Environmental Systems

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Program Faculty

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There can be little doubt that in the twentyfirst 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. The program offers both a B.S. and a B.A. in environmental systems. 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 lowerdivision 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 program places a significant value on interdisciplinary problem-solving and, in this connection, requires all students in the major to complete an off-campus "integrative project." The integrative project might involve work with endangered species including, for example, the development of habitat conservation plans. Other examples might include projects in coastal zone management, environmental health, marine pollution, climate change adaptation and mitigation, environmental justice, and urban air guality. The Environmental Systems Program will assist students in the major in locating off-campus entities with which to conduct their projects. To complete the integrative project requirement, all students will participate in the senior seminar where formal reports on the projects will be completed and presented.

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 integrative project (ESYS 190A) and senior seminar (ESYS 190B). Any questions concerning the requirements should be directed to the associate director or the program administrator. 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 ful-fillment 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. All courses (lower- and upper-division) required for the major must be taken for a letter grade.

LOWER-DIVISION CORE REQUIREMENTS

Biology 3—BILD 3

- Chemistry 6A, 6B, 6BL, 6C—Environmental Chemistry track students must also complete Chemistry 6CL
- Physics 1A, 1B, 1C—Earth Sciences track students complete Physics 2A-B-C
- Mathematics 10A, 10B, 10C—Earth Sciences track students complete Math 20A-B, 21C, and Math 21D is recommended

Economics 2A

UPPER-DIVISION CORE REQUIREMENTS

Economics 131. Economics of the Environment

Political Science 160AA. Introduction to Policy Analysis *or*

Political Science 168. Policy Assessment

"Integrating Course Sequence"

Environmental Systems 101. The Living Earth

Environmental Systems 102. The Solid and Fluid Earth

Environmental Systems 103. The Human Earth

Environmental Systems Major Tracks

There are four advanced tracks in which students must complete a minimum of seven upperdivision 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

The program is working with the School of Engineering to create an "Environmental Engineering" track to be offered at a future date.

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 103. Introduction to Geophysics
- ERTH 104. Geobiology
- 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
- ERTH 180. Geophysics of Natural Resources
- ERTH 182. Field Geophysics
- SIO 210. Physical Oceanography
- SIO 260. Marine Chemistry
- SIO 240. Marine Geology
- Other ERTH/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
- BIEB 130. Introduction to Marine Ecology
- Other ERTH/SIO courses by petition.

CURRICULUM GUIDE PLANNING

FALL	WINTER	SPRING
FRESHMAN		
Chem. 6A	Chem. 6B	Chem. 6C

Math. 20A	Math. 20B	Math. 21C
	Chem. 6BL	BILD 3
SOPHOMORE		
Math.21D	Phys. 2B	Phys. 2C
(recommended)		
Phys. 2A	Econ. 131	UD ESYS elective
Econ. 2a		Poli. 160AA or 168
JUNIOR		
ERTH 101	ERTH 102	ESYS 103
ESYS 101	ESYS 102	UD ESYS elective
Math. 183	UD ESYS elective	UD ESYS elective
SENIOR		
ESYS 190A	ESYS 190A	ESYS 190B
UD ESYS elective	UD ESYS elective	UD ESYS elective

Math 210

Ecology, Behavior, and Evolution Track

Required upper-division courses:

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

Upper-division electives [six courses required, including at least one 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 120. General Ecology**
 - BIEB 121. Ecology Laboratory
 - **BIEB 126. Plant Ecology**
- BIEB 130. Introduction to Marine Ecology
- **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
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)

CURRICULUM GUIDE PLANNING

FALL	WINTER	SPRING
FRESHMAN		
Chem. 6A	Chem. 6B	Chem. 6C
Math. 10A	Chem.6BL	Math. 10C
	Math. 10B	BILD 3
SOPHOMORE		
Phys. 1A	Phys. 1B	Phys. 1C
Econ. 2A	Econ. 131	UD ESYS elective
BICD 100	BIEB 100 (statistics)	Poli. 160AA or 168
JUNIOR		
ESYS 101	ESYS 102	ESYS 103
UD ESYS elective lab	UD ESYS elective	UD ESYS elective
SENIOR		
ESYS 190A	ESYS 190A	ESYS 190B
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) 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

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FALL	WINTER	SPRING
FRESHMAN		
Chem. 6A	Chem. 6B	Chem. 6C
Math. 10A	Chem. 6BL	Math. 10C
BILD 3	Math. 10B	Chem. 6CL
SOPHOMORE		
Phys. 1A	Phys. 1B	Phys. 1C
Econ. 2A	Econ. 131	Chem. 140A
Math. 183		Poli. 160AA or 168
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. It is also possible to complete the requirements for the Environmental Policy track with a specialization that includes courses from one of the other tracks. For example, a course of study with a focus on conservation biology and policy for students who may be interested in the policy and scientific dimensions of habitat conservation planning for endangered species, would include advanced courses from the Ecology, Behavior, and Evolution track.

One upper-division *Statistics* course—ANGN 157. The Analysis of Systematic Data

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 150A. Politics of Immigration
- IR-PS 452*. Seminar on the Environment
- 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
	Chem. 6BL	BILD 3
SOPHOMORE		
Phys. 1A	Phys. 1B	Phys. 1C
Econ. 2A	Econ. 131	ANGN 157
		Poli. 160AA or 168
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

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)

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-B-C*. (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 sealevel 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 global impacts of humanity through an understanding of population growth, the production and consumption of energy, the use of renewable and non-renewable resources, and the role of advances in technology. Building on the material covered in ESYS 101 and ESYS 102, this course employs a range of social science tools from policy analysis to economics to explore the human dimension of global environmental change. *Prerequisites: Economics 2A and* 131, ESYS 101 and 102, *Political Science 160AA or 168*.(5)

ESYS 190A. Environmental Systems Integrative Project (8)

Students are required to pursue research on an interdisciplinary environmental problem either individually or as part of a team over two terms (this may include summer term). The project will be conducted as an off-campus internship where students might work on, for example, the development of a comprehensive management plan for a threatened ecosystem. Students will work with an off-campus environmental group or agency. Prerequisites: ESYS 103 and upper-division standing.

ESYS 190B. Environmental Systems Senior Seminar (2) The seminar, to be completed in the senior year, provides a venue for the development, presentation, and evaluation of the Environmental Systems Integrative Project reports. The seminar will include work on research methods as well as paper presentation skills. Distinction in the major will be awarded for outstanding projects and reports. *Prerequisite: ESYS 190A.*

4