

Bachelor of Science in Environmental Science

-- Guidelines for Majors --

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

The University of Arizona

2014-2015

BACHELOR OF ENVIRONMENTAL SCIENCE DEGREE

Shantz Building Room 429

520-621-1646

www.ag.arizona.edu/ENVS

REVISED August 2014

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: 26-28

Career Preparation: 10-13

SUBPLAN Total: 18 units

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

<u>Foundation Courses</u> English Composition 6 Units Mathematics (satisfied by MATH 124/125)	<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 (32-34 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 184 Intro Biology (or MCB 181R/L)	7	X	X	S 2
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 Subplans;

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

Course	Units	Fall	Spring	Summer
ECOL 302 Ecology OR RNR 316 Nat Res Ecology OR ENVS 425 Env Microbiology OR ECOL 474 Aquatic Plants & The Environ OR ECOL 475 Freshwater & Marine Algae	4 3 3 4 4	X X X X	 * X	
GEOS 251 Physical Geology	4	X	X	
ENVS 420 Env Physics OR ATMO 336 Weather, Climate & Society	3 3	X X	 X	 S 2
WSM 460A Watershed Hydrology OR HWR 250 Principles of Hydrology	4 3	X X		
ENVS 200/201 Intro Soils	4	X	X	
ENVS 462 Env Soil & Water Chem OR HWR 417A Fundamentals of Water Quality	3 3	 X	X	
ENVS 305 Pollution Science	3		X	
CPH 418 Human Health Risk Assessment OR HWR 443A Risk Assessment for Env Sys	3 3	X X		

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

Course*	Units	Fall	Spring	Summer
ENVS 210 Fund Env Sci & Sustainability	3	X	X	
ENVS 415 Translating Env Sci OR AGTM 422 Comm Knowledge in Ag & Life Sci OR ENGL 308 Technical Writing	3 3 3	X X X	 X X	 S 1, W S 1, S 2, P
ENVS 393/493 Internship OR ENVS 397A Teaching Workshop OR ENVS 399/499 Independent Study	1 3-4 1	X X X	X X X	 S 1, S 2
ENVS 430R/L Env Monitor/Remed. (Capstone) OR ENVS 461 Soil/Water Cons (Capstone)	4 3		X	 S P

* ENVS 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 122A	MATH 111 & 112, or MATH 120R	PHYS 102	MATH 110 or higher

E. Environmental Science Subplans.

Students may pursue one of the following four Subplans. Each subplan has multiple options.

1. Subplan: Biology

Required Courses:

Select 12 units in consultation with your ENVS Advisor.

BIOC 384 Foundations in Biochemistry (3) I, II
BIOC 385 Metabolic Biochemistry (3) I, II
BIOC 462a Biochemistry (4) I
ECOL 302 Ecology (4) I
ECOL 320 Genetics (4) I
ECOL 335 Evolutionary Biology (4) II
ECOL 406R/L Conservation Biology (4) I
ENVS 425 Environmental Microbiology (3) I
ENVS 426 Env. Micro. Lab (2) I

Optional Courses:

Select 6 units in consultation with your ENVS Advisor

BIOC 462a Biochemistry (4-5) I
BIOC 460 Gen Prot & Gen Metab Biochem (3) I, II, SUM
ECOL 310 Living in Symbiosis (3) I
ECOL 320 Genetics (4) I, II
ECOL 330 Evol Animal Form & Function (3-4)
ECOL 340 Evolution Plant Form and Function (3)
ECOL 380 Mathematic Models in Biology (3)
ECOL 404R/L Biology of the Oceans (3/1) I
ECOL 475 Freshwater and Marine Algae (4) II
ECOL 482 Ichthyology (4) I
ECOL 483 Herpetology (4) II
ECOL 484 Ornithology (4) I
ECOL 485 Mammalogy (4) I
ECOL 487 Animal Behavior (4) I
EIS 415R Insect Biology (3) I
GEOS 412 Ocean Sciences (4) II
GEOS 478 Global Change (3), I
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
RNR 316 Natural Resources Ecology (3) I
RNR 355 Introduction to Wildland Fire (3)
RNR 384 Natural Resource Management (3)
RNR 403 Applied Geographic Info Sys (3) I,II
RNR 495F Cons. Biol: Field Studies in Namibia (6) Sum I
ENVS 316 Soil Fertility/Plant Nutrition (3) II
ENVS 425 Environmental Microbiology (3) I
ENVS 431 Soil Genesis, Morph/Taxon (3) I
ENVS 440 Biodeg of Pollutants (3) II (even years)
ENVS 453 Remote Sensing of the Environment (3) I
ENVS 456A Watersheds & Ecosys Function (3) II
ENVS 474 Aquatic Plants in the Environ (4) I
ENVS 495F Field Studies in Namibia (6) Sum I
ENVS 495G Rainforest Cons Biol/Ecuador (3) Winter
WFSC 441 Limnology (4) I

2. Subplan: Land, Air, and Water.

Required Courses:

Select 12 units in consultation with your ENVS Advisor.

ATMO 436A: Fundamentals of Atmo Sci (3) II
ATMO 451A: Physical Meteorology I (3) I
ATMO 441A: Dynamic Meteorology I (3) I
ATMO 441B: Dynamic Meteorology II (3) II
ATMO 451B: Physical Meteorology II (3) II
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
RNR 403 Appl Geog Info Sys (3) I,II
RNR 417 (3) I,II Geog Info Sys (3) I, II
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)
WSM 460 Watershed Hydrology (3) I

Optional Courses:

Select 6 units in consultation with your ENVS Advisor

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 436a Grazing Ecol & Manage (2) II
RA M 446 Veg Manage of Wildlands (3) II
RA M 456a Rangeland Invent & Mon (3) I
RA M 436a Grazing Ecol & Manage (2) II
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 355 Intro to Wildland Fire (3) I
RNR 406 R/L Cons Biol (4) II
RNR 448 Outdoor Rec Manage (2-3) II
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
ENVS 310 Residential Rain Harvesting (3) I
ENVS 330 Intro to Remote Sensing (3), I
ENVS 316 Soil Fertility/Plant Nutrition (3) II
ENVS 401 Mgt Arid Land/Salt Soils (3) II (even yrs)
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 Field Studies in Namibia (6) Sum I
ENVS 495F Rainforest Cons Biol/Ecuador (3) Winter
WFSC 441 Limnology (4) I
WFSC 444 Wildlife Manage Mammal Sp (4) I
WFSC 446 Wildlife Manage Avian Sp (4) II
WFSC 455 R/L Fishery Manage (4) II
WSM 452 Dryland Ecohydro & Veg Dyn (3) I
WS M 462 Watershed Manage (3) II
WS M 468 Wildland Water Quality (3) II

3. Subplan: Environment and Society.

Required Courses:

Select 12 units in consultation with your ENVS Advisor.

AGTM 422 Comm Know in Ag & Life Sci (3) I
ANTH 332 Environmental Archaeology (3) II
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
ENVS 408 Technical Writing (3) II
ENVS 415 Translating Env Science (3) II
ENVS 444 Applied Environ Law (3) I

Optional Courses:

Select 6 units in consultation with your ENVS Advisor

ANTH 307 Ecological Anthropology (3) I
ANTH 418 Southwest Land and Society (3) II
ANTH 424A Political Ecology (3) I
AREC 375 Land/Water in the American West (3) II
AREC 377 Econ of Env Resource Conserv (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) Iphy (3) II
HIST 355 U.S. Env Hist (3) I,II
HIST 356 Global Env Hist (3) I,II
JOUR 472 Science Journalism (3) I
MN E 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 480 Nat Resource Policy/Law (3) II
RNR 485 Nat Resource /Econ & Planning (4) I
ENVS 495F Field Studies in Namibia (6) Sum I
ENVS 495G Rainforest Cons Biol/Ecuador (3) Winter
SOC 313 Coll Behavior/Social Movements (3) I, II
ENVS 397A Teaching Workshop (3-4) I, II
ENVS 444 Applied Env Law (3) I
ENVS 495F Rainforest Cons Biol/Ecuador (3) Winter
TTE 350 Schooling in America (3) I, II, SUM

4. Subplan: Physics and Chemistry.

Required Courses:

Select 12 units in consultation with your ENVS Advisor.

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

Optional Courses:

Select 6 units in consultation with your ENVS Advisor

ATMO 469A Air Pollution I: Gases (3) I	GEOS 400 Intro to Geochemistry (3) I
ATMO 469B Air Pollution II, (3) II (odd years)	MSE 412 Physical Chemistry of Materials (3) I
CHEE 370R Env & Water Engineering (3), I, II	PTYS 407 Chemistry of the Solar System (3) I
CHEE 370L Env & Water Engineering (1) I, II	ENVS 340 Environmental Chem (3) I
CHEM 404 Inorganic Chem (3) I	ENVS 401 Mgt Arid Land/Salt Soils (3) II (even years)
CHEE 400R Water Chem for Engr (3) I	ENVS 425 Environmental Microbiology (3) I
CHEE 400L Water Chem for Engr (Lab) (1) I,II	ENVS 431 Soil Genesis, Morph/Taxon (3) I
CHEE 478 Intro to Hazardous Waste Mgmt (3) II	ENVS 440 Biodegradation (3) II (even years)

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, HWR, 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

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		
ENVS 210	3			ENVS 200	3		
Tier I Course	3			ENVS 201	1		
Tier I course	3			Tier I Course	3		
				ENVS 195A	1		
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/L	4			PHYS 102	3		
CHEM 241a	3			PHYS 181	1		
CHEM 243a	1			GEOS 251	4		
MATH 122A/B	5			Subplan Class	3		
TOTAL	16	TOTAL		TOTAL	14	TOTAL	

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			ENVS 305	3		
ECOL 302*	4			ENVS 462*	3		
ENVS 420*	3			ENVS 418	3		
				ENVS 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			ENVS 430 A/L	4		
MATH 263*	3			ENVS 493*	3		
HWR 250	3			Subplan Class			
Subplan Class				Subplan Class			
Subplan Class				Subplan Class			
TOTAL		TOTAL		TOTAL		TOTAL	

*or alternative

ENVS 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 ENVS; OSFA apprv.
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.