THE DEVELOPMENT OF AN ENVIRONMENTAL EDUCATION PROGRAM INVOLVING STUDENTS TEACHING STUDENTS IN THE ELLSWORTH COMMUNITY SCHOOL DISTRICT

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A Project Report
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ABSTRACT

The purpose of this project was to determine to what extent involving Ellsworth High School sophomore biology students in a citizen action experience where they teach Hillcrest Elementary School and St. Francis Elementary School students at the Ellsworth Community School District school forest would influence the environmental knowledge and citizen action skills of the sophomore biology students.

This project included several components; developing and implementing a school forest plan; utilizing a school forest to develop and execute environmental education lessons taught by sophomore biology students to elementary students; developing a pre- and post-test to measure changes in sophomore biology students’ environmental knowledge and citizen action skills; and assessing sophomore biology students and analyzing their scores on pre- and post-tests to measure changes in their environmental knowledge and citizen action skills.

A portion of the pre- and post-test asked students to rate to what extent they take part in recreational activities, they feel it is their and others’ responsibility to take environmental action in their community, and they are willing to work alone or with others to find a solution to an environmental issue in their community. This portion of the test saw responses decrease by 6.4% after participating in the citizen action experience of teaching EE lessons to elementary students. Students’ knowledge of and ability to use citizen action strategies showed no significant change in either the control group or experimental group, even though citizen action skills were taught to all students prior to the citizen action experience. This confirmed that participation in a citizen action experience does not necessarily increase students’ knowledge of and ability to use citizen action skills. Students’ knowledge of ecology and environmental science in both the control group and experimental group increased significantly, although there was little difference between the two groups. This suggests that participation in a citizen action experience where EE lessons were taught to elementary students does not necessarily lead to better environmental knowledge.
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INTRODUCTION

STATEMENT OF THE PROBLEM

To what extent will involving Ellsworth High School sophomore biology students in a citizen action experience where they teach Hillcrest Elementary School and St. Francis Elementary School students at the Ellsworth Community School District school forest influence the environmental knowledge and citizen action skills of the sophomore biology students?

STATEMENT OF SUBPROBLEMS

1. Develop and implement a school forest (SF) plan for the ECSD, using funds from a $5,000 Wisconsin Environmental Education Board (WEEB) grant.

2. Utilize the SF through development and execution of Environmental Education (EE) lessons that are facilitated by sophomore biology students and taught to elementary students at Hillcrest and St. Francis Elementary Schools in the Ellsworth Community School District (ECSD).

3. Develop a pre- and post-test to measure changes in sophomore biology students’ environmental knowledge and citizen action skills.

4. Assess sophomore biology students, using pre- and post-tests, to measure changes in their environmental knowledge and citizen action skills.

5. Analyze pre- and post-tests for changes in environmental knowledge and citizen action skills.
THE HYPOTHESIS

When sophomore biology students are involved in a citizen action experience where they teach Hillcrest Elementary School and St. Francis Elementary School students about EE, the sophomore biology students increase their environmental knowledge and citizen action skills.

SIGNIFICANCE OF THE PROBLEM

Students enrolled in the ECSD, and those around the world, do not receive adequate instruction to help them develop environmental knowledge. Gambro and Switsky (1996) state that teachers have a great deal of work to do to raise environmental knowledge in high school students.

However, it is not sufficient to only make students environmentally aware or knowledgeable; they must be also knowledgeable of environmental action strategies (Jordan, et al, 1986).

Through development, implementation, and utilization of a SF in the ECSD, sophomore biology students strengthened their environmental knowledge. By teaching elementary students EE lessons at the SF, sophomore biology students also had an opportunity to apply EE knowledge, which serves as citizen action experience.

LIMITATIONS

1. The study did not attempt to assess the environmental knowledge nor citizen action skills for any other students in the ECSD.
2. The study did not attempt to assess teachers in the ECSD for their attitudes toward learning how to use the SF in their curricula.
DEFINITION OF TERMS

Ellsworth High School
A high school located in western Wisconsin approximately 50 miles southeast of Minneapolis, Minnesota that educates approximately 600 students in grades 9-12.

Hillcrest Elementary School
One of three elementary schools in the ECSD located in Ellsworth, Wisconsin, that educates approximately 300 students in grades K-4.

St. Francis Elementary School
One of three elementary schools in the ECSD located in Ellsworth, Wisconsin, that educates approximately 140 students in grades K-5.

Ellsworth Community School District (ECSD)
ECSD is a district consisting of three elementary schools, a middle school, and a four year high school, responsible for educating approximately 1,750 children between kindergarten and twelfth grade.

School Forest (SF)
A forest situated on the ECSD property, adjacent to the Ellsworth Middle School, and within a half-mile walk from Hillcrest Elementary School, St. Francis Elementary School, and Ellsworth High School.

Environmental Knowledge
A basic understanding of how the natural environment functions, how its functioning is affected by human activity, and how harmony between human activity and the natural environment may be achieved.
Citizen Action Skills
The skills needed to identify, investigate, and take action toward the prevention and resolution of environmental issues.

Citizen Action Experience
Experience in applying acquired perceptual awareness, knowledge, an environmental ethic, and citizen action skills in working toward the prevention and resolution of environmental issues at all levels, local through universal.

Wisconsin Environmental Education Board (WEEB)
A group that provides leadership in the development of learning opportunities that empower Wisconsin citizens with the knowledge and skills needed to make wise environmental decisions and to take responsible actions in their personal lives, workplaces and communities.

Environmental Education (EE)
A lifelong learning process that leads to an informed and involved citizenry having the creative problem-solving skills, scientific and social literacy, ethical awareness and sensitivity for the relationship between humans and the environment, and commitment to engage in responsible individual and cooperative actions.

ASSUMPTIONS

1. A SF can be developed and implemented using a SF plan.
2. A SF is a valuable resource for teaching EE lessons that will increase environmental knowledge and citizen action skills for students utilizing such a site.
LITERATURE REVIEW

Benefits of Using an Outdoor Site for Teaching EE

Having an outdoor site for teaching EE is crucial to the success of an EE curriculum, within any discipline. An outdoor site can provide a vehicle for hands-on learning, a method often used to teach EE (Reading and Taven, 1996). Reading and Taven (1996) explain that in a Math class, studying how an outdoor site grows and changes over time can show students that math concepts have a tangible place to be applied. In Science, having a natural environment in close proximity to the school provides for great discussions and hands-on learning about the natural world. These ideas can be applicable to any subject area.

Using an outdoor site can also lead to stronger knowledge of and empathy for environmental issues and lead to positive actions for the environment (Palmberg and Kuru, 2000).

However, an outdoor site is not meant to just get students outside. Outdoor education should complement the current curriculum. Reading and Taven (1996) note “not only have our curriculum and learning opportunities increased, but our living and working environment has been greatly enhanced.”

An outdoor site does not only benefit students, but faculty, administration, and community members alike.

School Forests in Wisconsin

School forests, like the 15 acre forest in the ECSD, are not a new phenomenon to the Wisconsin landscape. School forests first appeared in Australia, but the idea was brought to Wisconsin by the late Dean Russell of the University of Wisconsin College of Agriculture in 1925 (Gibson-Pierce, 1994). Russell’s plan led to the Community Forest Law of 1927, which allowed school districts to own land for forestry programs (Solin, 2003). In 1949, schools became eligible to receive free seedlings from state forest nurseries, allowing them independence from relying on the school district for funds to purchase seedlings. At the same time, schools
were also privileged to have the use of foresters for their forest management plans. Today, Wisconsin is home to more than 300 registered school forests (Solin, 2003).

**Development and Implementation of a School Forest Plan**

Since one person cannot accomplish a project of this nature alone, it is imperative that a plan be put into place to designate and delegate the required operations that need to be completed to make a school forest successful. Mark Megalos (1996) recommends that to begin such a plan, one should promote the plan as a solution to an existing problem. A list should be created that is all-inclusive; include landscaping, beautification, recreation, and other opportunities that can be used for all curriculums (Megalos, 1996). For instance, elementary students can research which plants butterflies are attracted to, which could lead to an on-site butterfly garden. A science class can research birds and their specific shelter needs and an industrial technology class could build the appropriate birdhouses for the school forest. Math classes can conduct several measurements within the school forest, and art classes can create wildlife paintings or sketches. Megalos (1996) also recommends contacting partners within the school and community who can help in the plan implementation. In Ellsworth, such partners can include the DNR Forester, the Ellsworth Rod and Gun Club, and the Wild Turkey Federation, in addition to parent and community volunteers.

Including students in the development and implementation of a school forest plan will also eventually create environmentally knowledgeable citizens. Forest management affords science teachers an opportunity to incorporate hands-on learning to teach concepts such as plant classification, plant reproduction, and use of dichotomous keys (Markham, 2000). Science curriculum can be expanded to study soil productivity, water quality, biodiversity, and recreation (Markham, 2000).

The building and development of such a school forest, using a school forest plan, can result in the incorporation of various forestry activities, including the LEAF curriculum (Learning Experiences and Activities in Forestry), which is available for K-12 teachers with minimal training. By using a school forest to teach across the curriculum, Ellsworth students will greatly benefit.
Programs Involving Students Teaching Students

From the little research that exists on the subject, students teaching students, commonly called cross-age teaching, can be successful with any subject matter and beneficial to all students involved. With younger students learning from older students and older students teaching younger students, both have an opportunity to learn. Investigation is the key to understanding science, and as stated by Georgia teacher Susan Ade Potenza (2003), “A scientist is sometimes the leader, sometimes the follower, but always the investigator.” Whoever is doing the teaching, both age groups can benefit from such experience. To get the maximum benefit for older students involved, it is recommended that older students develop their own lessons to teach to the younger students, with teacher supervision (Christianson and Zee, 1999). Cross-age teaching also emphasizes inquiry-based teaching, part of the National Science Education Standards (Potenza, 2003).

Assessing High School Students for Changes in Environmental Knowledge and Citizen Action Skills

Jordan, Hungerford, and Tomera (1986) state that a student must be knowledgeable of an environmental issue before he or she can work towards its remediation. Environmental knowledge is EE subgoal 2, following perceptual awareness. Such knowledge seems easily assessable, according to an assessment used by Gambro and Switzky (1996). It seems beneficial to incorporate Gambro and Switzky’s assessment into the general EE assessment for ECSD sophomores. However, assessing high school students to determine their achievement of EE subgoals such as citizen action skills and citizen action experience can be difficult tasks. Two teachers from the Marshfield School District, Robert Christianson and Mark Zee, attempted this with their UW Stevens Point Master’s project in 1999: “Evaluation of high school students exercising EE citizen action skills and citizen action experience is subjective and not easily presented as data.” Christianson and Zee (1999) recommended that assessments be objective; however, if subjective data needs to be collected, it should be converted into a Likert scale to make the data more objective.
METHODOLOGY

The first subproblem was to develop and implement a SF plan for the ECSD, using funds from a $5,000 WEEB grant. This was accomplished during the 2005/2006 school year, when a committee was formed. The committee was comprised of two middle school science teachers, three high school science teachers, the Wisconsin school forest coordinator, and a Pierce County forester.

The SF plan described the SF’s physical features, location, history, management goals, key goals and objectives for the SF, educational connections, alignment with state standards, ideas for staff development, resources available and resources needed, ideas for student assessment, ideas for how SF information would be disseminated, long-range plans, an implementation plan, and the ECSD commitment.

The WEEB grant was essential to this project because it allowed the ECSD SF, as an outdoor site, to receive the educational and community support needed to implement a quality EE curriculum. It will also help to guide EE curriculum in the ECSD in the future.

After the SF plan was developed, it was submitted to WEEB for approval. The SF plan was implemented in the fall of 2006.

The second subproblem was to utilize the SF through development and execution of EE lessons that were facilitated by sophomore biology students and taught to elementary students at Hillcrest Elementary School and St. Francis Elementary School in the ECSD.

At the beginning of the third and fourth quarters of the 2007/2008 school year, a pre-test was administered to sophomore biology students to measure their environmental knowledge and citizen action skills. At the end of the third and fourth quarters of the 2007/2008 school year, sophomore biology students were given the same test as a post-test to measure their environmental knowledge and citizen action skills.

Third quarter sophomore biology students served as the control group, since they did not participate in the citizen action experience of teaching Hillcrest Elementary students and St. Francis Elementary students the EE knowledge they acquired throughout the quarter.

Fourth quarter sophomore biology students served as the experimental group, since they did participate in the citizen action experience of teaching Hillcrest Elementary students and St.
Francis Elementary students the EE knowledge they acquired throughout the quarter (Appendix B). In the spring of 2008, fourth quarter sophomore biology students were put into 18 groups, each with two or three students per group. Each group chose a specific EE lesson to teach to a group of elementary students from Hillcrest Elementary School and St. Francis Elementary School. EE lessons were teacher-selected from Aquatic Project Wild and Project Wild. Sophomore biology students had three days to prepare for the EE lesson they chose, determine how they were going to teach the lesson, and determine which students were assigned specific tasks within their group. After preparations were complete, sophomore biology students met elementary students at the SF to teach the EE lessons. Each of the 18 groups contained 9-15 elementary students and instruction for each lesson lasted approximately 30 minutes. 51 sophomore biology students participated in this citizen action experience as the experimental group.

Students in both the control group and experimental group received identical instruction in EE knowledge and citizen action skills. This was part of a Biology curriculum that included topics such as Classification, Viruses and Bacteria, Invertebrate Animals, and Vertebrate Animals. During a unit on Invertebrate Animals, students learned about coral and environmental changes that are leading to coral bleaching. This activity provided students with EE knowledge. During a unit on Vertebrate Animals, students wrote children’s books about endangered Wisconsin fish. In the books, students incorporated reason why certain fish are endangered. Students then read the books to kindergarten and first grade students. This activity provided students with an opportunity to practice a citizen action skill – persuasion. Students also learned about hypotheses regarding why amphibian populations were declining worldwide. They developed their own hypothesis with supporting research, and developed a plan to increase amphibian populations. This activity provided students with another opportunity to practice persuasion as a citizen action skill. Students learned about sea turtles, why they were endangered, and participated in a simulation game where they were all players in a sea turtle’s life cycle. Following the lesson, students developed a set of solutions they could do to help protect sea turtles. One of the solutions was to reduce plastic bag consumption, since sea turtles mistakenly ingest plastic bags because they resemble jellyfish. This activity provided students with EE knowledge and an opportunity to practice a citizen action skill – consumer action. Lastly, students learned about the complex background regarding wolves in Wisconsin and their
future in the state. They participated in a case study to research all aspects of the issue. Then, students participated in a mock town hall meeting where they were able to speak their opinion about whether they felt there should be a hunting season on wolves. This activity provided students with the opportunity to practice another citizen action skill – political action.

The third subproblem was to develop a pre- and post-test to measure changes in sophomore biology students' environmental knowledge and citizen action skills. The pre- and post-test, called an Environmental Knowledge Test (Appendix A), was developed by compiling questions from prominent EE assessments, as well as some self-authored questions. EE assessments that were used were the 2001 Roper Environmental Knowledge Quiz and The Secondary School Environmental Literacy Assessment, 4th Edition, 1995. Questions from The Secondary School Environmental Literacy Assessment, 4th Edition, 1995, were used with permission from Dr. Richard Wilke at the University of Wisconsin – Stevens Point.

The Environmental Knowledge Test was comprised of five parts: Part I – The Problems with which I am Familiar, Part II – How I Feel About the Environment, Part III – Knowledge of and Ability to Use Environmental Action Strategies, Part IV – Involvement in Environmental Protection (A 6 Month History), and Part V – Knowledge of Ecology and Environmental Science. Part I was collected on a sheet of paper which explained to students that they should present the causes, effects, and locations of environmental problems with which they are familiar. Since this portion of the test proved to be very subjective, the data collected from this portion was not analyzed nor interpreted within this study. Students answered Parts II-V on a Scantron Form. In Parts II and III, students responded to questions with the following answer choices: A = No Extent, B = A Slight Extent, C = A Moderate Extent, D = A Large Extent, and E = An Extreme Extent. In Part IV, students chose answer choices based on how often they participated in various environmental protection strategies over a six month period. Answer choices for Part IV were A = 0 times, B = 1-2 times, C = 3-4 times, and D = 5 times or more. However, because students did not receive instruction in environmental protection (citizen action experience), the data collected from this portion of the Environmental Knowledge Test was not analyzed nor interpreted in this study. Part V involved questions that contained multiple-choice answers.
The fourth subproblem was to assess all sophomore biology students, using the pre- and post-test, to measure changes in their environmental knowledge and citizen action skills.

At the beginning of the third and fourth quarters of the 2007/2008 school year, a pre-test (Appendix A) was administered to sophomore biology students to measure their environmental knowledge and citizen action skills. At the end of the third and fourth quarters of the 2007/2008 school year, sophomore biology students were given the same test as a post-test to measure their environmental knowledge and citizen action skills.

The fifth subproblem was to analyze pre- and post-tests for changes in environmental knowledge and citizen action skills.

The pre- and post-test were scored using the following criteria. Answers for Parts II and III were assigned point values based on the letter the student used to answer. For instance, if the student answered A, he/she earned one point. An answer marked B earned the student two points; C earned three points; D earned four points; E earned five points. Answers for Part V – Knowledge of Ecology and Environmental Science were scored based on if the answer was correct or incorrect. If the student marked the correct answer, his/her score increased. Consequently, if the students marked the incorrect answer, his/her score decreased. Student scores collected from the pre- and post-test can be seen in Table 1 – Pre- and Post-Test Scores.

Pre- and post-test scores were collected between January and June 2008 and statistically analyzed using a dependent t-test in June 2008. A dependent t-test measures the difference between two groups’ values and shows whether those differences are significant or not. The P value arrived at by the t-test can either be one-tailed or two-tailed. In this analysis, the one-tailed variety was used. A one-tailed P value is used when a group is expected to have a higher mean than another group. In this experiment, the experimental group was expected to have a higher mean than the control group, since the experimental group was the group that participated in the citizen action experience of teaching EE lessons to elementary students. In this research a P value of less than 0.05 was used to determine whether there were statistically significant differences. Results of the dependent t-test can be found in Table 2 – Statistical Analysis of Pre- and Post-Test Scores.
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### Table 3 - Statistical Analysis of Pre- and Post-Test Scores

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* Note: highlighted boxes are statistically significant results

### RESULTS

Contrary to expected results, students’ feelings about the environment (Environmental Knowledge Test Part II) decreased by 6.4% in the experimental group, after participating in the citizen action experience of teaching EE lessons to elementary students. This was a significant decrease ($P < .05$) in the experimental group, showing that participation in teaching EE lessons does not necessarily increase students’ feelings about the environment.

Students’ knowledge of and ability to use environmental action strategies (Environmental Knowledge Test Part III) showed no significant change in either the control group or experimental group, even though citizen action skills were taught to all students prior to the citizen action experience. This confirms that participation in a citizen action experience does not necessarily increase students’ knowledge of and ability to use citizen action skills.

Students’ knowledge of ecology and environmental science (Environmental Knowledge Test Part V) in both the control group and experimental group produced very low P values ($P = 0.001$ and $0.007$, respectively). Since there is little difference between the two groups’ results, this suggests that participation in a citizen action experience where EE lessons were taught to elementary students does not necessarily lead to better environmental knowledge.

Overall, students’ scores in the control group increased significantly, while the experimental group students’ scores did not.
CONCLUSIONS and RECOMMENDATIONS

The hypothesis of this study was “When sophomore biology students are involved in a citizen action experience where they teach Hillcrest Elementary School and St. Francis Elementary School students about EE, the sophomore biology students increase their environmental knowledge and citizen action skills.”

The results of this study indicate that the hypothesis was rejected. When Ellsworth High School sophomore biology students were involved in a citizen action experience where they taught EE lessons to Hillcrest Elementary students and St. Francis Elementary students, the experience of teaching did not significantly influence their environmental knowledge nor citizen action skills. Results similar to this study have been found in other environmental education programs. Bradley (1999) indicates that researchers have found increases in environmental knowledge, but not in student attitudes, following participation in an environmental education program.

There were a few unintended, beneficial outcomes of this study. First, sophomore biology students significantly increased their environmental knowledge, regardless of whether they participated in the citizen action experience of teaching EE lessons to the elementary students. Second, sophomore biology students in the experimental group exercised citizen action experience by teaching EE lessons to elementary students. They did this by applying their acquired knowledge they gained throughout the quarter in biology class when they taught EE lessons. Citizen action experience is an EE subgoal not often achieved by high school students (Christianson and Zee, 1999). Third, elementary students were also exposed to two EE subgoals – perceptual awareness and knowledge. If the elementary students had not participated in this experience, they might not have had exposure to these EE subgoals.

After completing this study, the following recommendations can be made for educators in similar settings. High school students who will be teaching EE lessons should select their own EE lessons to teach to elementary students. This will help high school students to have more interest in the lesson and will likely cause them to have a greater understanding of the EE lesson. Adequate time should be provided to high school students to plan and get involved in the EE lessons they will teach to elementary students. An assessment to evaluate elementary students should be developed so that EE subgoals such as perceptual awareness and knowledge can be
assessed and analyzed. In conclusion, one of the most important recommendations is to ensure such an experience is beneficial to all students and educators involved. If the experience can be directly linked to achieving content area standards, administrators are more likely to approve the implementation of such experiences into the curriculum.

REFERENCES


Environmental Knowledge Test

Name: ____________________________

Biology during (circle one): Quarter 3 or Quarter 4

Pre-Test or Post-Test (circle one)
Part I - The Problems with which I am Familiar

Directions: In this part, present the causes, effects, and locations of environmental problems with which you are familiar:

(A) up to 3 environmental problems found in Ellsworth or western Wisconsin
(B) up to 3 environmental problems found across the U.S
(C) up to 3 environmental problems which occur on a global basis

Do not repeat a problem in more than one section.

The example below shows you how to present a problem. It is important to include the cause, effect, and location of each problem. In this example, the cause is CFC emissions, the effect is ozone depletion, and the location is the Arctic Circle.

Example: The effects of CFC emissions on the depletion of ozone above the Arctic Circle.

A. Environmental Problems in Ellsworth or western Wisconsin
   1. 
   2. 
   3. 

B. Environmental Problems Across the U.S.
   1. 
   2. 
   3. 

C. Environmental Problems on a Global Basis
   1. 
   2. 
   3.
Part II - How I Feel About the Environment

Directions: Please fill in the letter of your response for each corresponding question on the accompanying Scantron form. The following items ask how you feel about different aspects of the environment. There are no right or wrong answers. Think carefully about each item before you complete the answer that best reflects how you feel. Please be completely honest. For questions 1-5, use the following scale:

A = No Extent
B = A Slight Extent
C = A Moderate Extent
D = A Large Extent
E = An Extreme Extent

1. To what extent do you take part in recreational activities which take place in natural places such as parks and wilderness areas (e.g., camping, hiking, canoeing, fishing, hunting, etc.)?

2. To what extent do you feel it is your personal responsibility to help improve environmental quality in your community?

3. To what extent do you feel it is also other people's responsibility to help improve environmental quality in your community?

4. To what extent are you willing to work on your own toward the solution of environmental issues in your community?

5. To what extent are you willing to work with others toward the solution of environmental issues in your community?

Part III - Knowledge of and Ability to Use Environmental Action Strategies

Directions: Please fill in the letter of your response for each corresponding question on the accompanying Scantron form. In this section, you are asked to rate your knowledge and capability in the area of environmental action. There are no right or wrong answers. Think carefully about each item before you complete the answer that best reflects how you feel. Please be completely honest.

For questions 6-15, use the following scale:

A = No Extent
B = A Slight Extent
C = A Moderate Extent
D = A Large Extent
E = An Extreme Extent

A. The term ecomanagement refers to those environmental actions in which people work directly with the natural world to help prevent or resolve environmental issues.

Examples of ecomanagement strategies include:
* taking part in or organizing litter clean-ups;
* installing devices to control soil erosion;
* constructing elevated boardwalks in sensitive park areas;
* building and installing nesting boxes for birds;
* helping set controlled fires to manage plant/animal habitats.

6. To what extent do you feel that you are knowledgeable about "ecomanagement" strategies?

7. To what extent do you feel that you are able to use "ecomanagement" strategies?
B. The terms consumer action and economic action refer to those environmental actions in which people use monetary support or financial pressure to help prevent or resolve environmental issues.

Examples of consumer/economic action strategies include:
* avoid buying products with excess packaging;
* purchasing products in reusable or recyclable containers;
* buying detergents which do not contain phosphates;
* boycotting products which damage to the environment, such as the unnecessary killing of animals or the disposal of untreated wastes.

8. To what extent do you feel that you are knowledgeable about “consumer/economic action” strategies?

9. To what extent do you feel that you are able to use “consumer/economic action” strategies?

C. The term persuasion refers to those environmental actions in which individuals or groups appeal to others to help prevent or resolve environmental issues.

Examples of persuasion strategies include:
* encouraging your family to save energy by adjusting the thermostat or turning off lights not in use;
* asking friends to help with your school recycling program;
* making a presentation to a local group about things they can do to help protect the environment;
* writing letters to the editor of your newspaper encouraging others to help solve a community problem;
* lobbying groups to support environmental protection measures.

10. To what extent do you feel that you are knowledgeable about “persuasion” strategies?

11. To what extent do you feel that you are able to use “persuasion” strategies?

D. The term political action refers to those environmental actions in which people use political means (e.g., political processes, organizations, parties, or offices) to help prevent or resolve environmental issues.

Examples of political action include:
* campaigning for candidates with “pro” environmental positions or good environmental voting records;
* voting for environmental protection measures;
* writing letters to elected officials asking them to support environmental protection laws/measures;
* joining or helping a political group/party that supports environmental protection.

12. To what extent do you feel that you are knowledgeable about “political action” strategies?

13. To what extent do you feel that you are able to use “political action” strategies?

E. The term legal action refers to those environmental actions which people use to support or enforce existing laws which are designed to help prevent or resolve environmental issues.

Examples of legal action include:
* reporting license plate numbers of vehicles which violate your state’s air pollution laws;
* reporting cases of poaching, illegal hunting, or illegal plant/animal collecting to the authorities;
* testifying in a case involving a violation of an environmental law;
* initiating legal action against people responsible for serious environmental damage.

14. To what extent do you feel that you are knowledgeable about “legal action” strategies?

15. To what extent do you feel that you are able to use “legal action” strategies?
Part IV - Involvement in Environmental Protection: A 6 Month History

Directions: Please fill in the letter of your response for each corresponding question on the accompanying Scantron form. In this section, you are asked to provide your own six month history of environmental action. For each action, please indicate the number of times you have taken that action over the past six months. You might not have taken any actions during this period, and that is fine. Please be as accurate and honest as you can. For questions 16-45, use the following scale:

A = 0 times
B = 1-2 times
C = 3-4 times
D = 5 times or more

A. **ECOMANAGEMENT** refers to those environmental actions in which people work directly with the natural world to help prevent or resolve environmental issues.

Over the past six (6) months, how many times have you, on your own or with others, engaged in each of the following ecomanagement practices?

16. Used an alternative form of transportation (e.g., mass transit, bicycle, car pooling)
17. Taken steps to reduce energy used for heating, cooling, and/or lighting
18. Taken steps to reduce water use
19. Taken steps to improve wildlife habitat or food supplies (e.g., plant trees or flowers; build bird houses or feeders)
20. Recycled materials such as paper, glass, plastic, metals, or organic refuse
21. Picked up litter or trash

B. **CONSUMER ACTION and ECONOMIC ACTION** refer to those environmental actions in which people use monetary support or financial pressure to help prevent or resolve environmental issues.

Over the past six (6) months, how many times have you, on your own or with others, engaged in each of the following consumer or economic actions?

22. Purchased products packaged in refillable, returnable or recyclable containers (e.g., aluminum cans, deposit bottles)
23. Avoided buying products with non-recyclable, non-biodegradable, or excessive packaging
24. Stopped buying products which cause pollution (e.g., aerosols, styrofoam, toxic chemicals or pesticides)
25. Paid membership fees to or donated money to conservation/environmental groups (local, state, national, international)
26. Avoided purchasing products directly associated with damage to animals or their habitats (e.g., products tested on animals, fur products, non-dolphin safe tuna)
27. Purchased products made, in whole or in part, from recycled materials (e.g., some paper and plastic products)
C. **PERSUASION** refers to those environmental actions in which individuals or groups appeal to others to help prevent or resolve environmental issues.

Over the past six (6) months, how many times have you, on your own or with others, engaged in each of the following acts of persuasion?

28. Encouraged others to help the environment (e.g., to recycle, buy recyclable or recycled products, conserve water or energy)

29. Prepare or publicly display "pro" environmental messages (e.g., posters, buttons, t-shirts, bumper stickers)

30. Prepared or passed out literature supporting the solution of environmental problems/issues

31. Signed or distributed a petition asking someone to take an action to improve the environment

32. Encouraged an individual or group involved in some kind of destructive environmental behavior to stop (e.g., to stop littering, buying aerosols, using harmful pesticides)

33. Encourage one or more individuals to support "pro" environmental positions or candidates

D. **POLITICAL ACTION** refers to those environmental actions in which people use political means (e.g., political processes, organizations, parties, or offices) to help prevent or resolve environmental issues.

Over the past six (6) months, how many times have you, on your own or with others, engaged in each of the following political actions?

34. Passed out materials or gathered signatures in support of "pro" environmental policies or legislation (e.g., flyers, petitions)

35. Supported or voted for a "pro" environment candidate

36. Supported or voted for a "pro" environment laws, regulations, or programs

37. Participated in political meetings or hearings concerning environmental policies or plans (e.g., City Council meetings, public hearings)

38. Wrote letters to elected officials encouraging them to support environmental protection (e.g., legislation, funds for enforcement)

39. Ran for or served in any position with the intent of supporting the environment (e.g., student council, youth organizations)

E. **LEGAL ACTION** refers to those environmental actions which people use to support or enforce existing laws that are designed to help prevent or resolve environmental issues.

Over the past six (6) months, how many times have you, on your own or with others, engaged in each of the following legal actions?

40. Reported pollution violations to authorities (e.g., littering, dumping)

41. Reported violations of fishing, trapping, or hunting laws to authorities

42. Reported the illegal collection of live plants or animals to authorities (e.g., in parks, preserves, or sanctuaries)

43. Persuading other not to break environmental laws or informing others they are breaking such laws

44. Helped authorities patrol areas for the purpose of enforcing environmental laws

45. Provided information for or testimony at a legal hearing on an environmental issue
Part V - Knowledge of Ecology and Environmental Science

Directions: Please fill in the letter of the correct response for each corresponding multiple choice item on the accompanying Scantron form for questions 46-78.

46. A material found in many soaps and detergents that adds to the pollution of water is:
   a. chlorine
   b. lye
   c. phosphate
   d. sodium

47. An aquatic ecosystem is contaminated by a chemical which tends to be stored in body fat. The highest concentration of this chemical would probably be found in which group of organisms in the ecosystem?
   a. fish-eating birds
   b. fish that eat insects and plants
   c. minnows
   d. plant life

48. An example of a "fossil fuel" is ...
   a. biomass.
   b. electricity.
   c. natural gas.
   d. uranium.

49. Carbon dioxide is a major contributor to global climate change. Which of the following is the biggest source of carbon dioxide?
   a. Factories and businesses
   b. Motor vehicles
   c. People breathing
   d. Trees

50. Dead leaves and twigs do not build up in a forest from year to year because ...
   a. animals eat them or use them for nests.
   b. decomposers break them down into the soil.
   c. non-living elements such as wind and rain remove them.
   d. none of the above

51. How is most of the electricity in the U.S. generated?
   a. At hydroelectric power plants
   b. By burning oil, coal, and wood
   c. Through solar energy
   d. With nuclear power

52. If all bacteria were suddenly removed from the earth ...
   a. animals would have no difficulty in digesting food.
   b. ecosystems would still function normally.
   c. human diseases would disappear.
   d. we would soon be knee deep in dead organic matter.

53. In an ecosystem, nutrients would remain in compounds and unavailable without ...
   a. carnivores.
   b. decomposers.
   c. primary consumers.
   d. producers.
54. In Capistrano, California, swallows, a type of bird, arrive on a day so constant from one year to the next that it would appear that some environmental factor triggers their migration. Which factor is capable of triggering such migration?
   a. time when the hours of day and night are equal in length
   b. time when the mountain snows melt
   c. time when the vegetation changes
   d. time when their food supply is exhausted

55. Ozone forms a protective layer in the earth's upper atmosphere. What does ozone protect us from?
   a. Acid rain
   b. Global warming
   c. Harmful, cancer-causing sunlight
   d. Sudden changes in temperature

56. Sharp thorns can help a plant keep animals from eating it. This is an example of ...
   a. adaptation
   b. commensalism
   c. competition
   d. mutualism

57. Soil can be unfit for farming if it has recently:
   a. become saturated with salt water.
   b. been covered with old manure.
   c. had its grass cover burned.
   d. had last year's crop plowed under.

58. Soil erosion of farmed land often causes ...
   a. farmers to stop their practice of "contour plowing."
   b. silting of nearby streams and rivers.
   c. the most fertile soil to be exposed.
   d. unneeded amounts of humus to be deposited in the soil.

59. Some pesticides that were once effective in killing insects no longer work very well. This is because:
   a. insects with natural resistance survived and multiplied
   b. new insect species develop on a regular basis.
   c. the insects produced many more offspring than the pesticide could kill.
   d. the wrong kinds of pesticides were used.

60. Some reason(s) for the decline in Wisconsin's Prairie Chicken populations is/are
   a. habitat loss.
   b. infrequent genetic mixing.
   c. both a and b.
   d. neither a nor b.

61. The _____ virus is killing sea turtles around the world, which they catch from polluted water.
   a. AIDS
   b. Flu
   c. Herpes
   d. HIV

62. The importance of coral reefs is
   a. that they provide insulation for the water.
   b. that they provide money to countries that have reefs.
   c. that they provide shelter.
   d. all of the above.
63. The main cause of amphibian deformities (loss or addition of a limb or limbs) is
   a. acid rain.
   b. air pollution.
   c. water pollution.
   d. all of the above.

64. The main reason turtle and tortoise populations are in danger of extinction is due to
   a. home/business developments.
   b. introduced, non-native plants and animals.
   c. poaching.
   d. all of the above

65. The most common way chemical pesticides become dangerous or deadly to humans is when ...
   a. people are exposed to them as they are manufactured.
   b. pests consume and concentrate them.
   c. they contribute to ozone depletion.
   d. they enter foods which humans later consume.

66. The removal of a top predator, such as the timber wolf, from an ecosystem is detrimental to that ecosystem because
   a. it will keep other populations of plants and animals under control.
   b. people who use the wolf fur to keep warm won't be able to do so any longer.
   c. people will no longer be able to hunt wolves.
   d. all of the above.

67. There are many different kinds of animals and plants, and they live in many different types of environments. What is the word used to describe this idea?
   a. Biodiversity
   b. Evolution
   c. Multiplicity
   d. Socio-economics

68. What is the most common cause of pollution of streams, rivers, and oceans?
   a. Dumping of garbage by cities
   b. Surface water running off yards, city streets, paved lots, and farm fields
   c. Trash washed into the ocean from beaches
   d. Waste dumped by factories

69. What is the most common reason that an animal becomes extinct? Is it because...
   a. Pesticides are killing them
   b. Their habitats are being destroyed by humans
   c. There are climate changes that affect them
   d. There is too much hunting

70. What is the name of the primary federal agency that works to protect the environment?
   a. Department of Health, Environment, and Safety (the DHES)
   b. Environmental Protection Agency (the EPA)
   c. Federal Pollution Control Agency (the FPCA)
   d. National Environmental Agency (the NEA)

71. What is the primary benefit of wetlands? Do they...
   a. Help clean the water before it enters lakes, streams, rivers, or oceans
   b. Help keep the number of undesirable plants and animals low
   c. Promote flooding
   d. Provide good sites for landfills
72. When a farmer uses a strong pesticide to kill insects destroying his/her crop, which of the following is true?
   a. This has immediate effects, but no long term effects.
   b. This has no short term effect, but has a significant long term effect.
   c. This has neither short term nor long term effects.
   d. This has both short term and long term effects.

73. Where does most of the garbage in the U.S. end up? Is it in...
   a. Incinerators
   b. Landfills
   c. Oceans
   d. Recycling centers

74. Which is most likely to cause groundwater pollution?
   a. municipal composting of yard wastes
   b. organic farming practices
   c. using large concentrations of fertilizer on lawns and fields
   d. wastewater treatment plants

75. Which of the following do scientists feel is the least important contributor to the greenhouse effect?
   a. burning of fossil fuels, such as gasoline and oil
   b. destruction of the earth's rainforests
   c. increased production of hydroelectric power
   d. production of methane gas by cattle and rice paddies

76. Which of the following is a renewable resource?
   a. Coal
   b. Iron ore
   c. Oil
   d. Trees

77. Which of these is NOT one cause for why algae leave their homes in coral, also known as coral bleaching?
   a. dirt and debris clouding the water
   b. increasing levels of ultra-violet (UV) light from the sun.
   c. increasing ocean temperatures
   d. predation from other organisms

78. Which would be most likely to result in soil erosion?
   a. aeration of soil by bacteria
   b. an increase in nutrients added to the soil
   c. contour plowing of hillsides
   d. the removal of vegetation

* Questions 51, 55, 67, 68, 69, 70, 71, 73, and 76 were taken from the Environmental Knowledge Quiz: 2001 NEETF/Roper Starch Worldwide National Report Card.

** Parts I, II, III, and IV are modified sections of The Secondary School Environmental Literacy Assessment, 4th Edition, 1995, used with permission from Dr. Rick Wilke at the University of Wisconsin – Stevens Point.

*** Questions 46, 47, 48, 50, 52, 53, 54, 56, 57, 58, 59, 65, 72, 74, 75, 78 were used with permission from Dr. Rick Wilke at the University of Wisconsin – Stevens Point.
## Appendix B

### EE Lessons

<table>
<thead>
<tr>
<th>Animal Group</th>
<th>Activity</th>
<th>Description of Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invertebrates</td>
<td>Plastic Jellyfish</td>
<td>Take students on a hike through the school forest looking for plastic litter. Discuss ways that each piece of litter might hurt specific wildlife.</td>
</tr>
<tr>
<td></td>
<td>Litter We Know</td>
<td>Students collect and evaluate litter, make a litter collage, discuss how litter is harmful to wildlife, and propose ways to eliminate or lessen littering.</td>
</tr>
<tr>
<td></td>
<td>Collecting Earthworms</td>
<td>Students collect earthworms and determine if they are juveniles or adults.</td>
</tr>
<tr>
<td></td>
<td>Hooks &amp; Ladders</td>
<td>Students simulate Pacific salmon and the hazards faced by salmon in an activity portraying the life cycle of these aquatic creatures.</td>
</tr>
<tr>
<td>Fish</td>
<td>Turtle Hurdles</td>
<td>Students become sea turtles and limiting factors in an active simulation game.</td>
</tr>
<tr>
<td>Reptiles</td>
<td>Migration Headache</td>
<td>Students role play migrating birds traveling between nesting habitats and wintering grounds and are subject to hazards at either end of the migration path as well as along the way.</td>
</tr>
<tr>
<td>Birds</td>
<td>Deadly Links</td>
<td>Students become hawks, shrews, and grasshoppers to simulate how pesticides enter food chains and their consequences.</td>
</tr>
<tr>
<td></td>
<td>No Water Off A Duck's Back</td>
<td>Students conduct experiments using water, oil, hardboiled eggs, detergent, and feathers to identify ways oil spills can affect birds.</td>
</tr>
<tr>
<td></td>
<td>Oh Deer</td>
<td>Students become deer and parts of their habitat in an active simulation game.</td>
</tr>
<tr>
<td>Mammals</td>
<td>Muskox Maneuvers</td>
<td>Students simulate muskoxen and wolves in an active simulation game.</td>
</tr>
</tbody>
</table>