Assessment Plan

Environmental Science Major

Spring 2017

1. 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.

The mission of the Environmental Science major relates well to the college's mission and 9 student learning goals. Most notably the following key components of the college mission statement resonate well with the program mission statement above: think critically, reason wisely, act humanely; cultivate meaningful lives; community activities; appreciate complexity. Similarly, the following components of the nine college student learning goals resonate well with the program mission statement above: understanding the physical world; depth in field; career preparation; fundamental literacies; critical thinking & application; ethical decision-making; engagement in problem-solving.

2. Environmental Science Program Goals

Five 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: *Investigate basic science and apply it to environmental issues*

GOAL 4: *Examine how the findings of environmental science are used in decision-making about environmental resources*

GOAL 5: *Learn and practice skills that contribute to successful pursuit of a career related to the environment – these skills include writing skills and technological skills as described below*

3. Learning Objectives for the Environmental Science Program

Learning objectives that flow from each of our five broad goals are outlined below.

GOAL 1: Examine the nature of the earth

Objective 1.1: Examine the nature of ecosystems
Objective 1.2: Examine the nature of natural resources
Objective 1.3: Examine the nature of the human-environment interaction

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

GOAL 3: Investigate basic science and apply it to environmental issues

Objective 3.1: Investigate fundamental scientific principles and inquiry in chosen area of specialization
Objective 3.2: Investigate how chosen area of specialization can be applied to environmental concerns

GOAL 4: Examine how the findings of environmental science are used in decision-making about environmental resources

Objective 4.1: Examine environmental policies and how they are developed

Objective 4.2: Examine how interests of various stakeholders interplay with the findings of environmental science

Objective 4.3: Examine how environmental science helps inform priority-setting and decision-making

GOAL 5: Learn and practice skills that contribute to successful pursuit of a career related to the environment

Objective 5.1: Learn and practice quantitative skills

Objective 5.2: Learn and demonstrate technical competency

Objective 5.3: Learn and practice writing skills

Objective 5.4: Learn and practice professional speaking skills

Objective 5.5: Learn and practice research skills

4. Learning Outcomes for the Environmental Science Program

Learning outcomes that correspond to each of our program objectives are outlined below.

GOAL 1: Examine the nature of the earth

Objective 1.1: Examine the nature of ecosystems

Outcome 1.1.1: Display knowledge of major biogeochemical cycles

Outcome 1.1.2: Be able to describe the 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: Demonstrate awareness of 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: Identify 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: Identify global agricultural practices and impacts

GOAL 3: Investigate basic science and apply it to environmental issues

Objective 3.1: Investigate fundamental scientific principles and inquiry in chosen area of specialization

Outcome 3.1.1: Demonstrate knowledge of the laws of nature in biology/chemistry/math & physics

Objective 3.2: Consider how chosen area of specialization can be applied to environmental concerns

Outcome 3.2.1: Articulate understanding of how biology/chemistry/math & physics informs environmental debates

GOAL 4: Examine how the findings of environmental science are used in decision-making about environmental resources

- Objective 4.1: Examine environmental policies and how they are developed
  - *Outcome 4.1.1*: Demonstrate knowledge of current environmental policies
  - *Outcome 4.1.2*: Be able to describe the genesis of major environmental policies
- Objective 4.2: Examine how interests of various stakeholders interplay with the findings of environmental science
  - *Outcome 4.2.1*: Explain nature and role of local and global conservation and environmental groups
- Objective 4.3: Examine how environmental science helps inform priority-setting and decision-making
  - *Outcome 4.3.1*: Describe how environmental science provides a basis for weighing options open to society
  - *Outcome 4.3.2*: Describe how societies can use the metrics of environmental science in decision-making processes

GOAL 5: Learn and practice skills that contribute to successful pursuit of a career related to the environment

- Objective 5.1: Learn and practice quantitative skills
  - *Outcome 5.1.1*: Be able to calculate and apply indices of environmental quality
  - *Outcome 5.1.2*: Show proficiency describing numerical dimensions of environmental issues
  - *Outcome 5.1.3*: Demonstrate competence in statistical approaches to data analyses
- Objective 5.2: Learn and demonstrate technical competency
  - *Outcome 5.2.1*: Demonstrate competency in geographic information systems
  - *Outcome 5.2.2*: Show proficiency in field work and sampling techniques
- Objective 5.3: Learn and practice writing skills
  - *Outcome 5.3.1*: Demonstrate ability to write in a clear, concise, and technically accurate manner
  - *Outcome 5.3.2*: Demonstrate ability to write using the conventions of scientific writing
  - *Outcome 5.3.3*: Demonstrate ability to use and cite literature appropriately
  - *Outcome 5.3.4*: Show proficiency in writing a primary scientific paper
  - *Outcome 5.3.5*: Show proficiency in writing a literature review
- Objective 5.4: Learn and practice professional speaking skills
  - *Outcome 5.4.1*: Show proficiency in preparing and delivering oral presentations
  - *Outcome 5.4.2*: Demonstrate ability to interact with colleagues in a professional manner
- Objective 5.5: Learn and practice research skills
  - *Outcome 5.5.1*: Demonstrate proficiency in using library resources
  - *Outcome 5.5.2*: Demonstrate proficiency in field and lab skills

5. Means of Assessment of Outcomes

Assessment of outcomes is 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. Table 2 specifies how particular elements integrated into required courses serve as assessment tools and allow us to evaluate outcomes. Student work is examined and evaluated throughout each academic year. We determine whether students achieved learning outcomes based on the quality of work completed. The outcome is considered met if 70% of students get a C or higher, and 50% of students get a B or higher. Course goals for each course are included in Appendix 1.

6. Utilization of Assessment Data

Faculty in the Environmental Science major discuss assessment outcomes annually, focusing on the outcomes of the previous academic year. The goal is to determine whether data on student learning suggests that the major's outcomes, objectives and goals are being met, or not. 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 natural resources and environmental issues, and ready to enter career paths in the field.

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

Courses → / Outcomes ↓	ENVR 101L	ENVR 102L	ENVR 131L	ENVR 195	ENVR 290[b]	ENVR 303	ENVR 340	ENVR 403[a]	BIOL 119L	MATH 151
1.1.1	X		X				X		X	
1.1.2	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										
3.2.1								X		
4.1.1	X	X				X				
4.1.2	X	X				X				
4.2.1		X								
4.3.1	X	X				X	X			
4.3.2	X					X				
5.1.1	X	X	X				X			
5.1.2	X	X	X			X	X			
5.1.3			X						X	X
5.2.1	X			X						
5.2.2	X		X						X	
5.3.1	X	X	X			X	X	X	X	
5.3.2	X	X	X			X	X	X	X	
5.3.3	X	X	X			X	X	X	X	
5.3.4	X		X						X	
5.3.5		X	X				X	X	X	
5.4.1	X	X				X	X	X	X	
5.4.2		X			X	X	X		X	
5.5.1		X	X			X	X	X	X	
5.5.2	X		X						X	

[a]Additional outcomes for ENVR 290 and ENVR 403 are highly dependent on nature of the internship and the topic of the thesis, respectively

Table 2. Course elements used to assess student learning outcomes in the Environmental Science major.

Outcomes	Course Elements
1.1.1	ENVR 101L final exam; ENVR 131L final exam;
1.1.2	ENVR 102L final exam
1.2.1	ENVR 101L final exam
1.2.2	ENVR 101L final exam
1.3.1	ENVR 101L final exam; ENVR 102L final exam
1.3.2	ENVR 101L final exam; ENVR 102L final exam
2.1.1	ENVR 101L lab homeworks; ENVR 102L lab discussions; ENVR 131L lab assignments; BIOL 119L lab assignments
2.1.2	ENVR 340 exams
2.2.1	ENVR 101L final exam
2.2.2	ENVR 340 exams
3.1.1	Depends on specialization chosen, and courses chosen within that specialization in other majors
3.2.1	ENVR 403
4.1.1	ENVR 102L final exam; ENVR 303 final exam
4.1.2	ENVR 102L homeworks
4.2.1	ENVR 102L final exam and lab discussions
4.3.1	ENVR 303 homeworks and exams
4.3.2	ENVR 303 exams
5.1.1	ENVR 101L lab homeworks; ENVR 340 exams
5.1.2	ENVR 101L, ENVR 102L and ENVR 340 exams; ENVR 403
5.1.3	MATH 151 exams; BIOL 119L lab assignments and write ups
5.2.1	ENVR 195 tutorial exercises
5.2.2	ENVR 101L lab activities; ENVR 131L lab activities
5.3.1	ENVR 101L lab paper*; research papers in ENVR 102L, ENVR 340; ENVR 403; ENVR 131L term paper
5.3.2	ENVR 101L lab paper*; research papers in ENVR 102L, ENVR 340; ENVR 403; ENVR 131L term paper
5.3.3	ENVR 101L lab paper*; research papers in ENVR 102L, ENVR 340; ENVR 403; ENVR 131L term paper
5.3.4	ENVR 101L lab paper*; BIOL 119L lab report
5.3.5	Research papers in ENVR 102L, ENVR 340; ENVR 403; ENVR 131L term paper
5.4.1	Presentations in ENVR 101L, ENVR 102L, ENVR 303, ENVR 340, ENVR 403
5.4.2	Participation in ENVR 102L labs and in ENVR 340 fields trips
5.5.1	Research Papers in ENVR 102L, ENVR 340; ENVR 403
5.5.2	ENVR 101L lab activities; ENVR 131L lab activities; BIOL 119L lab activities

*See associated checklist in Appendix 2

APPENDIX 1. Course Descriptions and Course Goals for Courses 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 401. Advanced Research in Environmental Science
(Optional course for seniors in the major)
Independent work on research of student's own design. Opportunity to direct and execute field or lab research and gain experience sharing primary research.

Students who successfully complete ENVR 401 will be able to
1) Conduct appropriate research related to the chosen topic;
2) Demonstrate the ability to work independently;
3) Effectively communicate research findings in written form;
4) Revise written work based on feedback received.

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

APPENDIX 2. Checklist Guidelines for Lab Paper on Corn Study – ENVR 101L

TITLE PAGE

- ❑ Title describes nature and scope of study
- ❑ Title includes reference to where and when study conducted

INTRODUCTION

- ❑ Introduction sets stage for study
- ❑ Definitions of GPP and NPP are included in own words
- ❑ Value of knowing NPP and measuring ecosystem characteristics is described
- ❑ Latin name of corn (*Zea mays*) included parenthetically after the common name the first time the species is mentioned in the introduction
- ❑ Introduction ends with the specific goals of the study

MATERIALS AND METHODS

- ❑ Complete information on how the study was done
- ❑ Past tense and active voice used
- ❑ Sample size (number of groups) included

RESULTS

- ❑ Five histograms
  - Each histogram has labeled axes
  - Each histogram has a descriptive caption below it
  - Figures are numbered consecutively, Figure 1 through Figure 5, as part of the caption
- ❑ Table
  - Includes correct means and standard deviations for 5 variables, each with appropriate units
  - Descriptive caption above table, caption starts with "Table 1."
- ❑ Narrative
  - Brief description of results as evident in the figures and table
  - Narrative includes reference to figures and table by number
- ❑ Calculations
  - Step by step calculations of net primary productivity (NPP)
  - NPP value accurate and presented with appropriate units

DISCUSSION

- ❑ Statements addressing spread of variables. Discuss which variables showed the most spread? Which showed the least? Why might this be?
- ❑ Reference to figures and table by number to support statements
- ❑ Comparison of calculated NPP with that of other ecosystems – use data in Figure 3.28 in your textbook.
- ❑ Citation of textbook using APA style
- ❑ Consideration of whether or not GPP can be calculated from data. Why or why not?

LITERATURE CITED

- ❑ APA citation style
- ❑ Complete citation

PAPER OVERALL

- ❑ Paper is divided into sections, each with a section title
- ❑ Paper is well-written and proofread
- ❑ Writing style is clear and concise
- ❑ Scientific tone and scientific vocabulary are used
- ❑ Use of own words
- ❑ Pages numbered
- ❑ Paper stapled