

Environmental Systems

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There can be little doubt that in the twenty-first century the global human community is facing a substantial growth in the environmental consequences of providing food, energy, materials, and basic services to a population of more than six billion inhabitants. The Environmental Systems Program recognizes the growing demand for environmental specialists and is designed to prepare undergraduates to enter a broad spectrum of environmental careers and graduate programs in, for example, the natural sciences, the social sciences, public policy, law, and business.

This interdisciplinary program recognizes that local, national, regional, international, and global environmental problems do not fit neatly into traditional academic departments. A measurable part of society's inability to effectively manage

complex environmental problems stems from the lack of specialists who can apply analytical tools that cross disciplinary boundaries. Many environmental specialists possess little training in the natural sciences including both the fundamental ideas and methodologies of the earth and *environmental sciences*. The environmental systems major was created to address both of these shortcomings.

To encourage and foster an interdisciplinary focus in the major, the Environmental Systems Program is supported by a wide range of UCSD faculty representing the natural sciences, the social sciences, the humanities, engineering, and medicine. The program includes a required lower-division core, an upper-division "integrating course sequence," two other upper-division courses and statistics, an advanced track, and a senior integrative project and seminar. There is a strong emphasis on a rigorous natural science foundation as well as an introduction to the policy sciences for all students enrolled in the major.

The Environmental Systems program places a significant value on interdisciplinary problem solving and all majors are expected to complete an integrative Senior Project in their final year. The Senior Project is designed by the student to focus on an interdisciplinary environmental problem or research topic. Appropriate topics for the Senior Project could conceivably include biodiversity conservation, coastal zone management, environmental health, climate change, environmental justice, and/or urban air quality. An important component of the Senior Project is an off-campus or laboratory internship where students might work on, for example, the development of a comprehensive management plan for a threatened ecosystem. The Senior Seminar provides a venue for the presentation and group evaluation of the ESYS Senior Projects.

The Environmental Systems Major

The requirements for completion of the environmental systems major include a lower-division core, two upper-division courses, a three course upper-division integrating sequence (ESYS 101, ESYS 102, ESYS 103), an upper-division statistics course, advanced courses in one of four tracks, and the senior project (ESYS 190A) and senior seminar (ESYS 190B). Any questions concerning the requirements should be directed to the associate director or the program adviser.

Students completing the advanced tracks

in "Earth Sciences," "Ecology, Behavior, and Evolution," and "Environmental Chemistry" will be awarded a B.S. in environmental systems. The B.A. in environmental systems will be granted to students completing the "Environmental Policy" track within the major.

A grade-point average of 2.0 or higher in the upper-division major program is required for graduation. Students must receive a grade of C- or better in any course to be counted toward fulfillment of the major requirements. In exceptional cases, students with a grade-point average in the major of 2.5 or greater may petition to have one grade of D accepted.

LOWER-DIVISION CORE REQUIREMENTS

(Should be completed early in student's degree program.)

Biology 3—BILD 3

Chemistry 6A, 6B, 6BL, 6C—Environmental Chemistry track students must also complete Chemistry 6CL

Physics 1A, 1AL, 1B, 1BL, 1C, 1CL—Earth Sciences track students complete Physics 2A-B-C

Mathematics 10A, 10B, 10C—Earth Sciences track students may complete Math. 20A-B-C instead and Math. 20D is recommended

Economics 1A

UPPER-DIVISION CORE REQUIREMENTS

Economics 131. Economics of the Environment
Political Science 160AA. Introduction to Policy Analysis

"Integrating Course Sequence"

(Should be taken junior year.)

Environmental Systems 101. The Living Earth
Environmental Systems 102. The Solid and Fluid Earth

Environmental Systems 103. The Human Earth
Environmental Systems 190A. Senior Project (two quarters)

Environmental Systems 190B. Senior Seminar

Special Studies Courses

Special studies in the environmental systems is offered as Esys 199. This course is subject to consent of the instructor and approval by the Environmental Systems faculty adviser. This course is open to students who have accrued at least ninety quarter-units and have a GPA of least 3.0. No more than two quarters of environ-

mental systems special studies may be counted toward any environmental systems major.

Environmental Systems Major Tracks

There are four advanced tracks in which students must complete a minimum of seven upper-division courses. Students will select courses following the requirements below in consultation with a faculty adviser.

Earth Sciences
Ecology, Behavior, and Evolution
Environmental Chemistry
Environmental Policy

It is possible to complete the requirements for any of the Environmental Systems tracks with five upper-division electives and a specialization that consists of two additional upper-division electives from any other track. For example, a student interested in the policy and scientific dimensions of habitat conservation planning for endangered species might plan a course of study to include five advanced courses from the Ecology, Behavior, and Evolution track and two advanced courses from the Environmental Policy track.

Earth Sciences Track

Required upper-division courses:

ERTH 101. Introduction to Earth and Environmental Sciences
ERTH 102. Introduction to Geochemistry
MATH 183. Statistical Methods (This statistics course, required in sophomore year)
Upper-division electives: (must complete a minimum of seven courses)

Solid Earth emphasis:

ERTH 104. Geobiology
ERTH 105. Sedimentology and Stratigraphy
ERTH 120. Introduction to Mineralogy
ERTH 130. Geodynamics of Terrestrial Planets
ERTH 144. Isotope Geochemistry
ERTH 160. Introduction to Tectonics
ERTH 162A. Introduction to Field Geology
ERTH 162L. Structural Analysis for Field Geology
ESYS 120. Science and Environmental Writing
SIO 210. Physical Oceanography
SIO 260. Marine Chemistry
SIO 240. Marine Geology
Other EARTH/SIO courses by petition

Ocean/Atmosphere emphasis:

ERTH 142. Atmospheric Chemistry and Biochemical Cycles
Chemistry 149A. Environmental Chemistry
Chemistry 173. Atmospheric Chemistry
SIO 240. Marine Geology
SIO 269. Special Topics in Marine Chemistry
SIO 280. Biological Oceanography
Other courses may be substituted by petition.

CURRICULUM GUIDE PLANNING

FALL	WINTER	SPRING
FRESHMAN		
Chem. 6A Math. 20A	Chem. 6B Math. 20B BILD 3	Chem. 6C Math. 20C Chem. 6BL
SOPHOMORE		
Math. 20D (recommended) Phys. 2A Poli. 160AA	Phys. 2B Econ. 131 Econ. 1A	Phys. 2C UD Esys elective
JUNIOR		
ERTH 101 ESYS 101 Math. 183	ERTH 102 ESYS 102 UD ESYS elective	UD ESYS elective ESYS 103 UD ESYS elective
SENIOR		
ESYS 190A UD ESYS elective	ESYS 190A UD ESYS elective	ESYS 190B UD ESYS elective

Ecology, Behavior, and Evolution Track

Required upper-division courses:

BICD 100. Genetics
BIEB 100. Biometry (satisfies upper-division statistics requirement)

Upper-division electives [a total of seven courses required, one of which must be a lab course, selected from the courses below.]
Students may satisfy some part of the upper-division elective requirements through enrollment in the Environmental Biology Program at the White Mountain Research Station (WMRS). The courses that make up this program are listed below as BIEB 170-171-172. For details contact the Environmental Systems Program office.
BIBC 100. Structural Biochemistry
BIBC 102. Metabolic Biochemistry
BIBC 103. Biochemical Techniques
BIBC 115. Computer Programming in Biology
BIBC 120. Nutrition
BIBC 130. Marine Biochemistry
BICD 110. Cell Biology
BICD 120. Fundamental of Plant Biology

BICD 130. Embryos, Genes, and Development
BICD 134. Human Reproduction and Development
BIEB 102. Introductory Ecology—Organisms and Habitats
BIEB 120. General Ecology
BIEB 121. Ecology Laboratory
BIEB 126. Plant Ecology
BIEB 132. Introduction to Marine Biology
BIEB 140. Biodiversity
BIEB 150. Evolution
BIEB 156. Population Genetics
BIEB 164. Behavioral Ecology
BIEB 166. Animal Communication
BIEB 170. Field Ecology (WMRS)
BIEB 171. Physiological Ecology (WMRS)
BIEB 172. Applied Conservation Biology (WMRS)
BIEB 176. Conservation and the Human Predicament
BIEB 178. Principles of Conservation Ecology
BIEB 179. Conservation Biology Laboratory
BIEB 180. Principles of Conservation Genetics
BIMM 100. Molecular Biology
BIMM 110. Molecular Basis of Disease
BIMM 114. Virology
BIMM 120. Bacteriology
BIMM 121. Laboratory in Microbiology
BIMM 124. Medical Microbiology
BIMM 126. Environmental Microbiology (BIMM120/BIBC 102 prerequisites **WAIVED**.)
BIMM 127. Environmental Microbiology Laboratory
BIPN 100. Mammalian Physiology I
BIPN 102. Mammalian Physiology II
BIPN 105. Animal Physiology Lab (6)
BIPN 106. Comparative Physiology (4)
ERTH 150. Environmental Perils
ESYS 150. Science and Environmental Writing
Other courses may be substituted by petition.

CURRICULUM GUIDE PLANNING

FALL	WINTER	SPRING
FRESHMAN		
Chem. 6A Math. 10A	Chem. 6B Chem. 6BL Math. 10B	Chem. 6C Math. 10C BILD 3
SOPHOMORE		
Phys. 1A, 1AL Econ. 1A Poli. 160AA	Phys. 1B, 1BL Econ. 131 BIEB 100 (statistics)	Phys. 1C, 1CL UD ESYS elective BICD 100
JUNIOR		
ESYS 101 UD ESYS elective lab	ESYS 102 UD ESYS elective	ESYS 103 UD ESYS elective

SENIOR

ESYS 190A	ESYS 190A	ESYS 190B
UD ESYS elective	UD ESYS elective	UD ESYS Elective

Environmental Chemistry Track

Students must complete two of the following courses:

Chemistry 149A. Environmental Chemistry
Chemistry 149B. Environmental Chemistry
Chemistry 173. Atmospheric Chemistry

Students must complete:

Math. 183. Statistical Methods (This statistics course required in sophomore year) OR
Math. 186. Probability Statistics for Bioinformatics
Chemistry 140A and B. Organic Chemistry One upper-division lab from either:
Chemistry 106. Instrumental Analysis Laboratory
Chemistry 143A. Organic Chemistry Laboratory
Two other upper-division courses, for example:
Chemistry 122. Biochemical Evolution
Chemistry 124. Bioinorganic Chemistry
Chemistry 126/127. Physical Chemistry
Chemistry 131/132/133. Physical Chemistry
Chemistry 140C. Organic Chemistry

Other courses may be substituted by petition.

CURRICULUM GUIDE PLANNING

FALL	WINTER	SPRING
FRESHMAN		
Chem. 6A	Chem. 6B	Chem. 6BL
Math. 10A	Math. 10B	Chem. 6C
BILD 3		Math. 10C
SOPHOMORE		
Chem. 6CL	Phys. 1B, BL	Phys. 1C, CL
Phys. 1A, AL	Econ. 131	Chem. 140A
Econ. 1A	Math. 183 or 186	
Poli. 160AA		
JUNIOR		
Chem. 140B	*Chem. 149B	*Chem. 173
*Chem. 149A	Chem. 106 OR	Chem. 143A
ESYS 101	ESYS 102	ESYS 103
SENIOR		
ESYS 190A	ESYS 190A	ESYS 190B
UD ESYS elective	UD ESYS elective	

* Choose (2) out of 3

Environmental Policy Track

Students complete a minimum of seven courses selected from the following list.

One upper-division *Statistics* course—Math 183. Statistical Methods or Economics 120A. Econometrics.

Economics 132. Energy Economics
Economics 125. Economics of Population Growth
Economics 116. Economic Development
Economics 130. Public Policy
Political Science 102L. The Politics of Regulation
Political Science 125. The Politics of Conservation in Developing Countries
Political Science 150A. Politics of Immigration
Political Science 160AB. Introduction to Policy Analysis
Environmental Systems 120. Science and Environmental Writing
Environmental Systems 150. Environmental Perils
IR-GN 459*. Conflict Resolution of Environmental Issues
IR-GN 488*. Corporate Strategy and the Environment
IR-GN 490*. Political Economy of Energy in Asia
IR-GN 490*. Political Economy of Energy in Latin America
IR-GN 490*. Special Topics
IR-PS 453*. Sustainable Development
IR-PS 458*. International Environmental Policy
HISC 105. History of Environmentalism
HIUS 154. Western Environmental History
ANBI 132. Conservation and the Human Predicament
Com/Cul 148. Communication and the Environment
Env. Studies 102. Selected Topics in Environmental Studies
Env. Studies 110. Environmental Law
Philosophy 148. Philosophy of the Environment
Philosophy 164. Technology and Human Values
USP 124. Land Use Planning
USP 144. Environmental and Preventive Health Issues
USP 170. Planning Theory and Practice
USP 171. Sustainable Development
Other courses may be substituted by petition.
* These graduate courses are offered through the Graduate School of International Relations and Pacific Studies. Enrollment in these courses requires the permission of the instructor.

CURRICULUM GUIDE PLANNING

FALL	WINTER	SPRING
FRESHMAN		
Chem. 6A	Chem. 6B	Chem. 6C
Math. 10A	Math. 10B	Math. 10C
	BILD 3	Chem. 6BL

SOPHOMORE

Phys. 1A, 1AL	Phys. 1B, 1BL	Phys. 1C, 1CL
Econ. 1A	Econ. 131	Math. 183 or Econ. 120A
Poli. 160AA		

JUNIOR

ESYS 101	ESYS 102	ESYS 103
UD ESYS elective	UD ESYS elective	UD ESYS elective

SENIOR

ESYS 190A	ESYS 190A	ESYS 190B
UD ESYS elective	UD ESYS elective	UD ESYS elective UD ESYS elective

Study abroad through the Education Abroad Program or Opportunities Abroad Program can enhance a student's major, particularly as an opportunity for diverse field experiences. However, careful planning is important to meet all major requirements. Please contact the Environmental Systems Office as early as possible if you are planning to study abroad.

COURSES

Many of the courses that are used to fulfill the requirements of the environmental systems major are offered by other departments and programs. Most of these courses are offered on a regular basis. Students should consult the Schedule of Classes or contact the Environmental Systems Office in order to obtain current information. The courses below are offered directly through the Environmental Systems Program.

LOWER-DIVISION**ESYS 10. Introduction to Environmental Systems (4)**

This course explores the interdisciplinary character of environmental issues through an examination of a particular topic [climate change, for example] from numerous disciplinary perspectives [e.g., biology, chemistry, physics, political science, and economics]. *Prerequisite: none.* (W)

ESYS 90. Perspectives on Environmental Issues (1)

Provides an introduction to environmental systems. Faculty members from departments in the natural sciences, geosciences, and social sciences will offer perspectives in these areas. (F)

UPPER-DIVISION**ESYS 101. The Living Earth (4)**

This course will survey the basic biochemical and physiological processes governing the relationship between organisms and their environments. Fundamentals of molecular biology, enzyme reactions, photosynthesis, and central metabolic processes, mechanisms underlying homeostasis at cellular and organismal levels will be discussed with a view toward understanding the adaptations and sensitivity of biological systems to environmental perturbations. *Prerequisites: Math. 10A, 10B, 10C, BILD 3, CHEM 6A-B-C, Physics 1A, AL-B, BL-C, CL.* (F)

ESYS 102. The Solid and Fluid Earth (4)

The physical Earth system can be divided into three components: the solid earth, the liquid earth, and the atmosphere. These components are all dynamic and interact in complex ways with profound impacts on our environment. We will examine the controls of natural phenomena such as earthquakes, volcanoes, landslides, soil formation (and destruction), and changes in sea-level and climate. *Prerequisites:* Math. 10A, 10B, 10C, BILD 3, CHEM 6A-B-C, Physics 1A-B-C plus either Chem/Physics lab. (W)

ESYS 103. The Human Earth (4)

This course explores the impacts of human, social, economic, and industrial activity on the environment. It highlights the central roles in ensuring sustainable development played by market forces, technological innovation, and governmental regulation on local, national, and global scales. *Prerequisites:* grade of C- or better in Math. 20B or Math. 10A-C; Physics 2B or Physics A-C; Chemistry 6B or by consent of instructor. In addition, ESYS majors, must take ESYS 101 and 102 or permission of instructor. (S)

ESYS 120. Science and Environmental Writing (4)

Course designed to improve the written communication of science majors through frequent writing assignments that develop the practical skills needed to communicate science to lay audiences. Topics include news writing, news releases, grant writing, broadcast script writing, and editorial writing. *Prerequisites:* upper-division standing in science or mathematics major and completion of college composition requirement (or consent of instructor). (W)

ESYS 150. Environmental Perils (4)

An advanced field-oriented course for engineering and science students stressing the geologic basis for environmental perils such as earthquakes, erosion,

flooding, and waste disposal. Two one-hour lectures, and a two-hour lab/field trip each week. *Prerequisites:* Math. 10 A-B-C sequence and Physics 1A,AL; 1B,BL; 1C,1CL sequence or equivalent. (S)

ESYS 190A. Senior Project (8)

All majors are required to complete an integrative Senior Project in their senior year. The Senior Project is designed by the student to focus on an interdisciplinary environmental problem or research topic and is developed either individually or as part of a team over two quarters. Appropriate topics could include biodiversity conservation, environmental health, and/or global change. An important component of the Senior Project is an off-campus or laboratory internship. *Prerequisites:* ESYS 103 and upper-division standing, departmental approval, majors only. (F,W)

ESYS 190A(W). ESYS/UCDC Senior Project (4)

ESYS majors may opt to complete the internship portion of their Senior Project through the UCDC Program. Students are expected to apply to the fall or winter quarter of UCDC Program and obtain an internship in a governmental agency, NGO, and/or research laboratory. *Prerequisites:* ESYS 103 and upper-division standing, departmental approval, majors only. (F,W)

ESYS 190B. Senior Seminar (2)

The Senior Seminar provides a venue for the presentation and group evaluation of the ESYS Senior Projects. *Prerequisite:* ESYS 190A or 190A(W) (NOTE: After completing (1) quarter of ESYS 190A, ESYS 190B may be taken concurrently), senior standing. (S)

ESYS 199. Independent Study (2-4)

Individually guided readings or projects in the area of environmental systems.