Environmental Science and Engineering

The George R. Brown School of Engineering

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Lecturer
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Degrees Offered: B.A., M.E.E., M.E.S., M.S., Ph.D.

This interdisciplinary undergraduate major, offered in joint programs with such majors as civil or chemical engineering, gives students academic training in solving technical environmental problems. The department provides an introduction to environmental engineering in topics that include hydrology, water and wastewater treatment, water quality modeling, environmental microbiology, and water chemistry. Graduate programs include both professional degrees and research degrees. A joint M.B.A./Master of Engineering degree is also available in conjunction with the Jesse H. Jones Graduate School of Management.

Degree Requirements for B.A. in Environmental Science and Engineering (as a double major)

The Department of Environmental Science and Engineering offers a dependent double major (B.A.) in environmental science and engineering. The double major has two tracks, one in environmental engineering sciences (EES), and one in environmental sciences (ES). Faculty from the Weiss School of Natural Science work with ES&E faculty in offering courses, advising, and administering the ES track of this double major. The double major is designed to accommodate:

- students wishing to obtain a solid preparation for later graduate study in environmental engineering, environmental science, or other careers as environmental professionals (e.g. environmental economics or environmental law), and
- students pursuing nonenvironmental careers (e.g. historians, lawyers, mechanical engineers, chemists) who will nonetheless benefit from a knowledge of the environmental dimensions of problems and issues they will confront.
The 68-semester-hour (minimum) double major in environmental science and engineering may be taken in conjunction with any stand-alone major offered in any school of the university. The EES track is highly recommended for students wishing to pursue graduate study in environmental engineering. Also, students wishing to obtain an ABET-accredited degree in engineering should pursue the EES track in conjunction with one of the environmental options offered through the Departments of Civil or Chemical Engineering. Students choosing the ES track are encouraged to select one of the following participating faculty members from the Weiss School of Natural Science as their adviser:

John Anderson *(Geology and Geophysics)*

Andre Droxler *(Geology and Geophysics)*

Arthur Few *(Space Physics and Environmental Science)*

F. M. Fisher *(Ecology and Evolutionary Biology)*

P. A. Harcombe *(Ecology and Evolutionary Biology)*

William Leeman *(Geology and Geophysics)*

D. Queller *(Ecology and Evolutionary Biology)*

R. L. Sass *(Ecology and Evolutionary Biology)*

Dale Sawyer *(Geology and Geophysics)*

J. E. Strassmann *(Ecology and Evolutionary Biology)*

Virginia B. Sisson *(Geology and Geophysics)*

A. Thornhill *(Ecology and Evolutionary Biology)*

The key components of the double major include:

- foundation course work in mathematics, physics, chemistry, and biology required in both tracks.
- a set of five undergraduate core courses, required of all double majors, that acquaint undergraduates with a range of environmental problems encountered by scientists, engineers, managers, and policy makers. Core courses in the EES track cover the breadth of water, soil, and air media within the context of engineering technologies and approaches to problem solving, and stress quantitative analytical tools used to address environmental problems. Core courses in the ES track stress the components of the global environment and their interactions.
- 24 semester hours of environmental electives, in both tracks, from four categories: 1) social sciences and business, 2) humanities and architecture, 3) natural sciences, and 4) engineering. Students may petition to have electives, in addition to those currently listed, apply toward the double major.

**Specific Course Requirements for a Double Major (B.A.) in Environmental Science and Engineering include:**

**General Prerequisites**

- CHEM 121 or 151 *General Chemistry with Laboratory*
- CHEM 122 or 152 *General Chemistry with Laboratory*
- MATH 101 *Single Variable Calculus I*
- MATH 102 *Single Variable Calculus II*
- PHYS 101 or 125 or 111 *Mechanics*
- PHYS 102 or 126 or 112 *Electricity and Magnetism*
- BIOS 201 *Introductory Biology*

- BIOS 202 *Introductory Biology* (Environmental sciences track only)

**One of the following two courses:**

- NSCI 230 *Computation in Natural Science* (Environmental sciences track only)
- MATH 211 *Ordinary Differential Equations and Linear Algebra* (Environmental engineering sciences track only)
Core Courses: Environmental Sciences Track

BIOS 325 Ecology
GEOL 326 Environmental Geology
SPAC 443 Atmospheric Science
(or ENVI 411 Air Resource Management)

Two of the following three courses:
ENVI 401 Introduction to Environmental Chemistry
ENVI 412 Hydrology and Watershed Analysis
GEOL 451 Analysis of Environmental Data

Core Courses: Environmental Engineering Sciences Track

ENVI 401 Introduction to Environmental Chemistry
ENVI 403 Principles of Environmental Engineering
ENVI 411 Air Resource Management

ENVI 412 Hydrology and Watershed Analysis
ENVI 434 Chemical Transport and Fate in the Environment

Sample Curriculum in the Environmental Engineering Sciences Track

Freshman Year

Fall
MATH 101 Single Variable Calculus I
PHYS 101 Mechanics
CHEM 121 General Chemistry with Laboratory
Electives
HPER 101

Spring
MATH 102 Single Variable Calculus II
PHYS 102 Electricity and Magnetism
CHEM 122 General Chemistry with Laboratory
Electives
HPER 102

Sophomore Year

Fall
MATH 211 Ordinary Differential Equations
BIOS 201 Introductory Biology
Environmental Elective*
Environmental Elective

Spring
Environmental Elective
Environmental Elective
*ENVI 201 Introduction to Environmental Systems recommended as environmental elective.

Junior Year

Fall
ENVI 401 Introduction to Environmental Chemistry
Environmental Elective
Environmental Elective

Spring
ENVI 411 Air Resource Management
Environmental Elective

Senior Year

Fall
ENVI 403 Principles of Environmental Engineering
ENVI 434 Chemical Transport and Fate in the Environment
Environmental Elective

Spring
ENVI 412 Hydrology and Watershed Analysis
Environmental Elective

24 semester hours of environmental electives are required, with at least 6 semester hours of course work from each of four categories. Consult the faculty adviser or Department of Environmental Science and Engineering for a list of approved electives.
Sample Curriculum in the Environmental Sciences Track

**Freshman Year**

*Fall*
- MATH 101 *Single Variable Calculus I*
- PHYS 101 *Mechanics*
- CHEM 121 *General Chemistry with Laboratory*
- Electives
- HPER 101

*Spring*
- MATH 102 *Single Variable Calculus II*
- PHYS 102 *Electricity and Magnetism*
- CHEM 122 *General Chemistry with Laboratory*
- Electives
- HPER 102

**Sophomore Year**

*Fall*
- NSCI 230 *Computation in the Natural Sciences*
- BIOS 201 *Introductory Biology*
- Environmental Elective
- Environmental Elective

*Spring*
- BIOS 202 *Introductory Biology*
- Environmental Elective
- Environmental Elective

**Junior Year**

*Fall*
- BIOS 325 *Ecology*
- GEOL 326 *Environmental Geology*
- Environmental Elective

*Spring*
- SPAC 443 *Atmospheric Science*
- or ENVI 411 *Air Resource Management*
- Environmental Elective

**Senior Year**

*Fall*
- GEOL 451 *Analysis of Environmental Data* or ENVI 401 *Introduction to Environmental Chemistry*
- Environmental Elective
- Environmental Elective

*Spring*
- ENVI 412 *Hydrology and Watershed Analysis*

24 semester hours of environmental electives are required, with at least 6 semester hours of course work from each of four categories. Consult the faculty adviser or Department of Environmental Science and Engineering for a list of approved electives.

**Degree Requirements for M.E.E., M.E.S., M.S., and Ph.D. in Environmental Science and Engineering**

Applicants for graduate study in environmental science and engineering should have at least a 3.00 (B) grade point average in undergraduate work and high Graduate Record Examination (GRE) scores. For general university requirements, see Graduate Degrees (pages 72–73) and Admission to Graduate Study (page 77).

**M.E.E. Program.** The Master of Environmental Engineering (M.E.E.) is a professional nonthesis degree requiring one year of study. Students who have a B.S. degree in any field of engineering may apply. Areas of study include hydrology and water resources engineering, water and wastewater treatment design and operation, and numerical modeling. Although the program is open to all qualified applicants, candidates usually are completing undergraduate programs in environmental engineering and wish to extend their education into a fifth year of specialized study.
M.E.S. Program. The Master of Environmental Science (M.E.S.) is a professional nonthesis degree requiring one year of study. To enter the M.E.S. program, applicants must have a B.A. or B.S. degree in any of the natural or physical sciences. Areas of study include environmental biology, environmental chemistry and toxicology, surface and groundwater hydrology, water and wastewater treatment, environmental geology, and environmental planning. Although the program is open to all qualified applicants, candidates typically are completing undergraduate programs in environmental science and wish to extend their education into a fifth year of specialized study.

M.S. Program. Most graduate students in environmental science and engineering pursue a thesis program culminating in the M.S. degree. Candidates must:
• Complete at least 8 approved courses, including 1 course each in environmental chemistry, water and wastewater treatment, hydrology, and environmental modeling (comparable course work completed previously may be substituted for the core courses)
• Select a thesis committee according to department requirements and conduct original research in consultation with the committee
• Present and defend in oral examination an approved research thesis
Students take the oral exam only after the committee determines the thesis to be in an acceptable written format for public defense. Normally, students take two academic years and the intervening summer to complete the degree.

Ph.D. Program. To earn a Ph.D. degree in environmental engineering sciences, candidates must successfully accomplish the following (spending at least four semesters in full-time study at Rice):
• Complete 90 semester hours of approved course work with high standing
• Pass a preliminary written examination on the field of environmental engineering sciences
• Pass a qualifying examination on course work, proposed research, and related topics
• Complete a dissertation indicating an ability to do original research
• Pass a formal public oral examination on the thesis and related topics
Ph.D. candidates typically take the preliminary exam, administered by department faculty, after one to two semesters of course work. Candidates who pass this exam then form a doctoral committee according to department requirements. The qualifying examination administered by the doctoral committee after candidates develop a research proposal evaluates their preparation for the proposed research and identifies any areas requiring additional course work or study.

See ENVI (pages 338–340) in the Courses of Instruction section.