Term Information

Effective Term	Summer 2017
Previous Value	*Summer 2012*

Course Change Information

What change is being proposed? (If more than one, what changes are being proposed?)

To make EEOB 1930 a General Education course.

What is the rationale for the proposed change(s)?

As an introduction to biological sciences course, it was designed to reach students of different areas of study. By having the Gen. Ed. designation, it will formally allow non-major students to fulfill their graduation requirements.

What are the programmatic implications of the proposed change(s)?

(e.g. program requirements to be added or removed, changes to be made in available resources, effect on other programs that use the course)?

Minimal changes are necessary to this course. Upon reviewing the general education guidelines for the Expected Learning Outcomes of a Natural Science - Biological Science course, the course currently strives to achieve these outcomes. As a Gen. Ed. course, it will be directly conveyed to the students that these are the goals of the course, and how those learning outcomes will be achieved.

Is approval of the requrest contingent upon the approval of other course or curricular program request? No

Is this a request to withdraw the course? No

General Information

Course Bulletin Listing/Subject Area	Evol, Ecology & Organismal Bio
Fiscal Unit/Academic Org	Evolution, Ecology & Org Bio - D0390
College/Academic Group	Arts and Sciences
Level/Career	Undergraduate
Course Number/Catalog	1930
Course Title	Introduction to Biological Studies - Aquatic Biology (Stone Lab)
Transcript Abbreviation	Intro Aq Biol SL
Course Description	An introduction to the organisms of the ecosystem in freshwater aquatic environments. 1-wk course available summer session at Stone Lab.
Semester Credit Hours/Units	Fixed: 2

Offering Information

Length Of Course	12 Week, 8 Week, 6 Week, 4 Week
Previous Value	*12 Week, 8 Week, 7 Week, 6 Week, 4 Week*
Flexibly Scheduled Course	Always
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Field Experience, Laboratory, Lecture
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never

Campus of Offering	Columbus
Previous Value	*Columbus, Lima, Mansfield, Marion, Newark*

Prerequisites and Exclusions

Prerequisites/Corequisites	Prereq: Completion of high school Biology course.
Exclusions	Not open to students with credit for 125.

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	26.1304
Subsidy Level	General Studies Course
Intended Rank	Freshman, Sophomore, Junior, Senior

Requirement/Elective Designation

General Education course:

Biological Science

The course is an elective (for this or other units) or is a service course for other units

Previous Value

The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes

- Students will understand the basic biological and ecological principles associated with freshwater ecosystems
- Students will understand key events in the development of science, exploring the history of taxonomic classifications, improvements of sampling equipment and technology
- Students will describe the interdependence of scientific and technological developments with the opportunity to collect, identify and analyze biological scientific data using a variety of traditional and modern techniques and tools
- Students will recognize implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world by discussing human impacts on aquatic communities

Previous Value

Content Topic List

- Properties of water
- Biological terms and concepts as applied to the aquatic environment
- Basic collection and sampling methods
- Aquatic organisms and identification
- Aquatic food webs
- Basic aquatic ecology

Attachments

- GE Rationale - expected learning outcomes - Intro Aquatic Bio.docx

  (GEC Model Curriculum Compliance Stmt. Owner: Burbacher,Emily Ann)

- EEOB 1930 Proposed GE Sylabus.docx

  (Syllabus. Owner: Burbacher,Emily Ann)

- GE Doc 5 - Assessment Plan - Expected Learning Outcomes - Intro to Aquatic Bio.pdf

  (GEC Course Assessment Plan. Owner: Burbacher,Emily Ann)

- GE Doc 5- Assessment plan updated March 2017.docx: Updated Version given revision request

  (GEC Course Assessment Plan. Owner: Burbacher,Emily Ann)

- EEOB 1930 Proposed GE Sylabus v2.docx: Updated Version, minor revisions

  (Syllabus. Owner: Burbacher,Emily Ann)

Comments

- See 3-10-17 e-mail to N Johnson. *(by Vankeerbergen,Bernadette Chantal on 03/10/2017 03:40 PM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Burbacher,Emily Ann	12/16/2016 11:09 AM	Submitted for Approval
Approved	Johnson,Norman F	02/22/2017 10:19 AM	Unit Approval
Approved	Fink,Steven Scott	02/22/2017 10:53 AM	College Approval
Revision Requested	Vankeerbergen,Bernadette Chantal	03/10/2017 03:40 PM	ASCCAO Approval
Submitted	Burbacher,Emily Ann	03/28/2017 11:20 AM	Submitted for Approval
Approved	Johnson,Norman F	04/14/2017 08:10 AM	Unit Approval
Approved	Haddad,Deborah Moore	04/14/2017 07:17 PM	College Approval
Pending Approval	Nolen,Dawn Vankeerbergen,Bernadette Chantal Hanlin,Deborah Kay Jenkins,Mary Ellen Bigler	04/14/2017 07:17 PM	ASCCAO Approval

The Ohio State University
Summer 2017

EEOB 1930: Introduction to Biological Studies - Aquatic Biology

Instructor Name, Email, Phone, Office Hours/location

Teaching Assistant Name, Email, Phone

Course Logistics
Sunday - Saturday, 7:00 AM - 9:00 PM; Stone Laboratory Classroom Building

Course Format
2 semester credit hours consisting of lecture, field work and laboratory time

This one-week, residential course immerses students in place-based learning from morning to night. Lectures and most lab work take place in classrooms at The Ohio State University's Stone Laboratory. Field work takes students to into creeks, streams, ponds, estuaries, and the open lake.

Course Description

EEOB 1930 introduces students to the components of freshwater ecosystems through experiential learning at The Ohio State University's Stone Laboratory. The course provides students with experiences in field and laboratory procedures while providing basic knowledge of biological and ecological principles in freshwater ecosystems. Overarching goals of the course include (1) classifying inland waters, (2) identifying the main structural components of aquatic ecosystems, (3) describing the general functioning of aquatic ecosystems, (4) identifying invertebrates, plants, and fish associated with different aquatic communities, and (5) discussing human impacts on aquatic communities.

Students learn common organisms associated with various aquatic ecosystems (e.g., large lakes, cold water streams, warm water streams, and warm water pond ecosystems) along with a description of each ecosystem's key features. They also gain a basic understanding of the properties of water, the physiochemical characteristics of lakes (i.e., relationship between physical, chemical, and biological aspects of aquatic habitats), lake seasonal dynamics, stream classification, and nutrient dynamics. Field and laboratory work are designed to enhance and reinforce major concepts discussed in lectures. Field trips will involve gathering physical and biological data from open lake research vessels; using a variety of methods to sample and identify plankton, macroinvertebrates, plants and fish from streams, estuaries and shallow bays; and experience with multiple types of lab equipment to analyze and draw conclusions related to water quality.

General Education Alignment VII.B.9 Natural Science (Biological Science)

Expected Learning Outcomes (ELO):
As an introductory course, *Introduction to Biological Studies - Aquatic Biology* satisfies the ELOs by building on many concepts of science education standards: patterns, cause and effect, systems and systems models, energy and matter, structure and function, and stability and change.

1. Students understand the basic facts, principles, theories and methods of modern science.
    - Students learn basic biological and ecological principles associated with freshwater ecosystems including, but not limited to: physical properties of water; lake types, formation, and classification; water chemistry; seasonal lake dynamics; identification techniques and strategies and classification of major taxa of local aquatic flora and fauna (phytoplankton, zooplankton, mollusks, macroinvertebrates, fish)
2. Students understand key events in the development of science and recognize that science is an evolving body of knowledge.
    - Students will explore the history of taxonomic classifications, improvements of sampling equipment and technology, and understand how science is helping to foster informed and responsible decision making
3. Students describe the interdependence of scientific and technological developments.
    - Students will collect, identify, and analyze biological scientific data using a variety of traditional and modern techniques and tools. These include, but are not limited to: kick seines, Ekman dredges, trawl nets, D-ring nets, dip nets, trap nets, electro-fishing, sifting seines, snorkels, microscopes, dissecting scopes, dichotomous keys, dissection protocols, and sketch techniques.
    - Students will have the opportunity to collect, identify and analyze physical and chemical scientific data using a variety of traditional and modern techniques and tools. These include, but are not limited to: light meters, lead lines, depth finders, YSI sondes that include temperature and dissolved oxygen probes, Secchi disks, and colorimeters.
4. Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.
    - Students will be able to describe the general functioning of aquatic ecosystems and discuss human impacts on aquatic communities
    - Students will gain Great Lakes literacy, understanding the characteristics, functioning, and value of the Great Lakes, so they can communicate about and make informed decisions regarding the resources of their watershed.

Course Materials

The Biology of Lakes and Ponds. 2005. Christer Bronmark and Lars-Anders Hansson. ISBN: 0-19-851613-4. Oxford University Press

Specimen collection containers and other field supplies can be purchased at Stone Laboratory as needed.

Course Outline

Day	Time	Description	Readings
Sunday	4:00p - 5:00p	Orientation: Introduction to Stone Laboratory	
	5:00p - 6:00p	Dinner	
	6:30p - 7:30p	Course introduction and ***Lecture I***: Properties of water, lake formation, and lake classification	Pgs. 1-6, 11-15, 24-31
Monday	7:00 - 7:45a	Breakfast	
	8:00 - 9:00a	Finish ***Lecture I***: Properties of water, lake formation, and lake classification	
	9:00 - 12:00p	***Field Trip***: Lake sampling aboard the *R/V Gibraltar III* (Record physical attributes of the lake and collect phytoplankton, zooplankton, benthic macroinvertebrates, and fish for later identification)	
	12:00 - 12:45p	Lunch	
	1:00 - 2:00p	***Lecture II***: Prokaryotes, phytoplankton and zooplankton	Pgs. 66-92; stop at mysids
	2:00 - 5:00p	**Lab**: How to use a microscope and examination of organisms collected from *R/V Gibraltar III*	
	5:00 - 6:00p	Dinner	
	6:15 - 8:00p	Microscope work continued and ***Field Trip***: Macroinvertebrate sampling and seining around Gibraltar Island and Terwilliger's pond on South Bass Island	
	8:00 - 9:00p	***Lecture III***: QHEI and Sampling Techniques	
Tuesday	7:00 - 7:30a	Breakfast	
	7:30 - 4:30p	Field Trip: Mainland rivers (sack lunches)	
	5:00 - 6:00p	Dinner	
	6:00 - 7:00p	***Lecture IV***: Macroinvertebrate ecology and identification and how to use a dichotomous key	Pgs. 92 - 102; up to fish
	7:00 - 7:30p	***Quiz I***	
	7:30 - 9:00p	***Lab***: Macroinvertebrate and Fish ID	
Wednesday	7:00 - 7:45a	Breakfast	
	8:00 - 8:30a	***Quiz II***	
	8:30 - 9:30a	***Lecture V***: Physiochemical characteristics of lakes	Pgs. 32-65
	9:30 - 11:00a	***Lab***: Open lab; continue to examine plankton, invertebrates and fish	
	11:00 - 12:00p	***Lecture VI***: Fish identification	Pgs. 101-102
	12:00 - 12:45p	Lunch	
	1:00 - 5:00p	***Field Trip***: Shock boat near Gibraltar Island and South Bass	
	5:00 - 6:00p	Dinner	
	6:00 - 7:30p	***Field Trip:*** Snorkel and Seine around Gibraltar Island	
	7:30 - 8:30p	***Lecture VII***: Seasonal lake dynamics	Pgs. 16-18
	8:30 - done	Work on assignments	

Thursday	7:00 - 7:30a 7:30 - 4:30p 5:00 - 6:00p 6:00 - 7:00p 7:00 - 7:45p 8:00 - 9:00p	Breakfast ***Field Trip***: Mainland Rivers (sack lunch) Dinner ***Lecture VIII***: Lotic systems and the stream continuum concept ***Research Lecture*** ***Guest Lecture***	
Friday	7:00 - 7:45a 8:00 - 8:30a 8:30 - 11:45p 12:00 - 12:45p 1:00 - 2:00p 2:00 - 5:00p 5:00 - 6:00p 6:00 - 6:30p 6:30 - done	Breakfast ***Quiz III*** ***Field Trip***: Lake sampling aboard the *R/V Gibraltar III* to collect additional plankton, macroinvertebrate, and fish samples Lunch ***Lecture IX***: Current environmental threats ***Lab***: Open Lab Dinner ***Quiz VI*** Open Review	Pgs. 235-250
Saturday	7:00 - 7:45a 8:00 - 9:00a 9:00 - 10:00a 10:00 - 12:00p	Breakfast Open Review **Laboratory Practical** **Final Exam**	

Major Assignments

Daily Assignments: You will receive written assignment based on laboratory activities for this course. Assignments may include, but are not limited to, graphing data or theoretical relationships, data analysis, and critical thinking questions based on information gained during lecture, lab, or fieldwork during this course.
Quizzes: A written quiz consisting of 10-15 short answer, multiple choice, true and false, and/or fill-in-the-blank style questions. You will be tested on material covered in lectures and the textbook readings.
Group Project: You will be required to complete **one** of the following as outlined by your instructor: a) Group Presentation - Students will work with a partner to give a presentation about a Great Lake species of their choice or an issue that negatively affects Great Lakes water quality or b) Group Specimen Collection - At least seven phyla need to be present in your group collection consisting of at least 60 different species; i.e., 60 organisms. Detailed instructions on both projects will be handed out at the beginning of the course.
Laboratory Practical: An hour-long examination with questions pertaining to organism identification, structure, and function, performance-based assessments on microscope usage and sampling techniques, and other questions as decided by your instructor on material covered during the lab and field components of this course.
Final Exam: A two-hour long written exam consisting of essay, short answer, multiple choice, true and false, and/or fill-in-the-blank style questions. You will be tested on material covered in lectures and the textbook readings. The final exam will have some questions similar to your quizzes, but will also include more in-depth critical thinking questions.

Grading Information

Daily assignments based on class activities	10%
Quizzes (four, announced)	20%
Group Project	30%

Written Lab Practical	20%
Written Final Exam	20%

Grading Scale

90-100%	A
80-89%	B
70-79%	C
60-69 %	D
<60%	E

Attendance Policy

Students are expected to actively participate in all class sessions, including lectures, fieldwork and laboratory time.

Academic Misconduct

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed: illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/csc/.

Disability Services

Students with disabilities (including mental health, chronic or temporary medical conditions) that have been certified by the Office of Student Life Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office of Student Life Disability Services is located in 098 Baker Hall, 113 W. 12th Avenue; telephone 614-292-3307, slds@osu.edu; slds.osu.edu.

The Ohio State University
Summer 2017

EEOB 1930: Introduction to Biological Studies - Aquatic Biology

Goals: Students understand the principles, theories, and methods of modern science, the relationship between science and technology, the implications of scientific discoveries and the potential of science and technology to address problems of the contemporary world.

Expected Learning Outcomes of Course Objectives

1. Students understand the basic facts, principles, theories and methods of modern science.
    a. Students learn basic biological and ecological principles associated with freshwater ecosystems including, but not limited to: physical properties of water; lake types, formation, and classification; water chemistry; seasonal lake dynamics; identification techniques and strategies and classification of major taxa of local aquatic flora and fauna (phytoplankton, zooplankton, mollusks, macroinvertebrates, fish)

2. Students understand key events in the development of science and recognize that science is an evolving body of knowledge.
    a. Students will explore the history of taxonomic classifications, improvements of sampling equipment and technology, and understand how science is helping to foster informed and responsible decision making

3. Students describe the inter-dependence of scientific and technological developments.
    a. Students will collect, identify, and analyze biological scientific data using a variety of traditional and modern techniques and tools. These include, but are not limited to: kick seines, Ekman dredges, trawl nets, D-ring nets, dip nets, trap nets, electro-fishing, sifting seines, snorkels, microscopes, dissecting scopes, dichotomous keys, dissection protocols, and sketch techniques.
    b. Students will have the opportunity to collect, identify and analyze physical and chemical scientific data using a variety of traditional and modern techniques and tools. These include, but are not limited to: light meters, lead lines, depth finders, YSI sondes that include temperature and dissolved oxygen probes, Secchi disks, and colorimeters.

4. Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.
    a. Students will be able to describe the general functioning of aquatic ecosystems and discuss human impacts on aquatic communities
    b. Students will gain Great Lakes literacy, understanding the characteristics, functioning, and value of the Great Lakes, so they can communicate about and make informed decisions regarding the resources of their watershed.

Expected Learning Outcomes of Readings

1. Students understand the basic facts, principles, theories and methods of modern science.
    a. Through the readings, students learn basic biological and ecological principles associated with freshwater ecosystems, including physical properties of water; lake types, formation, and classification; water chemistry; seasonal lake dynamics; identification techniques and strategies and classification of major taxa of local aquatic flora and fauna (phytoplankton, zooplankton, mollusks, macroinvertebrates, fish)

2. Students understand key events in the development of science and recognize that science is an evolving body of knowledge.
    a. Students will explore the history of taxonomic classifications in the course readings, and further recognize how science is helping to foster informed and responsible decision making.

3. Students describe the inter-dependence of scientific and technological developments.
    a. With assigned readings, students will discuss the recent developments of understanding the effects of human-induced environmental threats, like global climate change.

4. Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.
    a. With the readings, students will be able to describe the general functioning of aquatic ecosystems and discuss human impacts on aquatic communities
    b. With assigned readings and course field trips, students will gain Great Lakes literacy, understanding the characteristics, functioning, and value of the Great Lakes, so they can communicate about and make informed decisions regarding the resources of their watershed.

Expected Learning Outcomes of Course Topics

1. Students understand the basic facts, principles, theories and methods of modern science.
    a. With the topics emphasized in this course, students learn basic biological and ecological principles associated with freshwater ecosystems including, but not limited to: physical properties of water; lake types, formation, and classification; water chemistry; seasonal lake dynamics; identification techniques and strategies and classification of major taxa of local aquatic flora and fauna (phytoplankton, zooplankton, mollusks, macroinvertebrates, fish)

2. Students understand key events in the development of science and recognize that science is an evolving body of knowledge.
    a. Many topics of this course will explore the history of taxonomic classifications, improvements of sampling equipment and technology, and understand how science is helping to foster informed and responsible decision making

3. Students describe the inter-dependence of scientific and technological developments.
    a. Students will collect, identify, and analyze biological, physical, and chemical scientific data using a variety of traditional and modern techniques and tools, as a part of key topics of this course.
    b. Students will discuss the recent developments of understanding the effects of human-induced environmental threats, like global climate change.

4. Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.
    a. Students will be able to describe the general functioning of aquatic ecosystems and discuss human impacts on aquatic communities
    b. Students will gain Great Lakes literacy, understanding the characteristics, functioning, and value of the Great Lakes, so they can communicate about and make informed decisions regarding the resources of their watershed.

Expected Learning Outcomes of Course Assignments

1. Students understand the basic facts, principles, theories and methods of modern science.
    a. Students will understand and be able to describe basic biological and ecological principles associated with freshwater ecosystems including, but not limited to: physical properties of water; lake types, formation, and classification; water chemistry; seasonal lake dynamics; identification techniques and strategies and classification of major taxa of local aquatic flora and fauna (phytoplankton, zooplankton, mollusks, macroinvertebrates, fish)

2. Students understand key events in the development of science and recognize that science is an evolving body of knowledge.
    a. Students will explore the history of taxonomic classifications, improvements of sampling equipment and technology, and think critically about how science is helping to foster informed and responsible decision making

3. Students describe the inter-dependence of scientific and technological developments.
    a. Students will collect, identify, and analyze biological scientific data using a variety of traditional and modern techniques and tools. These include, but are not limited to: kick seines, Ekman dredges, trawl nets, D-ring nets, dip nets, trap nets, electro-fishing, sifting seines, snorkels, microscopes, dissecting scopes, dichotomous keys, dissection protocols, and sketch techniques.
    b. Students will collect, identify and analyze physical and chemical scientific data using a variety of traditional and modern techniques and tools. These include, but are not limited to: light meters, lead lines, depth finders, YSI sondes that include temperature and dissolved oxygen probes, Secchi disks, and colorimeters.
    c. Students will discuss the recent developments of understanding the effects of human-induced environmental threats, like global climate change.

4. Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.

a. Students will be able to describe the general functioning of aquatic ecosystems and discuss human impacts on aquatic communities
b. Students will gain Great Lakes literacy, understanding the characteristics, functioning, and value of the Great Lakes, so they can communicate about and make informed decisions regarding the resources of their watershed.

Expected Learning Outcomes of Other Course Components

1. Students understand the basic facts, principles, theories and methods of modern science.
    a. In the field, students learn and explore the basic biological and ecological principles associated with freshwater ecosystems including, but not limited to: physical properties of water; lake types, formation, and classification; water chemistry; seasonal lake dynamics; identification techniques and strategies and classification of major taxa of local aquatic flora and fauna (phytoplankton, zooplankton, mollusks, macroinvertebrates, fish)

2. Students understand key events in the development of science and recognize that science is an evolving body of knowledge.
    a. In the field and laboratory, students will explore the improvements of sampling equipment and technology, and understand how science is helping to foster informed and responsible decision making

3. Students describe the inter-dependence of scientific and technological developments.
    a. In the field and laboratory, students will collect, identify, and analyze biological scientific data using a variety of traditional and modern techniques and tools. These include, but are not limited to: kick seines, Ekman dredges, trawl nets, D-ring nets, dip nets, trap nets, electro-fishing, sifting seines, snorkels, microscopes, dissecting scopes, dichotomous keys, dissection protocols, and sketch techniques.
    b. In the field and laboratory, students will have the opportunity to collect, identify and analyze physical and chemical scientific data using a variety of traditional and modern techniques and tools. These include, but are not limited to: light meters, lead lines, depth finders, YSI sondes that include temperature and dissolved oxygen probes, Secchi disks, and colorimeters.

4. Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.
    a. From experience in the field as well as course readings, students will be able to describe the general functioning of aquatic ecosystems and discuss human impacts on aquatic communities
    b. Students will gain Great Lakes literacy, understanding the characteristics, functioning, and value of the Great Lakes, so they can communicate about and make informed decisions regarding the resources of their watershed.

GE Assessment Plan, EEOB 1930, Introduction to Biological Studies – Aquatic Biology

Expected Learning Outcomes	*Methods of Assessment*	*Expected student achievement*
1. Students understand the basic facts, principles, theories and methods of modern science.	Embedded questions in quizzes that ask students to identify and explain basic biologic principles associated with freshwater ecosystems discussed in class and explored in the field.[1]	Direct: At least 75% of the class receives scores of 3 or higher on the embedded grading rubric. Indirect: At least 75% of students will choose "agree" or "strongly agree" to describe their experience in the course.
2. Students understand key events in the development of science and recognize that science is an evolving body of knowledge.	Embedded questions in the quizzes and final exam that ask students to identify recent changes in technology and methodology that have led to better decision making in research and resource management.[1]	Direct: At least 75% of the class receives scores of 3 or higher on the embedded grading rubric. Indirect: At least 75% of students will choose "agree" or "strongly agree" to describe their experience in the course.
3. Students describe the inter-dependence of scientific and technological developments.	Embedded questions in the Laboratory Practical requiring students to identify and explain the progression of sampling technology, and this relates to an improved understanding of aquatic ecosystems.[1]	Direct: At least 75% of the class receives scores of 3 or higher on the embedded grading rubric. Indirect: At least 75% of students will choose "agree" or "strongly agree" to describe their experience in the course.
4. Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.	Assessment of final presentation or group project, requiring students to investigate contemporary environmental concerns, specifically in regards to native and non-native aquatic organisms.[2]	Direct: At least 75% of the class receives an average score of 3 or higher on the embedded grading rubric. Indirect: At least 75% of students will choose "agree" or "strongly agree" to describe their experience in the course.

Student self-evaluation will also provide an indirect method of assessing all 4 of expected learning outcomes.[3]

[1]For example questions and the scoring rubric, see Appendix A.
[2]A rubric will be used to score the final presentations. See Appendix B.
[3]Students will be asked to complete a self-evaluation that includes questions addressing the GE ELOs in this course. See Appendix C.

Follow-up and feedback process:
The results from the rubrics assessing direct and indirect measures of both ELOs will be evaluated through the week and as a whole at the end of the course, and forwarded to the Undergraduate Studies Committee for review. If the results suggest a particular weakness or strength in the course, it will be revised to address the need for improvement or to extend its successful components. Results will be archived digitally in the departmental Undergraduate Studies files.

Appendix A:

Sample questions to be embedded in quizzes, laboratory practical, and final exam with scoring rubrics.

ELO 1

- Example 1: Give three of the four reasons why we should study macroinvertebrates.
- Example 2: Compare and contrast Lake Erie and Lake Superior in terms of their land use (i.e., how does percent agriculture and percent forest differ in the two watersheds). What impacts to these differences have on lake trophic status (oligo- versus eutrophic)? Finally, how does productivity influence fish abundance (i.e., which lake has high fish abundance and which one has low) and why is this the case?

Scoring Rubric

1	2	3	4	5
Answer shows little understanding or knowledge -Missing majority of key variables -Variables identified are not relevant	Answer shows flawed understanding -Missing some key variables, or some variables mentioned are not relevant	Answer shows adequate understanding of topic -Some key variables or topics are identified, but contains flawed understanding -Portion of response is too general	Answer shows good understanding topic -Key concepts and variables are identified -Only minor variable missing	Answer shows excellent understanding of topic -All key variables are clearly identified with robust explanations as needed.

ELO 2

- Example: With your experience in this class (shore line and boat sampling with various equipment), identify modern changes in aquatic sampling technology and methodology that have led to better decision making in research and resource management.

Scoring Rubric

1	2	3	4	5
Answer shows little understanding or knowledge -Missing more than half of key variables -Variables identified are not relevant	Answer shows flawed understanding -Missing less than half of key variables, or some variables mentioned are not relevant	Answer shows adequate understanding of topic -Majority of key variables or topics are identified, but contains flawed understanding -Portion of response is too general	Answer shows good understanding topic -Key concepts and variables are identified -Only minor variable missing or very minor flawed understanding	Answer shows excellent understanding of topic -All key variables are clearly identified with robust explanations as needed.

ELO 3

- Example: Identify the aquatic sampling equipment here [2 or more; actual equipment present in lab or photo provided]. Explain their similarities, describe the advancement of the technology, and how this improvement has further enhanced our understanding of these systems.

Scoring Rubric

1	2	3	4	5
Answer shows little understanding or knowledge -Very few or no key variables are identified -Variables identified are not relevant	Answer shows flawed understanding -Missing some key variables, or variables mentioned are not relevant	Answer shows adequate understanding of topic -Some key variables or topics are identified, but contains flawed understanding -Portion of response is too general	Answer shows good understanding topic -Key concepts and variables are identified -Only minor variable missing or very minor flawed understanding	Answer shows excellent understanding of topic -All key variables are clearly identified with robust explanations as needed.

Appendix B

Rubric for assessment of presentations/group project

	1	2	3	4
Description of basic biological information: name, distribution, habitat, diet	Presentation missing basic information flawed understanding -Missing key variables, or some variables mentioned are not relevant	Answer shows adequate understanding of topic -Some key variables or topics are identified, but contains flawed understanding -Portion of response is too general	Answer shows good understanding topic -Key concepts and variables are identified -Only minor variable missing	Answer shows excellent understanding of topic -All key variables are clearly identified with robust explanations as needed.
Analysis of ecological concern: interactions with native species, remedial efforts	Very few or no examples ecological concern, issues mentioned are not relevant, no discussion of broader impacts	Few concerns are listed, but little discussion of broader impacts or remedial efforts	Some concerns are listed, with an attempt at discussion of broader impacts and remedial efforts	Numerous concerns are discussed with adequate examples of broader impacts and through discussion of remedial efforts.

Appendix C

Student Learning Self-Evaluation

As a result of this course I…..	Strongly disagree	Disagree	Agree	Strongly agree
have gained a better understanding of basic facts, principles, and methods of modern science.				

Please explain your answer:

As a result of this course I…..	Strongly disagree	Disagree	Agree	Strongly agree
have gained a better understanding of the developments in technology and methodology and the advancement of aquatic science.				

Please explain your answer:

As a result of this course I…..	Strongly disagree	Disagree	Agree	Strongly agree
have a better understanding of the inter-dependent relationship between technological and scientific advancements				

Please explain your answer:

As a result of this course I…..	Strongly disagree	Disagree	Agree	Strongly agree
have a better understanding of how scientific discoveries can affect human decision making and behavior, especially with modern environmental concerns				

Please explain your answer: