THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE, LIFE & ENVIRONMENTAL SCIENCES
Environmental Science

Graduate Student Handbook

PhD

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25/26

More Information
https://envs.arizona.edu/graduate/overview

Contents

1 Introduction

This handbook is for the benefit of students enrolled in the Main Campus PhD program of the Department of Environmental Science (ENVS), but it may also be informative for those interested in matriculating into this program. The purpose of this document is to provide useful information about admission and matriculation and to clearly outline the Department's expectations for a successful completion of the ENVS PhD degree.

The ENVS Graduate program provides Master's of Science (MS) and PhD programs, with its MS program being offered on UA's Online and Main Campuses. There is potential for confusion if we would provide one handbook for all these options and to better serve our current and future students, we will be distributing three ENVS Graduate Handbooks:

1. A Handbook targeted to MS students in our Online Campus. All coursework is asynchronously online.
2. A Handbook targeted to Main Campus MS students. Nearly all coursework is "in-person", but most online courses are also accessible to Main Campus Students.
3. **This document.** A handbook targeted to Main Campus PhD students.

Please make sure that you are consulting the "correct" handbook as some details vary between MS and PhD and between our Online and Main Campuses. Although this handbook consistently states the ENVS Graduate Program, it also applies to those who are still enrolled in the SWES PhD program.

1.1 Contact Information for the ENVS Graduate Programs

MS Program (Main Campus and AZonline)
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2 Welcome to the ENVS Department

The Department of Environmental Science (ENVS) brings together a community of distinguished scientists, knowledgeable staff, and motivated students. All of us strive to further their understanding of soil, water, and the environment, and carry out research, policy development, advising and planning towards the solution of today's environmental and resource-use challenges. Under the leadership of ENVS interim Department Head, Dr. Joan Curry, the ENVS community consists of 50 faculty, 30 researchers, 12 administrative staff, and 20 joint, adjunct, or emeritus faculty, 70 graduate students and over 500 undergraduate students, 300 of which reside at UAs microcampus in China.

Our Mission We educate and train future generations to solve environmental issues at the intersection of biology, chemistry, physics and social sciences. We collaborate with industrial and professional partners to identify and apply practical and scientific solutions to current and emerging human-environmental challenges. Furthermore, we engage the community, including under-served populations, through extension services and citizen science. Housed in the College of Agriculture, Life, and Environmental Sciences at the University of Arizona, our faculty and research cover the full breadth and depth of environmental sciences, with strong expertise in arid and water-limited regions.

Our Commitment to Equity, Diversity, and Inclusion We view championing diversity and inclusion as the only way to equitably and successfully solve the grand challenges associated with human-environment interactions. The University of Arizona embraces and practices diversity and inclusiveness and our department supports and protects all forms of social identities, including but not limited to: age, disability status, ethnicity, gender expression, gender identity, nationality, sex, sexual orientation, race, religion and veteran status. UA Land Acknowledgement can be found at: `https://www.arizona.edu/university-arizona-land-acknowledgment`. UA is a Hispanic Serving Institution: `HispanicServingInstitution`

2.1 The Environment of The University of Arizona

The ENVS Department is a key member of The University of Arizona's School of Earth and Environmental Sciences (SEES). This federation of units produces knowledge about earth and environmental processes and human-environment interactions at all geographic and temporal scales. SEES faculty and researchers provide the scientific basis for environmental and climate policy, train the next generation of scientists, and disseminate knowledge and solutions for the benefit of society (`https://sees.arizona.edu/`). SEES includes:

- Geosciences (GEO, `http://www.geo.arizona.edu/`)

- The department of Hydrology and Atmospheric Sciences (HAS, http://has.arizona.edu/)
- The Laboratory of Tree-Ring Research (LTRR, http://ltrr.arizona.edu/)
- Environmental Science https://envs.arizona.edu/
- The School of Natural Resources and the Environment (SNRE, http://snre.arizona.edu/)
- The School of Geography, Development, Earth and Environment: https://geography.arizona.edu/
- The Arizona Institute for Resilience (AIR, https://environment.arizona.edu/aires)

SEES facilitates interdisciplinary research, teaching, and outreach/extension activities across the six departments and laboratories. Graduate students feature prominently in SEES as manifested in the campus-wide student-organized EarthWeek symposium which features the latest environmental science advances researched by Graduate Students.

The total enrollment at the University of Arizona exceeds 45,000 (including nearly 10,000 graduate students), a size that offers a wide range of academic and extracurricular programs. Tucson is a diverse metropolitan area of over a million people situated in a desert valley surrounded by temperate Sky Islands that rise to elevations of 3,000 meters. The University of Arizona is an equal opportunity employer authorized to provide research, educational information and other services only to individuals and institutions that function without regard to race, color, sex or national origin. For more detailed information about the University of Arizona please visit: http://www.arizona.edu/about.

3 Overview of the ENVS Graduate Program

The ENVS Graduate Program is grounded in a strong natural science curriculum that represents the foundation for focused studies in environmental physics, chemistry, biology and/or social science. Graduate study in the ENVS Department is open to qualified students with undergraduate preparation in biological, chemical, physical, earth, or engineering sciences. Students with other backgrounds may be accepted into the program, with course deficiencies noted (see section 4.3).

The ENVS Graduate program is designed to train and educate the future generation of environmental scientists, land and water resource managers, engineers, agricultural producers, and policymakers. Through education and relevant practical activities we provide our students with the necessary skills to address a wide range of issues facing environmental systems and their intersection with human health and well-being.

ENVS Graduates are highly employable in academia, the private sector, state, federal and international agencies and NGOs, and are well-prepared to lead productive careers and to confidently pursue their passions. They are able to address societal needs pertaining to problems of agricultural production, water quality, natural resource management, environmental remediation, and environmental justice in a changing world. Description of major research and outreach thrusts within the Department can be found at: `https://envs.arizona.edu/`

The ENVS Graduate Program offers two degrees:

- An ENVS Master of Science (MS), which is offered "in-person" at our Tucson Campus as well as asynchronously online though AZonline (`https://online.arizona.edu/`). This program requires 30 units of study and has thesis and non-thesis options. Well-prepared students can complete the ENVS MS in two years.
- An ENVS PhD, which is offered "in-person" at our Tucson Campus and requires 36 units of coursework, 18 units of Dissertation, and a Minor (usually 9 or 12 units of study). Well-prepared students can complete the ENVS PhD in four years.

Both programs offer a Major in Environmental Science with sub-plans (or tracks) in either Environmental Science (ES) or Soil and Water Science (SWS, note that the SWS track is currently not available through our Online MS program). Both tracks require a small set of core courses to ensure foundational knowledge that will serve as a framework for their future course work, research, and professional career paths. The ENVS MS and PhD programs are multidisciplinary and designed to be flexible, providing ample elective course options to meet each student's specific needs and career goals.

In addition to the ENVS MS and PhD programs, we offer the following:

- Dual Master Degrees in Environmental Science and Master of Business

Administration (MBA) from the Eller College of Management (https://eller.arizona.edu/programs/masters/dual-degrees)

- Dual Master of Science (MS) Degree in Environmental Science and Master of Arts Degree in Journalism (https://journalism.arizona.edu/node/745)
- Graduate Certificate in Aquaculture (see: https://catalog.arizona.edu/programs/AQCCRTG)
- Graduate Certificate in Water Policy (see https://catalog.arizona.edu/programs/WPLCRTG)

Please contact us (see section: 1.1) if you would like to know more about these programs.

4 General ENVS Graduate Program Policies and Procedures

4.1 Introduction

In this section we will discuss the policies and procedures that apply to all graduate students enrolled in the ENVS Graduate Program. Should there be any questions for matters related to the ENVS Graduate Program, please contact us for further information (see: 1.1).

4.2 Program Governance and Student Engagement

Day-to-day business of ENVS graduate program is administered by the ENVS Academic Advisors and the ENVS Director of Graduate Studies (DGS), under the guidance of Interim Department Head Dr. Joan Curry. Changes in ENVS graduate program policies are discussed within the ENVS Graduate Program Committee (GPC, which -in addition to the DGS and Academic Advisors- includes several ENVS faculty members, and two graduate students). Major policy changes are discussed and approved by vote during ENVS faculty meetings or bi-annual faculty retreats.

A vibrant departmental community can only be maintained by student inclusion and involvement. To this end, the Advising Team and DGS organize orientation meetings for new graduate students in the week prior to the start of the fall and spring semester. In addition, we also organize a general assembly of all ENVS graduate students at the start of the fall semester. At this meeting, graduate student representatives are chosen for several important one-year term functions:

- Two representatives for the ENVS Graduate Program Committee (preferably one MS and one PhD student).
- Two co-chairs for social events (annual departmental social events, and weekly social hours for students and faculty).
- Two to four co-chairs to organize and coordinate ENViSion portion of EarthWeek (an interdisciplinary campus-wide environmental symposium fully organized by graduate students).
- Three to five graduate students for the ENVS Graduate Council to meet periodically with the ENVS Department Head and Director of Graduate Studies.

Representatives usually self-nominate and DGS and Department head will endeavor to get a good representation across programs. Each graduate student

Course Descriptions	UA Course Numbers
General Chemistry I - (Lecture & Lab)	CHEM 141 or 151 or 161
General Chemistry II - (Lecture & Lab)	CHEM 142 or 152 or 162
Introductory Physics I (Lecture & Lab)	PHYS 102/181 or PHYS 141
General Microbiology (Lecture), or Introductory Biology I	MIC 205 A or MCB 181R
Calculus I	MATH 122B or MATH 125
Statistics	ENVS 275 or MATH 263 or MATH 363 or MGMT 276 or SBS 200
Additional Prerequisites for the Environmental Science Track	
Physical Geology (Lecture),	GEOS 251
Additional Prerequisites for the Soil and Water Science Track	
Soil Science (Lecture)	ENVS 200

Table 1: Prerequisites for the ENVS Graduate Programs.

should seriously consider active involvement in an effective student voice in graduate program affairs.

4.3 Program Prerequisites and Deficiencies

The ENVS Graduate Program is an interdisciplinary program that relies on students knowing the fundamentals of Chemistry, Physics, Math, Statistics, and Geoscience. The minimum undergraduate preparation for admission into the ENVS Graduate Program includes the courses listed in Table 1 (or equivalent if transferred in):

Students who lack some program prerequisites, but who are otherwise qualified, may be admitted with the missing courses listed as deficiencies. Remediation of these program deficiencies is enforced by the ENVS Graduate Program. Deficient courses must be completed during the first two semesters of graduate enrollment. A higher-level course may be used to satisfy a prerequisite with prior approval of a petition to the ENVS Graduate Program, and approval by the relevant instructor. A grade of "B" or better must be obtained to satisfy deficiency requirements. Note that Table 1 provides ENVS *Program* requirements; individual graduate level courses may impose *additional* course prerequisites for course enrollment.

4.4 Expected Graduate Program Learning Outcomes

Expected Program Learning Outcomes (PLO) for both MS and PhD students in the ENVS Graduate Programs are listed below.

- Graduates should possess sound foundational knowledge in the biological, chemical, earth, and physical sciences as related to environmental systems.
- Graduates should demonstrate critical thinking skills necessary to evaluate the scientific literature essential for their research area(s) and articulate how this research fits into and/or advances the discipline.
- Graduates should demonstrate development of creative and innovative research ideas and approaches.
- Graduates use multiple research approaches to collect scientific data related to his/her research area, and can interpret, analyze and critique their data.
- Graduates communicate their research (importance, approaches taken, summary and interpretation of results) effectively through oral presentation.

In addition to the above program learning outcomes, PhD students are expected to:

- Gain a deeper understanding of contemporary research methods and tools to be able to independently conduct cutting-edge scientific research and publish findings in top-tier peer refereed journals.
- Be capable of teaching formal courses and translating research results for public outreach.
- Be able to develop sound proposals for scientific research and design experiments, models or field-based inquiry to develop and test hypotheses.
- Participate constructively in professional activities such as manuscript and proposal review, organizing working groups or symposia, and communicating effectively across disciplinary lines.

Individual Course Learning Outcomes (CLOs, which should be listed in each course's syllabus) may expand upon these or list additional criteria. The program learning outcomes are evaluated each semester through a variety of methods, including (but not limited to): exam scores in selected core courses, thesis or dissertation quality, student performance at (comprehensive and final) exams, oral, and student presentations at the annual ENViSion component of EarthWeek, as well as student self-reporting at exit surveys after the final defense/presentation. These surveys do not affect the student's grades in any way, but are intended to evaluate the quality of the ENVS Graduate Programs by semester. The information collected by the surveys will be used for corrective action should program performance not meet the standards set by the ENVS faculty.

4.5 Policies and Procedures

Graduate Students are expected to be knowledgeable of and comply with all policies and procedures for both the UA Graduate College and for the ENVS Department. Policies are updated and announced frequently. It is the student's responsibility to comply with current policies, even if these are changed after initial enrollment as a graduate student.

General Graduate College policies can be viewed online at `https://grad.arizona.edu/policies` university policies can be found at `https://catalog.arizona.edu/policy-audience/graduate`. The Graduate College sets *minimum* program requirements, upon which each graduate program can build their own specific program requirements that can exceed Graduate college requirements.

All graduate students are expected to take initiative regarding all aspects of their graduate studies. This includes getting together frequently with their faculty advisor(s), individually or during lab meetings, and to plan and discuss their research and academic progress. Students should also take the initiative to arrange annual meetings with the ENVS Graduate Program Advisor to plan coursework and to verify that graduate program requirements are being met. Our Graduate Advising Team has access to a wealth of information that will facilitate a student's success in the graduate program. Again, we stress the importance of the graduate student's individual responsibility to be "in charge" of their program. Frequent contact with research and program advisors minimizes the chance of unexpected (and possibly expensive) delays.

ENVS graduate students are required to develop a Plan of Study by the end of the first semester and to submit this plan by the end of the second (MS) or third (PhD) semester. It is highly recommended to discuss the Plan of Study (and any subsequent modifications thereof) with the ENVS Academic Advising team for compliance with ENVS Graduate program and Grad College requirements. Graduate students are further subject to annual evaluation for satisfactory progress based on their grade point average and overall progress towards completion of degree requirements. The annual ENVS Graduate Student Progress Report form (due June 15th), the Satisfactory Progress Policy and other forms, are readily available on the ENVS website or from the ENVS Graduate Program Coordinator.

The Plan of Study is available at:

- Gradpath: `https://grad.arizona.edu/gsas/gradpath`

Departmental forms and documents are available at:

- `https://envs.arizona.edu/graduate/graduate-student-resources`

Plan of Study and Progress Reports are reviewed by the ENVS Program Coordinator and ENVS Director of Graduate Studies. Non-compliant Plans of Study will be denied by the ENVS DGS. Approved Plans of Study are forwarded to the Graduate College for further verification and approval. Insufficient or missing

Progress Reports will be addressed by a departmental letter of unsatisfactory progress (see Section 7).

ENVS graduate students are expected present at ENViSion, which is the student-organized annual departmental component of the University-wide Earth-Week symposium, which usually occurs in March or April. A poster or oral presentation of planned or ongoing research is mandatory and a good practice of the student's presentation skills. Online students will be given the opportunity to participate remotely.

It is also highly recommended to participate in the *organization* of ENViSion or Earthweek. Each year several students function in different leadership roles, such as (co-)chair, room scheduling, organization of catering, collection and distribution of poster and oral program, etc., as well as interfacing with organizers from other departments and sponsors of awards.

4.6 GradPath and Timelines

GradPath is the UA Graduate College's degree audit process that tracks and monitors student progress. Students are able to fill in and submit forms online through UAccess Student. GradPath will notify students when there is a problem with their forms (e.g., courses outside the time limit, or forms or requests are denied), and link to relevant policy. All students should make sure their GradPath records remain up-to-date.

From UAccess Student, click the dropdown menu in the Student Center section and select "GradPath forms" to see a list of forms specific to your degree program. Figure 1 includes the forms for an MS (red box) and a PhD student (blue box).

Please note that after the student submits a form through GradPath portal there is a chain of approvers. There are several within the department (e.g., major professor, minor professor, Graduate Program Coordinator, Director of Graduate studies) and several more in the UA Graduate College. It may take some time before final approval is granted by the Graduate College. For reasons of efficiency, the ENVS Graduate Program processes approvals in "batches", usually once per week. It is therefore imperative that graduate students submit forms on time, i.e., well before deadlines. For example, an approved Doctoral Plan of Study must be in place before the form for Announcement of Comprehensive Exam can be submitted. The latter form must be approved before the date of the comprehensive exam itself. Submission of approval forms after-the-fact may result in extra review and denial by the graduate college. We strongly recommend that students meet with the ENVS Advising Team well before any deadline to avoid any delays. Emergencies happen, but it is ultimately the graduate student's responsibility that GradPath forms are submitted on time.

Important Degree Dates and Deadlines imposed by The Graduate College, as well as some the general steps necessary to complete a degree may be found at:

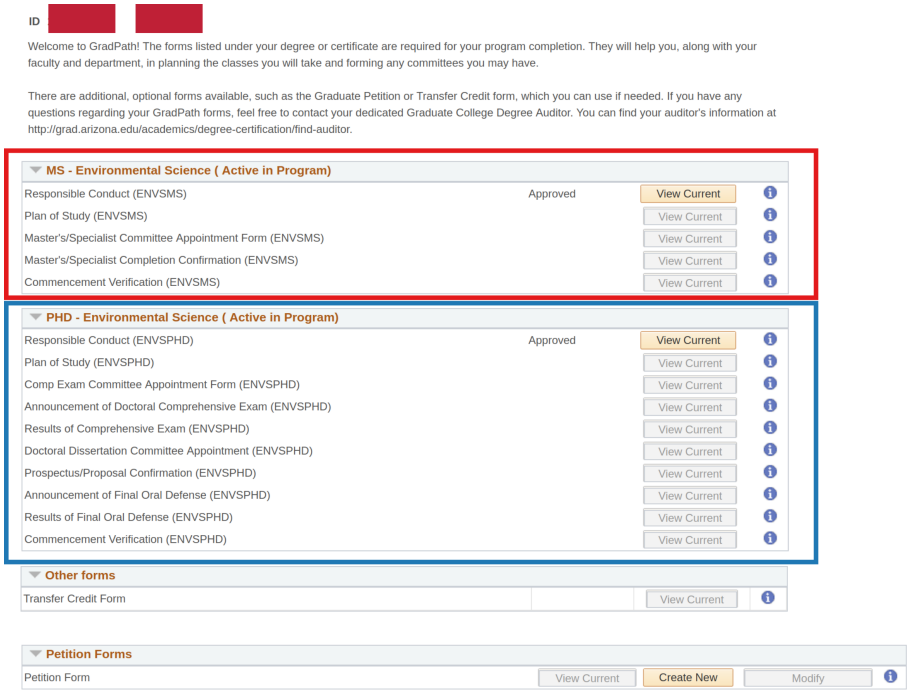

Figure 1: Example of a GradPath form for an MS student (outlined red) and a PhD student (outlined in blue). Forms for MS students are substantially simpler. This form can also be used to transfer external credit into the ENVS MS or PhD or send Graduate College Petitions. Some PhD students may still be in the SWESPHD program.

- https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines
- https://grad.arizona.edu/gsas/degree-requirements

Other forms that are sometimes necessary such as

- Change of Program
- Distribution Right
- Graduate Petition
- Leave of Absence
- Dissertation Formatting Guide forms

are available at https://grad.arizona.edu/forms/gsas.

4.6.1 Responsible Code of Conduct

Each student is responsible for submitting a Responsible Conduct of Research form to GradPath upon enrollment. Fostering a culture and expectation of responsible and ethical conduct of research is a critical component in the advancement of knowledge through research and scholarship. It is also a key element in the maintenance of public trust in the research enterprise. Given that ethical issues emerge when conducting research and scholarship across disciplines of all kinds, UA is committed to providing high quality instruction in responsible conduct of research to the entire campus community (https://rgw.arizona.edu/research-compliance/rcr).

4.7 Exceptions, Suggestions, and Concerns

Students have the right to formally request exceptions to department policies and procedures or formally appeal department decisions by submitting an ENVS Petition to the ENVS Director of Graduate Studies: https://envs.arizona.edu/graduate/graduate-student-resources. ENVS Graduate Program petitions are processed by the Department and cover matters specific to the *ENVS Graduate Program*; petitions to the Graduate college must be submitted through GradPath and cover matters *university-wide policies*. Please contact the ENVS Academic Advising team for more information or, if you are not sure whether to submit a ENVS petition or a Graduate College petition. The Grad College cannot approve Department petitions.

Specific and/or personal concerns regarding the student's progress in the ENVS graduate program can be discussed directly with the ENVS Advising Team, or in more serious cases the ENVS Director of Graduate Studies. When needed and possible, they will treat communications with confidentiality. In exceptional cases, it may be necessary to discuss matters with the ENVS Department Head, the Graduate College, or other University of Arizona offices.

Please note that University of Arizona Employees have certain mandatory reporting requirements (for example: https://www.titleix.arizona.edu/reporting_responsibility_for_employees).

4.8 Course Loads and Continuous Enrollment

The minimum required course load may depend on your personal circumstances and all students are recommended to review the Graduate College policies with regard to enrollment requirements: https://grad.arizona.edu/policies/enrollment-policies.

As a rule, students must maintain continuous enrollment which means that they must enroll in at least one graduate unit each semester. However, based on their personal circumstances they may also need to maintain full-time status, which implies that they must enroll in at least 9 units of study without Graduate Assistant (GA) support and at least 6 units of study with GA support.

All international students are required to maintain full-time status while studying in the US. To avoid violating current visa requirements international students should consult with the University of Arizona Office of Global Initiatives regarding enrollment requirements. Further information can be accessed at http://global.arizona.edu/international-students/maintaining-status and http://global.arizona.edu/international-students/summer-enrollment.

If students fail to obtain a motivated Leave of Absence to be exempt from continuous enrollment during one or two semesters, the graduate college will dismiss the student from the program. A new application and full review will be needed to be considered for a re-admission to the program.

4.9 Grades

The Graduate College has specific regulations on grades necessary for continuing in a degree program and additional scholarship requirements. Please carefully read the current UA Graduate Catalog (http://grad.arizona.edu/new-and-current-students). The ENVS department adheres to these regulations and further requirements for MS and PhD students are provided later in this document. *Should the grade point average fall below 3.00, the student will be placed on probation. If at the end of the following semester the cumulative average is still less than 3.00, the Graduate College will automatically disqualify the student from the program.* Disqualified students may apply for admission as a nondegree seeking student. Credit earned as a UA nondegree seeking student will be included into the cumulative UA graduate GPA. According to university policy, a student on academic probation cannot hold a scholarship, fellowship, assistantship, or an associateship during the period of probation (please see: https://grad.arizona.edu/policies/academic-policies/academic-probation and https://grad.arizona.edu/funding/gaships/qualifications-appointment.

4.9.1 Incomplete ("I") Grades

A grade of Incomplete (letter grade "I") is discouraged at the graduate level. Before taking or awarding an "I", students and instructors are encouraged to review the relevant Registrar information about incomplete course work: (`https://registrar.arizona.edu/faculty-staff-resources/grading/grading-policies/incomplete`). We note here that an incomplete can only be awarded if a minor part of the coursework has not been completed. An "I" may not be awarded instead of a failing grade. One or more missing exams is not likely to be minor missing part of coursework and should be awarded the proper grade at the end of the semester.

Students are encouraged to meet with their instructor *and* program advisor as soon as possible if personal circumstances prevent meaningful course participation. Instructors are encouraged to inform the program advisor(s) if a student is not performing to expectations (e.g., present grade is a "C" or less). Please note that while program advisors can see grades of previous semesters, they cannot monitor (are not able to) the student's progress in the current semester.

An incomplete grade must be remediated as soon as possible ("weeks" rather than "months"). An incomplete will default to a failing grade after 12 months.

4.10 Graduate Funding (Main Campus Only)

4.10.1 Graduate Assistants and Graduate Associates

Graduate Assistant and Graduate Associate positions ("GA") are limited-term appointments for graduate students, typically to perform instructional duties (GTA, Graduate Teaching Assistant/Associate) or to conduct research (GRA, Graduate Research Assistant/Associate). If awarded, Master's and PhD students fill assistant and associate positions, respectively, with the expectation that Teaching Associate positions require elevated responsibilities. Funding for GRA positions comes from faculty research grants, while GTA positions are funded from Departmental resources. This implies that those in GRA positions work under the guidance and mentorship of a researcher (usually the Major professor), while students in GTA position receive guidance and mentorship from an ENVS instructor (in most cases *not* the Major professor). GA positions come with partial or full tuition remission and health benefits. A comprehensive Graduate College GA Manual is posted online at `http://grad.arizona.edu/funding/ga` and the UA Student Employment Manual is online at `https://financialaid.arizona.edu/types-aid/work-study/student-employment-manual`.

PhD Students Upon admission, PhD students should be funded up to five years at 0.5 FTE (full-time equivalent, 0.5 FTE is 20 hours per week *on average*), provided that the student remains in good academic standing and makes satisfactory and timely progress toward their degree. This includes summer

support at 0.5 FTE, provided that the students continues to work on their research during this time; some faculty members increase summer support to a higher-level, commensurate with available funding and research needs. The five-year 0.5 FTE funding mandate does not apply if the student receives an equivalent level of support through a fellowship or stipend, or on UA Qualified Tuition Reduction (QTR), or is drawing salary or income elsewhere. The five-year funding mandate is also contingent upon the availability of funding. It is often difficult for faculty and departments to make financial plans that span more than two years.

The ENVS Department has limited funding to support GAs. Before we admit PhD students to the ENVS Graduate Program, we require Major Professors to provide us with a funding plan with the expectation that the majority of the funding comes from faculty resources (usually research grants). Because research funding may not always be available immediately (a grant-application/review cycle may take several months) we encourage all prospective PhD applicants to contact potential major Professors before submitting an application. A discussion between potential applicant and professor will further allow both to assess whether the student will "fit" in the professors research program. A discussion will also provide the Major Professor with adequate time to arrange funding (sometimes it is possible to do this with the student, such as NSF Graduate Research Fellowship Program, GRFP, `https://new.nsf.gov/funding/opportunities/grfp-nsf-graduate-research-fellowship-program`).

Here we note that we may be able to award a ENVS PhD Recruitment Award for competitive applicants. An ENVS PhD Recruitment Award typically includes two semesters of GTA funding at 0.5 FTE. We can only make such awards if the Major Professor submits a viable externally funded plan for the other four years of the student's program.

Master's Students No funding mandate currently exists for MS students. Many UA departments do not provide funding to their MS students. However, many main-campus ENVS MS students receive partial (0.25 FTE) or full (0.5 FTE) support from their Major Professor as GRA, or receive a one-semester GTA position from the Department. We also note that NSF Graduate Research Fellowship Program (GRFP) is open to applications from prospective MS students `https://new.nsf.gov/funding/opportunities/grfp-nsf-graduate-research-fellowship-progra` In some cases, students enrolled through UA's Online Campus may be eligible for GA positions.

Requesting GTA Positions Each semester, the ENVS Department has a substantial need for GTAs to assist instructors of high-enrollment ENVS undergraduate courses. Filling a GTA position has several benefits for the department, graduate student, and Major Professor. From the perspective of the Department, GTAs help instructors to deliver high-quality undergraduate courses. A graduate student filling a GTA will gain valuable work experience, sometimes

with actual class-room teaching experience that would benefit the student's career after graduation. A student taking a GTA position would further temporarily relieve budget pressure on a Major Professor's grants (Major Professors sometimes are "in between" grants and have no GRA funding). Here we note that mixed GRA/GTA positions are possible, so a student can continue grant work at 0.25 FTE, but also fill a teaching position (at 0.25 FTE) at the same time. Some restrictions apply.

In exceptional cases, experienced TAs may be asked to serve as instructor of record which implies that the TA becomes partially or fully responsible for the delivery of a particular course or course-sections. Such assignments are made only by discussion among DGS, Department Head and the student. While instructor of record status does not lead to additional pay, it benefits the TA because distinct instructional and leadership experience can now be listed on the student's CV.

Per instructor enrollment-based GTA needs (FTE) and assignment of graduate students to these positions are made through the ENVS Graduate Program. We use the following broad guidelines for GTA assignments:

1. We assess the GTA budget that is available to ENVS for the present Academic Year and determine how many GTA we *can* hire.

2. Newly admitted PhD students on an ENVS PhD recruitment award (0.5 FTE) will be assigned *first*. We strive to assign the student to the same instructor for both semesters of the award.

3. Next, we consider the list of continuing students (those in year 2 or later) who requested a TA position through the ENVS Financial Support form that is circulated each mid-semester. These requests can be for a 0.25 or 0.5 FTE position and are for *one semester only*. A new request must be submitted for each semester. We cannot guarantee that requests will be honored. Our TA requirements depend on actual undergraduate enrollment and the availability of Departmental funds. In recent years, we have honored virtually all requests, though not necessarily at the requested FTE.

4. Some courses have specific instructional requirements that we must match with graduate student skills (for example, it takes a certain aptitude to assist with a microbiology or soils lab). We will therefore sometimes ask a specific graduate student whether they are available for a TA position. This situation may also occur if there are unexpected increases in enrollment at the beginning of a semester.

5. Because undergraduate enrollments vary between semesters, it is sometimes necessary to switch an already-assigned GTA to another instructor.

Workload Expectation Form All GA positions should adhere to the Graduate Assistant and Associate Workload Policy, and we highly recommend that

all students and faculty read this policy in full (https://grad.arizona.edu/funding/ga/graduate-assistant-and-associate-workload-policy). Specifically, a student in a 0.25 GA position cannot be asked to work more than 10 hours per week *on average* (or 20 hours per week on average for a 0.5 FTE appointment). The "on average" phrase recognizes that instructional or research activities may occasionally be lower or higher during a some weeks, but that over a semester these should average out to 10 or 20 hours (for 0.25 and 0.5 FTE, respectively). We note that some of our courses are delivered in 7-week semesters. Unless the student specifically agrees in the Workload Expectation Form, it is unreasonable to expect GAs not to work during the first half of a semester, but double the time in the second half. Such an arrangement should be approved by the ENVS Director of Graduate Studies.

ALL GA appointments are governed by a formal contract sent by the CALES-HR office, but actual duties, expectation, mentoring, and review must also be documented in the ENVS Workload Expectation Form that both student and Instructor/Supervisor **must** fill out (the online form is made available each semester). We emphasize that it is important discuss and fill out the expectations, duties, and mentoring activities accurately. This information is especially helpful should there be any disputes between student and advisor. This goes both ways: based on documentation in this form, the student can argue that the workload was too high or mentoring was not provided. A supervisor can use the documented information to claim that certain duties were not carried out, or the student did not show up for meetings. We want to stress that disputes are infrequent, but detailed Workload Expectation Forms help to adjudicate conflicts. "Student performs duties as assigned" is definitely an insufficient description of duties and responsibilities.

Workload Expectation Forms for GTAs must be filled out each semester. Supervisors and GRAs should fill out the form each academic year or period that is consistent with the actual GRA appointment contract. This includes supplementary funding for summer.

4.11 Other Types of Funding

Here we briefly provide information that may provide alternative sources of funding for graduate studies.

4.11.1 University and Extramural Funding

UA's Graduate College maintains a list of UA-specific funding opportunities: https://grad.arizona.edu/funding/opportunities
Extramural sources of funding can be found at: https://financialaid.arizona.edu/ScholarshipUniverse

We will not discuss any of these funding opportunities in detail as they often depend on a student's demographic, nationality, or socioeconomic situation. However, if you think you qualify we are more than happy to work with you. In

certain cases, you will need support/information from a Major Professor or the Department must provide certain resources. Please contact us early and do not wait until the deadline. Please be assured we will treat your information confidentially.

4.11.2 Students on Wages/Grader Jobs.

Students working on "wages" work for a limited time-period, usually as "grader" for a medium-enrollment course that does not have sufficient enrollment to qualify for TA support. This is typically a one-hour to six-hour per week job (*about* $32/hour for Graduate Assistants and about $34/hour for Graduate Associates). A Wages job does not include tuition remission or health benefits, but it could work well as supplemental income for some students. ENVS establishes these jobs on an "as-needed" basis. If the student already has a staff position at the UA, it may be impossible to employ that person as a grader. Foreign students who already have a 0.5 FTE GRA or GTA position cannot be hired as graders. Domestic students may be hired up to 0.66 FTE per semester.

5 ENVS PhD Program Policies and Procedures

5.1 General Information

The ENVS Graduate Program offers a PhD Degree with a Major in Environmental Science. PhD students choose one of two tracks with different core requirements: Environmental Science (ES) or Soil and Water Science (SWS). The ES track has a broader environmental science focus, while the SWS track is targeted towards those students who would like to develop specific expertise in soil and/or water science. ES and SWS tracks have different core course requirements and students select electives that suit their research or career goals. Well-prepared students can complete the ENVS PhD in four years.

In addition to the ENVS Major, PhD students must also complete a Minor which can be in ENVS, but also in a different graduate program at the University of Arizona. A more detailed discussion of minor requirements will appear later in this document.

Program requirements for the ENVS PhD overlap with those of the ENVS MS, allowing a seamless transition from one program to the other by transferring a considerable number of units from the ENVS MS to the ENVS PhD. Up to 30 qualifying units of credit earned in one or more Master's degrees may be counted toward the PhD requirements. For limitations and exceptions we refer to: `https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#Credit%20Requirements,%20Transfer%20Credit,%20Prior%20Learning`

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5.1.1 Adding an ENVS MS while in the ENVS PhD

Some applicants are admitted to the ENVS without a pre-existing MS degree and become extremely successful. However, in general we *recommend* the completion of the two-year ENVS MS (either through the MS-report or MS-thesis route) before entering the ENVS PhD program. Most credits earned during the ENVS MS can be transferred to the ENVS PhD thereby not substantially lengthening the time to a PhD degree. The advantage is that an MS degree is earned at approximately the two-year mark.

An ENVS MS can be added while in the ENVS PhD program through a Program Addition Request available through: `https://grad.arizona.edu/policies/enrollment-policies/program-changes`Adding an ENVS PhD while in the ENVS MS is *not* possible with this form. If ENVS MS students would like pursue an ENVS PhD they must submit an application to the ENVS PhD program.

5.2 Entering the Program

5.2.1 Application to the ENVS PhD Program

All applications must be submitted through GradApp (`https://apply.grad.arizona.edu/users/login`). We highly recommend that you thoroughly review our Departmental website before applying (`https://environmentalscience.cals.arizona.edu/`, in particular check "about", "research", "graduate", and "directory") so that you become familiar with our instruction and research programs, people and facilities. We also recommend to contact potential faculty advisors (potential Major Professors) before you submit.

The application page will require you to provide several pieces of information. The following are among the key pieces of information in our review process:

- **Your statement of purpose.** In this document you should identify why you are interested in Environmental Science, our department, and what kind of career you currently have in mind. Please also discuss which kind of research and/or which ENVS faculty are closest to your interest(s)
- **Your CV (or resume) and three references.** We must have received three letters of reference before we can start our review.
- **Your Undergrad and** (if you have one) **Graduate GPA.** Note that we cannot admit applicants with a GPA below 3.0, though you may attain a GPA of 3.0 or greater as a non-degree-seeking student. Please contact us for further information.
- **ENVS professor(s) and research topics** you would prefer (you can specify three of each). We highly recommend that applicants contact potential faculty advisors (potential Major Professors) *before* submitting an application. Admission to the PhD program is more likely if the research interests of applicant and Major Professor align. We cannot admit applicants without an ENVS faculty member agreeing to be their Major Professor. Further, as explained elsewhere, a five-year funding plan must be established before we can admit applicants to the ENVS PhD program. It is best to start these conversations early because it may take considerable time for a faculty member to set up research projects and arrange grant funding or work with you on fellowship applications.
- **Interest to serve as Teaching Associate.** The Department has a considerable need for Graduate Teaching Assistants (GTAs) who help ENVS instructors with teaching undergraduate courses. ENVS GTA assignments come with built-in mentoring, instructional design and facilitation, leadership and career development opportunities which are important soft-skills required in many careers. It would be extremely helpful if you could elaborate in your Statement of Purpose or CV if you have a desire to fill a GTA position. Please provide some details about your experience with instruction, mentoring or outreach activities.

- **Whether you require funding.** There is limited Department and Faculty funding to support PhD students and admissions are therefore competitive. If you have funding, please state this in your application and identify the source. For UA and external funding opportunities, please see `https://grad.arizona.edu/funding/opportunities` and links therein.

5.3 Minimum Requirements for the ENVS PhD

5.3.1 General

The equivalent of at least six semesters of full-time graduate study is required for the ENVS PhD program. At least 36 units of coursework in the area of the Major subject, a minimum of 9 units in the Minor subject, and 18 units of dissertation (ENVS 920) must be completed. This combines to a minimum of 63 units. However, the ENVS minor as well as minors in other programs are 12 units, which means that most ENVS PhD students must complete a total of 66 units. Should a a Minor require 15 units, then the total unit requirement for the ENVS PhD increases to 69.

The ENVS PhD Program contains the following key components:

- **Career Coursework:** general presentation, writing, environmental science literacy, career development courses. These courses are required.
- **Core Coursework:** these courses provide solid foundations in environmental science courses. We offer these required courses in two tracks of specialization: Environmental Science (ES) and Soil and Water Science (SWS).
- **Elective Coursework:** courses chosen with major professor and/or graduate student support coordinator.
- **Comprehensive Exam:** this is an exam after all major and minor coursework has been completed. The comprehensive exam tests for broad knowledge in the Major and Minor areas of study. This exam has written and oral components. This exam is overseen by the Comprehensive Exam Committee. Once the student passes this exam, they become a PhD Candidate.
- **Prospectus:** this is an outline of the proposed research and includes a summary of the structure of the PhD dissertation.
- **Dissertation and Defense:** this is where the PhD Candidate demonstrates their ability to conduct independent research, supervised by their Major professor and Dissertation Committee. The dissertation is a written document that contains the (equivalent of) of three peer-reviewed manuscripts. A summary of the Dissertation is presented to the Department and defended before the Dissertation Committee in a Final Defense.

Career Skills	Units	Course Title
ENVS 508 and	3	Scientific Writing for Environmental, Agricultural and Life Sciences
ENVS 595 and	2	Colloquium
ENVS 696A, and/or ENVS 696B, and/or ENVS 697	2	Seminar; Inclusive Mentorship in the Sciences; Seminar and Professional Development,

Table 2: Career Skills. Students are required to take five units of Career Skills in three categories.

The next subsections will provide more detail about each of these categories. Here we note that the Comprehensive Exam Committee and the Dissertation Committee are not necessarily the same. The task of the Comprehensive exam committee is to test the student on broad knowledge of coursework taken in Major and Minor. This may require a Committee of ENVS and other UA faculty who have such expertise. The task of the Dissertation Committee is to mentor the PhD Candidate though their dissertation research and to conduct the final exam. As such, the range of expertise of Dissertation Committee members is more narrowly focused on the PhD Candidate's area of research.

5.3.2 Career Skills

As Table 2 shows, the program requires seven units total in ENVS 508 (Scientific Writing for Environmental, Agricultural and Life Sciences, 3 units), ENVS 696A (Seminar), ENVS696B (Inclusive Mentorship in the Sciences, 1 unit), ENVS 697 (Professional Development, 1 unit) and ENVS 595 (Colloquium, 1 unit). These courses are intended to expose students to a range of soft or career skills.

It is recommended to take ENVS 508 in the first or second semester since it practices the student's writing skills necessary for other activities (e.g., reports required in courses, written part of Comprehensive exam, and Dissertation).

All PhD students are required to take ENVS 595 (Colloquium) each semester, but can count only two units (PhD) on their plan of study. Colloquium exposes graduate students to ENVS Faculty research programs, as well as invited national and international speakers who discuss present the latest developments in Environmental Science. Colloquium exposes graduate students to ENVS Faculty research programs, as well as invited national and international speakers who discuss present the latest developments in Environmental Science. Colloquium speakers usually provide information about their career paths, and discuss exciting career opportunities for ENVS Graduates.

Two units each of ENVS 696A, ENVS 696B, or ENVS 697 or equivalent are required. Seminar requirements may be met by selecting one of the following options:

ES Track	Units	Select one course per category
Environmental (Soil) Physics		
ENVS 520	3	Environmental physics, or
ENVS 570	4	Soil Physics
Environmental (Micro) Biology		
ENVS 525	3	Environmental Microbiology
ENVS 574	3	Aquatic Plants & the Environment
ENVS 577	3	Principles of Ecotoxicology
WSM 552	3	Dryland Ecohydrology and Vegetation Dynamics
Environmental (Soil) Chemistry		
ENVS 562	3	Environmental Soil & Water Chemistry
ENVS 564	3	Environmental Organic Chemistry

Table 3: Core Courses in the Environmental Science (ES) Track. Students are required to take one course from each physics, biology, and chemistry category.

SWS Track	Units	Select four Courses
ENVS 502	3	Nutrient Dynamics in Soils
ENVS 525	3	Environmental Microbiology
ENVS 531	4	oil Genesis, Morphology, and Classification and Lab
ENVS 562	3	Environmental Soil & Water Chemistry
ENVS 570	3	Soil Physics and Lab
ENVS 580 **or** ENVS 582	3	Environmental Assessment of Contaminated Lands **or** Reclamation and Redevelopment of Impacted Lands

Table 4: Core Courses in the Soil and Water Science (SWS) Track. Students are required to take four courses.

- Two semesters of ENVS seminars (ENVS 696A, B **or** ENVS 697), courses cannot be retaken.
- One semester of ENVS 696A, B **or** ENVS 697, plus one semester as a teaching associate (GTA).
- One semester of ENVS 696A, B **or** ENVS 697, plus one semester of seminar from another department.
- One semester of ENVS 696A, B **or** ENVS 697, plus one semester of GRAD 697C “Workshop for Teaching at the College Level”

5.3.3 Core Courses

The core courses provide the student with a broad interdisciplinary foundation in either Environmental Science or Soil and Water Science. Required coursework for the ES and SWS tracks are provided in the Tables 3 and 4, respectively and is identical for the Main Campus MS and PhD programs. It is the student's responsibility to ensure that they select and complete the required core courses, otherwise their plan of study will be denied by the ENVS Graduate Program. The ES track requires nine units of core courses (three or four units each from biology, chemistry, and physics). The SWS track requires 12 units from a list of seven courses. Due to some overlap, ENVS 580 and ENVS 582 cannot both count as a core course. Some courses are shared among the ES and SWS tracks.

5.3.4 Electives

Electives give students the freedom to specialize within the field of Environmental Science, or to obtain relevant knowledge from other fields. These courses can be chosen out of personal interest, or because the knowledge provided is relevant for the student's final project and/or career. ENVS offers a broad range of graduate courses that can serve as electives and the full range and description is available at: `https://studentcenter.arizona.edu/app/ui/public/ps/course-catalog?tab=DEFAULT`. Not all courses may be offered due to availability of an instructor, or because course availability alternates between semesters or years. Excess core-courses (those taken beyond the minimum required in the ES and SWS tracks) can count as electives. Students can also take qualifying courses in other programs. Please see our ENVS program advisors if you need help selecting electives.

The number of elective units to be taken depends on the program and track (ES or SWS). For example, a minimum of 30 qualifying units are required for the ENVS MS:

- A MS student on the ES track with an MS-report will take 5 units in Career Skills, 9 units in core-courses and 3 units in the MS-report (ENVS 909). This implies this student needs to take a minimum of 30-(5+9+3)=13 units in electives.
- A MS student in the SWS track with an MS-thesis will take 5 units in Career Skills, 12 units in core-courses and 6 units in the MS-report (ENVS 909). This student must take 30-(5+12+6)= 7 units in electives.

PhD students have 36 in the ENVS major, 18 dissertation units (ENVS 920), plus the number of units in the minor, which is 9 units (some minor programs) or 12 units (ENVS and other departments). The number of electives for PhD students purely depends on whether the SWS track or ES tracks is taken. For example:

- A PhD student on the ES track will take 7 units in Career Skills, 9 units in core courses. This student needs to take 36-(7+9)=20 units in electives.
- A PhD student on the ES track will take 7 units in Career Skills, 12 units in core courses. This student needs to take 36-(7+12)=17 units in electives.

It is strongly recommended that students choose electives after consulting advising faculty and program advisors.

Internship and Independent Study We also offer ENVS 593 (Internship 1-3 units) and ENVS 599 (Independent Study, 1-4 units) for situations where students want to gain work experience in a specific setting (e.g., commercial or non-profit lab, etc.) or wants to gain specific knowledge for which no equivalent course is available. ENVS593 and ENVS 599 must be motivated by the student and approved in advance by the graduate program before the work can be started. Independent study units (ENVS 599, or ENVS 699) must be identifiably distinct from activities performed under ENVS 910 and be must be approved in advance by the ENVS DGS. Activities carried out under ENVS 599 or ENVS 699 should not appear in the Master's Thesis or Master's Report.

5.3.5 Minor

Besides taking coursework in the ENVS Major Field of study, PhD students are also required to complete a Minor program. ENVS students have two options for completing their minor:

- A 12-unit ENVS Graduate Minor or
- A minor in a different UA Graduate Program.

Irrespective whether the student takes an ENVS Minor or a Minor in a different program, a Graduate Faculty Member of a Minor program must agree to serve as the student's Minor Professor. This person will become member of the student's Comprehensive Exam Committee and is tasked to assign written assignments and ask questions about the Minor for the "written" and "oral" parts of the Comprehensive exam, respectively. Further information can be found at: `https://grad.arizona.edu/admissions-guides/`. Courses cannot count to both the Major and Minor.

The ENVS Minor In recognition of the diversity of the ENVS Department, ENVS PhD students can fill their minor requirements using 12 units of ENVS Graduate coursework. The set of courses used to satisfy the minor should comprise a topic area that is clearly distinguishable from the students Major focal area. For example, ENVS PhD students who are focusing on Environmental (Micro)Biology for their dissertation research, should take Minor courses outside this focal area. Likewise, students who focus on Environmental physics,

-chemistry, or -justice (to name a few areas), should construct a minor outside these respective fields. The specific courses used to complete the minor will be selected in consultation with the Minor Professor. For the ENVS Minor. All twelve units must be from the ENVS Graduate Program course listing. The Minor advisor must also be a member of the ENVS graduate faculty.

PhD students from other programs who want to take an ENVS Minor should consider to include coursework listed under "Core Courses" (Tables 3 and 4). These courses provide broad coverage of the field of Environmental Science. However, it is also possible to select any of the other ENVS Graduate coursework, should the student seek a particular specialization. All twelve units must be from the ENVS Graduate Program course listing (see Section: 7).

Learning Outcomes for the ENVS Minor are:

- Grad Students completing the ENVS minor should possess sound foundational knowledge in the biological, chemical, earth, and physical sciences as related to environmental systems.
- Grad Students completing the ENVS minor should demonstrate critical thinking skills necessary to evaluate the scientific literature essential for Environmental Science and how this is complementary with the research conducted for their major.

Minors in other Programs ENVS PhD students can also take their Minor in a different program. A comprehensive list of Minor Programs available at the University of Arizona can be found at: `https://grad.arizona.edu/catalog/#deg-minor` (here we note the Soil, Water, and Environmental Science Program is the ENVS Minor). Conducting a minor in a different program usually requires the following steps:

1. The ENVS PhD student should contact the program using the information listed for each minor available through the above website.
2. A Minor Professor should be found who can serve as advisor and is willing to be a member of the student's Comprehensive Exam Committee.
3. The student should verify if any of the minor coursework requires prerequisites. These (undergraduate) prerequisites must be fulfilled but cannot be counted towards the Major or the Minor.
4. The student should check how many units the minor requires. Some programs require the minimum 9 units, some (like ENVS) require 12 units, others require substantially more units. An ENVS PhD with a 9, 12, and 15-unit minors will require a minimum of 63, 66, and 69 total qualifying graduate units, respectively.

5.3.6 Comprehensive Examination for Advancement to Candidacy

General Before admission to candidacy for the doctoral degree, the student must pass a written and an oral Doctoral Comprehensive Examination. This examination is intended to test the student's comprehensive knowledge of the major and minor subjects of study, both in breadth across the general field of study and in depth within the area of specialization. The examination, therefore, should not take place until the student has completed all, or almost all, of their coursework. The student must be in good academic standing to sit for the comprehensive exam (`https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#comprehensive-exam`)

The Comprehensive Examination is considered a single examination, although it consists of written and oral parts. The minor department controls the minor portion of the written examination and may waive it at their discretion. A student will pass the written portion before sitting for the oral portion. Normally, the written and oral portions of the Comprehensive Examination should take place *at least* a semester prior to that in which the Final Oral Examination (defense of dissertation) is scheduled. The written and oral parts should be conducted within the same semester, or no more than four months. The exact time and place of the Oral Comprehensive Examination must be scheduled with the department and announced in GradPath using the Announcement of Doctoral Comprehensive Exam form before the exam can take place. Please contact the ENVS Graduate Advising staff several weeks before the exam is to take place.

We emphasize that the Announcement of Doctoral Comprehensive Exam form must be submitted before the oral exam takes place for two reasons. Firstly, there is a graduate college policy that states that: "The examination should not take place until the student has completed all, or almost all, of their coursework". The ENVS Graduate Program interprets this as 3 units of coursework, or less. We will check if all coursework listed o the Studen'ts Plan of Study is indeed complete. Secondly, if the form is submitted too late, then the approval will be at the discretion of the Dean of the Graduate College whether to allow the results to stand (i.e., it may be approved, but the exam could also be denied).

Upon successful completion of the written portion of the examination, the Oral Comprehensive Examination is conducted "live" with the examining committee of the faculty. The oral examination is the occasion when faculty committee members have both the opportunity and obligation to require the student to display a broad knowledge of the chosen field of study and sufficient depth of understanding in areas of specialization. The oral portion of the examination must cover both the major and the minor. The Oral Comprehensive Examination should last for at least an hour but must not last more than 3 hours. Remote participation by one or more committee members by video or phone is permitted on the condition that the student and all committee members can communicate effectively. All members must be present and participate in the entire examination.

The ENVS Graduate Program recommends (but does not require) that the student gives a brief (20 minute) presentation of the (planned) dissertation research. Discussion of proposed dissertation research may be included in the oral exam, but should not take the majority of the time. The examining committee must attest that the student has demonstrated the professional level of knowledge expected of a junior academic colleague. The Graduate College allows no more than one re-take of the oral exam.

A secret vote is completed by the committee (possible votes: Pass, Fail, and Abstain) and the outcome of that vote determines whether the student passes the oral comprehensive exam. More than one negative vote (Fail and Abstain are negative votes) will result in failure of the exam. Votes are tallied by the committee chair, who informs the committee, and ultimately the student, whether the vote resulted in a Pass or Fail decision. The identities of persons voting one way or the other should not be revealed to the student.

The committee chair is responsible for submitting the Results of Oral Comprehensive Exam form in GradPath. The chair will receive an email reminder, with a link to the form in the email, to submit the Results of Oral Comprehensive Exam form once the Announcement for the exam is approved by the Graduate College; alternatively, the chair can open the Results form from the GradPath Pending Transactions list. Regardless of the outcome of the Oral Comprehensive Examination, the chair must report results in GradPath.

Composition of the Comprehensive Committee The Comprehensive Exam Committee is a separate entity from the Dissertation Committee and consists of a minimum of four members. More members are permissible, but more than four members may increase the difficulty of scheduling the oral exam and may pose an additional burden on the student because each additional member may require a written portion of the Comprehensive Exam. The Major Advisor and two additional members must be current Graduate Faculty members, or approved tenure equivalent. The fourth member may be tenured or tenure-track, or an approved special member. Special members must be approved in advance by the ENVS Director of Graduate Studies and the Dean of the Graduate College. Any members beyond the fourth can also be current Graduate Faculty members, or approved special members.

The Oral Comprehensive Exam must cover both the Major and the Minor and for this reason the ENVS Department has some requirements regarding the composition of the Comprehensive Exam Committee. Committee members have the obligation to require the student to display a broad knowledge of the chosen field of study and sufficient depth of understanding in the areas of specialization. For students in the Environmental Science (ES) Track this requires that three committee members are chosen from the following four areas in ENVS:

- Environmental Biology and Microbiology
- Environmental Soil and Water Chemistry

- Environmental/Soil Physics, or Water Science
- Environmental Assessment, Communication, or Policy

The first three topic areas represent the ENVS core and test for “broad knowledge”. The fourth topic was included to meet the diversity of the ENVS faculty and provide some flexibility to represent the student’s advisor and/or the student’s research interests. The fourth member of the Comprehensive Exam Committee must represent the minor area of study.

For students in the Soil and Water Science (SWS) Track, three committee members are chosen from the following areas in ENVS:

- Environmental Biology or Microbiology
- Environmental Soil and Water Chemistry
- Soil Morphology or Nutrient Dynamics
- Soil Physics or Water Science
- Environmental Assessment
- An academic area within ENVS relevant for the student’s research.

The first four topic areas represent the ENVS core and test for “broad knowledge”. The six’th topic was included to meet the diversity of the ENVS faculty and provide some flexibility to represent the student’s advisor and/or the student’s research interests. The fourth member of the Comprehensive Exam Committee must represent the minor area of study.

Multiple ENVS faculty members are available for each topic and the student should query faculty members for availability before submitting the Comprehensive Exam Committee Appointment Form to GradPath.

While the above composition of the ES and SWS comprehensive committee will work effectively for most students, some exceptions may be necessary in particular cases. It is suggested that students discuss the comprehensive committee composition with the ENVS Advising Team at an early stage of selection. In general, however, it is undesirable to have two or more committee members asking questions with the same limited scope (e.g., two members asking solely about a narrow topic in soil physics, environmental microbiology, or environmental chemistry).

PhD students cannot be expected to know “everything” about the broad range of topics in Environmental Science. To allow the student some focus, each member of the committee shall provide a clear indication on which general area the student can expect questions at the oral examination. These suggestions should not have a narrow focus, but should be formulated like: “I will ask you about atmospheric systems & processes that are particularly relevant for environmental impacts” -or- “My questions will focus on the primary processes that influence the transport and fate of contaminants in the environment” -or- “I intend to ask you questions regarding the mechanisms behind

global climate change." Committee members may additionally ask follow-up questions about the student's written exam.

It is the student's responsibility to query each committee member regarding the general focus of the questions well in advance of the oral examination. A suggestion is to notify the entire committee of the focus of each member's questions.

Practical Guidelines for Oral Comprehensive Exam Many ENVS PhD students wonder what to expect at an oral comprehensive exam. This section provides some practical guidelines based on past oral comprehensive examinations in the ENVS department. These are guidelines, and the exact format should be confirmed with the Major Professor (or Chair of the Comprehensive Committee if this is not the Major Professor).

Prior to the Oral Comprehensive Exam:

- Make sure that the exam is scheduled well in advance (months) and that all committee members can be present. If one committee member must participate remotely, make sure that it can be done through a suitable video+audio connection (Zoom and Teams currently work well). If a presentation is given by the student, it may be necessary to share the computer's screen through the video link. Contact Departmental IT well in advance to arrange things, if needed.
- Contact the ENVS Advising Team well in advance. The Oral Exam must be announced in GradPath using the Announcement of Doctoral Comprehensive Exam form before the exam can take place.
- Query each Comprehensive Exam Committee member regarding the general focus of the questions. Students should do this well in advance to allow for sufficient time for review.
- There is absolutely no requirement or expectation that graduate students provide food or drinks for faculty members at meetings or defenses or at any other time for that matter. Should there be issues regarding this CALES policy, please contact the ENVS Director of Graduate Studies.
- It has happened that committee members forgot to come to a scheduled exam. Please send a reminder to the entire committee in the week before the defense. This also allows more effective actions should a member's availability have changed. The exam cannot be held if not all members are present.

At the Oral Comprehensive Exam:

- The exam is not open to the public.
- Please arrive early and make sure that all required technology is working (computers, cameras, audio, projectors). Contact Departmental IT

if there is an issue (i.e., the student should know how to contact the IT person).

- Once the entire committee is present, the student may be asked to leave the room for a few minutes. The chair of the Comprehensive Exam Committee will address some procedural matters with the committee. After this, the student is invited back into the room.
- Usually, the student will give a brief (20 minute) presentation about their (planned) Dissertation research. The committee may follow up with some questions regarding the presentation.
- Typically, the Comprehensive Exam Committee will ask questions about the topic areas: each member of the committee is given some time to ask questions (20 to 30 minutes, though it varies from committee to committee). Other members of the committee may be allowed to ask follow-up questions. Sometimes the committee will go through additional cycles of questions.
- It is OK to ask a committee member to repeat a question.
- It is OK for the student or a committee member to request a 5 or 10-minute break. These should be taken at "convenient" times.
- The student is often asked to use a white board to write text, draw conceptual diagrams, equations and chemical reactions. Please make sure that the room has erasable markers that work, as well as an eraser. Multi-colored markers may be handy and are stocked in the ENVS main office.
- The examination should be at least an hour, but not more than three. At the end of the examination the student is asked to leave the room again. The committee discusses the exam and the student's performance and each member decides upon pass/fail. The student is called back in and the committee chair informs the student of the result.

5.3.7 Major Professor and Dissertation Committee

When the student has an approved doctoral Plan of Study on file, has satisfied all course work, language, and residence requirements, and passed the written and oral portions of the Comprehensive Examination, they must file a Dissertation Committee Appointment form. This form reports the student's planned dissertation committee, dissertation title (subject to change) and the expected graduation term. It requires approval from the Major Professor and the ENVS DGS, as well as the Minor department. The approval signature from the minor department on this form indicates both approval of the reported dissertation committee and confirmation that the student has satisfied all requirements for the minor. At least two members of the Dissertation Committee must hold graduate faculty appointments in the ENVS Department. The student may also

have a co-director or committee member outside the ENVS Department, provided that he or she has credentials acceptable to the ENVS Department and the Graduate College.

The student should query faculty members for availability before submitting the Dissertation Committee Appointment to GradPath. Any changes to the committee should be reported to the ENVS Advising Team and through GradPath. Under normal circumstances, submission of is expected at least six months before the Final Oral Examination (i.e., Defense). Deadlines for the submission of paperwork pertaining to doctoral programs are available online at `https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines`

5.3.8 Prospectus

Doctoral candidates **must** submit a prospectus to their Dissertation Committee for review no later than one semester after advancement to candidacy (i.e., the Comprehensive exam). Where the Student's POS is the planned coursework in the Major, the Prospectus should document the student's planned activities and timeline for completion of the dissertation. Essentially it is a Scope of Work and/or research proposal and a valuable (time)planning document. The Prospectus is a GradPath requirement (see Figure 1) and ENVS must keep a prospectus on file (`https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#dissertation-prospectus`). The ENVS Advising Team will submit the prospectus/proposal confirmation form in GradPath on behalf of the student.

The prospectus must be approved by the Major Professor and Dissertation committee and should provide a preliminary description of the proposed dissertation and include:

- Title Page
  - Title
  - Name, Program, Student ID
- Problem Statement (1-2 pages)
  - Argument to address the gap in research literature in terms of relevance to the discipline
  - Evidence (citations) providing justification that this research is meaningful
  - Purpose of study
  - What needs to be studied, describing variables and conjectured relationships among them
- Research Question (which will be the foundation for the generation of hypotheses)
- Significance (1-2 paragraphs)

- Background (literature search supporting assertions in the problem statement)
- Framework (identifies research design decisions: method of inquiry, data collection and analysis)
- Other Information (e.g., challenges or barriers that may need to be addressed)
- References

The Background, Framework, and Other Information sections are intentionally vaguely worded as these vary from student to student and may depend on the requirements by the Major Professor. From the perspective of the ENVS Graduate Program, however, **these sections should not be excessively long**. For example, they should not be draft chapters of the dissertation.

The main purpose of the document should be to provide the Doctoral Committee (and the DGS) sufficient information about the viability of the student's research program and scope of dissertation and whether these can be completed within a reasonable amount of time. Should the student already have draft chapters of the dissertation then it is more appropriate to provide summaries/abstracts here. The time investment in preparing the prospectus should be much smaller than writing the dissertation itself.

5.3.9 Dissertation and Final Presentation of Defense

Dissertation We recommend that a research topic should be chosen by the student in consultation with their Major Professor in the first or second semester of the program. The research should culminate in an 18-unit dissertation (ENVS920). The dissertation should accurately report the research and is equivalent to three peer-reviewed manuscripts. The dissertation can either consist of :

- A set of publication-ready manuscripts that are included as appendices to the dissertation. The main document which should then include a comprehensive broader literature review, hypothesis, and synthesis/conclusions.
- A traditional chapter-based dissertation is also possible, in which case the actual work is included as chapters. In this case, none of the work is intended for publication.

The dissertation is subject to Graduate College rules regarding formatting and submission `https://grad.arizona.edu/gsas/dissertations-theses`. We *strongly* recommend that the student has regular contact with Major professor and Dissertation Committee.

Final Oral Defense Upon the completion of the dissertation, the candidate must have a Final Oral Defense Examination. A student must be in good academic standing to schedule the defense. The examination focuses on the dissertation itself but can include general questions related to the field(s) of study within the scope of the dissertation.

The date, time, and location of the final examination must be scheduled with the Graduate College in advance using the Announcement of Final Oral Defense form in GradPath. This form should be submitted at least one month before the defense date.

The Graduate College will place an announcement on the UA master calendar to invite the public to attend the candidate's presentation of his or her work. Final Oral Examinations should be scheduled during days when the university is in session and during normal business hours. Permission to hold examinations during university holiday closures or outside of normal university business hours may be granted by the Graduate College.

The Major Professor presides over the examination. The initial seminar portion during which the student presents the dissertation and entertains questions is open to the public. The Dissertation Committees' deliberation is closed to the public. There is no minimum time limit for the Final Oral Examination, but the entire proceeding is suggested not to exceed three hours. Members of the Doctoral Dissertation Committee must be present for the entire examination. All committee members must participate for the entire oral examination. If a committee member is participating remotely, that member needs to be able to communicate with the candidate and other committee members during the entire defense. If there are three committee members then all three members must pass the student in order for that student to pass the final defense. If there are more than three committee members then there may be only one negative vote (Fail or Abstain) for the student to pass.

The Dissertation Committee requires revisions after the defense and these must be done in a timely manner, not to exceed one year, and agreed upon by the committee. If the revisions are not completed by the dissertation submission deadline for the term when the student defends, the student will be required to register for the next semester. If revisions are not done by the end of the time-to-degree period, the student will have to retake comprehensive examinations to demonstrate up-to-date knowledge.

5.4 Plan of Study

With advice from their Major Professor and Graduate Student Support Coordinator, the student is responsible for developing a written Plan of Study by the end of the first semester. The plan of study must identify:

1. Courses the student intends to transfer from other institutions (if any). A maximum of 30 qualifying units may be transferred in per Graduate College regulations (`https://catalog.arizona.edu/policy/courses-credit/credit/graduate-transfer-credit`)

2. Courses already completed at The University of Arizona that the student intends to apply toward the graduate degree.

3. Additional courses the student plans to complete to fulfill the degree requirements.

A new plan of study must be submitted as soon as the student decides to use different courses for their degree completion (usually different electives, or a change from thesis units to report units). Approval of an updated plan of study is usually a formality, as long as it complies with the ENVS PhD degree requirements. We highly recommend consulting the ENVS Academic Advising team. The Plan of Study is to be submitted to GradPath by the end of the third or fourth semester in residence.

Below we list a general non-specific semester-by-semester schedule (Table 5). It is up to the student to select the appropriate electives while observing the ENVS PhD degree requirements.

5.4.1 Transfer Units

Transfer of units to the ENVS MS degree requirements is limited and subject to the following conditions. Please consult `https://grad.arizona.edu/degree-services/degree-requirements/doctor-philosophy#credit-requirements` for the latest UA policies.

- The credits must be approved by the major or minor department and the Graduate College.
- The minimum grade for transferred credits must be an A or B or the equivalent at the institution where course was taken.
- Transferred units may not count toward more than one doctorate.
- A maximum of 30 qualifying units of transfer coursework may be used toward the PhD requirements.

5.4.2 Time Limits

Doctoral students are expected to complete their degrees within 5 years after passing their comprehensive exams, or for those in programs that administer the comprehensive exams early in the career, within 10 years from the date of the first course on their plan of study. Students who do not meet these time limits are required to petition for an extension of time to complete degree. Doctoral students who do not finish their degrees within 5 years of passing their comprehensive examinations may be required to re-take their exams (see: `https://grad.arizona.edu/policies/academic-policies/time-degree`). The ENVS Unsatisfactory Progress Policy is described in Section: 7

Milestones – PhD Degree	
1st Semester	Attend ENVS orientation. Take required coursework; meet with Major Professor to develop preliminary Plan of Study (POS), and dissertation research.
2nd -4th Semester	Required and elective coursework; research. Select Minor and arrange Minor Advisor. Establish informal dissertation committee (members will guide and evaluate student's research); Schedule and hold a committee meeting; develop research proposal and discuss this and POS with committee. Submit POS via Gradpath.
5th - 7th Semester	Take remaining coursework on POS. Research. Establish **comprehensive** exam committee for advancement to candidacy (members will test for knowledge of the ENVS Major and chosen Minor). Comprehensive exam committee usually has a different selection of members than the dissertation committee. Submit Comprehensive Exam Committee Appointment Form on GradPath.
6th-8th Semester	POS complete. Research. Schedule Oral comprehensive exam date with comprehensive exam committee. Submit the Announcement of Doctoral Comp Exam Form on Gradpath; take the Comprehensive Examination (written and oral portions in one semester). Submit the Doctoral Dissertation Committee Appointment Form.
6th - 8th Semester	Write and submit Prospectus (research proposal) that will result in a dissertation. Schedule and hold a dissertation committee meeting, submit prospectus to ENVS.
8th+ Semesters	Dissertation research and writing; schedule and hold regular dissertation committee meetings; submit Announcement of Final Oral Exam Form on Gradpath; present and defend dissertation (equivalent to one peer-reviewed manuscript formatted according to Grad College guidance) before the end of the 12th semester; submit dissertation to Graduate College and graduate coordinator.

Table 5: Milestones for PhD Degree

6 ENVS Certificate Programs

6.1 Graduate Certificate in Aquaculture

6.1.1 Description

The University of Arizona Graduate Certificate in Aquaculture supports research, development, and training in aquatic food production systems with special interest in arid environments and developing countries. Current research includes rearing fish and shrimp in irrigation systems, fish, and shrimp nutrition and pathology, re-use of effluents as fertilizers for field crops and improving soils with fish wastes, and sustainable systems including aquaponics and integrated multi-trophic aquaculture. The certificate is especially designed for working professionals and international students who may want additional graduate experience on a flexible or reduced timescale.

All students must submit a formal application to the UA Graduate College to be considered for admission to the ENVS Graduate Certificate in Aquaculture. Further details about this graduate certificate including its admission requirements may be obtained at: `https://catalog.arizona.edu/programs/AQCCRTG`.

6.1.2 Certificate Requirements

The Graduate Certificate in Aquaculture requires completion of a minimum of 12 units of graduate credit. Courses may be added or removed from this list over time. Students should confirm that a particular course will be offered in a particular semester by checking the University of Arizona's Schedule of Classes. Certificate units may also be applied to degree programs; and up to six units of transfer credit may be used. For the latest requirements, please consult: `https://catalog.arizona.edu/programs/AQCCRTG`. Certificate units may also be applied to degree programs; and up to six units of transfer credit may be used.

6.2 Graduate Certificate in Water Policy

6.2.1 Description

The University of Arizona's Graduate Certificate in Water Policy offers breadth and depth of education. The Certificate is intended for two different and complementary groups of people who want to build their expertise in water policy: working professionals pursuing the Certificate only and UA graduate students concurrently enrolled in a graduate degree program. There is flexibility in both course selection and schedule, to meet the specific needs and interests of a variety of students. The program is interdisciplinary. Although there are some administrative details that differ between working professionals and UA graduate

students, all people admitted to the program must fulfill the same substantive requirements.

To earn the Water Policy Certificate, students must successfully pass 12 units of graduate credit, which is typically equivalent to four semester-long courses. These courses can be taken during a single semester of full-time study or spread out over two or three years. Much of the course-work emphasizes local and regional water policy issues in Arizona and the Southwestern U.S. However, students can also focus on broader national and international issues.

All students must submit a formal application to the UA Graduate College to be considered for admission to the ENVS Graduate Certificate in Water Policy. Further details about this graduate certificate including its admission requirements may be obtained at: `https://catalog.arizona.edu/programs/WPLCRTG`

6.2.2 Certificate Requirements

The Graduate Certificate in Water Policy requires completion of a minimum of 12 units of graduate credit as provided at `https://catalog.arizona.edu/programs/WPLCRTG`. Courses may be added or removed from this list over time. Students should confirm that a particular course will be offered in a particular semester by checking the University of Arizona's Schedule of Classes. Certificate units may also be applied to degree programs; and up to six units of transfer credit may be used.

7 ENVS Graduate Student Satisfactory Progress Policy

Graduate students in the Environmental Science Department are subject to annual evaluation for satisfactory progress based on their grade point average and overall progress towards completion of degree requirements.

A high level of performance is expected of all students in the ENVS graduate degree programs. Students must maintain a minimum of a 3.0 cumulative GPA throughout the program. Students failing to meet GPA requirements will be placed on probation by the Graduate College for one semester. If the cumulative GPA is not raised to the required minimum in the following semester, the student's major professor and the graduate advisory committee will decide whether to: (1) academically disqualify the student from the program; or (2) with Graduate College approval, allow the student to continue on probation upon approval of a remediation plan.

The Graduate Studies Milestones table below indicates the semester in which certain administrative steps should take place in order to meet satisfactory progress towards completion of degree requirements. These steps include scheduling annual committee meetings, comprehensive exams, submission of research proposals, and timely filing of required forms (e.g., plan of study, committee assignment, etc.).

No later than one month after final grades are posted for spring semester, all graduate degree seeking students are mandated to fill the annual progress report form to be distributed by the graduate coordinator. The progress reports will be prescreened by the graduate coordinator and in case of obvious deficiencies forwarded to the graduate committee for further evaluation. Students who fail to make satisfactory academic or research progress will be notified in writing of their status (with a copy of the letter going to the Graduate College). They will be asked to develop and submit a remediation plan signed by the faculty advisor. **Students must be in good standing with the ENVS Department to be eligible for financial aid (including GTAs and GRAs) and enrollment in individual studies course work.**

Time to Completion and Dismissal

It is in the best interest of both the students and the ENVS Department for degrees to be earned in a timely manner. MS students who have not completed degree requirements within 4 years, or PhD students who have not completed degrees within 6 years will receive a Departmental letter of Unsatisfactory Progress (DUP), which identifies lack of progress towards the student's degree. In addition, PhD students are required to take their comprehensive exams no later than one semester after the coursework for Major and Minor areas of study is complete as documented on the student's Plan of Study (POS). In general, the comprehensive exam should be taken in the third or fourth year in the ENVS PhD.

Beyond slow progress, there may be other reasons for the ENVS to send the affected student a NUP. In all cases, the ENVS DGS will consult with the student, their supervisor, the ENVS Department Head, and where needed the UA Graduate College and/or other UA organizations. The student will also receive a NUP if they or their supervisor have terminated their student-advisor relation.

If a DUP is sent to a student (and Major Professor) it will clearly outline what degree requirements must be completed during the next semester. Students and their Major Professor are required to submit a letter to the ENVS DGS to outline what action will be taken to accomplish meaningful progress towards the student's degree. This letter should be received by the DGS no later than 1 month after receipt of the DUP. If extreme extenuating circumstances prevent a student in good standing (i.e., GPA $\geq$ 3.0) from completing the degree requirements within the year, *one* leave of absence for one or two semesters may be requested.

Students who fail to meet the deadline(s) set in the DUP will be sent a Notice of Unsatisfactory Progress (NUP) (`https://grad.arizona.edu/policies/academic-policies/satisfactory-academic-progress`) with a copy going to the Graduate College. This letter will set explicit milestones that **must** be met within the next regular semester. If the student fails to meet **any** of the deadlines, the ENVS DGS or Department Head will request that the Graduate College dismisses the student from the ENVS graduate or certificate program. Students who receive a NUP may appeal with the ENVS DGS, the ENVS Department Head, or the Graduate College (see prior link).

If a student is dismissed from the ENVS graduate program they apply again to the ENVS graduate program, but only after two Academic Years have passed since their dismissal. This application will be considered a **new** application under the admission policies active at the time. There is no guarantee of admission.

When dismissed student applies to the ENVS Graduate Program, they should clearly address in their statement of purpose

- How the cause for dismissal (as stated in the DUP and NUP) will be remediated.
- What will be done to progress towards the degree. This should include a detailed schedule, including the semesters when the degree will be completed, For dismissed PhD students we also require the semester when the ENVS comprehensive exam will be taken (if no longer valid, or if never taken).

The applicant should be aware that ENVS graduate policies may have changed and that past graduate coursework or research may no longer be applied to degree requirements. In addition, the ENVS department will require a statement of an ENVS faculty member who positively agrees to advise (and where relevant: fund) the student in light of past dismissal. For applications to the ENVS PhD program, ENVS reserves the right to also request this for the UA faculty

member who represents the Minor area of study, if his was previously declared. Upon positive reviews, the ENVS department will discuss admission with UA Graduate College representatives and establish a mentoring plan if needed.

Glossary

AMP: Accelerated Master's Program. Mechanism to obtain an ENVS MS with one year of graduate studies after the ENVS BSES.

Career Courses: Required classes that all MS and PhD students must complete to fulfill the ENVS MS or ENVS PhD requirements.

Core Courses: Classes in the Major Track that all ENVS students must complete from the program curriculum.

Deficiency: Prerequisite coursework for the major that must be completed before the end of the first year of graduate study.

Director of Graduate Studies (DGS): ENVS faculty who oversees the ENVS Graduate Program, including setting and changing Graduate Program Policies. This position is currently filled by Dr. Marcel Schaap. Most Graduate Program-related questions should be directed to the Graduate Student Support Coordinator.

Elective Courses: Addition courses in the major that apply directly to the program curriculum.

GPA: Grade Point Average. Average Grade obtained in educational system. International grading systems are converted in the US 4-point system by UA's Graduate College. Applicants to the ENVS MS and ENVS PhD should have a GPA of 3.0 or greater (4-point scale). AMP applicants must have a GPA of 3.3 or greater.

Graduate Program Committee (GPC): Committee that advises DGS, Department Head and Faculty on Graduate Program Matters. Also reviews some applications to the graduate program. Members include five faculty members (including DGS who is chair), Graduate Student Support Coordinator and two students (ideally one MS and one PhD student).

GradApp: The UA Graduate College's paperless Graduate Program application system. All applications to the ENVS MS and ENVS PhD must be submitted through this system.

GradPath: The UA Graduate College's paperless degree audit process accessed via UAccess Student and allowing tracking and monitoring of student progress. Required graduate forms are filled out and submitted online.

Graduate Student Support Coordinator/Graduate Advisor: ENVS staff who carries out day-to-day administration of the ENVS Graduate Program, including academic advising of students. This document may also use "ENVS Advising Team".

Graduate Faculty: ENVS faculty who are qualified to serve on a graduate student's committee (Masters Committee, and PhD Comprehensive Exam committee, PhD Dissertation Committee). Some restrictions apply for career track graduate faculty.

GA (Main Campus only): Graduate Assistant (MS) or Graduate Associate (PhD). These are temporary appointments in which the student fulfills research duties (GRA) or assists and instructor in the ENVS Undergraduate Program (GTA).

Major: When MS and PhD degree requirements are fulfilled, ENVS students will obtain an MS or PhD degree in Environmental Science.

Major Professor: ENVS Graduate Faculty supervisor who accepts a graduate student into their field of research and acts as their mentor.

Minor Professor: (PhD only) Tenure track faculty from the minor area of study who is a member of the Dissertation Committee.

Special Member: Qualified experts who do not hold Graduate Faculty status but who would be valuable members of a Graduate student's committee. Needs approval from the Graduate College.

Track: The ENVS MS and PhD programs have core course requirements relevant for a general Environmental Science focus (ES track), and a Soil and Water Science Focus (SWS track).

ENVS Graduate Courses

This list is for informational purposes only and contains a possibly outdated and abbreviated summary of the courses. For an accurate listing of courses, semester offered, instructor, and prerequisites, please see: `https://uaccess.schedule.arizona.edu/psp/pubsaprd/UA_CATALOG/HRMS/h/?tab=DEFAULT` (select "E" and then "ENVS")

ENVS 501. Sustainable Management of Arid Lands and Salt-Affected Soils (3) Principles and practices of soil, water and crop management under arid and semiarid conditions, the use of diagnostic procedures for evaluating soils and waters, reclamation, and economics of irrigation project development. Spring semester. TBD.

ENVS 502. Nutrient Dynamics in Soils (3) Nutrient uptake by plant roots, soil microbial ecology, and soil chemical reactions affecting nutrients will be discussed and applied to environmental challenges related to nutrient cycling in arid land soils. Fall semester.

ENVS 506. Modeling of Mass and Energy Flow in Soils (3) Water flow in soils; closely related problems of solute, pollutant, and heat transfer. Fall semester. TBD

ENVS 508. Scientific Writing for Environmental, Agricultural and Life Sciences (3) This course will cover in-depth technical writing skills needed for scientific writing success, ranging from how to perform comprehensive reviews of the scientific literature, to performing peer reviews of the writing of fellow students. Spring semester.

ENVS 510. Microbial Biogeochemistry and Global Change (3) In this interdisciplinary undergraduate and graduate class we will cover major microbial bio-geochemical cycles, and how these cycles are impacted by, and feedback to, global change. Spring semester.

ENVS 515. Translating Environmental Science (3) In this course students learn journalism techniques to translate environmental science topics into language a layperson could appreciate. Spring semester.

ENVS 518. Introduction to Human Health Risk Assessment. (3) The purpose of this course is to enhance students knowledge and skills related to environmental risk assessment, including hazard assessment, exposure assessment, toxicity assessment, and risk characterization. Graduate-level requirements include conducting a case study that will require them to collect secondary data in the field. Fall semester.

ENVS 520. Environmental Physics (3) This course emphasizes conceptual understanding of mechanisms, data sets and modeling techniques and uses elementary math and physics principles to guide student to a comprehensive, but practical, understanding of the physical aspects of the environment of planet Earth. Fall and Spring semester.

ENVS 525. Environmental Microbiology (3) Current concepts in water quality, aerobiology, and microbial biogeochemistry. Fall semester.

ENVS 526. Environmental Microbiology Laboratory (2) Basic techniques for isolation and characterization of environmental soil and water micro-flora including methods for enumeration and measurement of physiological activity. Fall semester.

ENVS 528R Microbial Genetics (3) **ENVS 528R** Laboratory (2). Prokaryotic gene structure and function; methods of gene transfer and mapping, DNA structure, replication, transcription, and translation. Hands-on computer analysis of DNA sequences and gene cloning strategies. Principles of regulation of gene expression. Graduate-level requirements include a DNA sequence of an entire operon from any one of a variety of bacteria and additionally analyze one product from the operon using several GCG protein analysis programs plus an extensive exam. Fall semester.

ENVS 530R. Environmental Monitoring and Remediation (3) **ENVS 530L** (1) Lab. Basic statistics, data quality, field surveying, near-surface air measurement, automated data acquisition, soil, vadose zone and groundwater sampling and monitoring; soil and water biological properties, including pathogen monitoring and remote sensing. This course focuses on hands-on, laboratory and field experiences design to help the student better understand the principles of and the tools necessary for environmental monitoring. Fall and Spring semester.

ENVS 531R+L. Soil Genesis, Morphology, and Classification and Lab. Theory and practice of describing characteristics of soils; principles of soil classification and the classification systems; making soil interpretations for selected land uses. Field trips. Fall semester.

ENVS 531A Traditional Ecological Knowledge (3)An introduction to the growing literature on traditional ecological knowledge and its relationships to the ecological and social sciences. Graduate-level requirements include preparing for and leading a class discussion on a specific topic. Fall semester.

ENVS 536A Fundamentals of the Atmospheric Sciences. (3) Broadly covers fundamental topics in the atmospheric sciences. Topics include composition of the atmosphere, atmospheric thermodynamics, atmospheric chemistry, cloud physics, radiative transfer, atmospheric dynamics, and climate. Graduate-level requirements include additional questions on homework and exams plus a term paper on a specialized research topic. Spring semester.

ENVS 541 Soils and Landscapes of Arizona/Advanced Soil Genesis (3) Physical and chemical processes and mineralogy of weathering and soil formation; quantitative pedology; the soil as part of the ecosystem. Field trips. Spring semester (odd years only).

ENVS 541A Natural Resource Management in Native Communities. (3) This course is a survey of basic issues and concepts in natural resource management and the environment in Native communities using integrated case studies

that survey all the major varieties of environmental issues in Indian Country in the 21st century. A central theme will be developing tribally-specific solutions to rebuilding the resiliency of degraded ecosystems. We will consider particular case studies such as: tribal sovereignty, land tenure, reserved rights and Native claims; Native knowledge systems and Western science; co-management and restoration; water; fish and wildlife; agriculture and range-land management; energy, mining and nuclear waste; and global climate change. Graduate-level requirements include Increased length of writing assignments. Fall and Spring semesters.

ENVS 550 Green Infrastructure (3) The course provides an overview as well as more in-depth coverage of the science, practical context, and creation of Green Infrastructure. The built environment of arid regions is emphasized, with Tucson Case Studies providing practical focus to content and learning objectives. Fall semester.

ENVS 554 Water Harvesting (3) Focuses on water harvesting principles and techniques at a variety of scales and settings. Students participate in hands-on implementation of water harvesting projects on the UA campus. Spring semester.

ENVS 561 Soil and Water Conservation (3) Consideration of major world soil and water conservation problems and solutions; principles of soil and water degradation by erosion, ground water overdraft, chemical transport in surface and ground water and their effects on world food production and environmental problems. Offered during Pre-session. Field trips.

ENVS 562 Environmental Soil and Water Chemistry (3) An introduction to the principal chemical constituents and processes occurring in soils and sediments. The objective of the course is to provide students with a conceptual framework for understanding chemical reactions in heterogeneous natural systems. Spring semester.

ENVS 564 Environmental Organic Chemistry (3) Physical and chemical processes influencing the behavior of contaminants in the subsurface environment; equilibrium and kinetic theory of solubilization-dissolution, volatilization, sorption, hydrolysis, photolysis, surface catalysis, and radioactive decay. Fall semester.

ENVS 565 Contaminant Transport in Porous Media (3) The emphasis is on developing a thorough understanding of the critical processes and factors that influence transport and fate, including advection, dispersion, interphase mass transfer, transformation reactions, and physical and bio-geochemical heterogeneity of porous media. Spring semester (odd years only).

ENVS 566 Soil and Groundwater Remediation (3) This course examines the characterization and remediation of contaminated hazardous waste sites. The course is focused on the scientific and engineering principles supporting site characterization and remediation activities. Spring semester (even years only).

ENVS 567 Introductory Statistics and Multivariate Statistics with R. (3) The course (3 unit class) will teach the fundamentals of coding and programming using the R language (`https://www.r-project.org/`). The students will use code examples and practice problems to understand the statistical as well as the scientific viewpoint. Using R, students will explore and visualize real-world data and derive meaningful interpretations. The course will cover introductory statistics (descriptive statistics, hypothesis testing, t-test, ANOVA, correlation, regression) and multivariate statistics with a focus on ecological analyses (diversity, cluster analysis, unconstrained ordination, constrained ordination). Spring,

ENVS 570 Soil Physics (3) Theoretical and practical bases for understanding and quantifying physical and hydrological properties of soils; hydro-physical processes taking place near the Earth's surface emphasizing mass and energy exchange, and transport processes in saturated and partially-saturated soils at multiple scales; coupling of the atmosphere and the role of plants in the hydrological cycle; modern measurement methods and analytical tools for hydrological data collection and interpretation. Spring semester.

ENVS 572 Interfacial Chemistry of Biomolecules in Environmental Systems (3) Introduction to the chemical and adhesive properties of macromolecules at interfaces and inter-particle adhesion. Topics such as surface tension, self-assembly, adsorption of polymers and biomolecules, and bacterial cell adhesion will be discussed with emphasis on environmental applications. Spring semester (even years only).

ENVS 574 Aquatic Plants and the Environment (4) The role of riparian areas, estuaries, and constructed wetlands in the environment; emphasis on plants as wildlife habitat, nutrient cycling, and bioremediation. Spring semester.

ENVS 575 Freshwater and Marine Algae (4) Systematics, ecology, and evolution of planktonic and benthic species; field techniques and lab culture. Spring semester.

ENVS 577 Principles of Ecotoxicology, (3) and **ENVS 577L** Ecotoxicology Lab. Ecotoxicology is the study of the biochemical and molecular effects of chemical toxicants and non-chemical stressors, singly or in mixtures, on biological organization ranging from the individual to assemblages and ecosystems. Some of the detrimental effects of toxicants and stressors are acute causing immediate ecological and physiological harm, while many others are insidious and chronic causing long-term damage to populations over multiple generations. This course will provide knowledge to students of the very broad range of anthropogenic stressors and toxicants as well as their physiological and sometimes, behavioral, effects on individuals and populations of organisms.

ENVS 579 Boundary Layer Meteorology & Surface Processes, (3) Designed for students in the atmospheric sciences, hydrology and related fields. It provides a framework for understanding the basic physical processes that govern mass and heat transfer in the atmospheric boundary layer and the vegetated

land surface. In addition to the theoretical part of the course, there is a strong focus on modeling and students will be required to program numerical codes to represent these physical processes. Spring semester (even years only),

ENVS 580 Environmental Assessment for Contaminated Sites (3) Advances students' knowledge of various concepts and methods used in assessing human-impacted resources such as contaminated sites, waste places, and disturbed sites to ensure efficient and effective remediation and restoration programs. Fall Semester.

ENVS 582 Reclamation and Redevelopment of Impacted Lands (3) Introduces the concepts and methods governing the sustainable management, restoration, and redevelopment of human-impacted lands. The topics covered include: soil quality concepts; the energy-water-food nexus; redevelopment of brownfields and other impacted lands; reclamation of mining and other resource-extraction sites; natural-disaster cleanup; urban agriculture and community gardens. Spring semester.

ENVS 583 Geographic Applications of Remote Sensing. (3) Use of aircraft and satellite imagery for monitoring landforms, soils, vegetation and land use, with the focus on problems of land-use planning, resource management and related topics. Graduate-level requirements include the completion of a project report. Main campus: Spring Online campus: Spring semester.

ENVS 590 Remote Sensing for the Study of Planet Earth. (3) Remote Sensing for the Study of Planet Earth introduces basic and applied remote sensing science as a means to explore the diversity of our planetary environments (biosphere, atmosphere, lithosphere and hydrosphere) within the radiometric, spectral, spatial, angular and temporal domains of remote sensing systems. This survey course strikes a balance between theory, applications and hands-on labs and assignments. We explore how you can download, process, analyze and interpret multi-sensor data and integrate online remotely sensed data sources/products into your research of interest. Fall semester, Smith.
ENVS 595. Colloquium (1) The exchange of scholarly information and/or secondary research. Instruction often includes lectures by several different persons. Fall and Spring semester.

ENVS 596B Water Policy In Arizona and Semi-arid Regions (3) This course focuses on current water policy in Arizona, the Colorado River Basin, and other semi-arid regions from a multi-disciplinary perspective. Through readings, research, discussion and presentations, the student is exposed to major, current water resource issues and policies to address them. Spring semester.

ENVS 641 Water Law. The course in Water Law traditionally emphasizes state law rules that govern rights to use surface water and groundwater throughout the country. Although we will give ample attention to the prior appropriation doctrine, riparian water rights, and various systems for regulating groundwater use, this course will also emphasize how federal law may impact water rights. Increasingly, environmentalists and others claim that there are public rights

to water that may take precedence over rights under the prior appropriation system. Spring semester.

ENVS 696A Seminar (1) Topics in Soil, Water and Environmental Science. Development and exchange of scholarly information, usually in a small group setting; the scope of work shall consist of research by course registrants, with the exchange of the results of such research through discussion, reports/or papers. Fall and Spring semester.

ENVS 696N Indigenous Food Energy Water Security and Sovereignty Seminar (1) discuss research and extension on tribal lands. Additional faculty working on tribal natural resources challenges will be invited as needed. This seminar will be live-streamed to Dine College and NTU. First year PhD trainees will discuss preparation strategies for internships. Topics include career paths, Indige-FEWSS internship opportunities, written and oral mechanisms of scientific communication to reach disciplinary, cross-disciplinary and lay audiences, and work place expectations. Second year PhD trainees will prepare to work with Dine College and NTU faculty and teach FEWS modules. Topics include: inquiry based Fall and Spring semesters.

ENVS 696P Hazardous Waste Risk and Remediation in the US Southwest (1), Interdisciplinary trainees who participate in a colloquium, professional development activities and research translation/community engagement activities. Fall and Spring semesters.

ENVS 697 Graduate Seminar and Professional Development (1) ENVS graduate students will develop and practice oral and poster presentations in front of an audience (and camera), practice chairing a session of a professional meeting, and develop a relevant resume/CV appropriate for a professional career in their field. Students will appraise and critique the presentations of their fellow students. Students will also practice a simulated job interview, based on the CV they develop.