

Assessment Plan

Environmental Science Major

Spring 2015

I. Introduction

In the 2014 Environmental Studies assessment report we noted how assessment activities had led us to believe that a greater focus on Environmental Science would be beneficial for our students. In 2014 a new major in Environmental Science was approved. This document outlines an assessment plan for the new major. The assessment plan for Environmental Studies was discarded, partly because of significant differences between the broad Environmental Studies major and the new more focused Environmental Science major, and partly because some of its core elements, including the comprehensive examination, had been discontinued. This gave us an opportunity to look afresh at the development of goals and assessment outcomes for the new Environmental Science major. During spring 2015 faculty members in the Environmental Science major developed new program goals consistent with our program mission, and determined objectives and outcomes derived from these goals. The results are described in this document and put in the context of Wells College's student learning goals and mission statement.

II. Wells College Mission Statement

The mission of Wells College is to educate students to think critically, reason wisely, and act humanely as they cultivate meaningful lives. Through Wells' academic program, residential atmosphere, and community activities, students learn and practice the ideals of the liberal arts. The Wells experience prepares students to appreciate complexity and difference, to embrace new ways of knowing, to be creative, and to respond ethically to the interdependent worlds to which they belong. Committed to excellence in all areas of its reach, Wells College equips students for lifelong learning and for sharing of privileges of education with others.

III. Wells College's Nine Student Learning Goals

1. Breadth of knowledge: Understanding the physical world, cultures, individuals, personal health and well being
2. Depth in field: Developing expertise in a chosen major field
3. Career preparation: Acquiring substantive and professional competence
4. Fundamental literacies:
 - The ability to read critically across the disciplines
 - The ability to employ effectively oral, written and expressive communications
 - The ability to identify and evaluate relevant information

5. Critical thinking and application: The ability to use reasoning and evaluative skills in distinctive modes of inquiry and analysis
6. Ethical decision making: The ability to reason wisely and act humanely
7. Creativity: The ability to transcend established understandings to discover something new
8. Metacognitive: The ability to use self-reflective skills to understand what one knows, how one learns, and how to use resources effectively and to seek help
9. Skills and beliefs to navigate living and working in community:
 - The ability to engage in problem solving and to work in a team environment
 - The ability to manage time effectively and to possess a positive work ethic
 - The ability to offer and accept constructive criticism, to possess self-confidence, be flexible, adapt quickly and work well under pressure

IV. Mission of the Environmental Science Major

Environmental science is fundamental to environmental protection and restoration. The major in environmental science guides students in examination and analysis of the earth and the human-environment interaction, and develops the technical and scientific skills necessary to build a career related to the environment. Required courses in the major examine the following types of questions: What is the nature of the earth and its ecosystems? What is the nature of environmental problems? What is the scientific and technical basis for environmental problem-solving and mitigation of the human impact on planet earth? How are scientific findings used in society's decision-making about environmental resources? How can science and technology help us be better stewards of earth, its ecosystems, and its natural resources?

In addition to completing the core courses required of all students in the major, each student chooses an area of specialization in biology or chemistry or physics, based on their primary interests in the earth system. The specialization offers the opportunity to further develop skills and competencies that prepare students for the environmental careers of today and tomorrow.

V. Environmental Science Program Goals

Eight goals have been identified and are drawn from the mission of the Environmental Science major.

GOAL 1: *Examine the nature of the earth*

GOAL 2: *Analyze environmental issues and science-based approaches to environmental problem-solving on different scales*

GOAL 3: *Explore the interplay between achieving environmental protection and meeting society's resource needs*

GOAL 4: *Investigate basic science and apply it to environmental issues*

GOAL 5: *Examine how the findings of environmental science are used in decision-making about environmental resources*

GOAL 6: *Appreciate the various ways environmental science can contribute to successful stewardship of the earth*

GOAL 7: *Learn and practice skills that contribute to successful pursuit of a career related to the environment*

GOAL 8: *Gain practice analyzing environmental issues in an objective and sophisticated way*

VI. Environmental Science Program Objectives and Outcomes

Within our eight broad goals we have embedded objectives and outcomes as outlined below.

GOAL 1: Examine the nature of the earth

Objective 1.1: Examine the nature of ecosystems

Outcome 1.1.1: Demonstrate understanding of matter and energy flow through food chains

Outcome 1.1.2: Display knowledge of major biogeochemical cycles

Outcome 1.1.3: Show familiarity with earth's biodiversity

Objective 1.2: Examine the nature of natural resources

Outcome 1.2.1: Demonstrate awareness of the world's energy resources

Outcome 1.2.2: Show familiarity with the nature of the world's water resources

Objective 1.3: Examine the nature of the human-environment interaction

Outcome 1.3.1: Be able to describe how human activities degrade the earth

Outcome 1.3.2: Be able to describe how human activities protect and restore the earth

GOAL 2: Analyze environmental issues and science-based approaches to environmental problem-solving on different scales

Objective 2.1: Analyze environmental issues and problem-solving on local scale

Outcome 2.1.1: Demonstrate knowledge of how humans use and affect Cayuga Lake and its watershed

Outcome 2.1.2: Show familiarity with local agricultural practices and impacts

Objective 2.2: Analyze environmental issues and problem-solving on global scale

Outcome 2.2.1: Demonstrate knowledge of major contemporary global environmental issues

Outcome 2.2.2: Show familiarity with global agricultural practices and impacts

GOAL 3: Explore the interplay between achieving environmental protection and meeting society's resource needs

Objective 3.1: Examine how environmental science helps societies mitigate their environmental impacts

Outcome 3.1.1: Demonstrate familiarity with scientific issues around the concepts of "reduce, reuse, recycle"

Outcome 3.1.2: Show knowledge of scientific issues around the mitigation hierarchy “avoid, minimize, compensate”

Objective 3.2: Examine how environmental science helps inform priority-setting and decision-making

Outcome 3.2.1: Describe how environmental science provides a basis for weighing options open to society

Outcome 3.2.2: Describe how societies can use the metrics of environmental science in decision-making processes

GOAL 4: Investigate basic science and apply it to environmental issues

Objective 4.1: Investigate fundamental scientific principles and basic research in chosen area of specialization

Outcome 4.1.1: Demonstrate knowledge with the laws of nature in biology/chemistry/math & physics

Outcome 4.1.2: Demonstrate familiarity with the primary literature in biology/chemistry/math & physics

Objective 4.2: Investigate how chosen area of specialization can be applied to environmental concerns

Outcome 4.2.1: Articulate understanding of how biology/chemistry/math & physics informs environmental debates

Outcome 4.2.2: Describe the role of biology/chemistry/math & physics in addressing contemporary environmental issues

GOAL 5: Examine how the findings of environmental science are used in decision-making about environmental resources

Objective 5.1: Examine environmental policies and how they are developed

Outcome 5.1.1: Demonstrate knowledge of current environmental policies

Outcome 5.1.2: Demonstrate familiarity with the genesis of major environmental policies

Objective 5.2: Examine how interests of various stakeholders interplay with the findings of environmental science

Outcome 5.2.1: Demonstrate familiarity with local and global conservation and environmental groups

Outcome 5.2.2: Articulate roles of environmental advocates, businesses, government agencies and other entities in environmental concerns

GOAL 6: Appreciate the various ways environmental science can contribute to successful stewardship of the earth

Objective 6.1: Appreciate the role of scientific inquiry as a foundation of effective stewardship

Outcome 6.1.1: Articulate the nature and the value of the scientific lens in environmental issues

Outcome 6.1.2: Describe how scientific findings can be translated into effective environmental management

Objective 6.2: Appreciate how environmental technologies and engineering can address environmental problems

Outcome 6.2.1: Describe major ways in which technology & engineering can help us analyze the environment

Outcome 6.2.2: Describe major ways in which technology & engineering can mitigate environmental impacts

GOAL 7: Learn and practice skills that contribute to successful pursuit of a career related to the environment

Objective 7.1: Learn and practice quantitative skills

Outcome 7.1.1: Demonstrate familiarity with indices of environmental quality

Outcome 7.1.2: Show proficiency describing numerical dimensions of environmental issues

Outcome 7.1.3: Demonstrate competence in statistical approaches to data analyses

Objective 7.2: Learn and practice technical skills

Outcome 7.2.1: Demonstrate competency in geographic information systems

Outcome 7.2.2: Show proficiency in field sampling techniques

Objective 7.3: Learn and practice writing skills

Outcome 7.3.1: Demonstrate ability to write in a clear, concise, and technically accurate manner

Outcome 7.3.2: Demonstrate ability to write using the conventions of scientific writing

Outcome 7.3.3: Demonstrate ability to use and cite literature appropriately

Outcome 7.3.4: Show proficiency in writing a primary scientific paper

Outcome 7.3.5: Show proficiency in writing a literature review

Objective 7.4: Learn and practice professional speaking skills

Outcome 7.4.1: Show proficiency in preparing and delivering oral presentations

Outcome 7.4.2: Demonstrate ability to interact with colleagues in a professional manner

Objective 7.5: Learn and practice research skills

Outcome 7.5.1: Demonstrate proficiency in using library resources

Outcome 7.5.2: Demonstrate proficiency in field and lab skills

GOAL 8: Gain practice analyzing environmental issues in an objective and sophisticated way

Objective 8.1: Gain practice using evidence-based approaches to environmental issues

Outcome 8.1.1: Demonstrate familiarity with data-driven analyses of environmental issues

Outcome 8.1.2: Demonstrate ability to distinguish arguments based on emotion and anecdotal evidence from objective arguments grounded in data

Objective 8.2: Gain practice seeking and valuing complexity and context in environmental debates

Outcome 8.2.1: Demonstrate familiarity with historical aspects of environmental debates

Outcome 8.2.2: Demonstrate proficiency in articulating environmental issues in a nuanced and multifaceted way

VII. Assessment of Outcomes

Assessment of outcomes will be achieved through activities, testing, and assigned work in courses required for the Environmental Science major. Table 1 aligns courses required in the Environmental Science major with the major's learning outcomes, and course goals for each course are described in Appendix 1. Key assessment tools include the following:

A1: Final exams in introductory courses in the major

A2: Writing of a primary scientific paper in ENVR 101L

A3: Research papers in upper level courses in the major

A4: Presentations in upper level courses in the major

A5: Senior thesis

Table 1. Summary of alignment of courses required in the Environmental Science major and the major's learning outcomes.

Courses  Outcomes^a 	ENVR 101L	ENVR 102L	ENVR 131L	ENVR 195	ENVR 290^b	ENVR 303	ENVR 340	ENVR 403^b	BIOL 119L	MATH 151
1.1.1	X						X		X	
1.1.2	X		X				X		X	
1.1.3	X	X							X	
1.2.1	X		X						X	
1.2.2	X		X						X	
1.3.1	X	X	X				X		X	
1.3.2	X	X	X			X	X		X	
2.1.1	X	X	X			X			X	
2.1.2	X						X			
2.2.1	X	X	X				X		X	
2.2.2	X						X			
3.1.1	X									
3.1.2						X				
3.2.1	X	X				X	X			
3.2.2	X					X				
5.1.1	X	X				X				
5.1.2	X	X				X				
5.2.1		X								
5.2.2						X				
6.1.1	X	X	X						X	
6.1.2	X	X	X			X			X	
6.2.1	X	X				X				
6.2.2						X	X			
7.1.1	X	X	X				X			

Courses  Outcomes^a 	ENVR 101L	ENVR 102L	ENVR 131L	ENVR 195	ENVR 290^b	ENVR 303	ENVR 340	ENVR 403^b	BIOL 119L	MATH 151
7.1.2	X	X	X			X	X			
7.1.3			X							X
7.2.1	X			X						
7.2.2	X		X						X	
7.3.1	X	X	X			X	X	X	X	
7.3.2	X	X	X			X	X	X	X	
7.3.3	X	X	X			X	X	X	X	
7.3.4	X		X						X	
7.3.5		X	X					X	X	
7.4.1	X	X				X	X	X	X	
7.4.2		X			X	X	X		X	
7.5.1	X	X	X			X	X	X	X	
7.5.2	X		X						X	
8.1.1		X				X	X	X		
8.1.2		X				X		X		
8.2.1		X				X				
8.2.2		X				X		X		

^aOutcomes related to Goal 4 not included here, as they depend on specialization chosen, and courses chosen within that specialization in other majors

^bAdditional outcomes for ENVR 290 and ENVR 403 are highly dependent on nature of the internship and the topic of the thesis, respectively

VIII. Criteria for Success

Student work is examined and evaluated throughout each academic year by faculty members teaching the courses required for the major. This allows us to collect data on the assessment tools described above. We evaluate whether students achieved learning outcomes based on the quality of work completed. The outcome is considered met if 70% of the students received a passing grade on the assessed activity.

IV. Evaluation of Assessment

Faculty in the Environmental Science major discuss assessment outcomes annually, focusing on the outcomes of the previous academic year. The goal is to determine if student performance is resulting in the major's outcomes, objectives and goals being met. This is achieved using records of student performance relevant to the assessment tools described above. Assessment meetings provide us with an opportunity to consider, and reflect on, various aspects of student performance as manifested in assessment outcomes. Examined individually and together the assessment tools provide a reasonable way for us to assess whether our students are developing into graduates that can think, act and communicate as intelligent environmental scientists well-informed on environmental issues and principles.

We record our conclusions and any actions we feel are warranted for the future.

**APPENDIX 1. Course Descriptions and Course Goals for Courses Required in the
Environmental Science Major**

ENVR 101L. Introduction to Environmental Science

(Required for all students in the major)

An introduction to environmental science including an analysis of natural resources and the environmental impact of their extraction and use. Environmental quality, pollution, toxicology and environmental science as the basis for effective environmental policy are among the topics covered.

Students who successfully complete ENVR 101L will appreciate and understand

- 1) The nature of the world's natural resources;
- 2) The impact on humans and on the environment of resource extraction and use;
- 3) The role of humans as effectors of environmental change;
- 4) How complex environmental problems can be addressed and solved;
- 5) Each individual's impact on the natural world;
- 6) The importance of environmental science as the basis for sound environmental policies

ENVR 102 L. Conservation of Biodiversity

(Required for all students in the major)

An introduction to the field of conservation science. Local and global aspects of species, ecosystem and landscape conservation will be discussed.

Students who successfully complete ENVR 102L will be able to demonstrate their knowledge of the following:

- 1) major issues that define the discipline of conservation biology;
- 2) the nature and importance of biodiversity;
- 3) threats to biodiversity;
- 4) efforts and approaches to conservation of biodiversity, species, ecosystems and landscapes;
- 5) the history and significance of U.S. national parks;
- 6) local organizations and their efforts to protect local ecosystems and the biodiversity they contain.

ENVR 131L. Physical Geology

(Required for all students in the major)

The origin, composition, structure, and geological history of the earth. This will include the study of geological processes affecting the earth's crust and interior, and examination of theories concerning geological phenomena such as origin of mountains and plate tectonics.

Students who successfully complete ENVR 131L will be able to

- 1) Understand the process of science and how it is applied in Geology;
- 2) Understand Earth processes and their implications for the environment;
- 3) Understand plate tectonics: how it occurs, and its importance in Earth's history;
- 4) Understand mineral properties and classification, as well as the rock cycle and how rocks are classified;
- 5) Understand the Earth's interior, the importance of convection and magnetism, and the importance of earthquakes;
- 6) Understand the interplay of tectonic and surficial processes on Earth that create landforms;
- 7) Appreciate the geologic time scale and the formation of Earth, the hydrosphere and the atmosphere;
- 8) Read and interpret maps;
- 9) Understand the geologic history of New York State.

ENVR 195. Tutorial in Geographic Information Systems

(Required for all students in the major)

A self-guided tutorial in Geographic Information Systems (GIS). Focus is on the development of basic skills related to geospatial analysis, such as map symbology, data overlay and projection.

Students who successfully complete ENVR 195 will

- 1) Understand the theory of geospatial analysis
- 2) Be adept in the practical use of the basic application of ArcGIS software
- 3) Have developed an important career-relevant skills in the field of Environmental Science

ENVR 290. Internship in Environmental Science

(Required for all students in the major)

On-site practical experience with an not-for-profit, a company, an institution or other organization or group whose work includes a focus on environmental studies.

Students who successfully complete ENVR 290 will

- 1) Have obtained practical experience relevant to a career in environmental science
- 2) Have had the opportunity to apply theory of the field and put it into practice
- 3) Present their work to the Wells community

ENVR 303. Environmental Impact Assessment

(Required for all students in the major)

An examination of the process that seeks to determine the potential environmental impact of a proposed project. The aims, elements, strengths and limitations of environmental impact assessments will be discussed as they apply to a variety of factors.

Students who successfully complete ENVR 303 will

- 1) appreciate the purpose and role of environmental impact assessment (EIA) in various decision-making processes;
- 2) understand the benefits that EIA brings to environmental management;
- 3) know fundamental aspects of EIA policies on the state and federal level;
- 4) be familiar with the basic steps of EIA and the preparation of environmental impact statements;
- 5) understand the strengths and weaknesses of the EIA process;
- 6) Prepare and deliver oral presentations related to environmental impact assessment.

ENVR 340. Sustainable Agriculture

(Required for all students in the major)

This course will examine the environmental consequences of agriculture as it is practiced today in tropical and temperate regions, and discuss the agroecological basis for tools and techniques designed to address these problems.

Students who successfully complete ENVR 340 will be able to

- 1) Apply ecological principles to agricultural systems;
- 2) Understand the environmental impact of temperate agriculture;
- 3) Become familiar with the environmental impact of tropical agriculture;
- 4) Discuss how government policies affect decisions made by farmers in the United States;
- 5) Describe how the application of ecological principles can be used to reduce the environmental impact of agriculture;
- 6) Prepare and deliver oral presentations related to sustainable agriculture.

ENVR 403. Senior Thesis in Environmental Science

(Required for all students in the major)

Identification of an original topic and development of a senior research paper or alternative project in environmental studies. Preparation and presentation of a paper or project based on independent research and analysis. Work to be conducted in conjunction with a member of the ENVR faculty.

Students who successfully complete ENVR 403 will be able to

- 1) Demonstrate the ability to work independently;
- 2) Conduct library-based or other appropriate research related to the thesis topic;
- 3) Incorporate primary literature into their senior thesis paper;
- 4) Adequately review written work based on revisions suggest by faculty members;
- 5) Demonstrate overall proficiency in writing;
- 6) Prepare and deliver an oral presentation on the thesis;
- 7) Reflect on a variety of different presentation styles and topics by attending science colloquium weekly

MATH 151. Elementary Statistics

Fundamental techniques of applied statistics, descriptive statistics and data analysis, probability, population parameters, hypothesis testing, regression and correlation.

Students who successfully complete MATH 151 will be able to

- 1) describe the techniques of *data analysis* – summarizing and interpreting batches of data, with the aid of models;
- 2) articulate ideas important in the *collection of data* – as in designing experiments and sampling;
- 3) use the concepts and techniques of *statistical inference* – drawing conclusions from a set of data about the world it came from.

BIOL 119L. Ecology & Evolution

(Required for all students in the major)

Organic evolution, the unifying concept in biology, and its relationship with ecology, the distribution and abundance of organisms. The role of ecology and evolution in environmental science and conservation biology

Students who successfully complete BIOL 119L will be able to

- 1) Understand the basic components of the physical environment and describe how they interact to affect the living component of the environment, at multiple scales;
- 2) Understand basic evolutionary concepts, and why they are central to ecology;
- 3) Outline basic world climate patterns, and their importance;
- 4) Outline the pathways energy and nutrients take as they flow through an ecosystem;
- 5) Describe environmental interactions and behavior at the level of the organism, including homeostasis, acclimation, and developmental response;
- 6) Describe how species interact, showing how competition, predation, and co-evolution operate to influence the interdependence of species;
- 7) Describe the concept of the population, including growth and regulators;
- 8) Describe the concept of the community, giving special attention to biodiversity and its role in community well-being;
- 9) Use the scientific method to formulate and test hypotheses, as well as communicate the results with the greater scientific community;
- 10) Have a basic understanding of statistics, and be able to construct, read, and interpret graphs;
- 11) Prepare a research report in the standard style of such reports in the literature of ecology and evolution;
- 12) Understand that the solutions to environmental problems demand both scientific and social understanding.