Making Ecology Local: Engaging your students in environmental issues and biology

Georgianna Saunders and Sarah Dewey

Department of Biology
Southwest Missouri State University
901 S. National
Springfield MO 65804

gls294f@smsu.edu 417-836-6468

sarahdewey@smsu.edu 417-836-6468

Georgianna Saunders teaches biology courses for pre-service and in-service teachers. She has been leading the transition to guided inquiry-based labs for nonmajors. Her current areas of research include how instructors learn to teach science and how to teach about controversial issues in biology. Dr. Saunders received her doctorate in education from University of Oklahoma.

Sarah Dewey is the laboratory supervisor for the nonmajors biology courses. She supervises and mentors 8-10 Master-level graduate students in teaching 30 lab sections of nonmajors biology. Ms. Dewey designs and implements the lab activities. Ms. Dewey received her Master of Science degree from the University of Miami.

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Introduction

Often ecology education focuses on situations that are far removed from the student's life, such as tropical rainforest destruction and the ozone hole over Antarctica. While these are important issues, they can leave people with a feeling of hopelessness and lack of empowerment. By linking biology laboratories to local environmental issues, we hope to provide students with opportunities to become involved with public affairs while they are learning key ecological concepts.

Our objectives for this project are to engage students in learning about biology; to recognize biological issues in local, current events; to encourage students to find a connection between biology and their lives; and to promote awareness of the political and social component of biology.

Project Overview

Ecology with a local emphasis was themed throughout our nonmajor biology laboratory course. The students select topics for the semester-long project. Students work in small groups to research the issues, propose solutions, and present their findings during a lab meeting. At the culminating lab meeting, teams present the topic to their peers using either a poster or PowerPoint presentation.

Assignments throughout the semester keep the students on track. A timeline of these assignments is in the front of the lab manual. Each assignment is inserted immediately before the lab meeting that it is due. The assignments are a vehicle for feedback. The laboratory instructors review the teams' thinking and research, and provide suggestions to the teams on where to go for more information. The teams are given the opportunity to revise their assignment and resubmit it. In this manner, we encourage students to strive for better communication of their ideas.

Procedures

At the third lab meeting of the semester, students are required to submit a recent article on a local environmental issue and a summary of it (worth 5 points out of a total 300 points possible in lab and 800 points for both the lab and lecture). Students have web access to a list of possible topics and contacts (Figure 1). During lab, students briefly describe their article to each other. Students are then encouraged to form a team, based on the environmental topic, sharing the same lecture section, or prior friendships. Once a team is formed, they sign a contract with each other, share contact information and select a meeting time with their lab instructor. (See Appendix 1 for a summary of the assignments.) At the meeting of the team with the lab instructor, the team finalizes their environmental topic, discusses the direction and scope of their project with the instructor, and receives feedback on their first assignment.

The next assignment requires the team to do further research into the subject, summarize the information, identify stakeholders, and describe the impact on the local ecosystem (worth 10 points). The environmental topics generally fall into three major categories: community issues, organisms in trouble, and ecosystems in trouble.

The students have to identify the causes of their problem in Assignment 3 (worth 5 points). Teams analyze the evidence, evaluate different perspectives, make conclusions and evaluate the reliability of their sources.

Students then develop recommendations to correct the problems (worth 5 points). Sometimes the solutions are already under consideration or implementation, but many times the teams develop innovative ideas. For instance, students suggested that we build channels to connect dammed lakes to their streams. Their goal was to produce proper habitat for freshwater mussels that are going extinct locally. Students must also consider the costs -- not only monetary, but also political and societal -- of implementing their solutions.

During the Environmental Conference Lab meeting, students present their findings to their peers. They are assessed as a team on their verbal presentation (including any PowerPoint or overheads, worth 15 points) and a written presentation in the form of a poster or brochure (worth 20 points). The rubric for these assessments is in their lab manual (See Appendix 2). While teams are

presenting, the rest of the class also assesses their report and selects the top two teams. The top two teams receive a few bonus points.

After the lab, team members assess the contributions of the other team members using the Peer Evaluation form. This form is in their lab manual. The lab instructor averages the scores from the team members (worth 5 points). (In Appendix 2.)

Individual knowledge is assessed in a quiz the week after the Environmental Conference. The final exam contains higher thinking-order questions concerning their environmental topic. In total, the environmental conference project is worth 60 points out of 300 points available in lab.

Student Benefits

Students can achieve the following benefits from the Environmental Conference Project:

1. Practice using written and oral communication skills.
2. Using constructive feedback from their laboratory instructor and opportunities to improve their work. This type of non-evaluative feedback is difficult to accomplish in the large lecture sections of the course.
3. An opportunity to use their talents and interests, even though they are not necessarily science-oriented. For example, political-science majors have investigated issues of habitat loss due to urban development.
4. An appreciation for the possibility that there may not be a single solution that is best for both the health of the environment and people's lives and livelihoods. The students are often very interested in the social and political aspects of the environmental issues.
5. Increased exposure to the varied careers that require knowledge of science. Students have to seek information from a variety of resources about their environmental issue and so interact with many different people in the university and community.
6. Experience in utilizing the campus research tools, campus computer services, and other university services.

Challenges to This Project and a Few Solutions

The laboratories serve three different lecture sections, each with its own schedule. This makes it difficult to have concordance between the lab and lecture content. In addition, we have students from different lecture sections combined into the same lab section. Therefore, we cannot assume that relevant biological concepts have been addressed in lecture.

Most of the laboratory instructors are master-level graduate students, often with little or no teaching experience. The university provides one day of training and we give two more days of training prior to the beginning of the semester. In addition, we use the lab meetings to discuss teaching strategies and methods throughout the semester. Lab instructors are encouraged to share their research interests with their students and to identify similarities between their own research and the teams' projects. For instance, one lab instructor told his class of how he made a research poster and presented it at a national conference.

Since our lab periods are only one hour and fifty minutes long, much of the environmental conference group work must be done outside of lab. This can be difficult for students, since many live off campus and hold jobs. We encourage team members to use email to communicate with each other.

In order to further integrate the environmental issues into the lab, the fourth lab meeting is held at the local Department of Conservation Nature Center. Here students apply the concepts that we have presented in lab. Students can attend any one of 25 (or so) different lab times during the week

of lab, including evening and weekend times. The lab begins and ends at the Nature Center. We provide transportation for some of the lab times; otherwise, students are expected to carpool or go on their own. Students register for this field trip using a web-based registry.

Conclusions

This environmental issues research project is structured enough for novice laboratory instructors to manage, yet flexible enough for students to be able to have some choice in what they are learning. When students have choices in content and in how they pursue answers to their questions, they may be more intrinsically motivated to learn science. As a result of this program, some students reported that they have modified their behaviors and investigated community volunteer opportunities.

Figure 1. Some possible Environmental Issue Topics

- Lead mining restoration
- Environmental consequences of salting icy streets
- Recycling or pesticide use on campus
- Effects of channeling streams
- Effects of gravel mining of local streams
- How do shrinking tropical rainforests affect Missouri bird populations?
- Endangered plants and animals
- What are the environmental consequences of dams on Missouri and the White Rivers?
- Septic tanks in karst topography or poop in lake: alternatives?

Appendix 1. Assignments for the Environmental Conference Group Project

Assignment 1: Topic Identification

You must do research to identify your environmental issue. Attach pages to this worksheet from a web site, newspaper, or magazine that describes this local problem to receive credit.

In complete sentences, summarize the information. The research information must report on a local community issue, an endangered species or nature preserve. Your issue must occur in the Ozarks of Missouri.

Assignment 2: Topic Research

In order to understand all the different factors that can affect your topic, you and your team members need to research to gather more information. Research can take a variety of forms, such as interviews with stakeholders, articles in a magazine or newspaper, or a credible web page. This assignment marks the beginning of your research. Expect to do more.

Each person in your team must attach the following information and materials to this assignment:

- A copy of an article, web site or notes from an interview (only 1 web site will be accepted per team)
- A typed summary of the information and how it provides evidence for your project

As a team, answer the questions below. Write in complete sentences or you will be asked to redo the assignment.

1. In a few sentences, describe the topic you are investigating.

2. There are people who have an interest in this issue. They are called stakeholders. Identify who is involved and describe their concerns in this issue.
3. This topic impacts the local environment. Describe the ecosystem where this topic occurs. What is the name of this ecosystem?
4. Describe any changes in the energy pyramid and identify the organisms that are involved.

Assignment 3: Causes of the Problem

1. Based on your research and discussions, what is the source of the problem? (For example, why is the organism endangered, why is this environmental imbalance occurring, or why is the nature preserve not maintaining biodiversity?) Work together to create a coherent statement to explain your position.
2. Describe at least two pieces of evidence you have found to support your position. Identify the source of the evidence, explain why this source is reliable, and how this source supports your position.

Assignment 4: Your Recommendations

1. We believe the following should be done to correct the problem:
2. If our solution is implemented, these additional problems might arise:
3. We will pay for our solution by:
4. The benefits of our solution outweigh the cost of our solution because: (Remember, "costs" are not always about money!)

Appendix 2. Assessment of the Environmental Conference Group Project

Presentation Rubric

CRITERIA	Excellent	Good	Fair	
Issue Description: Have they clearly defined their issue? Have they described the stakeholders and how it impacts the environment?	**3**	**2**	**1**	**0**
Causes of the Problem: Are possible sources of the problem identified? Do they present *evidence* to support their hypothesis?	**3**	**2**	**1**	**0**
Recommendations: Do the students provide suggestions to correct their problem?	**3**	**2**	**1**	**0**
Effort: Does the presentation show attention to detail? Are the students well prepared and participate equally in the presentation? Do students respond adequately to questions?	**3**	**2**	**1**	**0**
Persuasiveness: Has the presentation inspired you to do something?	**3**	**2**	**1**	**0**

Poster Rubric

CRITERIA	Outstanding	Good	Adequate	Fair	Unacceptable	Not attempted
Dramatic Value: Is the display visually appealing? Do important ideas have more emphasis? Are all the components of the project well done?	**5**	**4**	**3**	**2**	**1**	**0**

CRITERIA	Excellent	Good	Fair	
Clarity: Is the information clearly presented? Is the information presented with correct spelling and grammar?	**3**	**2**	**1**	**0**
Issue Description: Is the issue clearly stated? Have they identified who this is a problem for? Is there a description of how this issue impacts the environment?	**3**	**2**	**1**	**0**
Causes of the Problem: Are possible sources of the problem identified? Do they present evidence to support their hypothesis?	**3**	**2**	**1**	**0**
Recommendations: Do the students provide suggestions to correct their problem? Have they identified any additional problems or costs from their solution(s)?	**3**	**2**	**1**	**0**
Persuasiveness: Do you agree with their recommendations? Has their poster inspired you to do something?	**3**	**2**	**1**	**0**

Peer Evaluation
Team Member being evaluated: _____

Value	Description of Assessment
	Quality of Work
5	Work could be used by the instructor as a model for other students.
4	May require minor improvements, but generally is of high standard.
3	Some major flaws, but flaws are fixable (and fixed in final product).
2	Team members may need to replace some parts of this individual's efforts.
1	Work was not usable by the team.
	Amount of Work
4	More than carries their weight.
3	Does just their share of the work.
2	Sometimes falls behind in work effort.
1	Is a slacker.
	Creativity
4	Contributes many ideas to the project.
3	Contributes a few ideas.
2	Occasionally makes a suggestion or contribution.
1	Never contributes ideas.
	Reliability
4	Always follows through on commitments. Attends and is on time for team meetings.
3	Follows through on commitments. May occasionally be late for a team meeting.
2	Completes tasks when reminded. May occasionally be late for a team meeting.
1	Cannot be counted on.
	Team work
4	Actively listens to others. Encourages others to speak. Shares the credit and work.
3	Listens, but interrupts others. Occasionally tries to control group focus.
2	May sit back and let others take control OR reacts negatively to new ideas.
1	Is rude or disrespectful of others.
	Overall evaluation
4	I would go out of my way to work with this individual again.
3	I would be pleased to work with this individual again.
2	I would not mind working with this individual again.
1	I would rather not work with this individual again.
	Total Score: _____