 146. Consequences of Air Pollution. 4 Units.
From public health to the global climate system, this course explores the impacts of air pollution from the beginning of human history to current and emerging issues. Scientific concepts behind air pollution and solutions will be discussed.
Prerequisite: (EARTHSS 60A and EARTHSS 60B and EARTHSS 60C) or (EARTHSS 51 and EARTHSS 53 and EARTHSS 55) or EARTHSS 40C
Restriction: Environmental Science and Policy Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.

EARTHSS 148. Marine Ecosystems and Global Change. 4 Units.
Presents an overview of marine ecosystem structure, diversity, and processes in the context of global change, including the impacts of climate warming, ocean acidification, marine fisheries, and anthropogenic additions of nutrients and pollutants.
Prerequisite: EARTHSS 53 or (EARTHSS 60A and EARTHSS 60C)
Restriction: Earth System Science Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment.
Concurrent with EARTHSS 248.

EARTHSS 152. Environmental Isotope Geochemistry. 4 Units.
Topics include the fundamentals of stable, radioactive, and radiogenic isotope variability in the Earth System. Focuses on theory, measurement techniques, biogeochemistry, hydrology, ecology, and climate related applications.
Prerequisite: (EARTHSS 51 and EARTHSS 53 and EARTHSS 55) or (EARTHSS 60A and EARTHSS 60B and EARTHSS 60C)
Restriction: Earth System Science Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment.
Concurrent with EARTHSS 252.

EARTHSS 158. Research Methods for Sustainable Systems Analysis. 4 Units.
Develops students' analytical skills that are necessary to engage and assess the sustainability of coupled human and natural systems and effectively communicate their findings.
Prerequisite: Satisfactory completion of the Lower-Division Writing requirement.
Restriction: Upper-division students only. Earth System Science Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment. Global Sustainability Minors have first consideration for enrollment.
EARTHSS 162. The Impact of Climate Change on California’s Landscape. 4 Units.
Overview of anticipated impacts of climate change on California’s landscape. Includes projections of future climate; anticipated impacts on ecology, hydrology, wildfire, coastal environment, and agriculture; and efforts to reduce greenhouse gas emissions or adapt to climate change through land management.

Prerequisite: (EARTHSS 51 and EARTHSS 53 and EARTHSS 55) or (EARTHSS 60A and EARTHSS 60B and EARTHSS 60C) or (EARTHSS 70A and EARTHSS 70B)

Restriction: Environmental Science and Policy Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.

EARTHSS 164. Ecosystem Ecology. 4 Units.
A mechanistic perspective on ecosystem processes. Covers ecosystem development, element cycling, and interactions with plants and microbes. The role of ecosystems in environmental change is also addressed.

Prerequisite: BIO SCI E106 or EARTHSS 51 or EARTHSS 60A or CHEM 51C

Same as BIO SCI E118.

Restriction: Earth System Science Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment. Ecology and Evolutionary Biol Majors have first consideration for enrollment.

Concurrent with EARTHSS 264.

EARTHSS 166. Physiological Plant Ecology. 4 Units.
An examination of the interactions between plants and their environment. Emphasis on the underlying physiological mechanisms of plant function, adaptations and responses to stress, and the basis of the distribution of plants and plant assemblages across the landscape.

Prerequisite: (EARTHSS 51) or (EARTHSS 60A and EARTHSS 60C) or (BIO SCI E106)

Same as BIO SCI E127.

Restriction: Biological Sciences Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment. Earth System Science and Environmental Science and Biological Sciences majors have first consideration for enrollment.

EARTHSS 170. Environmental Microbiology. 4 Units.
Establishes a fundamental understanding of microbes living in the environment, including their distribution, diversity, and biochemistry, and discusses how they attribute to global biogeochemical cycles.

Prerequisite: (EARTHSS 53) or (EARTHSS 60A and EARTHSS 60C) or (BIO SCI E106 and BIO SCI M122)

Same as BIO SCI E163.

Concurrent with EARTHSS 270.

EARTHSS 174. Ice in the Climate System. 4 Units.
Examines the major components of the Earth’s cryosphere. Characteristics, volume, extent, remote sensing observations, long-term trends, mass balance, key physical processes, relevance and importance to the climate system, responses and feedbacks, future evolution, and key uncertainties will be discussed.

Prerequisite: (EARTHSS 60A and EARTHSS 60B and EARTHSS 60C) or (EARTHSS 51 and EARTHSS 53 and EARTHSS 55)

Restriction: Earth System Science Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment.

Concurrent with EARTHSS 274.
EARTHSS 176W. Marine Conservation, Policy, and Society. 4 Units.
Conservation of marine ecosystems is important yet challenging due to competing physical, ecological, social, and regulatory issues. Students explore the principles of marine conservation, the scientific basics of marine ecosystems, and political and social processes involved with resource protection.

Prerequisite: (EARTHSS 51 and EARTHSS 53 and EARTHSS 55) or (EARTHSS 60A and EARTHSS 60B and EARTHSS 60C) or (EARTHSS 70A and EARTHSS 70B). Satisfactory completion of the Lower-Division Writing requirement.

Restriction: Upper-division students only. Environmental Science and Policy Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment. (Ib)

EARTHSS 177W. Documenting and Understanding Earth System Change. 4 Units.
Students select a time series of key environmental interest as the focus for their writing. They become familiar with common writing practices for the Earth Sciences, and exercise their ability to use the scientific method to produce reports.

Prerequisite: (EARTHSS 51 and EARTHSS 53 and EARTHSS 55) or (EARTHSS 60A and EARTHSS 60B and EARTHSS 60C) or (EARTHSS 70A and EARTHSS 70B)

Restriction: Upper-division students only. Environmental Science and Policy Majors only. Environmental Science Majors only. Earth System Science Majors only. (Ib)

EARTHSS 178. Solving the Energy-Carbon-Climate Problem. 4 Units.
Why is climate change such a difficult problem? What can we do about it? The course will introduce the global politics of energy and climate, assess options for decreasing energy demand, generating low-carbon energy, sequestering carbon, geoengineering, and adaptation.

Prerequisite: (EARTHSS 60A and EARTHSS 60B and EARTHSS 60C) or (EARTHSS 51 and EARTHSS 53 and EARTHSS 55)

Restriction: Earth System Science Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment.

EARTHSS 180. Environmental Sustainability I. 4 Units.
Provides an introduction to sustainability from different points of view: historical, scientific, political, ethical, and economic.

Same as UPPP 131.

Restriction: Social Ecology Majors have first consideration for enrollment. Urban Studies Majors have first consideration for enrollment.

EARTHSS 182. Environmental Sustainability II. 4 Units.
Investigates how sustainability can be implemented in a variety of contexts including water, energy, non-renewable resources, biodiversity, and urban policy, and also how it could be measured.

Same as UPPP 132.

Restriction: Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment. Social Ecology Majors have first consideration for enrollment. Urban Studies Majors have first consideration for enrollment.

EARTHSS 190A. Senior Seminar on Global Sustainability I. 2 Units.
Students attend weekly seminar to discuss current issues in global sustainability. Weekly attendance at Global Sustainability Forum is also required. Seminar utilized to analyze forum presentations. Prepare bibliography.

Same as BIO SCI 191A, SOCECOL 186A.

Restriction: Seniors only. Global Sustainability Minors have first consideration for enrollment.

EARTHSS 190B. Senior Seminar on Global Sustainability II. 2 Units.
Students attend weekly seminar to discuss current issues in global sustainability. Weekly attendance at Global Sustainability Forum is also required. Seminar utilized to analyze forum presentations. Prepare research proposal.

Prerequisite: BIO SCI 191A or SOCECOL 186A or EARTHSS 190A

Same as BIO SCI 191B, SOCECOL 186B.

Restriction: Seniors only.
EARTHSS 190CW. Writing/Senior Seminar on Global Sustainability III. 4 Units.
Students attend weekly seminar to discuss current issues in global sustainability. Weekly attendance at Global Sustainability Forum also is required. Seminar utilized to analyze Forum presentations and to prepare senior research paper. Prepare/write research paper under direction of faculty member.
Prerequisite: BIO SCI 191B or EARTHSS 190B or SOCECOL 186B. BIO SCI 191B or EARTHSS 190B or SOCECOL 186B. Satisfactory completion of the Lower-Division Writing requirement.
Same as BIO SCI 191CW, SOCECOL 186CW.
Restriction: Seniors only.

EARTHSS 191. Introduction to Research in Earth System Science. 1 Unit.
Weekly presentations by Earth System Science faculty describing ongoing research in their laboratories. Students are introduced to the range of research topics and methods in Earth System Science and to the research opportunities available within the Department.
Prerequisite: (EARTHSS 60A and EARTHSS 60B) or (EARTHSS 51 and EARTHSS 53)
Grading Option: Pass/no pass only.
Restriction: Earth & Atmospheric Sciences Minors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.

EARTHSS 192. Careers in Earth System Science. 1 Unit.
A weekly seminar course designed to help students transition to post-graduation career paths. Topics include designing effective resumes, applying to graduate school, and seeking employment. Also includes presentations by faculty, business, and government leaders describing potential environmental science career trajectories.
Grading Option: Pass/no pass only.
Restriction: Environmental Science and Policy Majors have first consideration for enrollment. Environmental Science Majors have first consideration for enrollment. Earth System Science Majors have first consideration for enrollment.

EARTHSS 197. Independent Study in Earth System Science. .5-4 Units.
Field study, educational outreach, or other independent projects under faculty direction. Interested students should arrange with an ESS faculty member to supervise and support an independent study project. A written summary is required at the end of each quarter.
Grading Option: Pass/no pass only.
Repeatability: May be taken for credit for 12 units.

EARTHSS 198W. Senior Thesis in Earth System Science. 4 Units.
Students receive guidance on the effective oral and written communication of research results. Students prepare and present a seminar, a poster, and a written thesis describing their research in Earth System Science.
Prerequisite: Two quarters of EARTHSS 199. Satisfactory completion of the Lower-Division Writing requirement.
Overlaps with EARTHSS H198.

EARTHSS H198. Honors Thesis in Earth System Science. 4 Units.
Students receive guidance on effective written and oral communication of research results. Students prepare and present a seminar, poster, and written thesis describing their honors research in Earth System Science. Submission of the thesis and successful completion of this course will also satisfy the UCI upper-division writing requirement.
Prerequisite: ESS 199A and ESS 199B
Restriction: Consent of instructor to enroll and Prerequisite required

EARTHSS 199. Undergraduate Research. 1-4 Units.
For undergraduates with majors in science or engineering. Interested students should arrange with an ESS faculty member to supervise and support a research project. A written summary is required at the end of each quarter.
Repeatability: May be taken for credit for 12 units.
EARTHSS H199A. Honors Research in Earth System Science. 4 Units.
Undergraduate honors research in Earth System Science. A student commitment of 10-15 hours a week is expected, and a written report is required at the end of the quarter.

Restriction: Earth System Science Honors students only. Campuswide Honors Program students only.

EARTHSS H199B. Honors Research in Earth System Science. 4 Units.
Undergraduate honors research in Earth System Science. A student commitment of 10-15 hours a week is expected, and a written report is required at the end of the quarter.

Restriction: Earth System Science Honors students only. Campuswide Honors Program students only.

EARTHSS H199C. Honors Research in Earth System Science. 4 Units.
Undergraduate honors research in Earth System Science. A student commitment of 10-15 hours a week is expected, and a written report is required at the end of the quarter.

Restriction: Earth System Science Honors students only. Campuswide Honors Program students only.

EARTHSS 200. Global Physical Climatology. 4 Units.
A descriptive overview of Earth’s climate system and energy budget. Large-scale circulations, key physical processes, and climate sensitivity of the atmosphere, ocean, land surface, and cryosphere.

Restriction: Graduate students only.

EARTHSS 201. Paleoclimatology. 4 Units.
Explores past changes in Earth's climate. Topics include tools and techniques used to reconstruct past climate from natural archives; records and mechanisms of past climate changes throughout Earth history; and lessons learned from the paleo-record for predication of future climate.

Restriction: Graduate students only.
Concurrent with EARTHSS 101.

EARTHSS 202. Climate Change. 4 Units.
Explores past, present, and projected changes in Earth's climate. Topics include paleoclimate records and mechanisms of natural climate variability at a range of timescales (orbital to seasonal); General Circulation Models; and IPCC observations and projections of future climate change.

Restriction: Graduate students only.

EARTHSS 204. Humans in the Earth System. 4 Units.
Focuses on the human systems of energy and food production which have the greatest effects on the Earth system. Assess the physical mechanisms and feedbacks of human-nature interactions and consider approaches of mitigation, interventions, and adaptation.

Restriction: Graduate students only. Earth System Science Majors only.

EARTHSS 212. Geoscience Modeling and Data Analysis. 4 Units.
Computer-based course. Fundamental statistical techniques needed to analyze Earth system data and models. Basic numerical techniques to solve Earth system models. Focuses on linear and non-linear ordinary differential equations, as well as simple partial differential equations.

Restriction: Graduate students only.

EARTHSS 222. Global Climate Change and Impacts. 4 Units.
Observations over the 20th century show extensive changes in atmospheric composition, climate and weather, and biological systems that have paralleled industrial growth. Evidence of globally driven changes in these biogeochemical systems is studied, including projected impacts over the 21st century.

Concurrent with EARTHSS 112.

EARTHSS 224. Ocean Processes. 4 Units.
Introduction to the physics, chemistry, and biology of the oceans. Offers a mechanistic perspective of the structure and functioning of marine ecosystems, nutrient cycles, and role of ecosystem dynamics in local and global biogeochemistry.

Restriction: Graduate students only.
EARTHSS 226. Land Surface Processes. 4 Units.
A mechanistic perspective of the structure and functioning of terrestrial ecosystems. Includes processes such as nutrient cycling, biogeochemical cycling, mass balance, energetics, terrestrial hydrology, and water cycle.

Restriction: Graduate students only.

EARTHSS 228. Geophysical Fluid Dynamics. 4 Units.
Introduces fluid dynamical processes that determine the large-scale flow of the atmosphere and ocean, with particular emphasis on the interactions between the stable density stratification and the Coriolis force associated with Earth's rotation.

Restriction: Graduate students only.

EARTHSS 228. Geophysical Fluid Dynamics. 4 Units.
Introduces fluid dynamical processes that determine the large-scale flow of the atmosphere and ocean, with particular emphasis on the interactions between the stable density stratification and the Coriolis force associated with Earth's rotation.

Restriction: Graduate students only.

EARTHSS 228. Geophysical Fluid Dynamics. 4 Units.
Introduces fluid dynamical processes that determine the large-scale flow of the atmosphere and ocean, with particular emphasis on the interactions between the stable density stratification and the Coriolis force associated with Earth's rotation.

Restriction: Graduate students only.

EARTHSS 238. Satellite Remote Sensing for Earth System Science. 4 Units.
Satellite remote sensing data are increasingly used to study the Earth system. Provides an overview of the principles behind remote sensing, and the types of satellite data available for study of the oceans, land, and atmosphere.

EARTHSS 240. Atmospheric Chemistry and Physics. 4 Units.
Examines the physical/chemical processes which determine the structure and composition of Earth's atmosphere and its role in the climate system.

Restriction: Graduate students only.

EARTHSS 242. Advanced Atmospheric Chemistry. 4 Units.
Chemistry of the troposphere and stratosphere. Topics include: processes controlling the lifetime and reaction pathways of chemicals in the atmosphere, the role of the atmosphere in biogeochemical cycles, and interactions between atmospheric chemistry and the physical climate system.

Restriction: Graduate students only.

EARTHSS 248. Marine Ecosystems and Global Change. 4 Units.
Presents an overview of marine ecosystem structure, diversity, and processes in the context of global change, including the impacts of climate warming, ocean acidification, marine fisheries, and anthropogenic additions of nutrients and pollutants.

Prerequisite: EARTHSS 224

Restriction: Graduate students only.

Concurrent with EARTHSS 148.

EARTHSS 252. Environmental Isotope Geochemistry. 4 Units.
Covers the fundamentals of stable, radioactive, and radiogenic isotope variability in the Earth System. Focuses on theory, measurement techniques, biogeochemistry, hydrology, ecology, and climate related applications.

Restriction: Graduate students only.

Concurrent with EARTHSS 152.

EARTHSS 256. Paleoclimatology and Paleoceanography. 4 Units.
Explores past changes in Earth's climate. Topics include tools and techniques used to reconstruct past climate from natural archives; records and mechanisms of past climate changes throughout Earth history; and lessons learned from the paleo-record for prediction of future climate.

Restriction: Graduate students only.

EARTHSS 264. Ecosystem Ecology. 4 Units.
A mechanistic perspective on ecosystem processes. Covers ecosystem development, element cycling, and interactions with plants and microbes. The role of ecosystems in environmental change is also addressed.

Prerequisite: CHEM 51C

Concurrent with EARTHSS 164 and BIO SCI E118.

EARTHSS 266. Global Biogeochemical Cycles. 4 Units.
Global biogeochemical cycling of the elements. Topics include global cycling of carbon, nitrogen, oxygen, and sulfur; impact of human activities on biogeochemical processes.

Restriction: Graduate students only.
EARTHSS 274. Ice in the Climate System. 4 Units.
Examines the major components of the Earth's cryosphere. Characteristics, volume, extent, remote sensing observations, long-term trends, mass balance, key physical processes, relevance and importance to the climate system, responses and feedbacks, future evolution, and key uncertainties will be discussed.

Concurrent with EARTHSS 174.

EARTHSS 280A. Special Topics in Earth System Science. 1-4 Units.
Each quarter is devoted to current topics in the field of Earth System Science. Topics addressed vary each quarter.

Repeatability: Unlimited as topics vary.

EARTHSS 280B. Special Topics in Earth System Science. 1-4 Units.
Each quarter is devoted to current topics in the field of Earth System Science. Topics addressed vary each quarter.

Prerequisite: EARTHSS 280A

Repeatability: Unlimited as topics vary.

EARTHSS 280C. Special Topics in Earth System Science. 1-4 Units.
Each quarter is devoted to current topics in the field of Earth System Science. Topics addressed vary each quarter.

Prerequisite: EARTHSS 280B

Repeatability: Unlimited as topics vary.

EARTHSS 282C. Special Topics in Climate. 1-4 Units.
Each quarter is devoted to in-depth analysis of an important and rapidly developing area in the field of climate dynamics. Topics addressed vary each quarter.

Prerequisite: EARTHSS 282B

Repeatability: Unlimited as topics vary.

Restriction: Graduate students only.

EARTHSS 284A. Special Topics in Atmospheric Chemistry. 1-4 Units.
Each quarter is devoted to current topics in the field of Atmospheric Chemistry. Topics addressed vary each quarter.

Repeatability: Unlimited as topics vary.

EARTHSS 284B. Special Topics in Atmospheric Chemistry. 1-4 Units.
Each quarter is devoted to current topics in the field of Atmospheric Chemistry. Topics addressed vary each quarter.

Prerequisite: EARTHSS 284A

Repeatability: Unlimited as topics vary.

EARTHSS 284C. Special Topics in Atmospheric Chemistry. 1-4 Units.
Each quarter is devoted to current topics in the field of Atmospheric Chemistry. Topics addressed vary each quarter.

Prerequisite: EARTHSS 284B

Repeatability: Unlimited as topics vary.

EARTHSS 286A. Special Topics in Biogeochemistry. 1-4 Units.
Each quarter is devoted to in-depth analysis of a subarea in biogeochemistry which is undergoing rapid development. Topics addressed vary each quarter.

Repeatability: Unlimited as topics vary.

Restriction: Graduate students only.
EARTHSS 286B. Special Topics in Biogeochemistry. 1-4 Units.
Each quarter is devoted to in-depth analysis of a subarea in biogeochemistry which is undergoing rapid development. Topics addressed vary each quarter.
Prerequisite: EARTHSS 286A
Repeatability: Unlimited as topics vary.
Restriction: Graduate students only.

EARTHSS 286C. Special Topics in Biogeochemistry. 1-4 Units.
Each quarter is devoted to in-depth analysis of a subarea in biogeochemistry which is undergoing rapid development. Topics addressed vary each quarter.
Prerequisite: EARTHSS 286B
Repeatability: Unlimited as topics vary.
Restriction: Graduate students only.

EARTHSS 288A. Special Topics in Ecosystems. 1-4 Units.
Each quarter is devoted to current topics relating to Ecosystems. Topics addressed vary each quarter.
Repeatability: Unlimited as topics vary.

EARTHSS 288B. Special Topics in Ecosystems. 1-4 Units.
Each quarter is devoted to current topics relating to Ecosystems. Topics addressed vary each quarter.
Prerequisite: EARTHSS 288A
Repeatability: Unlimited as topics vary.

EARTHSS 288C. Special Topics in Ecosystems. 1-4 Units.
Each quarter is devoted to current topics relating to Ecosystems. Topics addressed vary each quarter.
Prerequisite: EARTHSS 288B
Repeatability: Unlimited as topics vary.

EARTHSS 290. Seminar. 1 Unit.
Weekly seminars and discussions on topics of general and current interest in Earth System Science. Topics addressed vary each quarter.
Grading Option: Satisfactory/unsatisfactory only.
Repeatability: Unlimited as topics vary.
Restriction: Graduate students only.

EARTHSS 298. Practicum in Earth System Science. 4 Units.
Designed to introduce first-year graduate students to research. Students explore research opportunities and develop a proposal for a summer research project under the direction of a faculty mentor.
Restriction: Graduate students only.

EARTHSS 299. Research. 2-12 Units.
Supervised original research in areas of Earth System Science.
Repeatability: May be repeated for credit unlimited times.

EARTHSS 399. University Teaching. 1-4 Units.
Limited to Teaching Assistants.
Grading Option: Satisfactory/unsatisfactory only.
Repeatability: May be repeated for credit unlimited times.
Restriction: Graduate students only.