

Bachelor of Science in Environmental Science

-- Guidelines for Majors --

**Department of Soil, Water and Environmental
Science**

The University of Arizona

2015-2016

BACHELOR OF ENVIRONMENTAL SCIENCE DEGREE

Shantz Building Room 429

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SWES.CALS.arizona.edu

September 2015

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 and related fields;
- 2) Prepare students for graduate studies in environmental science and related fields;
- 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-impacted 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 sub-plan 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 sub-plan requirements.

GENED Total: 35 units

CORE Total: 69-76 units

General Science Core: 31-33

Environmental Science Core: 26-28

Career Preparation: 11-14

SUBPLAN Total: 18 units

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

<u>Foundation Courses</u> English Composition 6 Units Mathematics (satisfied by MATH 125 or 122B) 3-4 units	<u>Tier 1</u> Traditions and Cultures 6 Units Individuals and Societies 6 Units
<u>Pre-Major</u> Communications (satisfied by ENVS 408)	<u>Tier 2</u> Humanities 3 Units Arts 3 Units Individuals and Societies 3 Units
<u>Second Language</u> Second semester proficiency variable	

B. General Science Core (31-33 Units) Note: Required for the Environmental Science Core.

Course	Units	Fall	Spring	Other
CHEM 151, 152, Intro Chemistry I & II	8	X	X	S 1, S 2
CHEM 241A, & 243A Organic Chemistry	4	X	X	
MATH 122A/B Calculus I, OR MATH 125 Calculus I	5 3	X X	X X	S 1, S 2 S 2
MATH 263 Statistics OR MATH 363 Intro to Stat Methods OR MGMT 276 Stat Inference OR SBS 200 Introduction to Statistics	3 3 3 3	X X X X	X X X X	S 1 S 1, W S 2
ECOL 182R, MCB 181R Intro Biology	6	X	X	S 2 S1
MIC 205A Intro Microbiology	3	X	X	S 1
PHYS 102/181 Physics*	4	X	X	S 1

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

C. Environmental Science Core (26-28 units, 15-20 upper division units)

Course	Units	Fall	Spring	Other
ENVS 425 Env Microbiology OR ENVS 474 Aquatic Plants & The Environ OR ECOL 475 Freshwater & Marine Algae	3 4 4	X X		
ENVS 420 Env Physics OR ENVS 470 Soil Physics	3 3	X	X	
ENVS 200/201 Intro Soils	4	X	X	
ENVS 462 Env Soil & Water Chem OR ENVS 464 Env Organic Chem OR HWRS 417A Fundamentals of Water Quality	3 3 3		X	
ENVS 305 Pollution Science	3		X	
ENVS 418 Human Health Risk Assessment OR HWRS 443A Risk Assessment for Env Sys	3 3	X X		
GEOS 251 Physical Geology	4	X	X	
WSM 460A Watershed Hydrology OR HWRS 250 Principles of Hydrology OR HWRS 249A/B Principles of Hydrology	4 3 3	X X X		
			X	S 1, S 2

D. Career Preparation Courses (11-15 units, 7-11 upper division units)

Course*	Units	Fall	Spring	Other
ENVS 195A Careers in Environmental Science	1	X	X	
ENVS 210 Fund Env Sci & Sustainability	3	X	X	
ENVS 415 Translating Env Sci Or ENVS 408 Scientific Writing OR AGTM 422 Comm Knowledge in Ag & Life Sci	3 3		X	
ENVS 393/493 Internship OR ENVS 397A Teaching Workshop OR ENVS 399/499 Independent Study OR ENVS 392/492 Directed Research (for AMP)	1 3-4 1 1-3	X X X X	X X X X	S 1, S 2 S 1, S 2 S 1, S 2
ENVS 430R/L Env Monitor/Remed. (Capstone) OR ENVS 461 Soil/Water Cons (Capstone)	4 3		X	P

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	MATH 110 or higher
CHEM 241A/243A	CHEM 152	MIC 205A/L	CHEM 151, MCB 181R
MATH 122A	MATH 111 & 112, or MATH 120R	PHYS 102	MATH 110 or higher

E. Environmental Science Sub-plans.

Students may pursue one of the following four Sub-plans. Each Sub-plan has multiple options.

1. Sub-plan: Biology

Required Courses:

Select 12 units in consultation with your ENVS Advisor.

ENVS 425 Environmental Microbiology (3) I
ENVS 426 Env. Micro. Lab (2) I
ENVS 474 Aquatic Plants in the Environ (4) I
BIOC 462a Biochemistry (4) I
ECOL 302 Ecology (4) I
ECOL 320 Genetics (4) I
ECOL 335 Evolutionary Biology (4) II
ECOL 475 Freshwater and Marine Algae (4) II

Optional Courses:

Select 6 units in consultation with your ENVS Advisor

ENVS 316 Soil Fertility/Plant Nutrition (3) II	GEOS 412 Ocean Sciences (4) II
ENVS 425 Environmental Microbiology (3) I	GEOS 478 Global Change (3), I
ENVS 431 Soil Genesis, Morph/Taxon (3) I	MCB 411 Molecular Biology (3-4) I, II
ENVS 440 Biodeg of Pollutants (3) II (even years)	MCB 473 Recomb DNA Methods/Appl (4) I, II
ENVS 453 Remote Sensing of the Environment (3) I	MIC 328R Microbial Physiology (3) II
ENVS 456A Watersheds & Ecosys Function (3) II	MIC 421b Microbiological Techniques (3) I
ENVS 474 Aquatic Plants in the Environ (4) I	RNR 316 Natural Resources Ecology (3) I
ENVS 495G Rainforest Cons Biol/Ecuador (3) Winter	RNR 384 Natural Resource Management (3)
BIOC 460 Gen Prot & Gen Metab Biochem (3) I, II, SUM	RNR 403 Applied Geographic Info Sys (3) I, II
BIOC 462a Biochemistry (4-5) I	RNR 406 R/L Cons Biol (4) II
ECOL 310 Living in Symbiosis (3) I	RNR 495F Cons Biol: Field Studies in Namibia (6) Sum I
ECOL 320 Genetics (4) I, II	WFSC 441 Limnology (4) I
ECOL 475 Freshwater and Marine Algae (4) II	

Key for course offerings by semester

Fall = I; Spring = II; Pre-session = P; Summer 1 = S 1; Summer 2 = S 2; Winter = W

2. Sub-plan: Land, Air, and Water

Required Courses:

Select 12 units in consultation with your ENVS Advisor.

ENVS 316 Soil Fertility/Plant Nutrition (3) II
ENVS 401 Mgt Arid /Salt Soils (3) II (even yrs)
ENVS 431 Soil Genesis, Morph/Taxon (3) I
ENVS 470 Soil Physics (3) II
ENVS 444 Applied Environ Law (3) I
ENVS 454 Water Harvesting (3) II
ENVS 461 Soil/Water Cons (3) Pre (odd yrs)
ATMO 436A: Fundamentals of Atmo Sci (3) II

GEOS 302 Stratigraphy & Sedimentation (4) I
GEOS 412A Ocean Sciences (4) II
GEOS 450 Geomorphology (4) II
GEOS 478 Global Change (3) I
MATH 129 Calculus II (3) I, II, Sum
RNR 403 Appl Geog Info Sys (3) I, II
RNR 417 Geog Info Sys (3) I, II
WSM 460 Watershed Hydrology (3) I

Optional Courses:

Select 6 units in consultation with your ENVS Advisor

ENVS 330 Intro to Remote Sensing (3), I
ENVS 316 Soil Fertility/Plant Nutrition (3) II
ENVS 401 Mgt Arid Land/Salt Soils (3) I
ENVS 425 Env Microbiol (3) I
ENVS 426 Env Microbiol Lab (2) I
ENVS 453 Remote Sensing of the Environ (3) I
ENVS 454 Water Harvesting (3) II
ENVS 456A Watersheds & Ecosys Function (3) II
ENVS 474 Aquatic Plants & the Environment (4) I
ENVS 495F Rainforest Cons Biol/Ecuador (3) Winter
ATMO 471: Synoptic Meteorology (3) I
ATMO 421: Physical Climatology (3) I
ATMO 469a: Air Pollution I: Gases (3) I
ATMO 469b: Air Pollution II: Aerosols (3) II
ATMO 489: Atmospheric Electricity (3) II
ATMO 490: Remote Sensing of Planet Earth (3) II
ECOL 406 R/L Conservation Biology (4) I
ECOL 475 Fresh Water & Marine Algae (4) II
GEOG 304 Water, Environ, & Society (3) I, II, Sum
GEOG 397A Field Study in Geog (1) I, II, Sum

GEOG 461 Env & Resource Geography (3) II
GEOG 438 Biogeography (3) I
GEOS 450 - Geomorphology (Fall 4 units)
GEOS 453 - Glacial & Quaternary Geol (3) II
GEOS 478 Global Change (3), I
RA M 382 Range Plant Comm of West (3) II
RA M 456a Rangeland Invent & Mon (3) I
RA M 446 Veg Manage of Wildlands (3) II
RA M 456a Rangeland Invent & Mon (3) I
RNR 321 Nat Res – Measure (3) II
RNR 448 Outdoor Rec Manage (2-3) II
RNR 472 Env Land Use/Planning (3) I
RNR 480 Nat Res - Policy & Law (3) II
RNR 485 Nat Res - Econ & Planning (3) I
RNR 495F Cons Biol Field Studies in Namibia (6) Sum I
WFSC 441 Limnology (4) I
WSM 452 Dryland Ecohydro & Veg Dyn (3) I
WS M 462 Watershed Manage (3) II
WS M 468 Wildland Water Quality (3) II
WSM 473 - Spatial Analysis & Modeling (3) I

Key for course offerings by semester

Fall = I; Spring = II; Pre-session = P; Summer 1 = S 1; Summer 2 = S 2; Winter = W

3. Sub-plan: Environment and Society

Required Courses:

Select 12 units in consultation with your ENVS Advisor.

ENVS 415 Translating Env Science (3) II
ENVS 444 Applied Environ Law (3) I
AGTM 422 Comm Know in Ag & Life Sci (3) I
ANTH 332 Environmental Archaeology (3) I
AREC 476 Env Law/Econ (3) II
GEOS 439A Intro to Dendrochronology (4) I
GEOS 462 Intro to Quaternary Ecology (3) I
GEOS 478 Global Change (3) I
HIST 355 U.S. Environmental History (3), II
HIST 356 Global Environmental History (3) II
PA 481 Env Pol (3) I
PHIL 323 Environmental Ethics (3) I, II, SUM
RNR 480 Nat Resource Policy/Law (3) II
STCH 250 Teaching Science (3) I, II
JOUR 455 Environmental Journalism (3) II

Optional Courses:

Select 6 units in consultation with your ENVS Advisor

ENVS 397A Teaching Workshop (3-4) I, II
ENVS 444 Applied Env Law (3) I
ENVS 495F Rainforest Cons Biol/Ecuador (3) Winter
ANTH 307 Ecological Anthropology (3) I
ANTH 418 Southwest Land and Society (3) II
ANTH 424A Political Ecology (3) I
AREC 373 Environmental Economics (3) I, II, Sum
AREC 375 Land/Water in the American West (3) II
AREC 377 Econ of Env Resource Cons (3) II
AREC 464 Econ of Policy Analysis (3), I
AREC 476 Env Law & Economics (3) II
AREC 479 Econ of Water Management/Policy (3) II
ATMO 336 Weather, Climate, and Society (3) I, II
ATMO 421C Phys Climatology: Mech of Change (3) II
COMM 411 Comm/Conflict Management (3) I, II
ECOL 406 R/L Conserv Biol (4) I
ED P 310 Learning in the Schools (3) I, II
ED P 340 Research in Education (3) I, II
ENGL 306 Advanced Composition (3) I, II
GEOG 408 Arizona and the Southwest (3) I
GEOG 461 Env & Resource Geog (3) II
GEOS 478 Global Change (3) I
HIST 355 U.S. Env Hist (3) I, II
HIST 356 Global Env Hist (3) I, II
JOUR 472 Science Journalism (3) I
MNE 422 Engineering Sust. Development (3) I
PA 406 Bureaucracy, Politics, & Policy (3) I
PA 461 Global Climate Change Policy (3) I, II
PA 480 Formation of Public Policy (3) II
PA 481 Env Policy (3) I
PSYC 374 Env Psych (3) I
RNR 440 Adaptation to Climate Change (3) II
RNR 472 Env Land Use/Planning (3) I
RNR 480 Nat Resource Policy/Law (3) II
RNR 485 Nat Resource /Econ & Planning (4) I
RNR 495F Cons Biol: Field Studies in Namibia (6) Sum I
SOC 313 Coll Behavior/Social Movements (3) I, II
TTE 350 Schooling in America (3) I, II, SUM

Key for course offerings by semester

Fall = I; Spring = II; Pre-session = P; Summer 1 = S 1; Summer 2 = S 2; Winter = W

4. Sub-plan: Physics and Chemistry

Required Courses:

Select 12 units in consultation with your ENVS Advisor.

ENVS 462 Environmental Chemistry (3) II	CHEM 480A Physical Chemistry (3) I, II
ENVS 464 Environ Organic Chemistry (3) I	HWRS 431 Hydrogeology (4) I
ENVS 470 Soil Physics (3) II	HWRS 423 Hydrology (3) I
CHEM 322 Principles of Analysis I (2) II, Sum	MATH 129 Calculus II (3) I, II, Sum
CHEM 323 Principles of Analysis I Lab (1) II	WSM 460 Watershed Hydrology (3) I

Optional Courses:

Select 6 units in consultation with your ENVS Advisor

ENVS 340 Environmental Chem (3) I	CHEE 370L Env & Water Engineering (1) I, II
ENVS 401 Mgt Arid Land/Salt Soils (3) I	CHEM 404 Inorganic Chem (3) I
ENVS 425 Environmental Microbiology (3) I	CHEE 400R Water Chem for Engr (3) I
ENVS 431 Soil Genesis, Morph/Taxon (3) I	CHEE 400L Water Chem for Engr (Lab) (1) I, II
ENVS 440 Biodegradation (3) II (even years)	CHEE 478 Intro to Hazardous Waste Mgmt (3) II
ATMO 469A Air Pollution I: Gases (3) I	GEOS 400 Intro to Geochemistry (3) I
ATMO 469B Air Pollution II, (3) II (odd years)	PTYS 407 Chemistry of the Solar System (3) I
CHEE 370R Env & Water Engineering (3), I, II	

F. ENVS Minors. Students must complete following prerequisites: MATH 112 College Algebra (3) II and CHEM 151 Intro Chem I (4) I, II, Sum Note: At least 9 units should be unique to the minor.

Environmental Science Minor (20 units)

<p><u>GENERAL SCIENCE COURSES (14 units)</u> MCB 181R Intro Biol (3) I ENVS 195A Careers in Env Sci (1) I, II ENVS 200 Soils (3) I, II ENVS 201, Soils Lab (1) I, II ENVS 210 Fund. Env. Sci & Sustain (3) I, II GEOG 468 Water & Sustainability (3) II</p>	<p><u>UPPER DIVISION COURSES (6 units)</u> Select from AREC, ATMOS, HIST, HWRS, POL, RNR, ENVS or other relevant courses.</p>
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Soil and Water Science Minor (20 units)

<p><u>GENERAL SCIENCE COURSES (11 units)</u> GEOS 251 Physical Geology (4) I, II ENVS 200 Soils (3) I, II ENVS 201 Soils lab (1) I, II WSM 460A Watershed Management (3) I</p>	<p><u>UPPER DIVISION COURSES (9 units)</u> ENVS 316 Soil Fertility/Plant Nutrition (3), II ENVS 401 Mgt Arid Land/Salt Soils (3), I (even yrs) ENVS 431 Soil Genesis, Morph/Taxon (3), I ENVS 461 Soil/Water Cons (3) P ENVS 470 Soil Physics (3), II</p>
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Key for course offerings by semester

Fall = I; Spring = II; Pre-session = P; Summer 1 = S 1; Summer 2 = S 2; Winter = W

G. Undergraduate Certificate in International Environmental Conservation.

Students can graduate with an undergraduate certificate in addition to a Major or Minor. Note that the courses below can be used to satisfy the Certificate and can also apply to an Environmental Science Degree.

Student Outcomes:

Experience in Environmental Conservation
Communication of conservation topics with local and international stakeholders
Extensive Team-based Field Experiences in foreign countries

Competencies:

- *Proficiency in international studies, project management, and cultural awareness*
- *Written and oral communication skills relevant to local and international stakeholders*
- *Field Experiences in remote settings*
- *Current Environmental and Biodiversity Conservation topics*

- *Current Environmental and Biodiversity Conservation topics Courses:*

International Field Research Experience and Team Skills (select at least one):

ENVS 495F Environmental Conservation in Australia (6), S2
ENVS 495G Amazon Rainforest Conservation Biology in Ecuador (3) W
RNR 495F - Conservation Biology: Field Studies in Namibia (6) S1

Environmental Science Topics (select at least one):

ENVS 200 Introduction to Soil Science (3) I, II, online
ENVS 210 Fundamentals of Environmental Science and Sustainability (3) I, II, online
ENVS 415 Translating Environmental Science (3) II
GEOG 303 Field Study in Environmental Geography (3) I, II, S2
HNRS 170A1 Human Reproduction and the Environment (3) I
RNR 150C1 Sustainable Earth: Natural Resources & the Environment (3) I
RNR 200 Conservation of Natural Environments (3) I
RNR 458 Ecosystem Ecology & A Sustainable Future (3) II

Natural Resource Conservation Topics (select at least one):

ECOL 406R Conservation Biology (3) II
ENVS 422 Critical Zone Science and Management (3) I
HNRS 202H Introduction to Conservation Biology (3) II
RNR 160D1 Wildlife, Conservation, & American Culture (3) I
RNR 316 Natural Resources Ecology (3) I
WFSC 430 Conservation Genetics (3) I
WFSC 444 Wildlife Management (4) I
WFSC 445 Population Ecology (3) II
WFSC 447 Wildlife Conservation Behavior (3) II

Special Assignment:

Upon completion of coursework students will be required to give a 20 – 30 minute seminar to their peers about their international research experience. This will be conducted as a class presentation or at a relevant organizational meeting.

Environmental Science Major Schedule Planning Worksheet

FIRST SEMESTER (Fall)				SECOND SEMESTER (Spring)			
Recommended		Your Schedule		Recommended		Your Schedule	
ENGLISH 101	3			ENVS 200	3		
ENVS 210	3			ENVS 201	1		
CHEM 151	4			CHEM 152	4		
Tier I Course	3			ENVS 195A	1		
Tier I course	3			ENGLISH 102	3		
				Tier I Course	3		
TOTAL	16	TOTAL		TOTAL	15	TOTAL	

THIRD SEMESTER (Fall)				FOURTH SEMESTER (Spring)			
Recommended		Your Schedule		Recommended		Your Schedule	
Tier I course	3			ECOL 182R	3		
MCB 181 R	3			PHYS 102	3		
CHEM 241a	3			PHYS 181	1		
CHEM 243a	1			GEOS 251	4		
MATH 122A/B	5			Subplan Class	3		
TOTAL	15	TOTAL		TOTAL	14	TOTAL	

FIFTH SEMESTER (Fall)				SIXTH SEMESTER (Spring)			
Recommended		Your Schedule		Recommended		Your Schedule	
ENVS 408*	3			ENVS 305	3		
ENVS 474	4			ENVS 462	3		
ENVS 420*	3			MATH 263	3		
ENVS 418	3			MIC 205 A	3		
Tier II course	3			Tier II Course	3		
TOTAL	16	TOTAL		TOTAL	15	TOTAL	

SEVENTH SEMESTER (Fall)				EIGHTH SEMESTER (Spring)			
Recommended		Your Schedule		Recommended		Your Schedule	
HWRS 250	3			ENVS 430 R/L	4		
Subplan Class	3			ENVS 493*	1		
Subplan Class	3			Subplan Class	3		
Subplan Class	3			Subplan Class	3		
Tier II course	3			Elective	3		
TOTAL	15	TOTAL		TOTAL	14	TOTAL	

*or alternative Individual Studies

Department of Soil, Water, and Environmental Science

Desired ENVS Undergraduate Outcomes

1. 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 an 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 related to Environmental Science.
10. Be able to create a hypothesis, design an experiment to test that hypothesis, analyze the results, and draw appropriate conclusions.