Environmental Science | 2016-2017 Assessment Plan

1. Please review last year's assessment results (2015-2016) as well as the Academic Program Assessment Report with the faculty in your program. How does your program plan to take these results into consideration in future programmatic planning?

   We assessed Env Sci Outcome 1: *Understand fundamental physical and biological processes of the natural environment*.

   We used an embedded assessment question on the final exam given in Environmental Systems (ENV SCI 305) Fall 2015, a core ENV SCI course. The course was not taught in Spring 2016 as originally planned. The question asked the students to synthesize all of the fate-and-transport concepts that were presented throughout the semester to describe and contrast the movement of two differing chemical compounds through various environmental compartments (air, soil, sediment, water, and biota). Students needed to describe significant distribution processes, pathways, and factors that influence their relative distribution rates and magnitudes in the various environmental compartments.

   Performance Rating Scale:
   Outstanding: Students listed and demonstrated understanding of the majority of the pertinent pathways, processes, reservoirs, and rates of movement for carbon and contaminants in environmental systems. Students listed and correctly described important properties and their impacts on contaminant dissipation and distribution. Students correctly listed and described the influence of major physical environmental factors on contaminant dispersal in the atmosphere, hydrosphere and lithosphere. Student's discussion points were pertinent to the questions and very little if any superfluous points were made.
   Good: Students listed and demonstrated understanding of main pathways, processes, reservoirs, and rates of movement for carbon and contaminants in environmental systems. Students listed and correctly described some of the contaminant chemical properties and physical, environmental properties that influence the fate and distribution of the contaminants in environmental systems. Limited superfluous information was presented.

   Marginal: Students listed several pathways, processes, reservoirs, and rates of movement for carbon and contaminants in environmental systems. Some of the major elements were missing or students did not demonstrate understanding of the connection between elements of the environmental systems. Students listed and described several chemical and physical environmental factors that influence contaminant fate and distribution. Several key factors missing or incorrect.
   Unacceptable: Students did not list or demonstrate understanding of key elements to biogeochemical cycle or contaminant distribution pathways and processes. Major contaminant

factors and important physical environmental factors and processes not listed or described. Students' response contained incorrect information and/or substantial discussion not pertinent to stated questions.

Performance Rating	Number of Students	Percent of Class	Overall Average
Outstanding = 1	4	40	1.8
Good = 2	4	40	Good to Outstanding
Marginal = 3	2	20	
Unacceptable = 4	0	0	

Summary:

Based on the assessment, eight out of ten students satisfactorily achieved (outstanding or good performance ratings) the stated learning outcome. Only one of the two student responses that rated in the "marginal" category was clearly at that level. The other student response tended toward the "good" category.

This assessment question focused more on the "fundamental physical processes of the natural environment" but also did include biological processes. Understanding of fundamental biological processes is taught and assessed more thoroughly in other courses in the program.

2. How will you use what you've learned from the data that was collected?

   Overall the assessment showed that the vast majority of the students understand the fundamental physical and biological processes of the natural environment. There is, however, capacity for students to demonstrate a more complete or encompassing understanding of important processes and their linkages. Faculty will continue to encourage students to describe and contrast fundamental processes important to chemical fate in the environment in both lecture discussion and in laboratory exercises. Faculty will emphasize the importance of building on and linking the various physical and biological process that are studied progressively throughout the semester.

3. Please review your program's Learning Outcomes. Do any of them need to be updated or clarified?

   At our 27 January NAS meeting, we looked at the Environmental Science learning outcomes, and decided they are satisfactory as is.

   a. Please provide brief indications of the kinds of assessment that <u>might</u> be used to assess each outcome.

      Outcomes are listed below.

      The Environmental Science Program uses embedded assessment within Env Sci courses. We have a capstone course in which students go through all phases of the scientific research process, but this course is not used for all of our assessment; we would prefer to do assessment using a wide array of our course offerings.

Some of the outcomes (at least 1,2, 3, 6) can be evaluated based on students' demonstration of knowledge, via an exam question or a specific project in a course.

Outcomes 4 and 5 are more practical, hands-on skills that might perhaps be better evaluated via student performance of a lab activity or a research project.

Env Sci Outcome 1: Understand fundamental physical and biological processes of the natural environment.
Env Sci Outcome 2: Recognize relationships between humans and ecosystems at local, regional, and global scales.
Env Sci Outcome 3: Apply knowledge from multiple disciplines to environmental challenges and opportunities.
Env Sci Outcome 4: Build practical skills for scientific problem-solving, including familiarity with laboratory and field instrumentation, ability to use current computer technologies, and experience in statistical modeling techniques.
Env Sci Outcome 5: Demonstrate competency in collecting, managing, evaluating, interpreting, and communicating information through hands-on research.
Env Sci Outcome 6: Critically evaluate strategies for sustainable management and restoration of environmental systems.

Student Learning Outcomes. List your program's anticipated student learning outcomes. What do you expect all students to know or be able to do?

Students who have completed the Environmental Science major will be prepared for a broad range of career opportunities combining multiple disciplines, and they will be equipped to help build a sustainable future for humanity and other species. Specifically, graduates of the program should:
Env Sci Outcome 1: Understand fundamental physical and biological processes of the natural environment.
Env Sci Outcome 2: Recognize relationships between humans and ecosystems at local, regional, and global scales.
Env Sci Outcome 3: Apply knowledge from multiple disciplines to environmental challenges and opportunities.
Env Sci Outcome 4: Build practical skills for scientific problem-solving, including familiarity with laboratory and field instrumentation, ability to use current computer technologies, and experience in statistical modeling techniques.
Env Sci Outcome 5: Demonstrate competency in collecting, managing, evaluating, interpreting, and communicating information through hands-on research.
Env Sci Outcome 6: Critically evaluate strategies for sustainable management and restoration of environmental systems.

b. Please compare your Learning Outcomes to the University's main learning objectives. Which programmatic outcomes match university mission outcomes?

   a. Interdisciplinary: 1, 2, 3
   b. problem-focused education 3, 4, 5
   c. critical thinking 3, 4, 5, 6
   d. diversity None of our Learning Outcomes directly address this objective.
   e. environmental sustainability: 1, 2, 6
   f. engaged citizenship. 6

4. Which outcome will you assess this year (2016-2017)?

   Env Sci Outcome 3: Apply knowledge from multiple disciplines to environmental challenges and opportunities.

5. Which technique will you use to assess this outcome?

   We evaluated a semester project in Env Sci/ET 330/530 (Hydrology), in Fall 2016, taught by Prof. Patricia Terry.
   It will be assessed via the following end of semester project that requires students to apply statistics, environmental modeling, and the hydrologic mass balance.

   Hydrology project

   A town in India wants to build a 300 acre reservoir to hold rainfall excess from the annual monsoon to be used during the dry summer for irrigation and to help promote tourism. The annual monsoon lasts about 4 weeks in May. You will use the 100 year monsoon as the design basis for the reservoir. They have hired you to size the reservoir and estimate how much water from the reservoir will be available for irrigation in August. They also wish to have you derive the hydrograph for the river that flows by the edge of the village based on a previous storm hydrograph.

   You are given the following data:

   Total depth of precipitation (over the 4 week monsoon) for the past 20 years of monsoons:

Year	depth P (in)	Year	depth P (in)
2015	24	2005	30
2014	23	2004	25
2013	28	2003	23
2012	26	2002	27
2011	29	2001	29
2010	25	2000	25

2009	27	1999	31
2008	26	1998	28
2007	23	1997	32
2006	31	1996	28

The village is 15,000 acres, 13,000 of which is agricultural lands. Assume negligible infiltration over the 2000 acres that comprise the village due to excessive soil compaction and impervious surfaces. To estimate infiltration over the agricultural lands, field data was taken during a previous monsoon to be fitted to a Horton infiltration model. The rate of infiltration was measured initially, after 2 hours and after 4 days (96 hours) and is as follows;

time (hrs)	f (in/hr)
0	2.3
2	0.8
96	0.02

It can be assumed that 10% of precipitation goes to fill initial abstraction or is intercepted. In addition, a smaller village will draw 30 ft^3/sec from the river during the monsoon period to support its own irrigation reservoir.

Based upon this, determine how deep a 300 acre storage reservoir must be to hold the rainfall excess.

Second, determine the volume of water available for irrigation at the beginning of August. The average water temperature for the summer months is 70^{o}F and the average air temperature and humidity are 85^{o}F and 50%, respectively, and the coefficient C is assumed to be 16 and the wind speed is 12 mph.

Last, given the following total hydrograph data for the river during a 2 week monsoon, estimate the monsoon hydrograph for the 100 year event of duration 4 weeks. Find the value of the rational coefficient from the water mass balance above. When applying the depth of R to deriving the unit hydrograph and the new monsoon hydrograph, round depth of rainfall excess to the next highest integer value.

Time (weeks)	Q (cfs)
0	400
1	700
2	1000
3	1300
4	1600
5	1200
6	800
7	400

Your final report should include all calculations written neatly in an organized fashion, the rational coefficient C for the watershed, the depth of the reservoir, the volume of rainfall excess in the reservoir at the end of the April monsoon and at the beginning of August, and the hydrograph for the 100 year monsoon event of duration 4 weeks.

Each group or individual will turn in one report. Each group or individual may ask three free questions of the project manager (me). Consulting with any other student or faculty member constitutes cheating and will result in a failing grade for the course.

The project and learning outcome will be assessed with the following rubric.

	Unsatisfactory	Developing	Satisfactory	Exemplary
Write correct water mass balance from written problem description	Fails to write water mass balance	Identifies at least 70% of mass balance terms from written problem statement	Identifies all but one mass balance term from written problem description	Identifies all mass balance terms relevant to written problem description
Apply appropriate mathematical models to estimate each term in mass balance	Fails to identify appropriate models for mass balance terms	Applies correct models for at least 70% of mass balance terms	Makes only one error in determining values of mass balance terms	Applies appropriate math models for each term to correctly determine its numerical value
Apply statistics to determine design storm	Fails to apply statistics	Applies some statistics, but fails to consider all factors	Applies statistics correctly, but makes math error	Applies correct statistical models to determine design storm depth
Convert each term in mass balance to volume of water	Fails to convert mass balance terms to volumes	Correctly converts at least 65% of mass balance terms to volumes	Makes only one error in converting mass balance terms to volumes	Applies correct methodology to convert mass balance term to volumes
Determine correct storm storage volume/depth	Fails to use mass balance or design storm to determine correct volume/depth	Makes more than one error in determining storage volume/depth	Makes only one error in determining storage volume/depth	Correctly determines storage volume/depth
Convert given hydrograph into design storm hydrograph	Fails to model design storm hydrograph	Makes more than one error in modeling design storm hydrograph	Makes only one error in modeling design storm hydrograph	Correctly models design storm hydrograph

6. Which course or group of students will you assess on the outcome chosen above and when?

   Env Sci 330 is an upper-level elective course for the major and minor. Enrollment was 22.