

# **Bachelor of Science in Environmental Science**

**-- Guidelines for Majors --**

**Department of Soil, Water and Environmental  
Science  
The University of Arizona**

**2011-2012**

**BACHELOR OF ENVIRONMENTAL SCIENCE DEGREE**

Shantz Building Room 429  
520-621-1646  
[www.ag.arizona.edu/swes](http://www.ag.arizona.edu/swes)

**REVISED Dec 2011**

## INTRODUCTION

Environmental science is the scientific investigation of human interactions with natural systems. The goals of the Bachelor of Environmental Science Degree are to:

- 1) Offer a rigorous science-based preparation for careers in environmental science;
- 2) Prepare students for graduate studies in environmental science;
- 3) Facilitate assuming a leadership role in academia, business, government, private organizations, or other career venues.
- 4) Provide the academic tools needed to address fundamental and applied problems related to human-inhabited parts of the Earth.

With this degree, students will be well-prepared for careers in private and government agencies, educational institutions, and private consulting firms. Some titles associated with these jobs include: Environmental Scientist, Environmental Engineer, Industrial Hygienist, Environmental Health Specialist, Earth Scientist, Ecologist, Forester, Environmental Chemist, Environmental Microbiologist, Meteorologist, Soil Scientist, Environmental Lawyer, and Natural Resources Manager. Students will also be prepared for an advanced degree in a variety of fields, such as environmental health, resource management, engineering, law, and public policy.

## COURSEWORK

The Bachelor of Environmental Science Degree comprises general education, core, and subplan classes typically taken over eight semesters. A suggested course sequence is listed at the end of this brochure.

**Note: Some classes have prerequisite requirements; it is important to check the U of A online Schedule of Classes to confirm course availability and class prerequisites. Classes taken to fulfill Core requirements cannot also be used to fulfill Subplan requirements.**

**GENED Total: 35 units**

**CORE Total: 69-76 units**

General Science Core: 32-34

Environmental Science Core: 27-28

Career Preparation: 10-14

**SUBPLAN Total: 18 units**

**A. General Education.** These classes give undergraduates a diverse academic background to complement each major.

|   |  |
|---|--|
| <p><b><u>Foundation Courses</u></b><br/>           English Composition<br/>           Mathematics (satisfied by MATH 124/125)</p> <p style="text-align: right;">6 Units</p> | <p><b><u>Tier 1</u></b><br/>           Traditions and Cultures<br/>           Individuals and Societies</p> <p style="text-align: right;">6 Units<br/>6 Units</p>                    |
| <p><b><u>Pre-Major</u></b><br/>           Communications (satisfied by SWES 408)</p>  | <p><b><u>Tier 2</u></b><br/>           Humanities<br/>           Arts<br/>           Individuals and Societies</p> <p style="text-align: right;">3 Units<br/>3 Units<br/>3 Units</p> |
| <p><b><u>Second Language</u></b><br/>           Second semester proficiency</p> <p style="text-align: right;">variable</p>  |  |

**B. General Science Core (32-34 Units) Note: Required for the Environmental Science Core.**

| Course  | Units            | Fall             | Spring           |
|---|------------------|------------------|------------------|
| CHEM 151, 152, Intro Chemistry I & II   | 8                | X                | X                |
| CHEM 241A, & 243A Organic Chemistry   | 4                | X                | X                |
| MATH 124 Calculus I with Applications<br>OR MATH 125 Calculus I   | 5<br>3           | X<br>X           | X<br>X           |
| MATH 263 Statistics<br>OR MATH 363 Intro to Stat Methods<br>OR MGMT 276 Stat Inference<br>OR SBS 200 Introduction to Statistics | 3<br>3<br>3<br>3 | X<br>X<br>X<br>X | X<br>X<br>X<br>X |
| MCB 181R/L, ECOL 182 R Intro Biology  | 7                | X                | X                |
| MIC 205 A Intro Microbiology  | 3                | X                | X                |
| PHYS 102/181 Physics*   | 4                | X                | X                |

\*PHYS 141 Intro Mechanics required for Atmo Science & Water Resource Management Subplans

**C. Environmental Science Core (27-28 units, 18-19 upper division units)**

| Course   | Units                 | Fall             | Spring            |
|--|-----------------------|------------------|-------------------|
| ECOL 302 Ecology*<br>OR RNR 316 Nat Res Ecology**<br>OR SWES 425 Env Microbiology<br>OR ECOL 474 Aquatic Plants & The Environ<br>OR ECOL 475 Freshwater & Marine Algae | 4<br>3<br>3<br>4<br>4 | X<br>X<br>X<br>X | <br><br><br><br>X |
| GEOS 251 Physical Geology  | 4                     | X                | X                 |
| SWES 420 Env Physics<br>OR ATMO 336 Weather, Climate & Society   | 3<br>3                | X<br>X           | <br>X             |
| WSM 460 Watershed Hydrology<br>OR HWR 250 Principles of Hydrology  | 3<br>3                | X<br>X           | <br>              |
| SWES 200/201 Intro Soils   | 4                     | X                | X                 |
| SWES 340 Env Chemistry<br>OR SWES 462 Env Soil & Water Chem<br>OR HWR 417A Fundamentals of Water Quality   | 3<br>3<br>3           | X<br><br>X       | <br><br>X         |
| SWES 305 Pollution Science   | 3                     |                  | X                 |
| SWES 418 Human Health Risk Assessment<br>OR HWR 443A Risk Assessment for Env Sys   | 3<br>3                | <br>X            | <br>X             |

\*Required in Biosphere Science & Ecology Subplans; select other course here

\*\*Required for Natural Resources Subplan

**D. Career Preparation Courses (10-14 units, 7-11 upper division units)**

| Course*  | Units         | Fall        | Spring           |
|--|---------------|-------------|------------------|
| SWES 210 Fund Env Sci & Sustainability   | 3             | X           | X                |
| SWES 408 Technical Writing<br>OR SWES 415 Translating Env Sci<br>OR ENGL 308 Technical Writing | 3<br>3<br>3   | <br>X<br>X  | <br><br>X        |
| SWES 393/493 Internship<br>OR SWES 397A Teaching Workshop<br>OR SWES 399/499 Independent Study | 1<br>3-4<br>1 | X<br>X<br>X | X<br>X<br>X      |
| SWES 430R/L Env Monitor/Remed. (Capstone)<br>OR SWES 461 Soil/Water Cons (Capstone)            | 4<br>3        | <br>        | <br>X<br>Pre-ssn |

\* SWES 195A Careers in Environmental Science is also highly recommended

**General Science Core Prerequisite Courses**

| Core Class     | Prerequisite Courses         | Core Class            | Prerequisite Courses |
|----------------|------------------------------|-----------------------|----------------------|
| CHEM 151       | MATH 112 or MATH 120         | MATH 263              | MATH 110 or higher   |
| CHEM 152       | CHEM 151                     | MCB 181R/L, ECOL 182R | MATH 110 or higher   |
| CHEM 241A/243A | CHEM 152                     | MIC 205A/L            | CHEM 151, MCB 181R   |
| MATH 124       | MATH 111 & 112, or MATH 120R | PHYS 102              | MATH 110 or higher   |

## E. Environmental Science Focal Areas.

Students may pursue one of the following:

### 1. Atmospheric Science

Courses within this focus area are designed primarily as preparation for an atmospheric sciences graduate degree at the M.S. or Ph.D. level. It is also possible for a student to satisfy the course requirements for employment as a meteorologist in the National Weather Service with a BES. degree.

For further information contact:

Dr Chris Castro 520-626-5617 [castro@atmo.arizona.edu](mailto:castro@atmo.arizona.edu)

(18 units upper division)

| <b>Required Courses (15 units)</b>         | <b>Options (3 units)</b>                        |
|--|---|
| ATMO 436A: Fundamentals of Atmo Sci (3) II | ATMO 471: Synoptic Meteorology (3) I            |
| ATMO 451A: Physical Meteorology I (3) I    | ATMO 421: Physical Climatology (3) I            |
| ATMO 441A: Dynamic Meteorology I (3) I     | ATMO 469a: Air Pollution I: Gases (3) I         |
| ATMO 441B: Dynamic Meteorology II (3) II   | ATMO 489: Atmospheric Electricity (3) II        |
| ATMO 451B: Physical Meteorology II (3) II  | ATMO 490: Remote Sensing of Planet Earth (3) II |
|  | ATMO 469b: Air Pollution II: Aerosols (3) II    |

Students must complete following prerequisites: MATH 129 Calc II (3) I, II, Summer, MATH 254 Intro Ordinary Diff Eq (3) I, II, Summer, PHYS 141 Intro Mechanics (4) I, II, Summer, PHYS 142 Intro Optics & Thermodynamics (3) I, II

### 2. Biosphere Science

This focus concerns the Earth as an integrated and interacting system composed of land surfaces, water, air, and biology that both influences and is influenced by humans. The goal of this focus area is to yield an appreciation of how the interaction of systems contributes to the past, current, and future states of the Earth and offer students classroom knowledge, laboratory skills, and field experience. This focus was developed with Biosphere 2.

For further information contact:

Dr. Mitchell Pavao-Zuckerman, 621-8220, [mzucker@email.arizona.edu](mailto:mzucker@email.arizona.edu);

Dr. Greg Barron-Gafford, 548-0388, [gregbg@email.arizona.edu](mailto:gregbg@email.arizona.edu)

Dr. Stephen DeLong, 838-6148, [sdlong@email.arizona.edu](mailto:sdlong@email.arizona.edu)

Dr. Katerina Donstova, 838-6133, [dontsova@email.arizona.edu](mailto:dontsova@email.arizona.edu)

(18 units upper division)

| <b>Required Courses (10 units)</b>          | <b>Options (6 units)</b>                         |
|---|--|
| ECOL 302 Ecology (4) I                      | ECOL 310 Living in Symbiosis (3) I               |
| ATMO 436A Fund of Atmo Sci (3) II           | GEOS 342 Evol of Earth, Ocean, and Atmo (3) I    |
| SWES 456A Watersheds/Ecosys Function (3) II | GEOS 412 Ocean Science (4) II                    |
|   | GEOS 450 - Geomorphology (4) II                  |
|   | GEOS 453 - Glacial & Quaternary Geol (3) II      |
|   | GEOS 466 Stable Iso Geochem & Paleoclimate (3) I |
|   | GEOS 478 Global Change (3), I                    |
|   | RNR 384 Nat Resource Manage (3) II               |
|   | RNR 403 Appl Geog Info Sys (3), I                |
|   | RNR 417 GIS for Natural & Social Sci (3), I      |
|   | SWES 425 - Environmental Microbiology (3) I      |
|   | SWES 426 Env. Micro. Lab (2) I                   |
|   | SWES 330 Intro to Remote Sensing (3), I          |
|   | SWES 453 Remote Sensing of the Env (3), I        |
|   | SWES 461 Soil/Water Cons (3) Pre-session         |
|   | WSM 473 - Spatial Analysis & Modeling (3) I      |

### 3. Chemistry

This focus integrates physical and chemical sciences within a quantitative framework applied to the environment. It includes the study of sources, reactions, transport, effects and fates of chemical species in water, soil, air, and living environments.

For further information contact:

Dr. Joan Curry, 626-5081, [curry@ag.arizona.edu](mailto:curry@ag.arizona.edu)

Dr. Jon Chorover, 626-5635, [chorover@ag.arizona.edu](mailto:chorover@ag.arizona.edu)

(18 units upper division)

| <b>Required Courses (9 units)</b>             | <b>Options (9 units)</b>                              |
|---|---|
| CHEM 322 Principles of Analysis I (2) II, Sum | CHEM 404 Inorganic Chem (3) I                         |
| CHEM 323 Principles of Analysis I Lab (1) II  | CHEE 400R Water Chem for Engr (3) I                   |
| CHEM 480A Physical Chemistry (3) I, II        | CHEE 400L Water Chem for Engr (Lab) (1) I,II          |
| SWES 464 Environ Organic Chemistry (3) I      | CHEE 478 Intro to Hazardous Waste Mgmt (3) II         |
|   | GEOS 400 Intro to Geochemistry (3) I                  |
|   | MSE 412 Physical Chemistry of Materials (3) I         |
|   | PTY5 407 Chemistry of the Solar System (3) I          |
|   | SWES 340 Environmental Chem (3) I                     |
|   | SWES 401 Mgt Arid Land/Salt Soils (3) II (even years) |
|   | SWES 431 Soil Genesis, Morph/Taxon (3) I              |

Students must complete following prerequisites: MATH 129 Calculus II (3) I,II

PHYS 103 Intro Physics II (3) I, II, Sum, or PHYS 241 Intro Electricity & Mag (4) I, II, Sum

### 4. Communication & Education

This focal area trains students to bridge the communication gap between the applications and nomenclature of cutting-edge environmental technology and the perceptions of the lay public.

For further information contact:

Dr. Melanie Lenart 792-8736 [melenart@email.arizona.edu](mailto:melenart@email.arizona.edu)

Dr. Tom Wilson 621-9308 [twilson@ag.arizona.edu](mailto:twilson@ag.arizona.edu)

(18 Units upper division)

| <b>Required Courses (9 units)</b>            | <b>Options (3 units)</b>                    |
|--|---|
| AGTM 422 Comm Know in Ag & Life Sci (3) I    | AREC 476 Env Law & Economics (3) II         |
| PHIL 323 Environmental Ethics (3) I, II, SUM | ED P 310 Learning in the Schools (3) I, II  |
| STCH 250 Teaching Science (3) I, II          | ED P 340 Research in Education (3) I, II    |
| <b>Select one (3 units)</b>                  | GEOG 461 Env & Resource Geog (3) II         |
| SWES 408 Technical Writing (3) II            | GEOS 478 Global Change (3) I                |
| SWES 415 Translating Env Science (3) II      | SWES 397A Teaching Workshop (3-4) I, II     |
| <b>Select one (3 units)</b>                  | SWES 444 Applied Env Law (3) I              |
| HIST 355 US Environmental History (3) II     | TTE 350 Schooling in America (3) I, II, SUM |
| HIST 356 Global Environmental History (3) II |   |

## 5. Ecology

This focus centers on how living organisms, populations, communities, and ecosystems interact with their environment. It gives students basic grounding in ecological principles. It considers agricultural and aquacultural impacts on the environment, use of plants to clean up the environment (phytoremediation), global change, and management of freshwater and marine systems.

For further information contact:

(18 units upper division)

|  |  |
|--|--|
| <p><b>Required course (4 units)</b><br/>ECOL 302 Ecology (4) I</p>   | <p><b>Options (continued)</b><br/>ECOL 485 Mammalogy (4) I<br/>ECOL 487 Animal Behavior (4) I<br/>EIS 415R Insect Biology (3) I</p>  |
| <p><b>Select two (8 units)</b><br/>ECOL 320 Genetics (4) I<br/>ECOL 335 Evolutionary Biology (4) II<br/>ECOL 406R/L Conservation Biology (4) I</p>   | <p>GEOS 412 Ocean Sciences (4) II<br/>GEOS 478 Global Change (3), I<br/>RNR 316 Natural Resources Ecology (3) I<br/>RNR 355 Introduction to Wildland Fire (3)<br/>RNR 384 Natural Resource Management (3)<br/>RNR 403 Applied Geographic Info Sys (3) I,II</p>   |
| <p><b>Options (6 units)</b><br/>ECOL 310 Living in Symbiosis (3)<br/>ECOL 330 Evol Animal Form &amp; Function (3-4)<br/>ECOL 340 Evolution Plant Form and Function (3)<br/>ECOL 380 Mathematic Models in Biology (3)<br/>ECOL 404R/L Biology of the Oceans (3/1) I<br/>ECOL 482 Ichthyology (4) I<br/>ECOL 483 Herpetology (4) II<br/>ECOL 484 Ornithology (4) I</p> | <p>SWES 316 Soil Fertility/Plant Nutrition (3) II<br/>SWES 425 Environmental Microbiology (3) I<br/>SWES 431 Soil Genesis, Morph/Taxon (3), I<br/>SWES 453 Remote Sensing of the Environment (3) I<br/>SWES 456A Watersheds &amp; Ecosys Function (3) II<br/>SWES 474 Aquatic Plants in the Environ (4) I<br/>SWES 475 Freshwater &amp; Marine Algae (4) II<br/>WFSC 441 Limnology (4) I</p> |

## 6. Environmental Change

This focus emphasizes environmental change through time. It includes the study and reconstruction of past environments, the evaluation of current environments in the context of long-term change, and the projection for future change.

For further information contact:

Dr Paul Sheppard, 621-6474, [Sheppard@ltrr.arizona.edu](mailto:Sheppard@ltrr.arizona.edu)

Dr Pearce Paul Creasman, 621-2414, [pcreasman@ltrr.arizona.edu](mailto:pcreasman@ltrr.arizona.edu)

(18 units upper division)

|   |  |
|---|--|
| <p><b>Required course (7 units)</b><br/>GEOS 439A Intro. to Dendrochronology (4) I<br/>GEOS 478 Global Change (3) I</p>             | <p><b>Options (at least 5 units)</b><br/>ANTH 307 Ecological Anthropology (3) I<br/>ANTH 418 Southwest Land and Society (3) II</p> |
| <p><b>Select one (3 units)</b><br/>HIST 355 U.S. Environmental History (3), II<br/>HIST 356 Global Environmental History (3) II</p> | <p>ATMO 421C Phys Climatology: Mech of Change (3) II<br/>GEOG 408 Arizona and the Southwest (3) I</p>                              |
| <p><b>Select one (3 units)</b><br/>ANTH 332 Environmental Archaeology (3) II<br/>GEOS 462 Intro. to Quaternary Ecology (3) I</p>    |  |

## 7. Geosciences

This focus area allows integration of environmental principles and ongoing issues, learned in the core of the Environmental Sciences degree, into a framework of Geoscience studies on land and in the ocean.

For further information contact:

Dr P. Jonathan Patchett, 621-2070, [patchett@email.arizona.edu](mailto:patchett@email.arizona.edu)

(18 units upper division)

### **Required Courses (18 units)**

GEOS 302 Stratigraphy & Sedimentation (4) I  
GEOS 342 Evolution of Earth, Ocean, Atmosphere (3) I  
GEOS 412A Ocean Sciences (4) II  
GEOS 450 Geomorphology (4) II  
GEOS 478 Global Change (3) I

## 8. Microbiology

This focus primarily addresses issues such as the remediation of contaminated sites and natural processes of decomposition, as well as water and food quality (pathogens).

For further information contact:

Dr. Raina Maier, 621-7231, [rmaier@ag.arizona.edu](mailto:rmaier@ag.arizona.edu)

Dr. Ian Pepper, 626-3328, [ipepper@ag.arizona.edu](mailto:ipepper@ag.arizona.edu)

(18 Units upper division)

### **Required Courses (5 units)**

SWES 425 Environmental Microbiology (3) I  
SWES 426 Env. Micro. Lab (2) I

### **Select one (3-4 units)**

BIOC 384 Foundations in Biochemistry (3) I, II  
BIOC 385 Metabolic Biochemistry (3) I, II  
BIOC 462a Biochemistry (4) I  
ECOL 320 Genetics (4) I, II

### **Options (9-10 units)**

BIOC 462a Biochemistry (4-5) I  
BIOC 460 Gen Prot & Gen Metab Biochem (3) I, II, SUM  
ECOL 320 Genetics (4) I, II  
MCB 411 Molecular Biology (3-4) I, II  
MCB 473 Recomb DNA Methods/Appl (4) I, II  
MIC 328R Microbial Physiology (3) II  
MIC 421b Microbiological Techniques (3) I  
SWES 440 Biodeg of Pollutants (3) II (even years)  
ECOL 475 Freshwater and Marine Algae (4) II  
WFSC 441 Limnology (4) I

Students must complete following prerequisite: CHEM 241b Organic Chemistry (3) I, II (for BIOC & MIC courses)

## 9. Natural Resources

This focus area introduces students to applications of physical and biological science for the conservation and management of natural resources (e.g., wildlife, rangelands, water, and forests).

For further information contact:

Dr William Matter, 621-7280, [wmatter@ag.arizona.edu](mailto:wmatter@ag.arizona.edu)

(18 units upper division)

| <b>Options (18 units)</b>                | <b>Options (continued)</b>               |
|--|--|
| GEOG 438 Biogeography (3) I              | RA M 436a Grazing Ecol & Manage (2) II   |
| RA M 382 Range Plant Comm of West (3) II | RA M 446 Veg Manage of Wildlands (3) II  |
| RNR 321 Nat Res – Measure (3) II         | RA M 456a Rangeland Invent & Mon (3) I   |
| RNR 351 Ecosys Serv: Sci & Manage (3) I  | WFSC 441 Limnology (4) I                 |
| RNR 355 Intro to Wildland Fire (3) I     | WFSC 444 Wildlife Manage Mammal Sp (4) I |
| RNR 403 Appl of GIS (3) I, II            | WFSC 446 Wildlife Manage Avian Sp (4) II |
| RNR 417 GIS Nat & Soc Sci (3) I, II      | WFSC 455 R/L Fishery Manage (4) II       |
| RNR 406 R/L Cons Biol (4) II             | WSM 452 Dryland Ecohydro & Veg Dyn (3) I |
| RNR 448 Outdoor Rec Manage (2-3) II      | WS M 462 Watershed Manage (3) II         |
| RNR 480 Nat Res - Policy & Law (3) II    | WS M 468 Wildland Water Quality (3) II   |
| RNR 485 Nat Res - Econ & Planning (3) I  |  |

Students must complete the following prerequisite for RAM 382: RNR 230 R/L Native Plant Taxonomy (3) I

## 10. Pollution Science Focus

This focus was developed with the Chemical and Environmental Engineering Department. It prepares students to deal with environmental pollution and to solve complex environmental problems requiring an interdisciplinary background.

For further information contact:

Dr. Mark L. Brusseau, 621-3244, [brusseau@ag.arizona.edu](mailto:brusseau@ag.arizona.edu)

(18 Units upper division)

| <b>Required courses (6 units)</b>      | <b>Options (6 units)</b>                          |
|--|---|
| SWES 464 Environmental Chemistry (3) I | ATMO 469A Air Pollution I: Gases (3) I            |
| CHEM 480a Physical Chemistry (3) I, II | ATMO 469B Air Pollution II, (3) II (odd years)    |
| <b>Select one (3-4 units)</b>          | CHEE 400R Water Chemistry (3) I                   |
| SWES 470 Soil Physics (3) II           | CHEE 400L Water Chemistry (1) I                   |
| HWR 431 Hydrogeology (4) I             | CHEE 478 (CE 478) Intro Hazardous Waste (3) I, II |
| <b>Select one (3 units)</b>            | CHEE 370R Env & Water Engineering (3), I, II      |
| HWR 423 Hydrology (3) I                | CHEE 370L Env & Water Engineering (1) I, II       |
| WSM 460 Watershed Hydrology (3) I      | SWES 425 Environmental Microbiology (3) I         |
|  | SWES 440 Biodegradation (3) II (even years)       |
|  | SWES 453 Remote Sensing of the Environment (3) I  |

Students must complete following prerequisites:

MATH 129 Calculus II (3) I, II

PHYS 103 Intro Physics II (3) I, II, Summer, or PHYS 241 Intro Electricity & Mag (4) I, II, Summer



## 11. Remote Sensing and Geospatial Analysis

This focal area applies principles of remote sensing and geographic information systems analysis tools and their applications to the study of the environment and global change

For further information contact:

Dr. Phil Guertin, 621-1723, [phil@nexus.srn.arizona.edu](mailto:phil@nexus.srn.arizona.edu)

(18 Units upper division)

|   |   |
|---|---|
| <p><b>Required Courses (6 units)</b><br/> RNR 417 Geog Info Sys Nat Resources (3) I<br/> SWES 330 Intro Remote Sensing (3) I</p>  | <p><b>Options (6 units)</b><br/> GEOG 303 Field Studies of Env Geography (3) I, II, SUM<br/> GEOG 357 Geog Research Methods (3) I, II<br/> GEOG 416A Computer Cartography (3) I<br/> GEOS 478 Global Change (3) I<br/> OPTI 531 Image Processing Lab (3) I<br/> OPTI 550 Fundamentals of Remote Sensing (3) II<br/> RNR 271 Nat Resource Computer Appl (3) II<br/> RNR 321 Nat Resource Measurements (3) II<br/> RNR 473 Spatial Analysis/Modeling (3) I<br/> SWES 431 Soil Genesis, Morph/Taxon (3) I<br/> SWES 461 Soil/Water Cons (3) PreSession<br/> SWES 470 Soil Physics (3) II</p> |
| <p><b>Select two (6 units)</b><br/> RNR 419 Carto Model for Nat Resources (3) II<br/> RNR 420 Advanced Geog Info Sys (3) II<br/> SWES 453 Remote Sensing Environment (3) I<br/> SWES 483 Geog Appl Remote Sensing (3) II<br/> SWES 490 Remote Sensing Planet Earth (3) II</p> |   |

## 12. Science and Policy Focus

This focus emphasizes environmental science policy issues. It includes courses in a variety of disciplines, from public policy to ecology. This focal area is ideally suited for Pre-Law students.

For further information contact:

Dr. Robert G. Varady, 884-4393, [rvarady@u.arizona.edu](mailto:rvarady@u.arizona.edu)

Dr. Edella Schlager, 621-5840, [eschlager@bpa.arizona.edu](mailto:eschlager@bpa.arizona.edu)

(18 units upper division)

|  |   |
|--|---|
| <p><b>Required Courses (9 units)</b><br/> AREC 476 Env Law/Econ (3) II<br/> PHIL 323 Env Ethics (3), I,II, SUM<br/> SWES 444 Applied Environ Law (3) I</p> | <p><b>Option (3 units)</b><br/> ANTH 307 Ecol Anthro (3) II<br/> ANTH 424A Political Ecology (3) I<br/> AREC 375 Land/Water in the American West (3) II<br/> AREC 377 Econ of Env Resource Conserv (3) II<br/> AREC 464 Econ of Policy Analysis (3), I<br/> AREC 479 Econ of Water Management/Policy (3) II<br/> ATMO 336 Weather, Climate, and Society (3) I,II<br/> COMM 411 Comm/Conflict Management (3) I,II<br/> ECOL 406 R/L Conserv Biol (4) I<br/> ENGL 306 Advanced Composition (3) I,II<br/> GEOG 461 Env &amp; Resource Geography (3) II<br/> HIST 355 U.S. Env Hist (3) I,II<br/> HIST 356 Global Env Hist (3) I,II<br/> PA 406 Bureaucracy, Politics, &amp; Policy (3) I<br/> PA 461 Global Climate Change Policy (3) I,II<br/> PA 480 Formation of Public Policy (3) II<br/> PA 481 Env Policy (3) I<br/> PSYC 374 Env Psych (3) I<br/> RNR 480 Nat Resource Policy/Law (3) II<br/> RNR 485 Nat Resource /Econ &amp; Planning (4) I<br/> SOC 313 Collective Behavior/Social Movements (3) I, II<br/> MN E 422 Engineering Sustainable Development (3) I</p> |
| <p><b>Select one (3 units)</b><br/> PA 481 Env Pol (3) I<br/> RNR 480 Nat Resource Policy/Law (3) II</p>   |   |
| <p><b>Select one (3 units)</b><br/> HIST 355 U.S. Env History (3) II<br/> HIST 356 Global Env History (3) I,II</p>   |   |

Students must complete following prerequisite: POL 201 American Nat Gov (3) I,II (Tier II INDV)

### 13. Soil Science

This focus emphasizes the properties and uses of soils, their classification, management, and conservation as important natural resources. This focal area qualifies students to be soil scientists or soil conservationists in U.S. Government agencies (i.e. Natural Resources Conservation Service or Forest Service). **NOTE:** Students can become certified as a **Certified Professional Soil Scientist** with the Soil Science Society of America. The Council of Soil Science Examiners (CSSE) offers exams in October and March each year.

For further information contact:

Dr. Craig Rasmussen, 621-7223, [crasmuss@ag.arizona.edu](mailto:crasmuss@ag.arizona.edu)

Dr. Thomas Wilson, 621-9308, [twilson@ag.arizona.edu](mailto:twilson@ag.arizona.edu)

(18 units upper division)

| <b>Required Courses (12 units)</b>              | <b>Options (6 units)</b>                       |
|---|--|
| SWES 316 Soil Fertility/Plant Nutrition (3) II  | GEOS 450 - Geomorphology (Fall 4 units)        |
| SWES 401 Mgt Arid /Salt Soils (3) II (even yrs) | GEOS 453 - Glacial & Quaternary Geol (3) II    |
| SWES 431 Soil Genesis, Morph/Taxon (3) I        | GEOS 478 Global Change (3), I                  |
| SWES 470 Soil Physics (3) II                    | RNR 403 Appl Geog Info Sys (3), I              |
|   | RNR 417 GIS for Natural & Social Sci (3), I    |
|   | SWES 330 Intro to Remote Sensing (3), I        |
|   | SWES 425 - Environmental Microbiology (3) I    |
|   | SWES 426 Env. Micro. Lab (2) I                 |
|   | SWES 453 Remote Sensing of the Env (3), I      |
|   | SWES 456A - Watershed & Ecosys Function (3) II |
|   | WSM 473 - Spatial Analysis & Modeling (3) I    |

### 14. Sustainable Land/Water Management

This focuses on landscape-level processes in environmental science. It investigates human-caused deforestation and desertification, ecological restoration; water, soil and air pollution, and global change.

For further information contact:

Dr. Edward P. Glenn, 626-2664, [eglenn@ag.arizona.edu](mailto:eglenn@ag.arizona.edu)

Dr. Allan D. Matthias, 621-7226, [matthias@ag.arizona.edu](mailto:matthias@ag.arizona.edu)

Dr. James J. Riley, 591-4019, [jriley@ag.arizona.edu](mailto:jriley@ag.arizona.edu)

(18 units upper division)

| <b>Required course (3 units)</b>               | <b>Options (6 units)</b>                            |
|--|---|
| SWES 444 Applied Environ Law (3) I             | ECOL 406 R/L Conservation Biology (4) I             |
| <b>Select one (3 units)</b>                    | GEOG 304 Water, Environ, & Society (3) I, II, Sum   |
| RNR 403 Appl Geog Info Sys (3) I,II            | GEOG 397A Field Study in Geog (1) I, II, Sum        |
| SWES 453 Remote Sensing of the Environ (3) I   | GEOG 461 Env & Resource Geography (3) II            |
| <b>Select one (3 units)</b>                    | GEOS 450 Geomorphology (4) I                        |
| SWES 310 Residential Water Harvesting (3) I    | GEOS 478 Global Change (3) I                        |
| SWES 454 Water Harvesting (3) II               | RNR 403 Appl Geog Info Sys (3) I,II                 |
| SWES 461 Soil/Water Cons (3) Pre (odd yrs)     | SWES 310 Residential Rain Harvesting (3) I          |
| WSM 460 Watershed Hydrology (3) I              | SWES 316 Soil Fertility/Plant Nutrition (3) II      |
| <b>Select one (3 units)</b>                    | SWES 401 Mgt Arid Land/Salt Soils (3) II (even yrs) |
| SWES 401 Mgt Arid Salt Soils (3) II (even yrs) | SWES 425 Env Microbiol (3) I                        |
| SWES 431 Soil Gen, Morph & Taxon (3) I         | SWES 426 Env Microbiol Lab (2) I                    |
|  | SWES 431 Soil Genesis, Morph & Taxon (3) I          |
|  | SWES 453 Remote Sensing of the Environ (3) I        |
|  | SWES 454 Water Harvesting (3) II                    |
|  | SWES 456A Watersheds & Ecosys Function (3) II       |
|  | SWES 470 Soil Physics (3) II                        |
|  | SWES 474 Aquatic Plants & the Environment (4) I     |
|  | SWES 475 Fresh Water & Marine Algae (4) II          |

## 15. Water Resource Management

This focal area concentrates on water management and water-related courses to understand water quantity and quality issues associated with land use and climate change. This will prepare the student for careers in water policy and management.

For further information contact:

Dr. Tom Meixner, 626-1532, [tmeixner@hwr.arizona.edu](mailto:tmeixner@hwr.arizona.edu)

Dr. D. Phillip Guertin, 621-1723, [phil@nexus.srn.arizona.edu](mailto:phil@nexus.srn.arizona.edu)

(18 Units upper division)

|   |   |
|---|---|
| <p><b>Required Courses (6 units)</b><br/>         HWRS 423 Hydrology (3) II<br/>         HWRS 431 Hydrogeology (3) II</p>   | <p><b>Options (continued)</b><br/>         HWRS 443 Env Risk &amp; Eco Analysis (3) I<br/>         HWRS 449 Statistical Hydrology (3) II<br/>         HWRS 480 Isotope tracers in hydrogeo (3) I<br/>         PA 481 Env. Policy (3) II<br/>         RNR 403 Appls of GIS (3) I, II<br/>         RNR 417 GIS for Nat &amp; Soc. Sci. (3) I<br/>         SWES 310 Residential Rain Harvesting (3) I<br/>         SWES 444 Applied Environmental Law (3) I<br/>         SWES 454 Water Harvesting (3) II<br/>         SWES 461 Soil and Water Cons (3) Pre-session<br/>         SWES 471 Stream Ecology (3)<br/>         WFSC 441 Limnology (4) I<br/>         WSM 426 Watershed Engineering (3) I<br/>         WSM 452 Dryland Ecohydrology (3) I<br/>         WSM 467 Advanced Watershed Hydro (3) II</p> |
| <p><b>Select Two (6 units)</b><br/>         HWRS 413A Field Hydrology (3) II<br/>         SWES 470 Soil Physics (3) II<br/>         WS M 468 Wildland Water Quality (3) II</p>  |   |
| <p><b>Options (6 units)</b><br/>         AREC 476 Env Law &amp; Econ (3) II<br/>         CE 427 Comp. Appl. In Hydraulics (3) I<br/>         GEOS 478 Global Change (3) I<br/>         HWRS 482 Appl. Groundwater Modeling (3) I<br/>         HWRS 415 Intro Water Res. Policy (3) II</p> |   |

Students must complete following prerequisites: PHYS 141 Intro Mechanics (4) I, II, Summer, PHYS 142 Intro Optics & Thermodynamics (3) I, II, CE 214 Statics (3) I, II, Summer, CE 218 Mechanics of Fluids (3) I, II, MATH 129 Calc II (3) I, II, Summer

**E. SWES Minors.** Students must complete following prerequisites:

MATH 112 College Algebra (3) II

CHEM 151 Intro Chem I (3) I, II, Sum

### *Environmental Science Minor (20 units)*

|  |   |
|--|---|
| <p><b>GENERAL SCIENCE COURSES (14 units)</b><br/>         MCB 181R Intro Biol (3) I<br/>         SWES 195A Careers in Env Sci (1) I, II<br/>         SWES 200 Soils (3) I, II<br/>         SWES 201, Soils Lab (1) I, II<br/>         SWES 210 Fund. Env. Sci &amp; Sustain (3) I, II<br/>         WSM 460 Watershed Hydrology (3) I</p> | <p><b>UPPER DIVISION COURSES (6 units)</b><br/>         Select from AREC, ATMOS, HIST, HWR, POL, RNR, SWES or other relevant courses.</p> |
|--|---|

### *Soil and Water Science Minor (20 units)*

|  |   |
|--|---|
| <p><b>GENERAL SCIENCE COURSES (11 units)</b><br/>         GEOS 251 Physical Geology (4) I, II<br/>         SWES 200 Soils (3) I, II<br/>         SWES 201 Soils lab (1) I, II<br/>         WSM 460 Watershed Hydrology (3) I</p> | <p><b>UPPER DIVISION COURSES (9 units)</b><br/>         SWES 316 Soil Fertility/Plant Nutrition (3), II<br/>         SWES 401 Mgt Arid Land/Salt Soils (3), II (even yrs)<br/>         SWES 431 Soil Genesis, Morph/Taxon (3), I<br/>         SWES 461 Soil/Water Cons (3) Pre-session<br/>         SWES 470 Soil Physics (3), II</p> |
|--|---|

## Environmental Science Major Schedule Planning Worksheet

| FIRST SEMESTER (Fall) |           |               |  | SECOND SEMESTER (Spring) |           |               |  |
|-----------------------|-----------|---------------|--|--------------------------|-----------|---------------|--|
| Recommended           |           | Your Schedule |  | Recommended              |           | Your Schedule |  |
| CHEM 151              | 4         |               |  | CHEM 152                 | 4         |               |  |
| ENGLISH 101           | 3         |               |  | ENGLISH 102              | 3         |               |  |
| SWES 210              | 3         |               |  | SWES 200                 | 3         |               |  |
| Tier I Course         | 3         |               |  | SWES 201                 | 1         |               |  |
| Tier I course         | 3         |               |  | Tier I Course            | 3         |               |  |
|                       |           |               |  | SWES 195A                | 1         |               |  |
|                       |           |               |  |                          |           |               |  |
| <b>TOTAL</b>          | <b>16</b> | <b>TOTAL</b>  |  | <b>TOTAL</b>             | <b>15</b> | <b>TOTAL</b>  |  |

| THIRD SEMESTER (Fall) |           |               |  | FOURTH SEMESTER (Spring) |           |               |  |
|-----------------------|-----------|---------------|--|--------------------------|-----------|---------------|--|
| Recommended           |           | Your Schedule |  | Recommended              |           | Your Schedule |  |
| Tier I course         | 3         |               |  | ECOL 182R                | 3         |               |  |
| MCB 181 R/L           | 4         |               |  | PHYS 102                 | 3         |               |  |
| CHEM 241a             | 3         |               |  | PHYS 181                 | 1         |               |  |
| CHEM 243a             | 1         |               |  | GEOS 251                 | 4         |               |  |
| MATH 124              | 5         |               |  | Subplan Class            | 3         |               |  |
|                       |           |               |  |                          |           |               |  |
|                       |           |               |  |                          |           |               |  |
| <b>TOTAL</b>          | <b>16</b> | <b>TOTAL</b>  |  | <b>TOTAL</b>             | <b>14</b> | <b>TOTAL</b>  |  |

| FIFTH SEMESTER (Fall) |    |               |  | SIXTH SEMESTER (Spring) |    |               |  |
|-----------------------|----|---------------|--|-------------------------|----|---------------|--|
| Recommended           |    | Your Schedule |  | Recommended             |    | Your Schedule |  |
| Tier II course        | 3  |               |  | Tier II Course          | 3  |               |  |
| MIC 205 A/L           | 4  |               |  | SWES 305                | 3  |               |  |
| ECOL 302*             | 4  |               |  | SWES 462*               | 3  |               |  |
| SWES 420*             | 3  |               |  | SWES 418                | 3  |               |  |
|                       |    |               |  | SWES 408*               | 3  |               |  |
|                       |    |               |  |                         |    |               |  |
|                       |    |               |  |                         |    |               |  |
| TOTAL                 | 14 | TOTAL         |  | TOTAL                   | 15 | TOTAL         |  |

\*or alternative

| SEVENTH SEMESTER (Fall) |   |               |  | EIGHTH SEMESTER (Spring) |   |               |  |
|-------------------------|---|---------------|--|--------------------------|---|---------------|--|
| Recommended             |   | Your Schedule |  | Recommended              |   | Your Schedule |  |
| Tier II course          | 3 |               |  | SWES 430 A/L             | 4 |               |  |
| MATH 263*               | 3 |               |  | SWES 493*                | 3 |               |  |
| HWR 250                 | 3 |               |  | Subplan Class            |   |               |  |
| Subplan Class           |   |               |  | Subplan Class            |   |               |  |
| Subplan Class           |   |               |  | Subplan Class            |   |               |  |
|                         |   |               |  |                          |   |               |  |
| TOTAL                   |   | TOTAL         |  | TOTAL                    |   | TOTAL         |  |

\*or alternative

## SWES Scholarships

Scholarship funds include the following; check with your Advisor for more details.

| Scholarship       | Criteria   |
|-------------------|--|
| Buehrer, T-PR     | Undergrad/grad in soils/water sci. or env. sci. demonstrating academic excellence/leadership. Named by Dean with approval of OSFA.   |
| Fuller, W.H.      | Outstanding undergrads and grads involved in soils and water sci. to svc agriculture in AZ; Recipients must demonstrate academic excellence; good character; professional promise; Nominated by Dept Head of SWES; OSFA appr. v. |
| Jones, Geo-PR     | Upper division & grad students in crop production area of AG. 3.0 cum gpa. This award amount to be distributed in consultation with Plant Sciences. Approved by Dean & OSFA.   |
| Smith, H Schol-PR | Upper division; Soils, Water, Eng or Nutri. Schol. sub-committee nominates, Dean/OSFA approves.  |

### Department of Soil, Water, and Environmental Science Desired ENVS Undergraduate Outcomes

1. Be able to understand and describe the source and extent of current environmental pollution problems, and understand U.S. laws governing pollution and remediation.
2. Learn and integrate basic scientific principles involved in preventing soil and water degradation, and remediation of contaminated land and water.
3. Understand factors governing fate and transport of water and contaminants in the soil and vadose zone.
4. Have and appreciation and knowledge of the Earth with emphasis on a basic understanding of soils and water sources as critical entities in natural and human-impacted ecosystems.
5. Understand soils as natural entities and the factors of soil formation and erosion.
6. Understand important physical, chemical and biological properties of soils as they relate to their mineralogy, fertility, genesis and classification, biology and biochemistry, and land use management.
7. Understand important physical, chemical and biological properties of water with emphasis on water quality as it relates to human health, sustainable soil-plant systems and the preservation of the natural environment.
8. Understand how to properly collect soil and water samples, identify and implement appropriate analytical techniques, and interpret results.
9. Be proficient in writing a technical report or proposal in the field of Environmental Science.
10. Be able to create a hypothesis, design an experiment to test that hypothesis, analyze the results, and draw appropriate conclusions.