

# **Bachelor of Science in Environmental Science Indiana University, Bloomington**

*(a joint degree program between the)*

## **College of Arts and Sciences and the School of Public and Environmental Affairs**

### **Overview**

The B.S. in Environmental Science (BSES) is an undergraduate degree program that specifically considers the environment as a scientific entity. While it is possible to divide environmental science into numerous sub-disciplines or systems such as the atmosphere, the biosphere, the hydrosphere, and the lithosphere, these sub-systems are interdependent components of a single, large system. An individual working within the environmental sciences may pursue a wide range of problems using approaches and tools from any of the traditional sciences (e.g. biology, chemistry, geology, mathematics, meteorology, or physics). This degree should be selected by students preparing for employment as professionals in environmental science or preparing for graduate study in environmental science or in one of the traditional sciences.

The BSES degree program consists of:

1. A set of general requirements for the College of Arts and Sciences and the School of Public and Environmental Affairs;
2. A core curriculum, required of all students, designed to provide a base of knowledge from a wide range of scientific disciplines;
3. A concentration area, providing the student with a specific field of expertise. The concentration area is designed by the student in conjunction with a faculty advisor. It is designated by a major code (see headings listed in Career Options) and the major code and concentration name will appear on the student's final transcript.

### **Philosophy**

The problems encountered in the environmental sciences are inherently interdisciplinary; hence a scientist working in this field is required to possess both a breadth of knowledge and a specific set of skills and expertise. The BSES degree program is intended to instill an appreciation of the integrated nature of the discipline and supply a level of expertise in one area. It is only through systematic exposure over extended periods of time that this awareness can become second nature. Once this has been accomplished, the environmental scientist will be able to deal with the subtle connections and extremely sensitive feedback between various components they encounter. The overall organization of the BSES degree program reflects this philosophy with a broad core curriculum, a concentration area, and a senior research project providing advanced, hands-on experience.

### **Program Highlights**

- ▶ SPEA E262 - Environmental Problems and Solutions. An early introduction to the breadth and integrated aspect of the environmental sciences.
- ▶ GEOL G329 - Field Experience in Environmental Science. A 5-week field course taught from a research station located in the Tobacco Root Mountains in south west Montana. Students should enroll after completion of the second year of study. This course involves instructional work in a range of sites from pristine alpine settings to Environmental Protection Agency Superfund sites.
- ▶ Senior Research - Practical, focused experience at an advanced level.
- ▶ Special Sections - Sections of standard courses and specially designed courses from the core sciences will be available for students within this program.
- ▶ Socioeconomic Concerns - Required exposure to the social and economic implications and considerations that must be taken into account for implementation of practical solutions.

## Degree Preparation

Ideally, the student should have one year of high school biology, chemistry, mathematics (Calculus or pre-Calculus if this is the highest level course offered), and physics. For those students who did not have the opportunity to enroll in these science courses while in high school, academic programs will be created to provide the necessary sequence of courses during the early portion of their college career. Additional high school courses in any one of the basic sciences might permit immediate entry to an advanced course at the college level. A set of pre-college courses in the humanities and a foreign language is also necessary to both satisfy the general college entrance requirements and serve as preparation for the general IU baccalaureate degree requirements. A solid preparation in high school will permit the student to enroll in the BSES core curriculum immediately upon enrollment at IU. For transfer students, most standard first year or introductory level courses in biology, inorganic chemistry, calculus, etc. will transfer to the IU system and may be applied to the degree requirements.

## Career Options

Environmental scientists can find employment in a variety of fields. The jobs range from basic research to highly applied situations. Employers range from all levels of government and private industry to non-profit groups. In addition, employment is available in the legislative and legal sectors as well. Teaching positions are available, consistent with a bachelor degree status. The job settings are found throughout the world and can vary from a controlled laboratory, remote wilderness, or site work at the corner gas station.

The following is a listing of jobs under the various majors in the BSES. All of these jobs would be available at all levels of government and in private companies. In Indiana there are US Geological Survey offices, US Forest Service offices, US Environmental Protection Agency offices, Indiana Department of Environmental Management offices and Indiana Department of Natural Resources offices, etc.

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|--|---|---|
| General (G97):<br>Environmental scientist<br>Field Scientist<br>Field Site Manager<br>Physical Scientist   | Hydrology and Water Resources (G98):<br>Hydrologist<br>Aqueous Chemist<br>Water Quality Analyst<br>Ground Water Flow Specialist   | Surficial Processes (H02):<br>Soil Scientist<br>Forest Geomorphologist<br>Ground Water Instrumentation<br>Specialist<br>Agricultural Specialist<br>Environmental Remediation<br>Specialist<br>Mine Reclamation Specialist |
| Atmospheric Science (G95):<br>Atmospheric Chemist<br>Data Analyst<br>Climate Modeler<br>Meteorologist  | Mathematical Modeling (G99):<br>Spatial Data Analyst<br>Information Systems Analyst<br>Data Base Storage and Retrieval<br>Expert<br>Programmer<br>Water Flow Modeler<br>Population Dynamics Modeler |   |
| Ecosystem Science (G96):<br>Ecologist<br>Aquatic Biologist<br>Wetlands Delineation Specialist<br>Bioremediation Specialist<br>Lake and Watershed Manager | Pollution Control Technology and<br>Resources (H01):<br>Technologies Analyst<br>Waste Treatment Specialist<br>Air Quality Analyst<br>Systems Analyst  |   |

Other Career Possibilities with a Bachelors Degree: Because the students will have a strong background in a single, traditional subject area (e.g. biology, chemistry) they will compete for the same jobs as science majors from various science departments.

## Contacts

Students are encouraged to contact the Program Director, Dr. Bruce J. Douglas (phone:812-855-3848; email:bses@indiana.edu) or Andy Ruff (phone:812-855-0241; email:ajruff@indiana.edu) for additional information or to discuss scheduling. They may also view the BSES web site (<http://www.indiana.edu/~bses/>).

## B. S. in Environmental Science – Degree Requirements

Students must complete a set of fundamental-skills and distribution requirements, a core curriculum, and a concentration in a particular branch of environmental science.

### Fundamental Skills and Distribution (variable credit hours depending on course selection)

1. Writing: English-Composition (ENG W131, W231) and Intensive Writing, major fulfills IW requirement.
2. Mathematics, major fulfills requirement.
3. Public Speaking, select one course from the list (CMCL C121, C122, C205, C223, C225, C228, C229, or Theater T115 or T120).
4. Foreign Language, student must complete the study of a single foreign language through the second semester of the first year of college-level course work (8 credit hours). All or part of the requirement may be fulfilled by performance on placement examinations.
5. A COAS TOPICS course. Note that E103 also fills one of the Arts and Humanities requirements.
6. Arts and Humanities (A&H), two courses from the COAS *Bulletin* "Table of Approved Distribution Courses by Department". A TOPICS COAS E103 course may be included as one of the two A&H courses.
7. Social and Historical studies (S&H) with emphasis on economics or political science, one course selected from ECON E201, ECON E202, ECON E364, POLS Y103, or POLS Y313. Note: one of these courses plus one from item 8 fill the two course S&H requirement.
8. Social and Historical studies (S&H) with emphasis on public policy, one course selected from SPEA V263, SPEA V371, SPEA V376, SPEA V449, or SPEA V472.
9. Natural and mathematical sciences, major fulfills requirement.

### Core Requirements (61- 63 credit hours)

1. Biology: BIOL L111 and either BIOL L473 or SPEA E332.
2. Chemistry: either CHEM C117, C118, and C341 OR CHEM C117, R340, A314, and A316 OR CHEM C117, R340, and N330. SPEA E464 may be used in place of CHEM C341 or R340 and C341 may be used in place of R340. Students who did not earn at least a B- in high school chemistry should contact the B.S.E.S. program director and the Department of Chemistry Undergraduate Placement Office to determine the appropriate starting course.
3. Computing: CSCI A202, or GEOG G250, or SPEA E325. Any one of these three courses may be selected.
4. Environmental Science overview: SPEA E262.
5. Atmospheric Science: GEOG G304.
6. Geological Science: GEOL G225
7. Field experience: GEOL G329 is offered at the IU Geological Field Station in Montana and should be taken during the summer following the fourth semester of enrollment. Students with certain needs can substitute two of the following courses for G329: BIOL L465 Advanced Field Biology, GEOG G350 Instrumentation and Field Methods in Atmospheric Science, SPEA E442 Habitat Analysis—Terrestrial and SPEA E443 Habitat Analysis—Aquatic.
8. Mathematics: MATH M211, M212, and either MATH M343 or SPEA E426. M119 and X201 may be substituted for M211.
9. Physics: PHYS P221 and P222.
10. Statistics: MATH K300 or GEOG G488 or MATH M365 or SPEA K300.
11. Environmental science senior research: Guided by a faculty member, each student undertakes a project closely related to his or her concentration (see below). Completion of a written thesis and an oral presentation are required; the thesis may be used to fulfill the College's intensive writing requirement if the guidelines for this requirement are met. Students should enroll in 3 credit hours in the appropriate course within the faculty supervisor's department (BIOL L490, CHEM C409, CSCI Y390, GEOG G450, GEOL G410, INFO I460, MATH M490, PHYS S406, SPEA E490) or other courses as appropriate given the affiliation of the faculty advisor.

### Concentration (minimum of 18 credit hours)

Whereas the core curriculum provides each student with a solid background in the basic subjects pertinent to the environmental sciences, the concentration is aimed at preparing students for graduate study or professional employment in specific fields. A partial list of the available topics includes atmospheric sciences, applied ecology, earth-system science, energy production, environmental toxicology, global environmental change, surface-groundwater systems, numerical modeling, and oceanic sciences. Additional or alternative topics can be defined in order to fit specific needs or opportunities. Programs include 18 credits of course work selected by students in consultation with a faculty advisor, active in the field in which they have chosen to concentrate, and two additional faculty members. Each program is then approved by the BSES Program Committee.

## Environmental Science B. S. Example Four-year Program

### BSES Example Four-year Program (Physical Sciences Primary Interests)

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| <b>Freshman Year, Fall:</b><br>CHEM C117 Inorg. Chem I + Lab (5 cr.)<br>MATH M211 Calc. I (4 cr.)<br>COAS E103 (3 cr.)<br>ENG W131 (3 cr.)<br><u>15 cr.</u>   | <b>Freshman Year, Spring:</b><br>BIOL L111 (3 cr.)<br>MATH M212 Calc. II (4 cr.)<br>Foreign Lang. 100 (4 cr.)<br>COAS A&H (3 cr.)<br><u>14 cr.</u>  |
| <b>Sophomore Year, Fall:</b><br>CHEM R340 Org. Chem (3 cr.)<br>GEOG G304 Meteorol. and Clim. (3 cr.)<br>PHYS P221 Physics I (5 cr.)<br>Foreign Lang. 150 (4 cr.)<br><u>15 cr.</u>   | <b>Sophomore Year, Spring:</b><br>SPEA E262 Envir. Prob. and Sol. (3 cr.)<br>GEOL G225 Earth Materials (4 cr.)<br>Econ. or Poly. Sci. (3 cr.)<br>PHYS P222 Physics II (5 cr.)<br><u>15 cr.</u>                              |
| <b>Sophomore-Junior Summer:</b><br>GEOL G329 Field Exp. in Env. Sci. (5 cr.)  |   |
| <b>Junior Year, Fall:</b><br>BSES Conc. Elective 1 (3 cr.)<br>MATH K300 or GEOG G488 or<br>MATH M365 or<br>SPEA K300 Stats. (3 cr.)<br>BSES Conc. Elective 2 (3 cr.)<br>SPEA Pub. Pol. (3 cr.)<br>Elective (3 cr.)<br><u>15 cr.</u> | <b>Junior Year, Spring:</b><br>CHEM A314+A316 Anal. Chem. (4 cr.)<br>BSES Conc. Elective 3 (3 cr.)<br>CMCL C121 Pub. Speaking (3 cr.)<br>MATH M343 Differential Eqns. (3 cr.)<br>Elective (3 cr.)<br><u>16 cr.</u>          |
| <b>Junior-Senior Summer Optional Elective:</b><br>Advanced Field Course or Internship*  |   |
| <b>Senior Year, Fall:</b><br>BIOL L473 Ecology (3 cr.)<br>ENG W231 Prof. Writ. Skills (3 cr.)<br>BSES Conc. Elective 4 (3 cr.)<br>BSES Conc. Elective 5 (3 cr.)<br>Elective (3 cr.)<br><u>15 cr.</u>                                | <b>Senior Year, Spring:</b><br>BSES Conc. Elective 6 (3 cr.)<br>BSES E499 Senior Research (3 cr.)<br>CSCI A202 or SPEA E325 or<br>GEOG G250 Computing (2-4 cr.)<br>Elective (3 cr.)<br>Elective (3 cr.)<br><u>14-16 cr.</u> |
| <b>TOTAL CREDITS</b> 124-126  |   |

\*The advanced field course or internship is not a requirement and so no credits are given. It is listed here as an example of what students might do to enhance their program of study. Credit hours associated with this experience could replace elective credits.

### BSES Example Four-year Program (Biological Sciences Primary Interests)

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|---|---|
| <b>Freshman Year, Fall:</b><br>BIOL L111 (3 cr.)<br>CHEM C117 Inorg. Chem I + Lab (5 cr.)<br>COAS E103 (3 cr.)<br>ENG W131 (3 cr.)<br><u>14 cr.</u>   | <b>Freshman Year, Spring:</b><br>BIOL L112 (BSES Conc. Elective 1) (3 cr.)<br>GEOG G304 Meteorol. and Clim. (3 cr.)<br>Foreign Lang. 100 (4 cr.)<br>COAS A&H (3 cr.)<br>Elective (3 cr.)<br><u>16 cr.</u>                         |
| <b>Sophomore Year, Fall:</b><br>BIOL L211 (BSES Conc. Elective 2) (3 cr.)<br>CHEM R340 Org. Chem (3 cr.)<br>MATH M211 Calc. I (4 cr.)<br>Foreign Lang. 150 (4 cr.)<br><u>14 cr.</u>                     | <b>Sophomore Year, Spring:</b><br>SPEA E262 Envir. Prob. and Sol. (3 cr.)<br>GEOL G225 Earth Materials (4 cr.)<br>MATH M212 Calc. II (4 cr.)<br>Econ. or Poly. Sci. (3 cr.)<br><u>14 cr.</u>                                      |
| <b>Sophomore-Junior Summer:</b><br>GEOL G329 Field Exp. in Env. Sci. (5 cr.)  |   |
| <b>Junior Year, Fall:</b><br>PHYS P221 Physics I (5 cr.)<br>BSES Conc. Elective 3 (3 cr.)<br>BSES Conc. Elective 4 (3 cr.)<br>ENG W231 (3 cr.)<br>Elective (3 cr.)<br><u>17 cr.</u>                     | <b>Junior Year, Spring:</b><br>PHYS P222 Physics II (5 cr.)<br>MATH K300 or GEOG G488 or<br>MATH M365 or<br>SPEA K300 Stats. (3 cr.)<br>CHEM A314+A316 Anal Chem (4 cr.)<br>Elective (3 cr.)<br><u>15 cr.</u>                     |
| <b>Junior-Senior Summer Optional Elective:</b><br>Advanced Field Course or Internship*  |   |
| <b>Senior Year, Fall:</b><br>BIOL L473 Ecology (3 cr.)<br>MATH M343 Differential Eqns. (3 cr.)<br>BSES Conc. Elective 5 (3 cr.)<br>CMCL C121 Pub. Speaking (3 cr.)<br>Elective (3 cr.)<br><u>15 cr.</u> | <b>Senior Year, Spring:</b><br>BSES Conc. Elective 6 (3 cr.)<br>BSES E499 Senior Research (3 cr.)<br>SPEA Pub. Pol. (3 cr.)<br>CSCI A202 or SPEA E325 or<br>GEOG G250 Computing (2-4 cr.)<br>Elective (3 cr.)<br><u>14-16 cr.</u> |
| <b>TOTAL CREDITS</b> 124-126  |   |

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