

ENVIROTHON TEACHING METHODS:
HOW DO THEY IMPACT LEARNING IN THE TRADITIONAL BIOLOGY
CLASSROOM?

by
Janet Elise Perry

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Janet E. Perry

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DEDICATION

To my very special family –
 my husband Stan, our three sons, Ethan, Randall, and Spencer, and the
 wonderful ladies in their lives who have also become such a joy to me...
 my brother, Roland, a teacher before me, who has always inspired me, both in and out
 of the classroom...
 and equally, the rest of my family who have all loved and supported me in so many
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And to ALL my students, past, present, and future- you are my inspiration to
 continue my education and to remember always-
 "While we try to teach our children all about life, our children teach us what life is all
 about." Angela Schwindt

and
 "Children are the living messages we send to a time we will not see."
 John W. Whitehead

THANK YOU Everyone!

ABSTRACT

My Action Research Project connects the Envirothon contest with a traditional biology classroom. In the Envirothon, a national environmental contest, teams of high school students work together outdoors, solving site-based natural resource questions and problems in aquatics, forestry, soils, wildlife, and a current environmental issue. During this competition, teams rotate from Station to Station, working on a variety of “hands on” tasks specific to each environmental area; the students are also tested on sets of questions that cover a very wide range of information for each topic.

“Envirothon Teaching Methods” typically used to successfully prepare teams for this competition involve bringing in knowledgeable professionals to help students learn about each of these environmental areas. The lessons, presented by local natural resource people with expertise and experience, usually focus on providing students with “real world” information. Students typically learn in an outdoor setting and/or use local materials and resources. “Hands on” authentic activities are emphasized as an important way to increase student comprehension of environmental subject matter.

In this Action Research Project, I incorporated the same teaching methods commonly used to train students for Envirothon contests into my high school College Biology course. When used by an entire class of students within a traditional school day setting, Envirothon teaching methods had positive impacts on students’ comprehension of environmental topics.

INTRODUCTION AND BACKGROUND

My Action Research (AR) project investigates the impact of incorporating Envirothon Teaching Methods into environmental science activities for an entire class of students, not only using them with the students who are Envirothon team members. Specific questions included are: 1) What is the Envirothon, and why are the methods used to prepare students for this competition successful? 2) Will these methods also be valuable teaching tools to increase student comprehension of subject matter if used within the regular biology classroom curriculum? 3) If using these methods, are they more effective if embedded into the Environmental Science section of the course? And 4) Will these methods also increase learning if used as stand alone mini units presented while students are studying unrelated areas of the biology curriculum?

The Envirothon (Appendix A) is an annual nationwide environmental contest that has been held since 1988. In an outdoor setting, teams of high school students work together to solve site-based natural resource questions and problems in the areas of aquatics, forestry, soils, and wildlife plus a current environmental issue.

The teaching methods to prepare students for this contest include using “presenters” as instructors for each environmental area. Presenters are people who have expertise in the natural resource topics; many times they are professionally employed in the area. The lessons often take place outdoors at local sites or use materials found at local sites. Each natural resource topic has a separate “Station”, and students move from Station to Station as a team. At each Station, the professionals teach the students concepts and skills using “hands on” authentic activities. According to Tish Carr writing for the Education and Envirothon committee of the Maine Association of Conservation Districts,

(T)he Envirothon is an academic program that is aligned with the Maine Learning Results. The Program raises students' awareness of local and national environmental issues. Envirothon integrates math, language arts, cultural land-use history, and science in ways unique to the field. Students build critical thinking and decision-making skills as they practice solving real environmental problems....students have an opportunity to meet and learn from state soil scientists, biologists, foresters, and other natural resource professionals. (Carr, 2011, p. 1)

I chose this topic because over the years I have observed that the curriculum of many biology courses includes fewer and fewer “hands on” authentic environmental activities. One reason might be that the teacher or school system does not think that there would be any measurable difference in student learning through the use of these methods. I have been extremely fortunate in my teaching career to have had many opportunities to see first-hand how my students appear to benefit from the numerous activities they have done while participating in Envirothon, but these activities have involved relatively few students who have chosen to take part outside the normal school day.

While I have also used outdoor activities, field trips and guest speakers to teach various environmental topics within my classes, and I have anecdotal evidence that students enjoy and learn well from this type of teaching, I have never documented the differences in learning which may be seen between regular indoor classroom methods and the use of more “hands on” authentic environmental activities. My Administration has always been extremely supportive of this type of teaching, based on my requests and justifications for wanting to do this, but I have never planned a series of activities and

evaluations to actually show the possible increases in learning by implementing these methods. In these days of budget cuts and increased responsibilities, we all need to make the best possible use of our teaching time. In my Action Research project, I investigated what the impact of including “hands on” authentic activities would be on student learning- specifically focusing on student comprehension of subject matter. If the data showed that students did learn more when a teacher incorporated Envirothon teaching methods, personally I would be more likely to use them in the future. If a teacher requires more time and/or resources to teach using these methods, perhaps school administrations would be more likely to approve these requests.

Ashland, Maine and the surrounding towns, plantations, and unorganized units that are part of our school district can be described as a natural resource based, rural area. My AR project has been completed within the course content for College Biology, which had an enrollment of 11 students, all sophomores. Immediate and extended families of many of these students have lived in the Ashland area for years, so my students all came from very similar backgrounds with little variation in ethnicity. Many of my students have a love of the outdoors and specific expertise in natural resource topics that are part of their family heritage. However, their knowledge of a wide variety of other environmental science concepts and skills was limited to what they learned in school. Similar to other teenagers, some would prefer to stay indoors and use technology rather than do outside activities.

The major businesses and industries employing workers in this area are those associated with production forestry, mills that manufacture forest products, outdoor recreational sports such as hunting, fishing, snowmobiling, and more. Unless people

work in education or natural resources, there are few professional careers available within our school district. In these times of economic recession, a number of local employers have downsized or gone out of business, resulting in loss of jobs for many families who live here. Within my College Biology class, 45% of my students were on free or reduced lunch.

My AR project fit well with the environmental science section of College Biology, and this course had the most time available for extended activities. In addition to the daily 43-minute class period, this course has a double period (86 minutes long) every other day where students are able to work outside and/or do longer activities in this double time period. I have limited my “hands on” authentic activities to those which could be completed within a normal school day, usually within the single or double class period, so all students enrolled in the course could take part. For each data collection method, I sampled my entire College Biology class of 11 sophomore students.

My primary focus question is:

- How would the addition of “hands-on” authentic lessons into the environmental studies curriculum of a biology class affect student comprehension of subject matter?

My sub questions include:

- How does the introduction of specific “hands on” authentic skills and activities modeled after Envirothon competitions affect student comprehension of subject matter when they are embedded into the environmental studies section of the curriculum?

- How does the introduction of specific “hands on” authentic skills and activities modeled after Envirothon competitions affect student comprehension of subject matter when they are taught as a separate “mini unit” outside the timeframe of the environmental studies section of the curriculum?
- How will implementing “hands-on” authentic lessons impact me as a teacher?

CONCEPTUAL FRAMEWORK

The use of “hands on” activities in an outdoor setting to learn about the environment has a long history. From the writings of Henry David Thoreau to the best selling book *“Last Child in the Woods”* (Louv, 2005) people have learned about the environment, both informally through life lessons and formally in school. However, methods and techniques by which students learn about the environment have undergone many changes. During the last century, people moved from farms into urban and suburban areas, and many people lost touch with nature as part of their everyday home and work life. “In fewer than a half century, the culture has moved from a time when small family farms dominated the countryside...to a transitional time when many families’ vegetable gardens provided little more than recreation, to the current age of shrink-wrapped, lab-produced food” (Louv, 2005, p. 21). Many post-secondary schools now emphasize more laboratory and/or computer based science courses such as genetic engineering over the more traditional natural science courses (Louv, 2005).

There is great value to using local sites and community resources, including guest speakers who are professionals working in various environmental fields to help teach

specific skills, and to make the activities more authentic and relevant to students. It is very important to give students a sense of a familiar place to increase student engagement; students want to feel some connection with the areas they are investigating (Griset, 2010). When students participate in site-based, outdoor activities, learning that occurs is “far greater than any lecture on biodiversity or quiz on the scientific names of small mammals- it went beyond disseminating information” (Pacifici, 2008 p. 37). Data collection and analysis can document increases in student comprehension of subject matter using “hands on” authentic teaching methods. Effective methods to evaluate students for increased learning include using various interview techniques (Monroe, 2001), and the use of props to supplement the more traditional interview methods (Brody, 1984).

“Hands on” activities in an outdoor setting allow the student to use multiple senses as part of the learning process. “The great worth of outdoor education programs is their focus on the elements that have always united humankind: driving rain, hard wind, warm sun, forests deep and dark- the awe and amazement that our Earth inspires, especially during our formative years” (Louv, 2005 p. 224). This immersion into the environment through outdoor activities can impact all of a student’s senses, creating a more lasting learning experience (Louv, 2005). “Hands on” learning is an important way to combine “thinking, feeling, and acting” (Brody, 1984, p. 5) activities as part of any program. Field work is important to teach environmental concepts which can be linked together in a meaningful way, and also to teach associated skills so students can investigate these concepts in a “hands on” authentic scenario (Brody, 1984).

It is possible to see the effects on student learning when “hands on” authentic activities have been eliminated. In 2001, fieldwork in Great Britain became impossible for a time due to a very unusual set of circumstances – a real life scenario where there was an outbreak of foot-and-mouth disease. Students and teachers could no longer move from one agricultural site to another because they might transfer the disease and infect new animals. Interview questions posed to both instructors and students affected by the lack of field work showed the importance of field work- “there are difficulties in the field, weather, terrain, those sorts of thing which gives you an additional problem solving experience as well, which I think you miss out on if you don’t have extensive fieldwork” and “Spending longer on projects than they would in the lab helps to build up a deeper level of team working and team skills” (Scott, Fuller, & Gaskin, 2006 p. 166). Students mentioned how lack of fieldwork affected their learning. Specifically they thought they were missing the whole, big picture for acquiring skills and knowing how these skills would be used in the real world. Both instructors and students felt fieldwork was essential to take theory and put in into practice (Scott, Fuller, & Gaskin, 2006, pp. 166-167). This is supported by Brody who states, “Through field work students can participate in ‘acting’ by learning skills and using them to investigate important aspects of the environment” (Brody, 1984 p. 5).

It is important to continue the tradition of “hands on learning” because it is successful. In 2002, approximately 91 Louisiana high school and middle school students participated in a daylong set of environmental activities that took place outside at five different stations to learn about water quality, plant science, soil science, land management, and aquaculture. This program, developed at the University of Louisiana at

Lafayette, was called an “agricultural and environmental challenge program” (Poudal et al., 2005, p. 10). The format for this program was based on Envirothon teaching methods in which environmental concepts and skills were both studied together using resource professionals as presenters, and there were many “hands-on” activities for students. In addition, actual specimens were used to make the activities more authentic. Students spent ½ hour at each site, the approximate timeframe of one class period, and then they rotated to another station. Data was collected and analyzed, and there were questions associated with each topic for students to answer. Problem solving and critical thinking skills were utilized as students compared results, and students actually proposed solutions to local, authentic environmental problems based on their data and observations.

After the program was completed, nearly 70% of the students stated the program was both interesting and educational, and a list of individual comments showed students were very positive about their learning outcome (Poudal et al., 2005, p. 17 and 20). For quantitative measurement of student learning using these methods, data was provided showing the number of correct student responses to environmental questions asked at each station immediately following each section of the Challenge Day. Overall, using a wide variety of content-specific questions, 61% of the questions were answered correctly by students (Poudal et al., 2005, p. 18 and 19).

Currently, teaching environmental science is important to the state of Maine as part of the Maine Learning Results (Maine Learning Results) and it is also part of the Ashland Community High School Vision statement, (Ashland Community High School) adapted in the 1990’s. Choice of the methods to be used is left to the individual teacher, and “Teachers have an overwhelming array of environmental materials and curricula

from which to choose” (Griset, 2010, p. 41).

It has been widely documented in the literature that there are many choices of “hands on” authentic lessons for teachers to use. In a variety of ways, each provides students with multi-sensory experiences to enhance learning. Many successful programs have shown increased learning occurs as students perform site-based tasks and handle tools and materials associated with environmental topics, especially in an outdoor setting. Conversely, decreased learning has been shown when students are deprived of these methods.

Envirothon teaching methods incorporate many of the strategies discussed in the conceptual framework as coaches routinely use these methods to successfully prepare teams for Envirothon competition. In my AR project I have implemented “hands on” authentic activities modeled after Envirothon teaching methods into a traditional classroom setting to see their impact on students.

METHODOLOGY

My Action Research took place during the school year from October 2010 to March 2011 using Envirothon Teaching Methods. The sample group I chose was my 10th grade College Biology students. Seven female students and four male students took this course, and the entire class participated in this project. Most of these students have attended the Ashland School District since kindergarten so they are very comfortable with each other as a group. They all have studied the same curricula which included

various science topics taught each year during grade school classes, Life Science units in 7th grade, and Earth Science/Physical Science units in 8th and 9th grades.

To begin the treatment activities for my AR research project, I planned a series of environmental lessons that fit the necessary criteria and used Envirothon teaching methods. Once I decided on suitable topics, I divided my research units into two sections. The first Unit, Forestry Integrated with Soils, was embedded into the traditional environmental studies unit of the curriculum during October and November, while the second Unit, Wildlife Integrated with Aquatics, was taught using separate “mini” activities during January to March.

Since Envirothon teaching methods use professionals with expertise in specific environmental fields to interact with students and teach them about local environmental topics, I first took advantage of a free program already in place, “Fall Field Days” hosted by The (northern Maine) Central Aroostook Soil and Water Conservation District. Held from 9AM to 1:30 PM on Thursday the 14th of October, 2010 at the Aroostook National Wildlife Reserve, students from northern Maine high schools selected three out of four stations (Soils, Forestry, Wildlife, Aquatics) and spent about one hour at each Station with resource professionals. The presenters all chose what activities they wanted to cover and what teaching methods they wanted to use. Some presenters featured “hands on” activities, and brought in “props” such as wildlife skulls and skins to help teach, while others used a “lecture style”. I randomly divided my students into groups to provide fairly equal numbers of students in the four sections I wanted to gather data on to use for my AR project; each of my College Biology students attended three sessions. This field trip provided my students their first opportunity in my AR project to learn

local environmental information presented in an outdoor setting by experts in the fields of aquatics, forestry, soils, and wildlife.

On October 25 and 26, my students did another soils activity using Envirothon Teaching methods. Although this took place indoors in my science laboratory, each activity was designed to be “hands on” and authentic, featuring tools a soils specialist would also use. Small groups of students rotated through a set of laboratory Stations, and completed activities to learn about soil. At one Station, they put different soil samples through a set of three sieves to determine percentages of various soil particle sizes in each sample, while at another Station, they saturated samples of different soil types with water and then compared how much water each could hold by measuring the mass of the soil (dry) compared to the mass of the soil (wet). They also gathered data to show how much time it took for water to leach through various soil samples. Sample directions for the activities at each Station are provided in Appendix B. Each Station was designed to teach a different soils concept, using “hands on” teaching methods.

On October 29, 2010 during a College Biology double lab period, I again returned outside with my students and used resource professionals to teach additional Forestry and Soils activities in a local setting. Ken White, a forester very familiar with Envirothon Contests, and my husband, Stan Perry, a forester and soil site evaluator, presented an outdoor workshop to my College Biology students, teaching them skills used by a forester and/or soil science person. Appendix C shows how Ken and I communicated to set up this activity. Forestry lessons included cruising, determining volume of wood, measuring tree diameter breast height (dbh), practicing pacing distances, taking tree core samples, and more. Soils skills included calculating slope, determining soil texture and

composition, identifying soil colors and horizon layers, recognizing hydric and well-drained soils, and more. The goal of this lab activity was to utilize specific Envirothon teaching methods to present Forestry and Soils information- bring in expert resource professionals to teach environmental topics using “hands-on” authentic activities in an outdoor setting.

During this same timeframe, I was also teaching environmental concepts to my class using my regular textbook, *BSCS Biology- A Molecular Approach* Chapter 2 “Energy, Life, and the Biosphere” (BSCS, 2006). I embedded the activities using Envirothon teaching methods into my traditional College Biology curriculum.

Research on my other sub question - “How does the introduction of specific ‘hands on’ authentic skills and activities modeled after Envirothon competitions affect student comprehension of subject matter when they are taught as a separate ‘mini unit’ outside the timeframe of the environmental studies section of the curriculum?” took place in the late winter. The treatment activities for “Wildlife Integrated with Aquatics” were much shorter in duration and very separated from the traditional environmental studies section of the biology course, since they were taught at a completely different time of the school year. The aquatics section focused on the abiotic factor of weather. Students listened to a 90 minute presentation given by our local television meteorologist, and then gathered accumulation data during February through mid-March based on precipitation, snow depth, snow melt and how weather conditions affected native wildlife. During this same time period, once a week for five weeks, students also conducted a high school wide wildlife survey to answer the question “Where is Ashland Wildlife Spending the Winter?” Each Thursday morning, individually or in pairs, my

College Biology students went into all the high school classrooms and asked everyone what wildlife they had seen Wednesday evening and/or Thursday morning on the Ashland area roads or trails as they traveled home from school and came into school (Appendix D). The final AR resource professional who presented environmental information to students was Rich Hoppe, Northern Regional Biologist, Maine Inland Fish and Wildlife. He came to class one period after the survey was completed to help students analyze their data and to explain why people were seeing more wildlife in some places than in others.

The Data Collection Methods for my Action Research Project included Pre and Post Treatment Questionnaires, Pre and Post Treatment Teacher Adapted Tests, Student Interviews, Student Focus Groups, and Teacher Field Notes. The Matrix in Table 1 shows how I integrated data from various sources to answer my focus question and sub-questions.

Table 1
Triangulation Matrix

Pre & Post Treatment Questionnaires	Pre & Post Treatment Teacher Adapted Tests	Student Interviews	Student Focus Groups	Teacher Field Notes
Focus Question - "How would the addition of "hands-on", authentic lessons into the environmental studies curriculum of a biology class affect student comprehension of subject matter?"				
X		X		X
Sub Question 1 - "How does the introduction of specific "hands on" authentic skills and activities modeled after Envirothon competitions affect student comprehension of subject matter when they are embedded into the environmental studies section of the curriculum"				
X	X	X		X
Sub Question 2 - "How does the introduction of specific "hands on" authentic skills and activities modeled after Envirothon competitions affect student comprehension of subject matter when they are taught as a separate "mini unit" outside the timeframe of the environmental studies section of the curriculum.				
X	X		X	X
Sub Question 3 - "How will implementing authentic, hands-on lessons impact me as a teacher?"				
X	X	X	X	X

The data collection instruments I chose were designed to show me if Envirothon teaching methods had an impact on student comprehension of environmental subject

matter. One of the important instruments I developed for data collection was questionnaires. The first instrument used in my AR project was a two-section questionnaire (Appendix E) given to students before and after the first treatment activity, Fall Field Days. The pre-treatment section was designed to gather baseline data on students' preferred learning styles, and the post-treatment section was designed to get feedback on which methods used in the treatment activity were actually the most effective to increase learning. Specifically, in the post-treatment section I wanted to determine if and/or how the choice of environmental topics, the setting, materials and props used in the lessons, and knowledge and delivery style of the presenter each may have influenced student learning. I also used other questionnaires to determine the effect of embedding treatment activities into the environmental science section of the biology course compared to doing the activities as stand alone "mini units". In addition, questionnaires were important to ask students for feedback on presentations given by resource professionals. "Hands on" authentic lessons, knowledge and delivery style of the presenter, and use of an outdoor setting are all Envirothon teaching methods. Each of the questionnaires I used as a data collection instrument provided both qualitative and quantitative information to determine their importance.

Another instrument I developed, the Pre & Post Treatment Teacher Adapted Tests, (Appendix F) was selected to provide quantitative data on students' knowledge of subject matter before treatment activities and to document any changes in comprehension of subject matter after treatment activities. To determine this, I evaluated students before and after each treatment section in my AR project using these tests. In an actual Envirothon contest, teams of students answer a series of questions specific to

each of the four environmental topics chosen for my AR activities. – aquatics, forestry, soils, and wildlife. Although students are given a packet of resource information and encouraged to learn as much as possible about each topic when preparing for the Envirothon competition, it is always impossible to accurately predict what questions they will be tested on. In my AR project, I wanted to reproduce this portion of the Envirothon as closely as possible by putting together a set of 20 Questions for each treatment area to evaluate learning. Many of these questions were taken from former Envirothon tests that are available to the public, while I adapted other questions from my biology textbook, *Biology – A Molecular Approach* (BSCS, 2006) or other text and online resources. Whenever possible, I relied on actual Envirothon questions to closely emphasize the idea that I was teaching with Envirothon methods. To determine the validity and reliability of these questions, I contacted some of the people from Maine who wrote them (Appendix G). All the writers are highly qualified, knowledgeable professionals employed by the state of Maine, the United States Department of Agriculture (USDA) or other environmental organizations. They include Soil Scientists, people from Maine Audubon, Maine Department of Inland Fish and Wildlife, the Maine Forest Service and more. A great deal of thought is put into preparing each question. Merle Ring, Maine District Forester, shared his thought process with me:

the questions come from my experience as a professional forester and the resource information they have. The criteria are several - 1. making the questions challenging without being so hard as to be discouraging. That's based on many years of doing these tests. 2. Trying to use the "teachable moment", meaning trying to word the questions to teach as well as to test. 3. Making the

questions “do-able” within the given time frame. 4. For the regional tests – making questions that are not so “site specific” that they can’t be reproduced and used at all the different regional competition sites (M. Ring, personal communication, March 16, 2011).

Within each set of questions I used for this AR project, I selected the first ten to evaluate my students’ knowledge of concepts and vocabulary terms, while the goal of next ten was to challenge students to use higher order, critical thinking skills applying basic knowledge to solve real-life problems. Students were first given the questions to answer before each topic area was covered; this way I could gather data on what each knew before studying forestry, soils, wildlife, and aquatics using Envirothon teaching methods. Students were not told the answers or how well they had done for these pre-treatment Teacher adapted tests. After each treatment unit, students were again asked to answer the same set of questions to determine if comprehension of basic material and/or higher order thinking skills had increased as a result of the teaching methods I used.

Other instruments important to my AR project included individual student interviews and/or focus groups. Student Interviews, (Appendix H) conducted after the treatment activities were embedded into the environmental science portion of the college biology course, featured the use of “props” which students had used during the activities. I had available all of the props used in the indoor Soils Stations laboratory held on October 25 & 26, and the outdoor forestry/soils laboratory held on October 29. These props included: calipers, clinometer, diameter tape, increment borer, Munsell chart, soil sieves, and a wedge prism. During the interview, each student was given an opportunity to demonstrate learning by handling prop(s) of her/his choice and simulating what she/he

had done during the actual activity.

Focus groups (Appendix I), held at the completion of the “mini units” which were implemented in January-March, months after the completion of the environmental studies section of the biology course, were used to determine if learning was impacted by this time separation. The focus groups gave students a chance to describe what they had learned by gathering wildlife data from classmates and the impact of hearing from resource professionals who could explain why these wildlife sightings were occurring at certain times and places. The interviews and focus groups provided more specific qualitative information to determine how comprehension of subject matter had changed after each activity.

During each of the six treatment activities I also used field notes as an instrument (Appendix J). Whenever possible, I wrote notes as the activity was taking place, providing me with “on the spot” glimpses of the student learning I observed. However, there were times when I needed to take an active role in facilitating the activity as a privileged observer, and my note taking was delayed. Although further removed from the time of learning, these notes did allow for more reflection. Whatever the timeframe for writing, my field notes were a valuable instrument to provide me with excellent insights in showing the best way students learn. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained.

DATA AND ANALYSIS

When I first began this AR project, my students had little or no knowledge of “Envirothon” or what coaching methods would typically be used to prepare for this competition. Data analysis for my AR treatment activities began with a questionnaire given to students before I actually started any “hands on” authentic environmental science activities to determine if they had any preferences for styles of learning followed by a post-treatment focus group wrap-up discussion. Data comparing these two analyses are presented in Table 2. Data showed students liked “hands on” learning, but they were also very open to other methods. However, by the time the AR project finished, when students took part in the focus group wrap-up discussion, they indicated the use of Envirothon teaching methods was very important to increased learning. The first theme to emerge was that the more students experience Envirothon teaching methods, the more they want to continue their use.

Table 2
Changes in Student Preferences for Methods to Learn Environmental Topics, (N= 10)

	Prefer “Hands on” activities for learning (%)	No preference for “Hands on” vs. “other” activities (%)	Prefer outdoor setting for learning (%)	No preference outdoor learning vs. other (%)	Prefer indoor learning (%)
Pre-treatment Questionnaire October	40	60	40	50	10
Post- Treatment Focus Groups March	100	0	70	30	0
change increase or decrease	60 increase	60 decrease	30 increase	20 decrease	10 decrease

Data analysis from the Pre-treatment Questionnaires compared to the focus group wrap-up clearly shows these changes in student preferences for learning. When I analyzed data from the first questionnaire, students differed in their preferences regarding both the setting and teaching methods by which to learn environmental topics. Out of ten students who responded to this questionnaire, 50% had no preference to learn inside or outside, while an additional 40% indicated they would like learning to take place outside. Only one student (10%) preferred inside learning more than outside learning.

If students had a preference to learn using either technology, including interactive computer programs vs. “hands on” activities, 40% students would prefer “hands on” learning while the other 60% had no preference. None preferred computer lessons.

There was also a fairly even division between students who wanted to spend less time on a particular topic so they could study a wider variety of topics vs. those who preferred a more in-depth look at fewer areas; 60% of the class expressed no preference.

Regarding the wide variety of environmental topics and activities to choose from, data analysis showed many different rankings for the importance of learning environmental concepts, skills, and vocabulary. Over half the students (60%) stated the most important reason they wanted to study the environment was because it is a required part of the curriculum. However, there were several students who listed their desire to become an “environmentally conscious decision maker” as the major reason to study these topics, and one student was interesting simply because he/she wanted to be a person with a life-long love of learning.

Looking back to the beginning of the AR project, students showed openness to choice of setting and method. Both male and female students of varying academic abilities entered the treatment activities with the idea that they like outdoor, “hands on” activities, but most were ready to try a variety of different methods. My data in Table 2 showed student preferences from the first questionnaire compared to the wrap-up student focus group questions in March changed dramatically in the preference for “hands on” vs. other methods of learning, while the preference for learning in an outdoor setting also showed an increase.

During Fall Field Days, my first treatment activity, I had the opportunity to gather and analyze data from my entire class to document the effect Envirothon teaching methods had on student learning. This all-day activity, designed as a training activity to prepare Envirothon teams, incorporated all of the important Envirothon methods used to effectively teach environmental topics which include “hands on” authentic learning in an outdoor setting, presentations from highly qualified professionals, and groups of students moving from Station to Station performing tasks and answering questions regarding each Envirothon topic- aquatics, forestry soils, and wildlife. Since every Station was outdoors and every Station had competent resource persons to present information, I kept these Envirothon teaching methods as constants, and focused on differences in the teaching styles of the presenters at each Station. At Fall Field Days, my students first experienced a variety of presentations using Envirothon teaching methods. Using my field notes, a questionnaire given to students following this field trip, and student interviews, a second important theme emerged:

The teaching style of the presenter and the pace of the presentation have a large impact on student comprehension of subject matter (Table 3).

Table 3

Impact of Presentation Style and Pace on Student Learning, (N = 11)

Station topic & brief description of delivery style and pace of presentation	Students who indicated presenters provided too much information within the given timeframe for comprehension of subject matter (%)	Students who indicated presenters provided too little information within the given timeframe for comprehension of subject matter (%)	Students who indicated presenters provided the correct amount of information within the given timeframe for comprehension of subject matter (%)
<u>Aquatics:</u>			
*Lecture style delivery	77.8	11.1	11.1
*Many different topics			
*Large amount of information on each topic			
<u>Forestry:</u>			
*Interactive style delivery			
*3-4 major topics			
*only information necessary to complete tasks is presented	33.3	0	66.7
<u>Soils:</u>			
*lecture style delivery	75	0	25
*Many different topics			
*Large amount of information on each topic			
<u>Wildlife:</u>			
*Interactive style delivery	0	0	100
*3-4 major topics			
*only information necessary to understand topics is presented			

I first recognized this pattern as I moved from Station to Station during Fall Field Days, observing students and writing field notes. Almost immediately, without realizing it was important, I started to notice definite differences in the presenters of the various topics. One of the groups, the presenters at the Wildlife Station, had a retired science teacher and another really good speaker as the presenters, and they used a very interactive Question & Answer method of teaching with lots of enthusiasm. Another group, the presenters at the Forestry Station, had an older, very experienced “woods person” who had lots of stories to share, told many jokes and interacted well with the students. He also pushed them to participate in each activity and wouldn't take “no” for an answer when he asked them to try something. In contrast, at the Aquatics Station, there were the “lecture” presenters - very knowledgeable, but not very interactive, and the “middle of the road” Soils Station presenters.

In my field notes I also observed learning was affected by speed and level of information; if information was not presented at a level students could understand, or presented too quickly, students stopped focusing. I wrote that some of the presenters at Fall Field Days tried to provide students with a large amount of information in a very short period of time.

When I gave students the Fall Field Days Post-treatment section of the questionnaire, the data strongly showed the impacts of delivery style and pace of presentation on learning. Students indicated preferences for interactive teaching styles and for information to be presented at a basic level and slow speed. Too much information presented in a short period of time using a lecture style overwhelmed students, and they learned very little when this occurred. A variety of student quotes

included “Aquatics was kind of boring and too much information was given” “Aquatics was definitely the muddiest part of the trip- I did not know almost anything about it.” (The muddiest point was) “Aquatics. I didn’t really understand what they were saying” (The muddiest point was) Aquatics. They didn’t really let us do anything and I didn’t understand it.” Students even injected some humor into their responses- “The muddiest part of the trip was the soils ha ha! She was going really fast it was hard to keep track of it. It was difficult to stick with.” Therefore, the starting point for successful student learning is the presentation; if the presenters are not able to connect with students, the students will not stay focused, and learning of subject matter decreases. Students also indicated that once presenters had connected with them, another major theme emerged:

In addition to the delivery style of the presenter, the use of “hands on” activities and/or props had a very positive impact on student comprehension of subject matter.

After students attended “Fall Field Days” they indicated in the post-treatment section of the questionnaire they did not like presenters who did not provide activities, but only used a “lecture style” (Table 4).

Table 4

Impact of “Hands On” Activities and/or Props on Student Learning, (N = 11)

Station topic and brief description of delivery style and types of activities and or participation by students at each Station	Students who indicated presenters provided too many ‘hands on’ activities for comprehension of subject matter (%)	Students who indicated presenters provided too few ‘hands on’ activities for comprehension of subject matter (%)	Students who indicated presenters provided the correct number of ‘hands on’ activities for comprehension of subject matter (%)
<u>Aquatics:</u>			
*No “hands on” activities	0	100	0
*No props			
*Students remain in 1 place			
<u>Forestry:</u>			
*Variety of “hands on” activities	0	0	100
* props			
*Students move through forest			
<u>Soils:</u>			
*few “hands on” activities			
*Tools provided as props	0	75	25
*Students in 1 place			
<u>Wildlife:</u>			
*Variety of “hands on” activities			
* props	0	0	100
*Students remain in 1 place but actively handle all props			

In addition to data from the questionnaire, when students were interviewed, they compared how much they had learned from forestry and wildlife to the other Stations.

One student noted “I learned a lot about wildlife and forestry. I hated aquatics.

Both wildlife and forestry always had my attention. Aquatics was too much talking”

At this point, I realized most students had indicated they had learned very little about aquatics or soils from the presenters at Fall Field Days. Since I was embedding soils into the environmental studies curriculum, I decided I wanted my students to practice more with the “hands on” activities associated with soils. With the help of a soils specialist, my husband, I presented treatment activity #2, a double period indoor lab with stations where students completed a variety of “hands on” Soil Station activities.

This second treatment activity incorporated some, but not all, of the Envirothon teaching methods. Most of the activities were “hands on” and authentic. Students rotated from Station to Station within the classroom gathering and analyzing data, but there were no resource professionals to present the information, and the setting was indoors. In this activity I divided the class into 5 groups and rotated each group of students through five Soils Stations; four of the Stations involved “hands on” activities, while one was a reading assignment. I planned the activity for a double (86 minute period), allowing approximately 15 minutes per Station. I quickly found it was going to take longer than planned so I added in an additional class period the next day to finish. My field notes showed I was guilty of the same type of “information overload” as some of the Stations at Fall Field Days when I tried to complete this activity too quickly.

Following this indoor lab, I completed a second outdoor presentation based on Envirothon teaching methods. I asked two local resource professionals, a forester and forest soils person, to come to my double period class and take the students outside to a small forest stand located next to the school building to provide my students with additional outdoor laboratory activities for forestry and soils.

Data analysis following these presentations showed substantial differences in learning between the Soils Station at Fall Field Days and the Soils Presentations on October 25, 26, and 29th (Table 5). In comparison, the Forestry Station kept the same presenter and methods at Fall Field Days and the Outdoor lab on October 29th but the forestry activities changed. Forestry continued to receive high ratings from students, showing the selection of activities is not the important criteria, but rather the presenter's delivery style and her/his ability to connect with students.

Table 5

Changes in Teaching Methods for Forestry & Soils Presentation, (N = 11)

Station topic & brief description of delivery style, pace of presentation, types of activities and or participation by students at each Station	Presenter(s) at this Station had a positive impact on student learning. Students indicate excellent or very good rating for comprehension of subject matter (%)	Presenter(s) at this Station had a neutral impact on student learning. Students indicate average rating for comprehension of subject matter (%)	Presenter(s) at this Station had a negative impact on student learning. Students indicate poor or useless rating for comprehension of subject matter (%)
<u>Forestry: Fall Field Days</u>			
*Interactive style delivery			
*3-4 major topics			
*Only information necessary to complete tasks is given	75	25	0
*"Hands on" activities			
*Tools provided as props			
*Students move			
<u>Forestry: Double Period Lab</u>			
*Interactive style delivery			
*3-4 major topics			
*Only information necessary to complete tasks is given	81.8	18.2	0
*"Hands On" activities			
*Tools provided as props			
*Students move			
<u>Soils: Fall Field Days</u>			
*Lecture style delivery			
*Many different topics			
*Large amount of information	33.3	44.4	22.2
*Few "hands on" activities			
*Tools provided as props			
*Students remain in 1 place			
<u>Soils: Indoor/Outdoor School Activities</u>			
*Interactive style delivery			
*3-4 major topics			
*Only information necessary to complete tasks is given	72.7	27.3	0
*"Hands on" activities			
*Tools provided as props			
*Students move			

When it was time to assess students to determine changes in comprehension of subject matter following the use of these 3 treatment activities, I chose to compare how successfully students were able to answer the same series of questions in the Teacher Adapted Test before and after forestry and soils activities were presented using Envirothon Teaching Methods (Appendix K). In Table 6, data analysis showed that following the use of Envirothon teaching methods embedded into the environmental science curriculum, students demonstrate increased comprehension of subject matter.

Table 6

Impact of Envirothon Teaching Methods Embedded into the Environmental Science Curriculum, (N = 10)

	Forestry Questions 1-10 relating to concepts and vocabulary	Forestry Questions 11- 20 relating to higher order thinking skills	Soils Questions 1-10 relating to concepts and vocabulary	Soils Questions 11-20 relating to higher order thinking skills
Number of correct responses before treatment activities	45	49	61	32
Number of correct responses after treatment activities	63	65	76	62
change increase or decrease	18 increase	16 increase	15 increase	30 increase

Additional data supporting this theme was shown when students came in for individual interviews. Each student was asked to provide details on the most effective ways for them to learn. Students were eager to share their thoughts, and they had some

very strong opinions. Out of 11 students, 100% stated emphatically that “hands on” activities, whether used indoors or outdoors, were the most effective way to learn. As a male student stated “definitely hands on- it always has your attention. In class, your mind can wander, but not when you’re busy.” A female student said “when I see it and try it, I can tell you how to use it” as she referred to the forestry tools on the table. The “hands on” activities they chose as most useful to learning varied widely, and there was no apparent top choice of one activity.

Conversely, when students were asked to describe least effective ways to learn, most students commented that bookwork, reading, and/or a lot of worksheets were not the best ways to learn and retain subject matter. One student stated “its boring. If I’m not interested, then I don’t learn” while another student said “answering 1 question at a time doesn’t get into my head- sometimes I don’t even remember I did it”

Students were also asked to demonstrate comprehension for either a forestry or soils topic of their choice. Props, including soil sieves, increment borer, calipers, and more were available on the lab tables, and most students immediately reached for a prop and moved it in the air, showing me what they had learned. As displayed in Figure 1, out of 11 students interviewed, two students selected the clinometer, a device for measuring slope, two students chose the increment borer, a device for counting the tree rings, two students chose the prism, a device for counting trees within a specific area to determine volume of wood, and five chose the soil sieves, a tool for separating a soil sample into different size particles; this was the only tool which had not been used outside, but was one of the “Hands On Soils Stations” classroom activities.

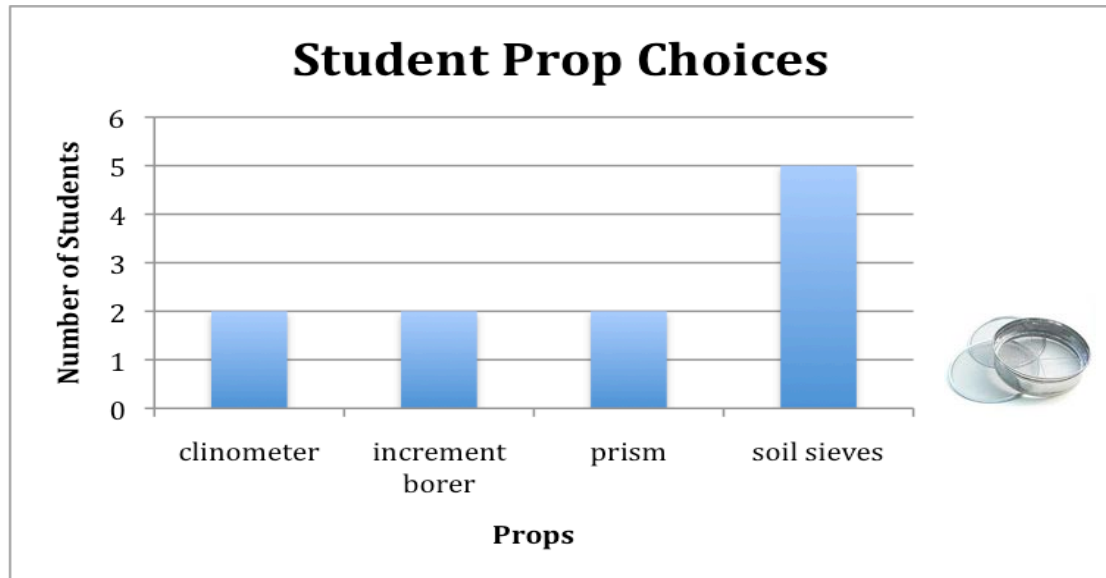


Figure 1. Student Prop Choices, ($N = 11$)

All students were very proficient, showing skillful use of the tool they had selected. They each picked up the tool, assembled it if necessary, demonstrated the proper way it worked, and also explained the purpose of the tool, all without further prompting from the interviewer! The reasons for selecting each tool were informative to show student learning. Working with the soil sieves, one student said, “its not just cool to look at, they are fun.” As she set up the three sieves in the correct order, she continued, “it sizes the soil particles. Put (The sieve) with the biggest holes on top- the first time I did this, it confused me, but now I know. Everything smaller than the holes falls through.” Another student stated the soil sieves “was my favorite activity- I know very well how to use it” Using the props, it was apparent students knew what information each would provide and how each was used. My data showed props are a very useful way to demonstrate student proficiency and comprehension of subject matter. If many different activities and tools were presented, students did not learn about all equally well;

however, if the presentations were of high quality, different students learned a variety of skills and concepts, depending on their interest.

During January through March, my students completed three “stand alone” treatment activities based on aquatics and wildlife. Two of these activities involved indoor presentations by professionals, each very knowledgeable, but there were differences in their delivery styles. The first treatment activity, a presentation by a local meteorologist took place in the school auditorium before a large student audience. The purpose of this presentation was to provide students with information on weather terminology, current and historical local winter conditions, and dramatic weather situations that might occur. The local winter weather information would be useful to students when they collected data on the next treatment activity, a wildlife survey. Although students were encouraged to ask questions, the meteorologist used mostly a lecture style presentation. The only Envirothon teaching methods in this mini-unit were the use of a highly qualified resource professional and the presentation of local information.

In comparison, treatment activities five and six, featuring information on local wildlife, incorporated a greater variety of Envirothon teaching methods compared to the meteorologist presentation. One part of this activity, the wildlife census, was “hands on” and authentic; observations of wildlife sightings took place outdoors as students and staff traveled to and from school. As part of the survey group, my students were active participants, using their observation skills outside the school setting to document where and when they had sighted wildlife. As the survey implementers, they also gathered and analyzed data based on the observations of other students and staff. With the addition of

treatment activity #6, the presentation by Maine Inland Fish and Wildlife Regional Biologist, Rich Hoppe, my students had access to the expertise of a professional to help them interpret the data and make conclusions. A theme that emerged showed Envirothon teaching methods could be used successfully as stand alone presentations, but there was greater comprehension of subject matter if students were active participants in some type of “hands on” activity. Table 7 shows the number of correct responses to the Teacher Adapted Test for Wildlife Integrated with Aquatics pre and post treatment (Appendix L).

Table 7
Impact of Envirothon Teaching Methods in “Stand Alone” Activities, (N = 10)

	Aquatics Questions 1-10 relating to concepts and vocabulary	Aquatics Questions 11- 20 relating to higher order thinking skills	Wildlife Questions 1-10 relating to concepts and vocabulary	Wildlife Questions 11- 20 relating to higher order thinking skills
Number of correct responses before treatment activities	44	52	50	38
Number of correct responses after treatment activities	51	61	68	51
change	6	9	18	13
increase or decrease	increase	increase	increase	increase

Table 7 shows although there was increased comprehension in some areas of aquatics, much more occurred in the area of wildlife. With wildlife, students were active participants in a “hands on” authentic activity plus there was a resource person who provided information specific to this local topic of interest. Table 8 shows the style of the two presenters was also a factor in students’ ability to learn.

Table 8

Impact of Presentation Style in “Stand Alone” Activities, (N = 11)

Stand-Alone Presentations- brief description of delivery style and types of activities and or participation by students at each presentation	Presenter had a positive impact on student learning Students who indicate excellent or very good rating for comprehension of subject matter (%)	Presenter had a neutral impact on student learning Students who indicate average rating for comprehension of subject matter (%)	Presenter had a negative impact on student learning Students who indicate poor or useless rating for comprehension of subject matter (%)
<u>Meteorologist</u> *No “hands on” activities *no props *students stay in 1 place *no immediate connection to ongoing class project	27.3	72.7	0
<u>Wildlife Biologist</u> *interactive delivery style *No “hands on” activities *props *Students stay in 1 place *direct connection to ongoing class project “Wildlife Census”	81.8	18.2	0

The greater increase in comprehension of subject matter for wildlife compared to aquatics depended on the ability of the speaker to connect with students, the presentation style, and how closely students were actively engaged in learning about the topic. If the information presented had relevance, and students used multiple senses while learning, the timeframe of the presentation did not matter.

To evaluate the overall impact of using Envirothon teaching methods, I analyzed data for each of the students enrolled in the College Biology course; an overview of general information and academic achievement for each student is presented in Table 9. The Grade Point Average (GPA) is an indication of how well each student performed throughout freshman year and during the first two quarters of the sophomore year in all high school classes, including core courses such as English, math, and science plus electives, and physical education. The Environmental Science data sections are separated into treatment activities using Envirothon teaching methods, non-treatment lab activities such as microscope drawings of various organisms that live in ponds or soil, graphing, analysis of data, and more. The combined Environmental science data are the total grade for the Environmental science unit; these data include treatment and non-treatment lab activities, class work, homework, and assessments featuring information covered while the treatment activities were embedded into the traditional curriculum. Also included in Table 9 is the gender of each student and the number of absences from biology class during the AR year through April 1, 2011.

Table 9
College Biology Student Records, (N = 11)

Student Identification Letter	Gender f= female, m=male	Number of Periods Absent From College Biology 9/8/10 to 4/1/11	Grade Point Average (GPA) To 4/1/11	Environmental Unit Grade- Forestry & Soils Treatment Activities	Environmental Unit Grade (Non-Treatment Lab Activities)	Environmental Unit Total Grade- Treatment & Non-treatment Activities, Assessments, Homework, Labs etc.	Proficiency in Wildlife & Aquatics Treatment Activities Satisfactory=S, Unsatisfactory =U	Grade –Biology Units unrelated to Environmental Unit 11/09/10 to 4/1/11
A.	m	10	89.38	95.0	86.3	92.2	S	90.9
B.	m	0	88.42	90.0	89.3	90.3	S	83.3
C.	f	4	82.26	83.8	83.4	81.4	S	74.4
D.	f	1	85.78	78.3	76.7	84.7	S	81.8
E.	m	9	87.21	84.0	82.2	89.7	S	91.9
F.	f	1	81.25	80.0	77.3	85.5	S	75.8
G.	m	1	97.15	96.7	95.0	96.4	S	97.2
H.	f	2	83.92	80.0	68.4	83.5	S	77.4
I.	f	7	76.38	78.3	57.1	74.5	S	70.9
J.	f	4	82.15	85.0	58.1	74.4	S	72.8
K.	f	4	81.92	72.5	56.1	71.3	S	73.8

Data from Table 9 shows 75% of students showed their highest average in either the Environmental science treatment activities or the Environmental science total grade, which would include treatment activities. When comparing data from all areas of the

College Biology curriculum covered to 4/1/11, 73% of students had the lowest average grade in the Environmental science non-treatment lab activities. If the data are combined, they show 75% of students had the highest averages using some combination of Envirothon teaching methods and a nearly equal percent had the lowest averages doing lab activities without using these methods. This strongly showed Envirothon Teaching methods had a very positive impact when embedded into the traditional environmental science curriculum. Even an outlier student (k) who had a substantially higher GPA (81.92) compared to either treatment activities (72.5), non-treatment environmental activities (56.1), or combined treatment/non-treatment activities (71.3) stated during the interview that she really liked doing the “hands on” Envirothon activities; it was her difficulty following up the activity with required write-ups that kept pulling her scores down. Therefore, even though her grades did not reflect a high level of achievement with Envirothon teaching methods, this outlier student did think she learned a lot from her participation, the “doing” part of the lesson.

In summary, data analysis showed Envirothon teaching methods increased comprehension of subject matter for the majority of students whether embedded into the environmental studies section of the course or used as “stand alone” activities.

INTERPRETATION AND CONCLUSION

Reflecting on my focus question, “How would the addition of ‘hands-on’ authentic lessons into the environmental studies curriculum of a biology class affect student comprehension of subject matter?” Fall Field Days, the first treatment activity,

provided me with valuable data and observations. Every presenter was very knowledgeable in content material; therefore, they all met this Envirothon teaching method criterion. Outdoor location, however, did not necessarily lead to increased comprehension if the presenters did not have the students' attention. Overall, my data showed the primary ways to gain students' attention were to connect with them and to present information at a level they could understand. According to 100% of my students, using "hands on" authentic activities was the Envirothon teaching method that worked best to accomplish this goal. "Hands on" activities increased sensory stimulation and the more senses students used, the greater positive impact on learning. The Wildlife presenters who brought in props for the students to handle, such as wildlife skins and skulls, and the Forestry presenters who had the student's practice with tools and equipment, such as increment borer and tape measure, were able to impact comprehension of subject matter the most. All of the students thought the Wildlife presenters at Fall Field Days used the correct combination of amount of information and number of "hands on" activities to increase comprehension and 81.8% of students thought the classroom presentation by the Wildlife biologist at the end of this AR project, also had an excellent or very good impact on student comprehension. In forestry, 75% of students at Fall Field Days and 81.8% of students at the outdoor lab thought these presenters had excellent /very good impact on comprehension. At the end of this AR project, the focus group discussions also clearly showed the value of "hands on" authentic activities and the need for a connection between the presenter and students.

Regarding my sub question, "How does the introduction of specific 'hands on' authentic skills and activities modeled after Envirothon competitions affect student

comprehension of subject matter when they are embedded into the environmental studies section of the curriculum?” not surprisingly, my AR project showed typically the more time spent on subject matter, the more comprehension. Looking at students’ College Biology achievement level, the grades which combined both Envirothon treatment activities and traditional environmental studies assessments and the grades which were based on treatment activities alone both averaged 84% while the non-treatment environmental science average was 75.4%. This is an increase of 8.6% using Envirothon teaching methods.

There was also an increase in correct responses in the Teacher Adapted Tests pre and post treatment in the Envirothon areas embedded into the environmental studies curriculum. There was an average of 20% increase in correct responses between the pre and post treatment Forestry (+17%) Integrated with Soils (+22.5%) questions.

I was very interested to analyze my data on the sub-question “How does the introduction of specific ‘hands on’ authentic skills and activities modeled after Envirothon competitions affect student comprehension of subject matter when they are taught as a separate ‘mini unit’ outside the timeframe of the environmental studies section of the curriculum?” since this was a deliberate attempt to insert environmental activities into the time of year where they fit best rather than keeping them within the time frame of an environmental studies unit. Since students were given only a “pass-fail” evaluation on the wildlife survey, much of my data in this section is qualitative.

Regarding the content material of the two guest speaker presentations and the effect of each on student comprehension, the meteorologist gave students important background information on winter weather, including water data important to

understanding how wildlife is affected by weather. However, he was not as closely linked with the wildlife survey activity as the final presenter, the wildlife biologist. Although increased learning occurred with both presentations, on the questionnaire (Appendix M) 81.2% of students thought the wildlife biologist presentation had “excellent” or “very good” information leading to a positive impact on comprehension of subject matter compared to 18.2% who thought the information was of “average” value. In comparison, only 27.3 % of students thought the meteorologist had an “excellent” or “very good” impact on comprehension vs. 72.7 % who thought the information presented was only of average value. To a classroom teacher, this would indicate the more Envirothon teaching methods a presenter uses, the stronger the link becomes between the lesson and its relevance to students. Developing this strong connection leads to greater positive impact on student comprehension.

Specific comprehension changes in the answers to questions on the Teacher Adapted Test showed a smaller positive change in comprehension pre and post treatment in aquatics and wildlife compared to forestry and soils. There was an average 11.5% increase in the pre and post treatment answers for Aquatics (+8%) Integrated with Wildlife (+15%). This smaller increase in learning was especially noticeable in the aquatics unit, probably because less time was spent on this section and there were no “hands on” activities. Additionally in aquatics, there were more negative changes from correct responses to incorrect responses, showing students did not have a strong knowledge base, but instead were willing to change answers easily.

In contrast to aquatics, data analysis from questionnaires, focus group discussions, and my field notes all indicated significant positive changes in comprehension in forestry,

soils, and wildlife, showing Envirothon teaching methods can be used successfully whether they are embedded into the environmental science curriculum or whether they are used as “stand alone” activities. However, for greatest positive impact on students these methods should feature some “hands on” activities or props and have a direct connection between a speaker and a “mini unit”.

VALUE

The value of this AR project has been established through careful analysis of the data gathered to answer my final sub-question, “How will implementing ‘hands-on’ authentic lessons impact me as a teacher?” I now have a much greater understanding and appreciation of the time and effort it takes to present students with high quality environmental science lessons. I also more fully comprehend the importance of being able to call on resource personnel who have a deep knowledge base in a specific field as well as effective delivery style and strong connection with students. Using Envirothon teaching methods within a traditional classroom setting has allowed me to utilize highly qualified resource people as presenters, as well as to take my students to programs which have been carefully developed to teach aquatics, forestry, soils and wildlife concepts and skills in a local, outdoor setting. When these knowledgeable presenters relate well to students and incorporate “hands on” authentic activities, the highest increase in comprehension of subject matter takes place. There is a synergy that occurs when teachers and resource personnel work together to develop the best possible environmental studies programs using these Envirothon teaching methods.

It has also been very encouraging to see my students continue to show interest in an activity after it has been completed. For example, when I finished the wildlife survey in early March, several students asked why we were stopping, and told me they were disappointed not to keep tallying data. My students continued to share sightings of various wildlife species with me, using observation skills and increasing their knowledge of local wildlife and habitat conditions beyond a classroom setting. In future years I plan to continue the high school wide wildlife survey much longer into the spring.

As a teacher, I would definitely continue to use these methods and to look for additional ways to incorporate them into my classes. For example, in this AR project, I chose to embed forestry and soils into the environmental studies curriculum, spending far more instruction time on these areas compared to wildlife and aquatics. My reasons were valid- time of year, availability of resource people and proximity of suitable sites, but instead I could have chosen to spend more time on aquatics and wildlife. There are many excellent “hands on” authentic activities which could be accomplished in these areas including, but not limited to, macro-invertebrate identification and water quality analysis in aquatics and scat and track identification in wildlife. In future years, I hope to expand on these areas within my College Biology curriculum.

If other teachers would like to incorporate Envirothon teaching methods within a traditional classroom setting, the following suggestions are offered to maximize positive impact:

- The ideal presenter should be selected based on her/his knowledge of the topic; content-based knowledge is essential for a successful presentation.

- The ideal presenter should relate well to students and connect the presentation to subject matter with direct relevance to students; the speed and depth of information should be suitable for students' level of understanding.
- The ideal presenter should encourage active participation by all students; the more "hands on" activities and/or tools or "props" available for students to actually handle, the greater the positive impact on learning.
- The ideal presenter should develop and strengthen each new presentation based on past experiences; collaboration with colleagues is a valuable way to see Envirothon teaching methods in action and to insure reliability and validity of information presented.
- The ideal presenter should ask for feedback from students and the classroom teacher and use their suggestions to modify future presentations; keeping successful activities and changing others if needed, leads to even more effective teaching styles.
- The ideal presenter should invigorate and motivate students; a dynamic teaching style keeps students interested and focused on the topic.

Sharing these tips, and providing each presenter with background information on basic content that students have already learned, will help each to prepare and deliver the highest quality presentation.

One portion of this AR project I would definitely change is the way I use the Teacher Adapted Tests in all four areas. Although I decided to give the tests pre and post treatment in order to gather data on changes in student comprehension, this was not useful to the students. They received no feedback on correct vs. incorrect responses the

first time they took each test, and I believe part of the reason answers sometimes went from correct to incorrect during the second test was students were not reassured they had gotten the answer correct initially. Also, in an effort to gather individual student data, I deviated from actual Envirothon contest procedures. In an Envirothon competition, students would take each test as a team of three to five students, emphasizing collaboration between students, allowing each student to have input based on their strength of knowledge in a particular area. In future years, I will use each set of questions only once, after a unit of aquatics, forestry, soils, and wildlife is completed, and students will be randomly divided into “teams” to answer questions. I will also continue to look for new questions to use, especially higher order questions. The tests will not be static, but instead will be modified each year.

Observing my students working with presenters, writing my field notes, asking students for feedback, and modifying lessons based on this information, have all had positive impacts on me as a teacher. There are many excellent free, local resources that can be accessed to teach environmental studies, and I would definitely recommend the use of Envirothon Teaching Methods to increase student comprehension of environmental studies subject matter. Do I have final data analysis for this class of students on the effects of Envirothon Teaching Methods? Absolutely not! More and more, as I continue my teaching career, I realize the full impact of what is taught may only be seen years after students have graduated! Therefore, results of this AR project will continue to help me succeed as a teacher.

REFERENCES CITED

- Ashland Community High School. (n.d.). *School Vision Statement*. Retrieved April 4, 2010 from SAD32.org: <http://www.sad32.org/vision-statement.html>
- Brody, M. (1984). *The Floating Lab Research Project: An Approach to Evaluating Field Programs*. (ED 260 911 SE 045 949). Ithaca, NY: Cornell University Department of Environmental Education
- BSCS. (2006). *BSCS Biology: A Molecular Approach* (9th Edition ed.). Columbus, Ohio: Glencoe/McGraw Hill.
- Envirothon. (n.d.). Retrieved March 30, 2010 from Envirothon: <http://www.envirothon.org>
- Griset, O. (2010). Meet us outside! A field ecology course to engage all students inexploring environmental issues. *The Science Teacher*, 77, 40-51.
- Louv, R. (2005). *Last Child in the Woods Saving Our Children From Nature-Deficit Disorder*. New York City, NY: Algonquin Books
- Maine Governor's Conference. (2008). Retrieved March 30, 2010 from Take It Outside: <http://www.take-it-outside.org>
- Monroe, M. (2001). *Evaluation's Friendly Voice: The Structured Open-Ended Interview*. Retrieved March 30, 2010 from http://www.aeec.org/preview/research_mcm.asp
- Poudel, D., Vincent, L., Anzalone, C., Huner, J., Wollard, T., Clement, A., Deramus., and Blakewood, G. (2005). Hands-On Activities and Challenge Tests in Agricultural and Environmental Education. *The Journal of Environmental Education* , 36 (4), 10-22.
- Scott, I., Fuller, I., & Gaskin, S. (2006). Life without Fieldwork: Some Lecturers' Perceptions of Geography and Environmental Science Fieldwork. *Journal of Geography in Higher Education* , 30, 161-171.
- Tish Carr, Maine Association of Conservation Districts. (2011). *2011 Maine Envirothon Registration Packet* .

APPENDICES

APPENDIX A

ENVIROTHON INFORMATION

Envirothon Information

The following online information has been downloaded from the website:

<http://www.envirothon.org/>

CANON ENVIROTHON

The Canon Envirothon is North America's largest high school environmental education competition. Reaching more than 500,000 students across North America annually, the Envirothon succeeds in its mission to develop knowledgeable, skilled, and dedicated citizens who are willing and prepared to work towards achieving a balance between the quality of life and the quality of the environment.

WHAT IS THE ENVIROTHON?

The Envirothon is a hands-on environmental problem-solving competition for high school-aged students in the United States and Canada. Participating teams complete training and testing in five natural resource categories: i.e., soils and land use, aquatic ecology, forestry, wildlife, and current environmental issues. The Envirothon works in partnership with local conservation districts, forestry associations, educators, and cooperating natural resource agencies to organize and conduct competitions on the local, regional, state, and/or provincial level. Winning teams from each state and province advance to the Canon Envirothon for an opportunity to compete for recognition, scholarships, and prizes.

BENEFITS

"The Envirothon is the most rewarding educational experience I've had in nineteen years of teaching." – Greg Turner, Educator · Nova Scotia

Combining in-class curriculum and hands-on field experiences, the Envirothon program is an excellent way to supplement environmental education inside and outside the traditional classroom.

Envirothon participants gain valuable knowledge and training in ecology and natural resource management principles and practices. Many students step away from the Envirothon experience excited about learning and motivated to pursue careers in environmental studies, environmental law, natural sciences, and natural resource management.

"I've participated in the Envirothon for three years and it has been a wonderful experience. I have gained years of experience that will definitely help me in college and in my future career as a biologist." – Sarah Larose, Student · Maryland

THE ENVIROTHON IS NOT ONLY A VALUABLE LEARNING EXPERIENCE – IT'S A LOT OF FUN !

With the Envirothon, students have the opportunity to get "up-close and personal" with North America's natural resources. Envirothon groups participate in hands-on learning activities delivered by natural resource professionals and attend field trips to state/provincial parks, natural history museums, nature centers, zoos, aquaria, and other natural resource sites.

"I'm very excited! Envirothon gives us the opportunity to learn outside the classroom.

This is a great chance to visit actual ecosystems and to meet and compete with other students who have a passion for the environment." – Kate Harnish, Student · Nova Scotia

We invite you to join us as an Envirothon participant. Contact us today to find out how you can become involved! Or for more information, visit: www.envirothon.org

APPENDIX B

“HANDS ON” SOILS STATIONS LAB

“Hands On” Soils Stations Lab

SOIL SIEVE STATION:

1. Place the 3 soil sieves in the correct order to capture 4 different sizes of soil particles. What order of the sieves did you choose?
2. Using soil sample (A or B) at this station, crumble the soil into small particles. Describe the texture of the soil(s):
3. Find the mass of 1 cup of soil:

mass of empty cup _____(g)

mass of cup + soil _____(g)

mass of soil _____(g)
4. Sieve the soil sample into 4 separate fractions, and find the mass of each fraction
Use the information on the soil sieve to determine what size particle each sieve will capture.

mass of sample in 9-mesh sieve _____(g) gravel is in the sieve

mass of sample in 32-mesh sieve _____(g) very coarse sand in sieve

mass of sample in 200-mesh sieve _____(g) medium & fine sand in sieve

mass of sample on newspaper below 200-mesh sieve _____(g)

(very fine sand, silt, and clay are on the newspaper)
5. Using the original cup, estimate the volume of each particle size within the sample as a percentage of 1 cup

volume of sample in 9 mesh sieve _____(%) (gravel)

volume of sample in 32-mesh sieve _____(%) (very coarse sand)

volume of sample in 200-mesh sieve _____(%) (medium and fine sand)

volume of sample on newspaper below 200-mesh sieve _____(%)
6. Ignoring the gravel, estimate amount of sands compared to the amount of silt/clay in this sample. Use the soil texture triangle to try to determine this soil type:
7. Follow teacher directions to dispose of your sample.
8. If time allows, run a second trial with the other soil sample and compare results.

LEACHING TIME STATION:

1. At this Station there are 2 cans with both ends open.
2. Securely fasten cheesecloth over one open end of each can using duct tape.
3. Fill each of the cans with 1 soil sample (A, B); be sure to label each can so you can identify the samples.
4. Place each can on the ring stand set-up, and put a large beaker under each can.

4. Pour 100 ml of water into each soil sample.
5. Record the time needed for the water to start dripping from each sample, and how long the water continues to drip.

SOIL WEIGHT STATION

1. Start with dry soil samples A & B
2. Fill 2 cans with equal amounts of soil A & B-
3. Empty soil samples onto cloth squares.
4. Pull up the corners of cloth and tie securely.
5. Mass each sample and record.
 Soil sample A - mass of dry soil _____ (g)
 Soil sample B - mass of dry soil _____(g)
6. Saturate each sample in a bucket of water, remove, and allow to drip for a few minutes.
7. Mass each sample again and record.
 Soil sample A - mass of saturated sample _____(g)
 Soil sample B - mass of saturated sample _____(g)
8. Describe differences between soil samples:
9. Follow teacher directions to dispose of your sample.

EXTENSION: Observe the 2 sponges at the station; Describe differences between them. If time allows, find mass of each. Saturate both with water, then squeeze them out (into the bucket!) If time allows, measure the volume of water each can hold, and remeasure the mass of the saturated sponges.

Do they each absorb an equal quantity of water?

If not, explain why 1 sponge may hold more water than the other:

“MAKE YOUR OWN SAMPLE” STATION

Showing Soil Particles Layered By Size

1. Fill a large jar two-thirds full of water.
2. Add soil sample A or B to the water until the level of soil and water is nearly to the top of the jar. Identify the soil sample you used.
3. Cover and shake vigorously. Set the jar on a level surface and allow time for the particles to settle. The smallest particles may take overnight or even several days to settle.
4. Hold a piece of white paper against the jar and mark the different layers. Label each layer based on the soil particle size.

Based on your results from the different Stations, describe differences between Soil Samples A and B. Write a paragraph conclusion showing what you learned about soils by doing this lab.

APPENDIX C

EMAIL CORRESPONDENCE-FORESTRY & SOILS – PART 2

Email correspondence-Forestry & Soils – Part 2

From: JPwhisper@aol.com [mailto:JPwhisper@aol.com]
Sent: Wednesday, October 27, 2010 6:36 AM
To: kwhite@sevenislands.com
Subject: Thank you for saying "yes" to coming in to school Friday morning!

Ken, I really appreciate having you come in to do some "hands on" forestry activities with my biology class! This is the same group I had at the Fall Field Days - you got great reviews from them as a presenter! - I'll divide the group into 2 sections- each will have ~ 5-6 students, and you and Stan will switch after ~ 35-40 minutes with each group. I would really like them to learn about **taking dbh** and **an increment bore, what a prism is** and how a prism would be used by a forester would take a sample tally (although you probably wouldn't have time to do the whole thing) and **how to pace**- I know that's a lot to cover, but if they at least got a sampling of each, that would be great! You and Stan can decide about slope- Stan says he is thinking about what he wants to do with soils. I'll try to have the class outside at ready to go by 9am (**or hopefully a little before 9!**) at the trees right behind the superintendents office and the class ends at ~ 10:15. I'll take whatever time we get and basically divide it between the 2 groups. Thanks again!! If you have any questions, please just email me at jperry@sad32.org Looking forward to seeing you and Stan! JanP

Janet

Not a problem – your students were paying attention and seemed to be listening and eager to learn at the Fall Field day. One of the best groups we had.

APPENDIX D

WILDLIFE CENSUS

Wildlife Census

Procedure to conduct a high school wide wildlife census:

1. If necessary, get approval from the school administration to do a wildlife survey during class time.
2. Choose locations to count wildlife and a time frame for the activity.
3. Explain the Purpose of the survey and Announce the day(s) of the survey.
4. Fill out the tally sheet(s) for each day of the wildlife count. Specific directions:
 - a. On the top of the tally sheet, write the date, class period, and total number of students who are answering survey questions (total number includes students/staff who did and did not see wildlife)
 - b. For each student who has seen wildlife going to/from school during the survey time frame, record the following information:
 1. Date and time of sighting(s) example: Wed. pm
 2. (Approx.) location of sighting(s) example: Rt 11 ~1 mile north of Ashland
 3. Type of transportation student is using example: car/truck (private vehicle) school bus, snow sled, on foot etc.
 4. Species and (approximate) number of wildlife seen example: 1 fox
 - c. When each student's data has been recorded, draw a line between students and collect data from the next student.
5. Please return all tally sheets to Mrs. Perry Thank you!

Sample Weekly Tally Sheet:

Date_____ **Class Period**_____

Number of students who are in class today taking this survey_____
(whether or not they have seen mammals)

For each student in your class who has seen wildlife, please record:

Name of student	type of transportation & (approximate) location of sighting(s)	Wed. PM or Thurs. AM	Type & (approx) numbers of wildlife observed
-----------------------	--	-------------------------	--

ASHLAND AREA WILDLIFE CENSUS – 2011

WEATHER DATA has been gathered from the website:

<http://www.wunderground.com/history/airport/KPQI/2011/2/3/DailyHistory.html>

SNOW DEPTH DATA has been gathered from the website:

<http://www.nohrsc.noaa.gov/nsa/index.html?region=Northeast&year=2011&month=3&day=8&units=e>

ASHLAND AREA MAINE	WEEK 1 February 2 & 3	WEEK 2 February 9 & 10	WEEK 3 February 16 & 17	WEEK 4 March 2 & 3	WEEK 5 March 8 & 9
WEATHER Time of Day Temperature (F) Wind Speed Wind direction Conditions Precipitation Snow Depth Time of Day Temperature (F) Wind Speed Wind direction Conditions Precipitation Snow Depth	Wednesday PM 4:15 PM 6.8 degrees 8.1 mph NNE overcast 0 20-39 inches Thursday AM 7:15 AM -7.6 degrees calm calm clear 0 20-39 inches	Wednesday PM 4:15 PM 15.8 degrees 10.4 mph S Mostly cloudy 0 20-39 inches Thursday AM 7:15 AM -14.8 degrees calm calm overcast 0 20-39 inches	Wednesday PM 4:15 PM 19.4 degrees 6.9 mph SE Mostly cloudy 0 20-39 inches Thursday AM 7:15 AM 30.2 degrees 8.1 mph W Overcast 0 20-39 inches	Wednesday PM 4:15 PM 30.2 degrees 4.6 mph SSW Overcast .01 inches 39-59 inches Thursday AM 7:15 AM -4 degrees 13.8 mph WNW Clear 0 39-59 inches	Tuesday PM 4:15 PM 23 degrees 9.2 mph N Clear 0 39-59 inches Wednesday AM 7:15 AM -7.6 degrees calm calm clear 0 39-59 inches
WILDLIFE OBSERVED	WEEK 1 February 2 & 3	WEEK 2 February 9 & 10	WEEK 3 February 16 & 17	WEEK 4 March 2 & 3	WEEK 5 March 8 & 9
DATES & TIME of DAY	Wednesday PM Thursday AM	Wednesday PM Thursday AM	Wednesday PM Thursday AM	Wednesday PM Thursday AM	Tuesday PM Wednesday AM
Within center of town	1 hare/rabbit 1 turkey 1 deer	8 deer 3 red squirrels 1 deer 3 red fox 2 turkeys	6 hare/rabbits 1 moose 3 deer 25 turkeys 1 small rodent 1 red fox	3 coyote 1 turkey 3 deer 1 red fox 1 turkey 1 red fox	~7 deer 1 red squirrel 1 red squirrel
Sheridan Road	~30 deer ~30 deer	1 deer ~20 deer	1 coyote 4 deer 6 deer	~12 deer	~30 deer 1 red squirrel
Route 227 (State Road)	1 deer	Turkeys 1 crow	1 deer 2 turkeys	1 deer 1 turkey	3 deer

	2 deer 2 turkeys	1 deer 1 turkey		2 turkeys	1 deer 1 moose 1 turkey
Route 163 (Haystack Road)		3 moose 1 deer	1 moose 1 weasel 1 raven	1 owl	~15 deer 1 hawk
Route 11 (North of Ashland)	1 coyote 2 deer 1 red squirrel	6 deer 1 red fox	1 red fox 1 hare/rabbit 7 deer	1 coyote 1 moose ~ 9 deer	5 deer 2 red squirrels 1 raccoon 1 deer 1 turkey
Route 11 (South of Ashland)		1 deer	1 coyote 1 red squirrel	~6 deer 2 hare/rabbits ~10 turkeys	2 deer 1 red squirrel
Garfield Road	1 hare/rabbit 1 raven		3 deer ~22 turkeys	1 deer ~25 turkeys 1 raven	1 coyote 4 turkeys 1 small rodent
Snowsled Trails		~30 deer	3 deer	~12 deer	~12 deer
Number of people Surveyed	74 people	77 people	80 people	77 people	76 people
Number of Different Species Spotted	6	6	8	7	7

APPENDIX E

FALL FIELD DAYS– PRE-TREATMENT & POST-TREATMENT
QUESTIONNAIRES

Fall Field Days– Pre-Treatment & Post-Treatment Questionnaires:

Pre-Treatment section:

Given a choice, would you prefer to learn about the environment in a

classroom setting outdoor setting no preference for setting

Give reason(s) please:

Given a choice, would you prefer to learn about the environment using:

Interactive technology outdoor no preference
Such as computer simulations “hands on”

Give reason(s) please:

Given a choice, would you prefer to:

spend more time on spend less time per topic no preference
fewer topics for more but learn a wider variety
in-depth learning of information

Give reason(s) please:

Please rank each of the following 1-5 based on their IMPORTANCE to learning:
1 = no importance 5 = essential

knowledge of concepts

place-based learning (learning in a local setting about local topics)

knowledge of “the big picture” – a broad overview

knowledge of skills

knowledge of terminology (vocabulary)

Please rank your CURRENT BASELINE KNOWLEDGE of the following topics

1 = no knowledge 10 = complete mastery of the subject

knowledge of aquatics

knowledge of forestry

knowledge of soils

knowledge of wildlife

Where did this baseline knowledge come from? Please rank each of the following based on how important each was to your current knowledge of the environment. 1= no importance 5 = extremely important

Home environment

Media (computer, newspapers, television, etc)

Organizations (Scouts, 4-H, FFA, etc.)

Please list the organization(s) you belong to:_____

School Classes

Other (please specify)

Please complete the following statement with one of the following choices which is the MOST IMPORTANT to you:

“Learning about the Environment is important to me because:

It is a required section of the science curriculum

I am interested in a possible career in this area

The environment affects everyone and we all need to be “environmentally conscious decision makers”

I like to learn about many topics, and I consider myself a “life-long learner”

Learning about the environment is not important to me.

Other:

THANK YOU FOR YOUR TIME AND EFFORT!

“Fall Field Days” Questionnaire
Post-Treatment section

Please circle or underline which of the following choices BEST describes the amount of information presented at each station:

AQUATICS:

Too little Information Presented	Too much information Presented	“ Just Right “ information Presented	Did not attend this session
---	---	---	--

FORESTRY:

Too little Information Presented	Too much information Presented	“ Just Right “ information Presented	Did not attend this session
---	---	---	--

SOILS:

Too little Information Presented	Too much information Presented	“ Just Right “ information Presented	Did not attend this session
---	---	---	--

WILDLIFE:

Too little Information Presented	Too much information Presented	“ Just Right “ information Presented	Did not attend this session
---	---	---	--

Please circle or underline which of the following choices BEST describes the amount of “hands on” activities presented at each station:

AQUATICS:

Too little	Too much	“ Just Right “	Did not attend
-------------------	-----------------	-----------------------	-----------------------

FORESTRY:

Too little	Too much	“ Just Right “	Did not attend
-------------------	-----------------	-----------------------	-----------------------

SOILS:

Too little	Too much	“ Just Right “	Did not attend
-------------------	-----------------	-----------------------	-----------------------

WILDLIFE:

Too little	Too much	“ Just Right “	Did not attend
-------------------	-----------------	-----------------------	-----------------------

List and/or describe the MOST IMPORTANT THING YOU LEARNED while attending any Environment Station on the field trip:

LIST AND/OR DESCRIBE THE MOST SURPRISING THING YOU LEARNED while attending any Environment Station on the field trip:

WHO WAS (WERE) THE MOST MEMORABLE PRESENTER(S)? WHY?

WHAT WAS THE “MUDDIEST POINT” OF THE TRIP (what did you NOT understand?) Why do you think this was “muddy” to you?

Please circle or underline which of the following rankings BEST describes the level of learning at each Station:

1= no value 5 = extremely valuable

AQUATICS: 1 2 3 4 5 Did not attend

FORESTRY: 1 2 3 4 5 Did not attend

SOILS: 1 2 3 4 5 Did not attend

WILDLIFE: 1 2 3 4 5 Did not attend

Please Rank the Fall Field Days trip for overall effective learning about the Environment on a score of 1 – 5.

APPENDIX F

TEACHER ADAPTED QUESTIONS: FORESTRY, SOILS, AQUATICS, WILDLIFE

Teacher Adapted Questions: Forestry, Soils, Aquatics, Wildlife

Questions and correct answers are provided in bold print

FORESTRY:

Pre and Post Treatment – FOR EACH QUESTION, CHOOSE THE BEST ANSWER:

1. The term “biotic” can refer to plant population numbers, and the term “abiotic” can refer to:

- a. birth (natality) and death (mortality) rates
- b. climate and precipitation**
- c. pyramid of biomass
- d. predators vs. prey species

2. What is the following describing? “Fire to bare soil to herbs or grasses to white birch to oak.”

- a. survival of the fittest
- b. evolution
- c. succession**
- d. progression

3. Ecosystems are:

- a. complex relationships among living things
- b. complex relations among nonliving factors of the environment
- c. natural resources
- d. complex networks of living organisms and nonliving factors in which each organism may be affected by the others.**

4. Renewable resources are:

- a. any material that provides energy
- b. irreplaceable
- c. replaceable**
- d. not natural resources

5. Trees that have broad leaves instead of needles and are often called hardwoods can also be called?

- a. conifers
- b. deciduous**
- c. evergreen
- d. mixed deciduous conifer climax forest

6. “Dominant”, “Co-dominant” and “Suppressed” are terms used to refer to a tree’s relative position in the forest layers. Which layer are the “suppressed” trees most likely to be found:

- a. canopy
- b. herb
- c. forest floor
- d. **understory**

7. Choose the TRUE statement from the following:

- a. a shrub is a perennial plant, but it dies back to the ground each winter
- b. a shrub is a young tree
- c. **a shrub typically has multiple stems**
- d. given the correct growing conditions, shrubs will usually become trees

8. This stable stage of a tree/plant community will remain the same as long as the climate and soil remain unchanged by nature or people.

- a. **climax stage**
- b. evolution stage
- c. pioneer stage
- d. succession stage

9. A plant species which first appears after a fire or clear-cut is often called:

- a. dominator species
- b. climax species
- c. **pioneer species**
- d. uneven age species

10. Aspen trees are often found growing in recently abandoned fields while beech trees are typically found growing in mature forests. Within the period of succession from abandoned field to mature forest, which species would be found in greatest numbers late in succession and why?

- a. aspen because they are a shade intolerant species
- b. aspen because they are a shade tolerant species
- c. beech because they are a shade intolerant species
- d. **beech because they are a shade tolerant species**

READING FOR QUESTIONS 11 & 12

A Deed is a record of land transfer from one ownership to another, and is used as a record of ownership for the present land owner. Forest boundary lines may be composed of stonewalls, old barbed wire, blazed and painted trees, or a combination. There are specific markers at the intersection of boundary lines- these are called corner posts.

11. Which of the following do you think would make the best corner marker:

- a.. a prominent rock
- b. a blazed and painted tree
- c. an iron pin with a surveyors identification stamp on it**
- d. the stump left from a tree that was located at the correct spot

**12. Which do you think are more important- boundary lines or corner posts?
Give reasons for your choice:**

Sample Answer: corner posts are most important- if these can be found, the boundary lines can be relocated and remarked using a compass. If the corners are lost, it is necessary to contact a professional surveyor.

READING FOR QUESTIONS 13 & 14

From the website:

<http://www.dnr.state.md.us/education/envirothon/forestry/measurements.html>

"In forestry, distance measurements are based on a **chain**, which equals 66 feet. Many years ago surveyors literally dragged a 66-foot-long chain around with them to measure properties, which were measured in *chains* and *links*.

Today, foresters measure *chains* by knowing how many steps they take in 66 feet (19.8 meters). To determine your pace, measure out 66 feet (19.8 meters) using a 100-foot (30 meter) measuring tape, and count every other step (for example, every time your right foot hits the ground). Most people have between 12 and 15 paces per chain."

13. Given this information, what is the primary purpose of pacing:

- a. To measure distances of exactly 66 feet
- b. To know the direction you are traveling in the woods
- c. To determine how far you have walked in the woods**
- d. To recognize various tree species as you walk through the woods

14. COMPLETE THIS STATEMENT "Pacing is a skill we can learn, so....."

- a. after we practice, everyone will have the same pace
- b. after we practice, everyone will know his/her individual pace**

READING and DIAGRAM to answer Questions 15 & 16

From the website:

<http://www.dnr.state.md.us/education/envirothon/forestry/measurements.html>

"An important forestry measurement is tree age; foresters typically use a tool called an increment borer to get a core sample from a tree to count the tree growth rings. Not only is counting the number of growth rings important to determine the tree's age, but interpreting the *spacing* of growth rings can tell us much about its life. Examining the growth of a tree can tell us many things about the growing conditions about the *site*, or environment the tree is growing in."
(if the diagram does not appear immediately, click on the blank space)

Growth Rings on Pine tree Crosscut



15. In addition to documenting a tree's age, the growth rings of a tree can serve as a "history book" of the tree and its surrounding community by recording:

- a. droughts or wet seasons,
- b. injuries to the tree
- c. forest fires
- d. all of the above**

16. Which of the following statements is NOT TRUE, A tree's age, when compared to its diameter or height, can be an excellent indicator to determine:

- a. how productive a specific *site* is for growing a particular species of tree
- b. how crowded the trees are
- c. if a tree is old enough to be marketed**
- d. when an area was last thinned

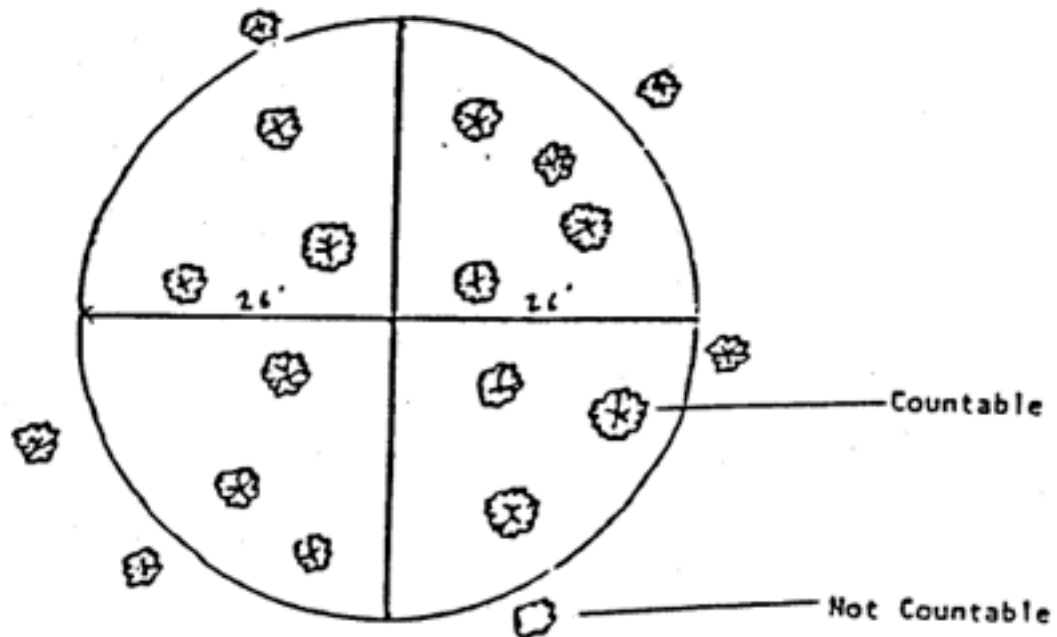
READING and DIAGRAM for QUESTIONS 17 - 19

From the website:

<http://www.dnr.state.md.us/education/envirothon/forestry/measurements.html>

"An important piece of data a forester can gather is the *stocking level*, of a forest stand, often expressed in "trees per acre". Nobody has time to measure off an entire acre (.4 hectare) and count every tree, so foresters depend on a *sample point* to give them a representative number of the *stand* or property they are collecting forest data on.

To complete this measurement, a forester begins at the "*plot center*" and measures out 26 feet (7.8 m) in each of the *cardinal* directions (north, south, east, and west) and flags the circle boundaries. This circle is equal to 1/20th acre. The forester then counts all of the trees within this circle that are greater than 2" (5.08 cm). He/She then calculates the *trees per acre* by multiplying that number of trees by 20. In the example below, all of the trees shown are greater than 2".



1/20TH ACRE CIRCULAR PLOT

17. Using this information, determine the number of trees per acre in this diagram. Show your work.

Answer: the 13 trees within the circle multiplied by 20 indicates there are 260 trees per acre.

18. This method to determine the number of trees per acre would provide the following information:

- a. a reliable estimate of the number of trees in a given acre**
- b. the exact number of trees in a given acre
- c. the species of all the trees within the circular plot
- d. the market value of the trees

19. If you were told you could also use a “wedge prism” and a “variable radius tally sheet” to get the same type of information found in Questions 17&18 you would know these forestry tools are most useful to:

- a. determine the height of a specific tree
- b. estimate the volume of wood growing on a site**
- c. key out what species of trees are present
- d. pace the boundary of a forest plot

20. A “diameter tape” is used by foresters to measure the diameter of living trees without cutting them down. A forester can make dbh (diameter breast height) measurements as he/she walks through the forest “cruising timber” to see what size trees are on a certain site. Where on each tree, do you think is a logical place for a forester to put a diameter tape to get a dbh measurement:

- a. the circumference of the tree**
- b. the diameter of the tree
- c. two points on neighboring trees that are each breast high (4.5 feet)
- d. the radius of the tree

SOILS:**1. The most accurate definition of soil is:**

- a. any substance that farmers use to support plant growth
- b. a group of valuable minerals
- c. a mixture of mineral components that supports plant growth
- d. a mixture of organic material, mineral components, water, and air that supports plant growth**

2. The wearing away of rock or soil by natural forces such as water and wind is called:

- a. contamination
- b. erosion**
- c. runoff
- d. weathering

3. A measure of the amount of acidity or alkalinity of soil or water is called:

- a. hydrology
- b. pH**
- c. precipitation
- d. Silva culture

4. Water that runs across the surface of the ground is called:

- a. discharge
- b. groundwater
- c. recharge
- d. runoff**

5. Soil, sand, and materials washed from land into waterways is called:

- a. edge
- b. groundwater
- c. hydric soils
- d. sediment**

6. What process is occurring when freezing and thawing breaks down rocks:

- a. construction
- b. dehydrification
- c. regeneration
- d. weathering**

7. Which of the following is a TRUE statement about soils and land use:

- a. any soil can be used for any purpose if it is modified
- b. with the right fertilizers any soil can be used to grow corn
- c. specific types of soil vary in their suitability for construction, sewage disposal, and agricultural production**
- d. generally any soil can be used for sewage disposal without polluting ground water

8. The soil “site” is the environment in which a plant or a plant community lives. There are a number of site factors that determine the desirability of a location for any plant crop- whether the plants will grow in a vigorous and healthy manner and reach maturity in a sound state. Given this definition and information on site factors, which of the following would NOT qualify as a site factor:

- a. aspect (what direction- north, south, east or west- the site faces)
- b. number of acres in the site**
- c. slope of the land
- d. soil depth

9. Define “hydric” soil?

(this question was very difficult for students to answer, even after 2-3 soils activities- I should not have asked for a definition, but instead, should have provided multiple choices. From the website: <http://soils.usda.gov/use/hydric/intro.html> samples with acceptable words are provided: **“a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part....soils developed under sufficiently wet conditions to support the growth and regeneration of hydrophytic vegetation. Soils that are sufficiently wet because of artificial measures ...(wet) soils...depending on water table, flooding, and ponding characteristics.”**

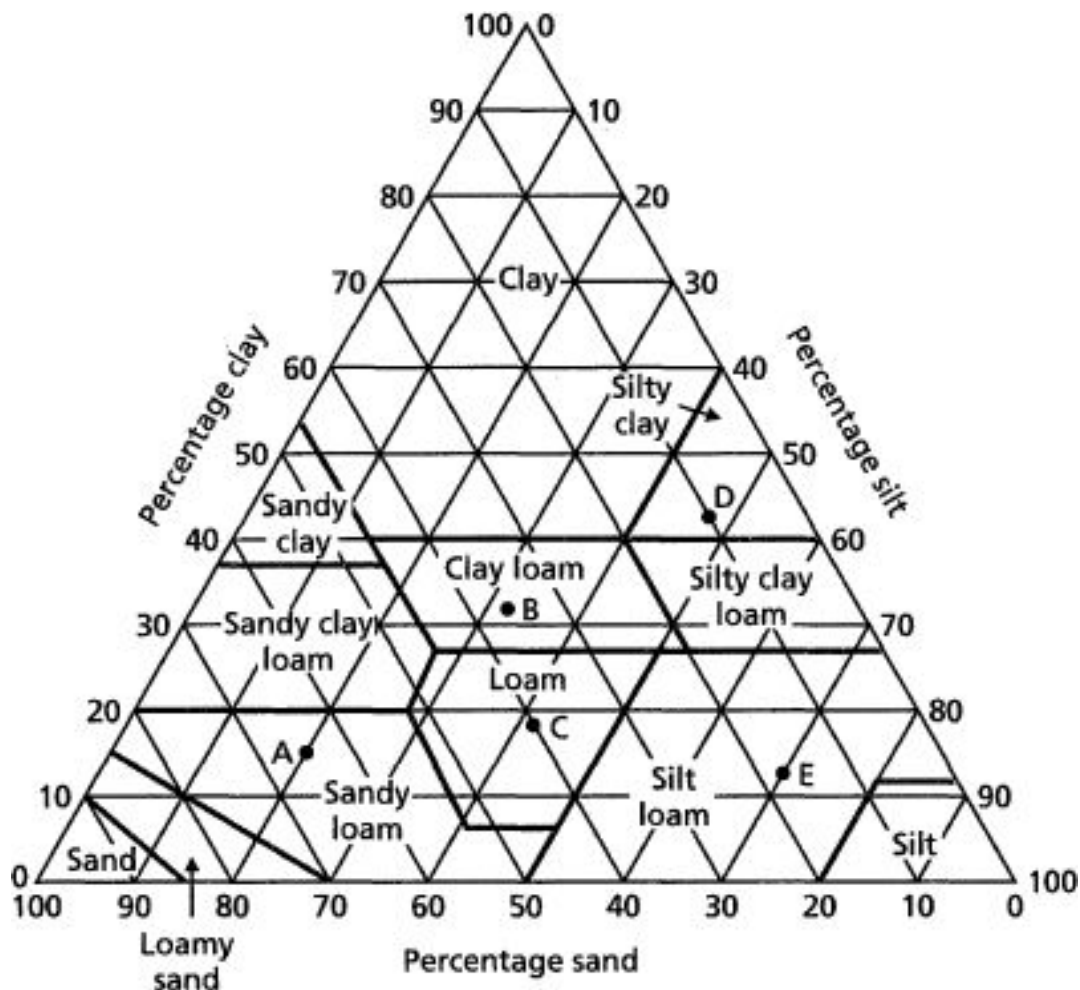
10. Which of the following is NOT part of the organic material found in soils:

- a. microorganisms
- b. **minerals**
- c. plant roots
- d. worms

“Loam” is a fairly common type of soil in found in our area (northern Maine)

Use the “soil texture triangle” below to answer questions 11&12.

(image taken from: <http://legacyla.net/transformation/?p=262>)



11. Why is loam not found on 1 of the edges along with percent sand, percent clay, and percent silt?

Answer: loam soil is a combination of sand, silt, and clay particles

12. What is the difference between a “sandy loam” soil and a “loamy sand” soil

- a. there is no difference between these 2 types of soil
- b. loamy sand has more sand and less clay than sandy loam**
- c. sandy loam has more sand and less clay than loamy sand
- d. loamy sand has 90% silt particles while sandy loam has 80% silt particles

Use the following Table to answer questions 13 - 15:

Number of spherical particles and total surface area in 1 gram of material with different particle size:

Kind of Particle	Diameter of Particle	Number of Particles in 1 gram	Surface Area Of 1 gram
SAND	2 mm	90	11 cm ²
SILT	0.02 mm	90 000 000	1130 cm ²
CLAY	0.0002 mm	9 x 10 ¹³	113 000 cm ²

13. What is a TRUE STATEMENT:

- a. the larger the particle size, the more surface area per gram
- b. The smaller the particle size the more surface area per gram**
- c. The larger the particle size, the more particles there are per gram
- d. The larger the diameter of the particle, the larger the surface area per gram

14. If the amount of surface area and the capacity to hold water are directly related, which soil type is most likely to hold the most water:

- a. clay**
- b. sand
- c. silt
- d. all choices have equal drainage capability

15. A poorly drained soil is most likely to be:

- a. clay**
- b. gravel
- c. loam
- d. sand

16. From the website: www.learner.org/courses/envsci/unit/unit_gloss.php the definition of porosity is "the total volume of soil, rock, or other material that is occupied by pore spaces" (holes).

Using this definition, solve this problem and show your work:

You have a beaker filled with 120ml of gravel. You also have a graduated cylinder containing 200 ml of water. You pour water from the graduated cylinder slowly into the beaker until the water level just reaches the top of the gravel. You now have 170 ml of water left in the graduated cylinder. What is the percent (%) porosity of the gravel?

ANSWER: 30 ml of water went between the pores of the gravel;

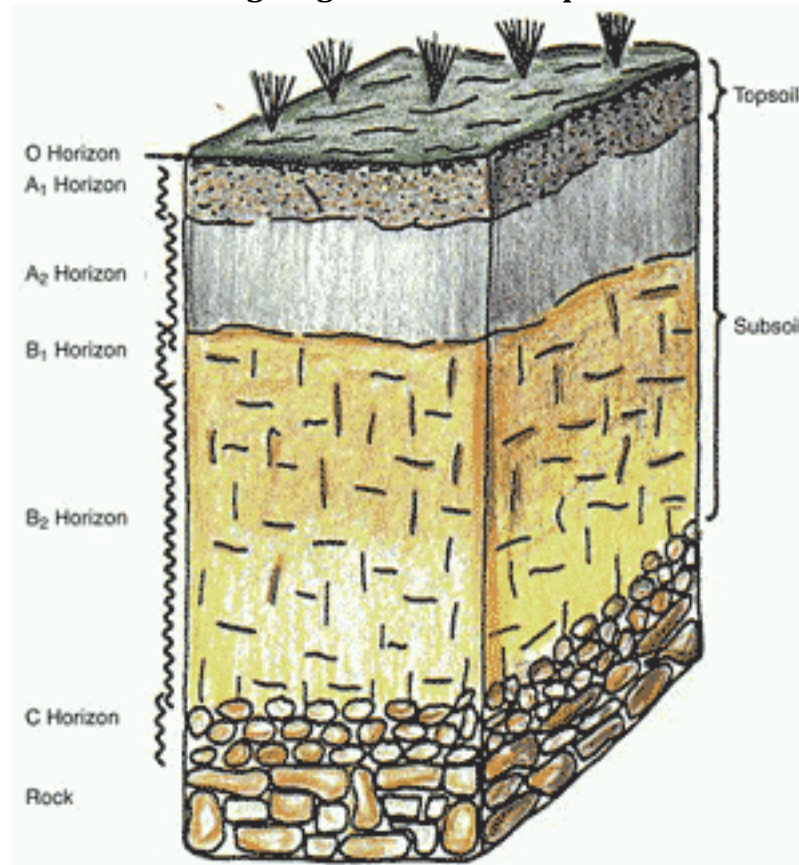
therefore 170 ml of water did NOT fit between the pore spaces.

30 divided by 170 = .25 (the decimal number for the porosity of the gravel) which would be 25%

From the website:

<http://soils.usda.gov/education/resources/lessons/profile/>

Use the following diagram to answer questions 17 & 18



17. Within a soil profile, the parent (unconsolidated) material would be found:

- a. at the top of the soil profile
- b. between each individual layer of the soil profile
- c. at the bottom of the soil profile**
- d. the parent material is usually not present because it has eroded away.

18. A soil profile report does NOT provide the following information:

- a. size and shape of soil aggregates
- b. soil color
- c. soil temperature**
- d. soil texture

19. A soil sieve unit consists of 3 or more circular sections which can be placed one on top of the other. A standard unit has sections with mesh sizes of "9 mesh", "32 mesh", and "200 mesh". The higher the mesh number, the finer the screening at the bottom of the section, which gives more holes per square inch. We will label the 9-mesh unit "A," the 32-mesh unit "B", and the 200 mesh unit "C". If you wanted to separate as many particle sizes of soil as possible, how should these units be placed on top of each other?

- a. A, B, C**
- b. B, C, A
- c. C, B, A
- d. C, A, B

20. If used properly, how many different soil particle size categories can this 3-section soil sieve separate?

- a. 2
- b. 3
- c. 4**
- d. unlimited

AQUATICS

1. Which of the following is usually the most limiting factor to life in an ecosystem?

- a. clean air
- b. water**
- c. soil
- d. solar energy

2. The hydrologic cycle receives its energy from:

- a. shifts in the ocean tides
- b. the moon
- c. carbon dioxide
- d. the sun**

3. Important processes of the water cycle include all of the following except:

- a. condensation
- b. evaporation
- c. rock weathering**
- d. transpiration

4. A water-bearing layer of earth, gravel, porous stone, or bedrock is called:

- a. aquifer**
- b. eutrophication zone
- c. riparian zone
- d. thermocline

5. Land area immediately adjacent to streams and rivers is called:

- a. aquifer
- b. riparian zone**
- c. thermocline
- d. vernal pool

6. Which of the following is NOT considered an important wetland function:

- a. agriculture**
- b. flood control
- c. nutrient retention

d. sediment retention

7. Buffers in an ecosystem do not provide which of the following:

- a. barrier to nuisance species
- b. control of non-point source pollution
- c. climate control**
- d. erosion control

8. A temporary body of freshwater that provides important spring habitat for frogs and salamanders is called:

- a. estuary
- b. peat bog
- c. vernal pool**
- d. watershed

9. An area of land from which all the water from the surrounding area drains into is called:

- a. estuary
- b. river basin
- c. understory
- d. watershed**

10. The gradual transformation of a pond into a bottomland forest over the passage of years is an example of:

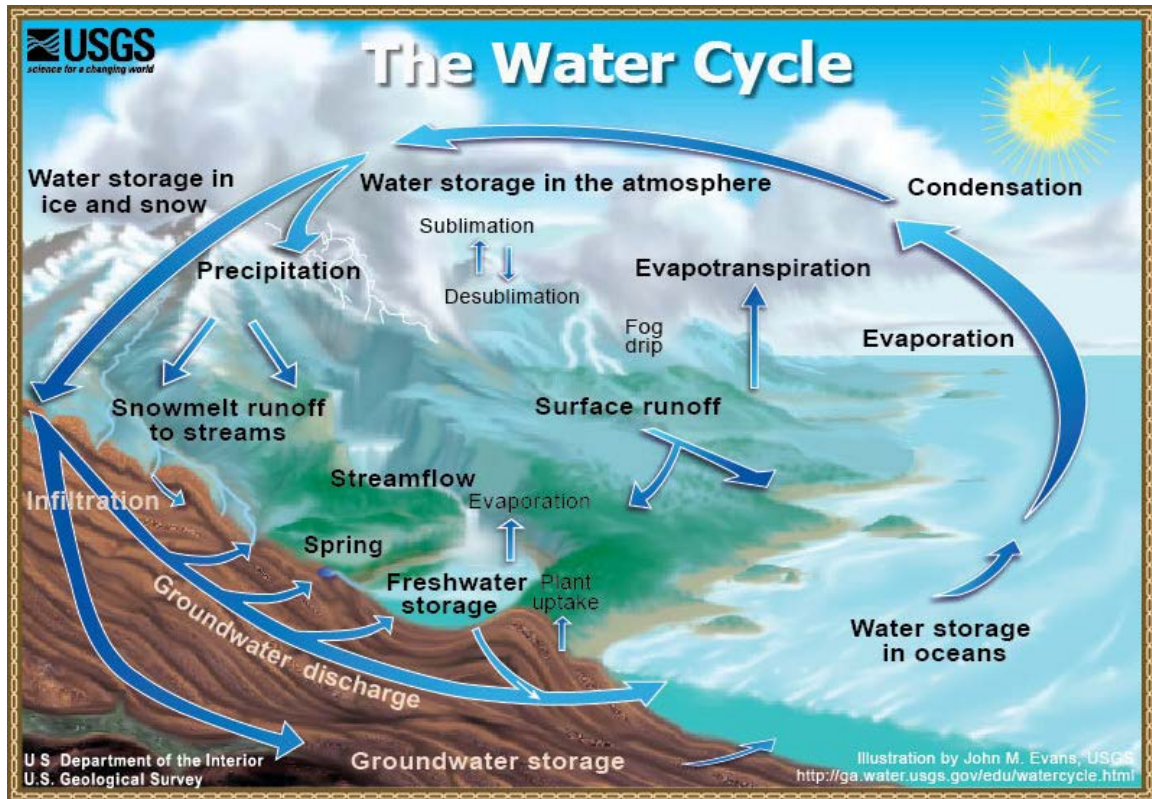
- a. a community rather than an ecosystem
- b. carrying capacity
- c. ecological succession**
- d. limiting factors

11. Groundwater possesses its own taste, odor, and color, which is created by dissolved:

- a. acids
- b. bacteria
- c. minerals**
- d. sugars

12. Given this diagram from the website:

<http://ga.water.usgs.gov/edu/watercyclehi.html>



12. What is one possibility for the correct order of the water cycle:

- a. infiltration, precipitation, surface runoff, water storage in oceans
- b. evaporation, ground water discharge, infiltration, precipitation
- c. condensation, precipitation, surface runoff evaporation**
- d. precipitation, ground water discharge, transpiration, surface runoff

13. Freezing rain, hail, sleet, rain, and snow are all different types of:

- a. condensation
- b. evaporation
- c. precipitation**
- d. transpiration

14. Which of the following conditions would produce freezing rain?

- a. Freezing rain occurs in the wintertime when rain produced in a warm air mass falls through a shallow cold air mass below it, freezing on contact with the ground**
- b. Freezing rain occurs in the wintertime when snow produced in a cold air mass falls through a shallow warm air mass below it, freezing on contact with the ground
- c. Freezing rain occurs in the wintertime when snow produced in a warm air mass falls through a shallow cold air mass below it, freezing on contact with the ground
- d. Freezing rain occurs in the wintertime when rain produced in a cold air mass falls through a shallow warm air mass below it, freezing on contact with the ground

Use the following information to answer Questions 15 & 16:

Typically, as temperatures increase, molecules move faster and stay further apart from each other.

15. Ice (solid water) and liquid water are an exception to the statement above because:

- a. ice molecules move slower than liquid water molecules
- b. ice molecules are further apart than liquid water molecules**
- c. liquid water move slower than ice molecules
- d. ice and liquid water molecules are NOT an exception to the statement above

16. Which type of atmospheric conditions can hold the most (liquid)water:

- a. cold air
- b. warm air**

Use the following information to answer question 17:

Mountains can have an especially important effect on the climate of an area. Air passing over a mountain loses moisture as it rises and cools. This dry air warms as it descends on the other side of the mountain. In the USA, weather patterns typically move from west to east.

17. Which side of the Rocky mountains typically receives the least rainfall and is most likely to form a desert?

- a. the east side of the Rocky Mountains**
- b. the west side of the Rocky Mountains

Use the following information to answer Question 18. Relative humidity is the water-vapor pressure in the air divided by the maximum water-vapor pressure for air at the same temperature.

Relative humidity is usually expressed as a percentage.

Relative humidity can be calculated as the amount of water vapor in a certain amount of air divided by the maximum amount of water vapor that can exist in air at that temperature.

18. Problem: If the maximum amount of water vapor in air at 20 degrees Celsius is 17.0 g/m³ and the actual amount of water vapor in the air is 10.0 g/m³, what is the relative humidity? Show your work.

$$10 \text{ divided by } 17 \times 100 = 59 \%$$

19. Air that has a relative humidity of 100% is said to be “saturated”. What is the definition of “saturated”?

accept reasonable answers – sample definitions given below:

“being the most concentrated solution possible at a given temperature; unable to dissolve still more of a substance;” wordnetweb.princeton.edu/perl/webwn

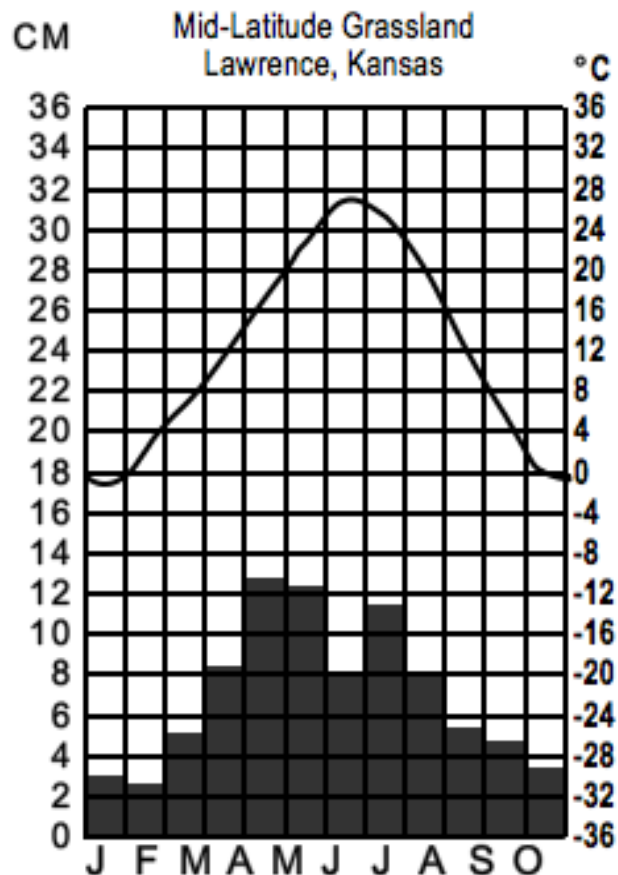
“a solution that cannot dissolve any more solute under the given conditions”

Modern Chemistry Holt, Rinehart and Winston

20. From the website: classjump.com/Bio/documents/3089022800.doc

Use the following diagram to answer this question:

What does a climatogram



measure?

Answer: Temperature and Precipitation in a given area over a period of time

WILDLIFE

1. Which of the following exhibits internal fertilization, external development of the embryo, few eggs, and much parenting:

- a. amphibians
- b. birds**
- c. fish
- d. mammals

2. A place where an animal finds food, water, shelter, and space in a particular arrangement is:

- a. atmosphere
- b. biosphere
- c. environment
- d. habitat**

3. Food chains never consist of more than 4 or 5 levels. The reason for this is:

- a. energy is lost along the food chain**
- b. there are fewer primary consumers in the world than secondary consumers
- c. producers compete with consumers
- d. all of the above are correct

4. The number of organisms that can be supported by a habitat is called:

- a. carrying capacity**
- b. climax community
- c. limiting factor
- d. mutualism

5. A species that is not native to a particular region is called:

- a. endangered
- b. exotic**
- c. extirpated
- d. keystone

6. Species that are very important to the functioning of an ecosystem are:

- a. endangered
- b. exotic
- c. extirpated
- d. keystone**

7. An animal that results from combining genetic material is called:

- a. bottleneck offspring
- b. hybrid offspring**
- c. keystone offspring
- d. mutant offspring

8. A close interaction between 2 species in which one benefits while the other one is harmed is called:

- a. coevolution
- b. competition
- c. mutualism
- d. parasitism**

9. The area that a species uses to travel between segments of its habitat is called:

- a. edge
- b. corridor**
- c. cover
- d. home range

10. The area where 2 habitats meet is called:

- a. canopy
- b. cover
- c. edge**
- d. home range

11. The vocabulary term “biodiversity” refers to “the number and variety of different species found in an area”. Which level of biodiversity may still be reduced for a particular species after it recovers from a threat to its survival?

- a. ecosystem diversity
- b. **genetic diversity**
- c. human diversity
- d. biome diversity

12. From the website: wordnetweb.princeton.edu/perl/webwn symbiosis is defined as “the relation between two different species of organisms that are interdependent”

Which of the following is an example of symbiosis:

- a. **bacteria in a deer’s digestive system help it digest food**
- b. a fox hunts and feeds on a mouse
- c. a moth pollinates a flower
- d. a wren builds a home in a tree

13. All of the following contribute to variation in a population EXCEPT:

- a. **asexual reproduction**
- b. genetic drift
- c. isolation
- d. mutation

14. Some organisms have external skeletons while others have internal skeletons. Which of the following correctly identifies an advantage of an internal skeleton over an external skeleton:

- a. an internal skeleton supports the animal better
- b. an external skeleton can dissolve easily in wet climates
- c. **an external skeleton does not grow with the animal’s body**
- d. animals with external skeletons are not as successful as animals with internal skeletons

15. Which of the following is NOT a density dependent factor that affects population numbers:

- a. disease
- b. famine
- c. **floods**
- d. predation

16. The growth rate of any species is the ratio of births to deaths in a population. The computation to find the growth rate of any species is:

- a. birth rate in year 1 minus birth rate in year 2 = growth rate
- b. birth rate in one year divided by 10 = growth rate
- c. **birth rate minus death rate = growth rate**
- d. birth rate multiplied by the death rate = growth rate

17. A species of wildlife has exponential growth after it is introduced into an area where it has never been. Which statement best describes “exponential growth”:

- a. each individual animal grows much larger than usual
- b. the population immediately decreases
- c. **within a few years the population dramatically increases**
- d. the species produces many more females than males

An analogy is a relationship between 2 parts of words or phrases as a:b as c:d. Choose the correct analogies for Questions 18 & 19.

18. harvesting : poaching as:

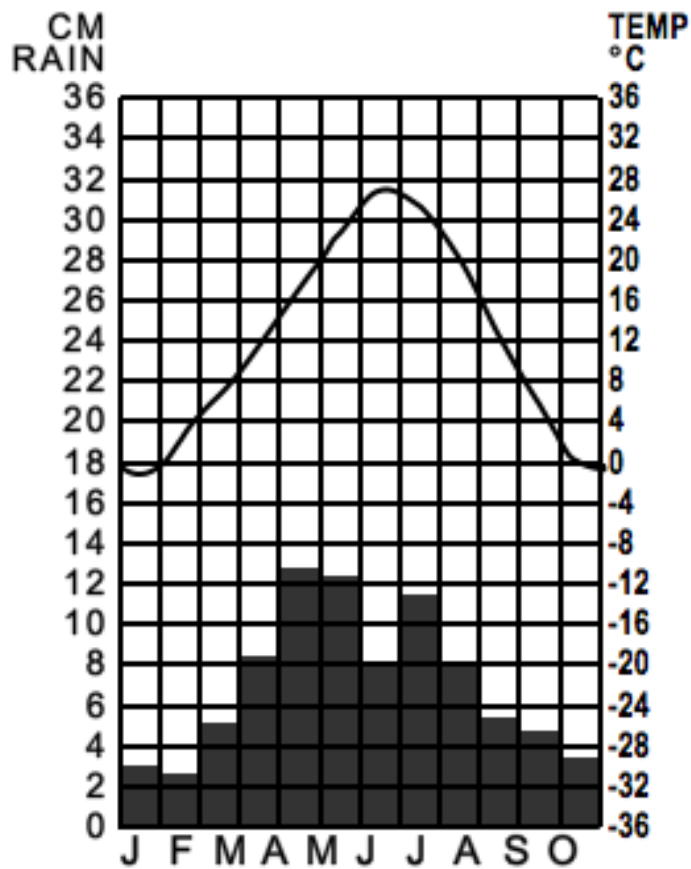
- a. buying: selling
- b. gene : chromosome
- c. supply: demand
- d. **traveling: ecotourism**

19. extinct: endangered as:

- a. **death: illness**
- b. dinosaur: mass extinction
- c. coral: reef
- d. fern: coal

20. From the website: classjump.com/Bio/documents/3089022800.doc

Using this sample of a climatogram, which area of the world could be represented:



- a. desert
- b. **mid-latitude grassland**
- c. tallest mountain in the world
- d. tropical rainforest

APPENDIX G

VALIDITY/ RELIABILITY OF ENVIROTHON QUESTIONS

Validity/ Reliability of Envirothon Questions

Copy of email sent from Tish Carr
 Contact for 2011 Maine Regional and State Envirothon Contests
 Website www.maineenvirothon.org
 Representative Tish Carr
 Address 693 Manchester Rd., Belgrade, Maine, USA, 04917
 Telephone 207-622-7847, ext. 3
 E-mail journeysendfarm@roadrunner.com

From: tish carr [mailto:journeysendfarm@roadrunner.com]
Sent: Monday, March 14, 2011 6:19 PM
To: Rocque, David; Ring, Merle; Lisa Kane; Clukey, Robin; Granger, Greg - Dover Foxcroft, ME; Wilkinson, David - South Paris, ME; Linda Woodard; Betty
Cc: Janet Perry
Subject: E'thon developing testing questions ..

Folks,

Jan Perry is an Envirothon advisor (and has been for a number of years!) Right now, in addition to her teaching, she is enrolled in a Master of Science in Science Education at Montana State University, and her Capstone paper is titled " **Envirothon Teaching Methods- How Do They Impact Learning in the Traditional Biology Classroom?**"

Part of the data she collected was having her students answer questions from old Envirothon tests. From that she has been asked by her professio(r) about the validity/reliability of these questions.

Her questions to me are below. I've answered them the best that I could but perhaps you could shed some light on the subject and help her have a more comprehensive answer here. I'm sure mine was not as I am not the guru for the regional/state exams.

I have included Tish's/others' answers to me in italics

- **where do the questions come from for the regional/state/national Envirothon exams?**
- *The regional and state exam questions come from the "Station Master" for the respective station. Thus soils is developed by Dave Rocque, Dave Wilkinson and Greg Granger. Forestry is done by Merle Ring.. etc. So in essence the resource professional in that area of expertise develops it.*
-
- **> Who makes them up on each level?**
-
- *The Station Masters develop them for the regional and state events.*
- **>**
- *> I know on the regional level, many of the same questions show up over the*
- *> years, so I can say that the questions have been used more than once, -- oh yea ..that would be the case (and students STILL get it wrong!!)*

- >
- > where do they originally come from and what is the criteria for
- > choosing questions to use on the tests?
-
- *I'm not sure there .. you would need to contact the station master to answer that. I can get you every one's email if need be.*
- >
- > Thanks so much for any information you can send me! Also, please pass
- > this email along to anyone else you think might be able to provide me with
- > information! *When I get home, I'll pass this along to the station masters and cc you on it. Hopefully that will help!*
-
- *tish*
-

I've cc'd Janet here so you have her email to get back to her. Hopefully you can take a few moments to help her out!

Thanks everyone.

think trees . . . tish

Copy of email from David E. Wilkinson
Soil Resource Specialist
USDA- Natural Resources Conservation Service

Jan,

I will give you some insight from the Soil expert's point of view?if the other judges want to chime in they will?

Where do the questions come from for the regional/state/national Envirothon exams?

General soil questions always come from the attached document, 2011 Envirothon Soil Resource. The current issue questions always come from a document that is written each year regarding soil issues as they relate to the current issue (see attached).

Who makes them up on each level?

The soil judges for the Maine envirothon make up the tests as a group effort. The soil judges are the 2 Maine NRCS - USDA Area Soil Resource Specialists and the Maine Dept. of Agric. State Soil Scientist.

Where do they originally come from and what are the criteria for choosing questions to use on the tests?

The Soil judges have developed the resource documents for use by the students to study for the exams. We make sure the answers will come from one of these 2 documents each year to avoid having students look hither, thither and yon for soil resources. We narrow

the study focus down for them.

The soil judging part of the test requires them to use their powers of observation to describe a soil profile and fill in a soil judging sheet. They are using the same observational skills required for all soil scientists evaluating the soil resource. Hope this helps.

David E. Wilkinson
Soil Resource Specialist
USDA- Natural Resources Conservation Service
17 Olson Road. , Suite 2, South Paris, ME 04281
207-743-5789 Ext. 106
david.wilkinson@me.usda.gov

Soils Information: <http://soils.usda.gov>
Web Soil Survey: <http://websoilsurvey.nrcs.usda.gov/app/>
Maine NRCS : <http://www.me.nrcs.usda.gov/>

Copy of email sent from Dave Rocque
Dave Rocque, Maine State Soil Scientist
david.rocque@maine.gov
207-287-2666

Us soils guys take all of our questions from two documents. One is called "SOILS" that I developed about 20 years ago was just updated this year and the other is a document I develop each year that relates soils to the current issue. I do that because students may have a hard time trying to see how soils and the current issue relate. I also do it because I believe it is a good teaching tool. In my opinion, that is the most important part of envirothon. Instead of making students research several lengthy documents, we have them read a couple with concentrated material.

Copy of email sent from Lisa Kane:
Lisa J. Kane
Maine Department of Inland Fisheries and Wildlife
284 State Street, SHS #41
Augusta, ME 04333
207-287-3303
fax: 207-287-6395
www.mefishwildlife.com
www.mainewildlifepark.com

where do the questions come from for the regional/state/national Envirothon exams?
Linda Woodard from maine Audubon and I write the test questions based on the

resources we have directed the teams to review for each year and the current topic

Who makes them up on each level?

Linda and i

Where do they originally come from and what is the criteria for choosing questions to use on the tests?

criteria for questions comes directly from the resource list provided to the teams to review and the current topic

Copy of email sent from Merle Ring

Merle Ring

District Forester

Maine Forest Service

131 Bethel Rd.

West Paris, Me. 04289

merle.ring@maine.gov

441-3276

where do the questions come from for the regional/state/national Envirothon exams?

All the forestry questions come from my head based on the resource information available to all the students in the resource packet.

Who makes them up on each level?

I make up both the regional and state forestry tests.

Where do they originally come from and what is the criteria for choosing questions to use on the tests?

As I said, the questions come from my experience as a professional forester and the resource information they have. The criteria are several - 1. making the questions challenging without being so hard as to be discouraging. That's based on many years of doing these tests. 2. Trying to use the "teachable moment", meaning trying to word the questions to teach as well as to test. 3. Making the questions "do-able" within the given time frame. 4. For the regional tests – making questions that are not so "site specific" that they can't be reproduced and used at all the different regional competition sites.

APPENDIX H

STUDENT INTERVIEW QUESTIONS

Student Interview Questions:

What do you think is the most effective way for you to learn? Can you give me an example of an activity you did in this environmental science unit which helped you learn the most?

What do you think is the least effective way for you to learn? Can you give me an example of an activity you did in this environmental science unit which was not an effective method for you to learn with?

Look at the tools (provide forestry/soils tools as props)* Do you remember using all of them? If not, which tool(s) don't you remember?

*the tools provided as props included calipers, clinometer, diameter tape, increment borer, measuring stick, prism, soil sieves

Which tool(s) were most important to learning about the environment? Why were these important?

Please choose a tool and show me how you would use it? Why did you choose this tool for your demonstration?

How would you like to be evaluated to show what you have learned in the environmental science unit? Why?

APPENDIX I

STUDENT FOCUS GROUP QUESTIONS

Student Focus Group Questions:

Start with this statement:

The “Envirothon Teaching Method” involves bringing in knowledgeable professionals to teach about environmental topics such as aquatics, forestry, soils, wildlife, and a current environmental issue. With the Envirothon teaching method, the lessons cover one environmental topic at a time, and they usually take place in an outdoor setting and/or use local materials and resources. In an actual contest, students would rotate from one topic “Station” to another as a team. For each topic, students work on a variety of “hands on” tasks plus they are tested on a set of questions- the questions cover a very wide range of possibilities for each topic, and it is difficult to predict what specific questions will be asked. In this project, I tried to use these methods as a teaching tool-

Do you think these methods were used?

What impact did these methods have on your ability to learn about the environment?

What importance do each of the following have for learning about the environment?

GUEST SPEAKERS?

Is it their knowledge?

Is it their delivery style?

Is it your interest in the subject matter?

Please describe why guest speakers are/are not important to your learning

“HANDS ON” LEARNING- please explain why/why not (important to your learning)

LEARNING ABOUT LOCAL TOPICS – please explain why/why not.....

OUTDOOR LEARNING- please explain why/why not.....

“PROPS” USED TO CONVEY INFORMATION and/or DEMONSTRATE
CONCEPTS/SKILLS please explain why/why not.....

QUESTIONS USED TO SHOW KNOWLEDGE OF THE TOPICS – please explain
why/why not.....

APPENDIX J

FIELD NOTES

Field Notes:

1. Fall Field Days

October 14, 2010 - all day field trip

Field notes written by Janet Perry- I consider myself to be a passive observer left school at ~8 am on a school bus with 16 students - 11 sophomore students enrolled in College Biology, three 9th graders who expressed interest in Envirothon, an 11th grader who has been on our Envirothon and FFA Environment/Natural Resources team for several years, and one 12th grader who I have been trying to convince to do these activities for a LONG time!

What was the purpose of the lesson? The "lesson" was a choice of 3 environmental topics- each lasting ~ 1 hour which would be presented by professionals. Students got to attend 3 of these 5 choices - aquatics, forestry, soils, wildlife, and current issue (estuaries is this year's contest topic) Since I wanted to have students in all 4 areas of my AR project - aquatics, forestry, soils, and wildlife, students selected 1 or 2 areas they were particularly interested in and I balanced them out with my choice of the 3rd session. I had students in fairly equal numbers attending all 4 sessions - aquatics, forestry, soils, and wildlife.

What were some logistics of the lesson? Each station was outdoors at a National Wildlife Refuge- students had to walk up to ~1/4 mile between stations. Although it was beautiful and sunny out, early in the morning the woods was cold and there were no bathrooms right around! :-() students did a variety of activities at each station.

These 2 questions coming up are the parts I'm really interested in detailing! first of all, taking field notes is REALLY hard work! I had students at 4 different stations every timeframe so I tried to balance out my note taking. During session 1, I concentrated on Wildlife and Aquatics, session 2 I worked between Forestry and Soils, and the 3rd session I tried to get to all groups plus talk a bit with the teachers from various schools. I was pooped after 3 hours! BUT it was great and I learned SO MUCH that I didn't realize I was going to! Before we went, I tried to develop some strategy for what I was going to look for to determine learning, but I really got nowhere so I decided to be open to the moment- whatever snapshots I could get for learning. Almost immediately, without realizing it was important, I started to notice definite differences in the presenters of the various topics. One of the groups had a retired science teacher and another really good speaker as the presenters and they used a very interactive Q & A method of teaching with lots of enthusiasm. Another group had an older, very experienced "woods person" who had lots of stories to share, joked lots and lots with the students, and wouldn't take "no" for an answer when he asked them to try something. There were the "lecture" presenters - very knowledgeable, but not very interactive, and the "middle of the road" presenters. I started looking for props each station was using - most had samples of tools or specimens, but there was a big difference in who let the students handle things and "try things" and who just talked about the tools or samples. I found myself pulled toward the more interesting Stations, spending more time at Forestry and Wildlife because I was enjoying myself more- I was learning subject matter along with the students, and I was also getting teaching tips by watching the presenters; I had to keep track of the time to be

sure I didn't "short change" Aquatics, where I found my attention wandering- I kept looking at the lake shore and wondering why they didn't scoop up some aquatic samples! I personally enjoyed the information presented at soils, but it was pretty detailed- and it was a long walk to get up the hill to that Station! Now I'm very curious to see how the students felt about the different stations- I didn't want to ask them too much as a group on the bus coming back to school because I decided I wanted them to answer some questions individually and not be influenced by others. So the presenter's style was something I had not really counted on to influence learning, and I don't know yet what effect, if any, the presenters had on student learning. I also tried to jot down some specific topics the presenters covered- I asked each set of presenters whether they had done all 3 sessions basically the same and they said "yes"- this means I should be able to use my glimpses from any session and assume that the other students had also gotten the same info. And I got a chance to talk with the other teachers - who is teaching what course and whether they use these activities in the regular classroom - very interesting!

I decided to jot down whenever I saw a student (or group of students) smiling or laughing at a comment or bit of information given by a presenter. I also noted how sometimes students were asked to use a variety of their senses to learn something - the feel and smell of various conifer species needles, the feel and color of various animal skins. I kept a list of "hints" presenters were giving students to help them remember information - for example, "east is least, west is best" to remember compass declination. If I happened to be there when an Ashland student answered a Q, I jotted this down. And I did notice some of my students seemed to be shy and not want to try something in front of students from other schools. ALSO, I definitely remember every presenter saying Ashland had a really good group of students! So the Ashland students were polite, attentive, and paying attention. Now I need to try to determine what they learned! What would you do differently next time? I don't know yet - did my student think this was effective as a method of learning? I need to ask them! Although this activity only takes place 1 time a year, I now know more what I would like my next presenter- who is coming to our school in a few weeks- to focus on; I would like additional specific "hands on" activities- I really want my students moving and doing! I also know I may try to find a 2nd presenter to come at the same time so I can divide the 11 students into 2 groups. I found the smaller groups seemed to work better than the larger groups in this Field Day

Forestry Integrated with Soils Unit

2. Indoor "hands on" lab Stations featuring soils activities

Janet Perry – with "behind the scenes" assistance from Stan Perry

October 25 & 26, 2010 (double period on 10/25 & single period on 10/26)

With the help of my husband Stan, who works in the area of forest soils as part of his job as a forester, this indoor activity was designed to provide my student's with more "hands on" activities and basic soil information than they had received at Fall Field Days.

Reading my students' feedback from Fall Field Days, I was concerned they had come away with little "hands on" experience in Soils- also, the presenters were knowledgeable, but they assumed the students already had some background in soils so some of the information they covered was "over the student's heads"- I don't think that was a realistic assumption for the presenters to make, since even teachers bringing Envirothon team members might have new students who have never studied soils. So I wanted to

give the students a chance to move around my classroom “station to station” doing activities to help them learn more about soil. What a lot of prep time there was!- My husband and I spent a good portion of the weekend digging and then drying 2 five gallon pails filled with 2 different soil samples- a gravelly loam and a loam sample. Then we took the buckets to the school, put them on my lab cart, moved them to the second floor via elevator, and set them in my classroom. We also got together balance scales, cans, cloth, tape, and other supplies as we discussed what would be needed at each station- we chose to do a soil particle activity using soil sieves, a soil leaching activity, a soil mass activity, and a soil particle layering activity. Originally I hoped to rotate all the students in groups of 3 through the stations in a double period timeframe (86 minutes), but as the lab started, I soon realized that I was rushing the students too much, so I decided to slow the pace down- a good choice! Students really loved the soil sieve activity- they couldn’t believe how the soil sample would separate into particle sizes, and they very quickly realized how the different mesh sizes of the sieves needed to be set in order to capture the each particle size. I think using the sieves was most students’ favorite activity! The students were patient if they had to wait for other students to finish before they could rotate to the next station- more set-ups would have been nice, but I was happy with what we had accomplished to do this. Students could definitely see that the gravelly loam sample had a faster leaching time and held less water than the loam sample. They each got to choose what soil to use for the layering activity, and as we did this activity, I also let them mix the 2 samples together, keeping track of how much of each sample they used. My classroom (in a brand new school building!) got quite messy- with soil and water, and combinations of both = mud! The students were careful, but this was a really “hands on” opportunity for them! As the activity progressed, I would have loved to have “the expert presenter” there to help the students understand more about different soil characteristics, but I already had Stan and another forester scheduled for forestry and soils outdoor activities later the same week- I knew it would be impossible for Stan to take 2 mornings off from work. I felt fairly knowledgeable, but I really do think the way the Envirothon emphasizes student – professional interactions is the ideal teaching method to use whenever possible! I was feeling pressed for time with both the indoor/outdoor activities so I put them fairly close together – I needed to finish my environmental studies unit and move to other areas of the biology curriculum, plus I knew the weather in northern Maine could change toward colder conditions at any time! All in all, I think the indoor stations prepared the students well for the upcoming outdoor soil activities.

3. Presenters Ken White (forestry) and Stan Perry (soils)

October 29, 2010 ~8:45 am - ~10:15 am

Field notes written by Janet Perry I consider myself to be a privileged observer

The outdoor setting is a forested area right outside our new school building – it has a variety of mature softwoods and hardwoods, including pines; there is very little vegetation on the ground. The soils are well drained; most of the ground is flat, but the ground slopes down toward the school parking lot. Although the weather is sunny, the wind is blowing and its quite chilly! Most students are dressed for the weather, but not all, even though I mentioned dressing for the weather each day for several days before the activity! I have one student in a dress – but she’s doing good- not complaining (much)!

This outdoor activity is designed as another follow-up to Fall Field Days- The Forestry Station at Fall Field Days had gotten great reviews from many of my students, but not everybody had attended, so today I wanted to bring in professionals who – I knew were knowledgeable, I knew had experience in how Envirothon contests, and coaching was done, I knew could relate to students, and I knew wouldn't mind me giving them suggestions and directions for what information and “hands on” activities I wanted the outdoor sessions today to include ☺. I've known Ken White for years- as a volunteer, he has successfully coached his son's Envirothon teams (in a neighboring town) to both state and even National level- he's great with students – lots of encouragement, lots of “hands on”, “try every activity” enthusiasm with each student he comes in contact with- I love watching him interact with students, and today was a perfect example of his style.

My College Biology students were divided into 2 groups – they spent ~35 minutes doing forestry activities and then switched with the other group of students who had been doing soils. Ken has so much experience, he really got a lot done in a short period of time. He had every student pace, one right after the other, explaining how they should count their steps over a measured distance. (he had come to the site ahead of time so he knew exactly how and where he wanted to do each activity, and he also provided all the forestry tools for the students to use), then every student measured where on their body 4.5 feet would be so they could each calculate a diameter breast height (dbh) measurement (this standard height is the same on every tree- here is the place to put the diameter tape which is then used to calculate volume of wood in a tree. Ken explained that each person needed to know where 4.5 feet is on the body- he got a lot of laughs when the shorter students compared the 4.5 foot height on their bodies to the taller students! Ken also showed all the students how a prism could be used to determine whether or not to include a tree in a sample tally plot. The students really found it intriguing that when they looked through the prism, sometimes the outline of a tree would appear offset but still be connected between the top and bottom of the tree, (count that tree in) while other times the top of the tree would appear to be completely separated from the bottom of the tree (that tree is too far away from the center point of the plot you are measuring so don't count it!)

And although not every student actually did an increment bore, Ken made sure they all gathered around when the core was pulled out of the tree so they could count the growth rings. He really kept every student engaged doing something while he was working with the group – and he made it look easy!

The other Station is Soils – my husband, Stan, is the soils presenter, but actually most of the students don't know this. Stan also visited the site before the activity, and he took the time to dig a hole 2-3 feet deep to make a soil profile pit (he then filled the hole back in after the presentation- people just don't realize how much advance preparation goes into an outdoor “hands on” activity!) Stan always finds himself at a disadvantage with providing “hands on” activities using soil compared to forestry- foresters can move around, have lots of fun tools etc. but Stan jokes the soil “just sits there” in a hole for people to look at- he does always encourage the students to feel the soil, and today was no exception- he was much more patient than the soils presenters at Fall Field Day; he took the time to explain how the grittiness they were feeling meant there were sand particles in the sample, and how the colors they were seeing in the profile could be compared to those in a Munsell chart. Stan is much more laid back in his presentation

style than Ken, but I could tell the students were focused; he really got the students attention when he showed them a soils map of the exact spot where they were standing and explained how the soil they were looking at was being described on the map. The other part of the soils group activity was finding slope of land, and this turned into a terrific group activity. Stan had one student hold the measuring stick, another student used a long tape to find the distance from the top to bottom of the slope, yet another took more measurements, looking through a clinometer, and another did math- each student had a specific job, and when all had completed the tasks, the answer was found! This was a great example of a site-based authentic activity where every student had an important job, everyone participated, and everyone wanted to know the end result.

The set-up was excellent for me as an observer. The groups were close together and I could walk easily between them- lots of time I could actually hear them talking without getting up too close so I didn't interfere with the activities. I found the students engaged and having a good time. They were definitely learning lots of skills and concepts. As the morning progressed some students were getting cold; I think weather did play a factor, and these students were ready to go in at the end of class. However, others were happy to stay and talk with both Ken and Stan right up until the bell rang; I was happy to see they thanked the presenters for coming in. I thanked them both too!!

Wildlife Integrated with Aquatics Unit

4. Ted Shapiro-local tv meteorologist-weather presentation including winter conditions
January 6, 2011 12:30 to 2 pm

Field notes written by Janet Perry I consider myself to be a passive observer
Presentation is given in new school auditorium with approximately 50 students in attendance – all 11 College Biology students are present– students are quiet and attentive.

Ted began his presentation with this question- “What kind of weather do you like the least?” - students agreed with his answer “Hot & humid” – the air is very heavy.
Question- “is this hot and humid air heavy because it is full of water vapor?” – Answer is false – hot and humid air is actually lighter because it is full of water (molecular mass of water is ~18g while molecular mass of oxygen molecule is ~32g) but it is “heavy” because our cooling mechanism works less efficiently – the air already has a lot of moisture in it, so it can't accept our perspiration as well.

Other topics covered-

Ted gave an easy way to convert between Celsius and F temperatures

Then discussed education required to be a meteorologist

Question for students - “Do adults tend to exaggerate?” This introduced a section on dramatic weather events- Ted first showed dust bowl with graphic pictures and then showed picture of palm tree while keeping bottom of picture covered – it was uncovered a bit at a time while students were asked what they see – it was a 2x4 board which completely pierced the tree! This definitely got the students' attention! Ted gave many anecdotes about weather- students enjoyed millipede story.

Tide stories with more anecdotes– storm tides are a vertical rise, hurricanes- Camille, Katrina- 28 foot storm surge, Katrina surpassed the storm surge of Camille and the death toll of the 1938 New England hurricane

Driving across a flooded roadway- Ted's video showed it is not a good idea!

“Worldwide, how many people died in a single storm?” - 1 student said 100,000- most thought this was way too high- actually 700,000 people died in Bangladesh in a single storm

Lightning – what is safe? – several stories about lightning

Students seemed engaged and interested

“Do you like snow?” Ted discussed the ~200 inch northern Maine snow winter of 2008 & the jet stream, a high altitude river of air. He then discussed what is “normal” – 30 year average of data – and climate is “everything in the closet while weather is what you wear”

I found it very interesting that Ted showed examples of weather, his “Tools of the trade” – knowledge of the sky, field glasses, sling psychrometer (wet bulb and dry bulb/ relative humidity /temperature/ dew point) compass for wind direction (measured where the wind is coming from), barometer, book –Field Guide to North American Weather . People should look for weather trends.

Ted had many characteristics similar to other successful presenters- he communicated with students on their level, used stories and anecdotes to illustrate his points, covered local information, and seemed to relate well to the students as people he was interested in. However, I did notice many different topics were covered within the program, and the presenter was jumping around between topics, I'm curious to know if the students are following his presentation? Since there was Q & A between Ted and the students, but no “hands on” activities, how will students feel about this? Also, does it matter for the College Biology students this is a “stand alone” presentation, not covered at the same time as the ecology section of the course- will this affect learning?

5. Wildlife Survey – Pre-Survey set-up and Week 1 field notes written by Janet Perry

On Tuesday February 1, College Biology students took the pre-activity set of 20 Questions & Answers for Wildlife – 3 students out of 11 were absent – 2 came in on Wed. 2/2 so they were also able to do the Questions. We picked “out of a hat” for choices of teachers/classes who students would do the wildlife survey with; the first survey is scheduled for Thursday Feb. 3 at the start of period 2. There are 7 high school teachers/classes and 11 College Bio students so 7 students have been assigned a class and 4 are “alternates” to either fill in if the primary student is absent OR to go in as a second person to help with the survey. We spent class time discussing the Questions students would ask in the survey and role playing how the students would be the “survey takers”. A few students are hesitant about “speaking” in front of a class – even with students they

know- but most seem to be looking forward to the activity. I spoke individually with all the high school classes and explained how the survey would work; the teachers all were very accommodating about College Bio students coming in to do the survey.

This activity is stressing me somewhat – the preparation of school announcements, survey forms, and methods to do the wildlife tally are fairly simple and straight-forward because I had done this activity myself last year as part of my MSSE Wildlife Ecology course, BUT now it is very different to be preparing my students to do the survey instead of doing it myself with the other science teacher! It is also difficult to be doing this activity while I'm teaching a completely different biology unit within the class curriculum- we are currently studying cell membranes! I've thought a lot about how to stop teaching the "regular" unit and take the necessary class time to do the wildlife survey 1 time a week for a month; there's been the most student prep time this week- (Tuesday 2/1 we needed 1 period out of a double period, Wed 2/2 we used approximately 20 minutes out of a 40 minute period and Thursday we used 1 period out of a double period) so I decided to have students do cell membrane coloring drawings in between the wildlife survey prep times. It actually worked quite well, since students could draw and color without needing to absorb new cell membrane knowledge. I definitely recommend thinking about what students will be doing if an activity such as this is not embedded into the ecology curriculum, but instead used as a "stand alone" activity.

February 3, after the first survey my College Bio students and I "debriefed" – most students were extremely positive and happy with how they had handled the wildlife tally- some commented on students who didn't listen to them carefully ☺ and/or who kept remembering other wildlife they had seen after my student thought they were finished! One student did state the class she had visited was not very polite and kept talking instead of listening; we will brainstorm what to do about this more before next week. I have one very shy student and she had a very difficult time getting started; she really would have liked to back out! However, I went with her at the beginning, her class was good, and the teacher in the class helpful. Although not really sure she liked the experience, she was a little more confident after taking the tally than before! Also after the survey, we discussed the current weather conditions and the wildlife data the students had gathered- I think it was a very productive week #1 post-survey discussion.

weeks 2 – 5 February March 9, 2011

Wow, what a difference in confidence my students now have when talking with other students and asking for information! Any students who had issues the week before seem to have worked through them without my help. Now they just come into biology class on Survey Day, pick up their tally sheets and head off to the other classrooms. They tell me that some of the students are "jokers", trying to tell them about unbelievable sightings, but they are not at all fazed by this; they simply smile and go on. Each has developed a system for asking questions, and taking down the results. Sometimes they have to switch classes because one (or more) of my biology students is absent, but most are not bothered by this. I ask for volunteers when possible. Since I have more students than classrooms, often 2 of my students work together surveying one class. When everybody gets back with their tally sheets, we discuss the species and the weather conditions back in class, and then go on with whatever subject matter we are currently studying. Students seem to

be able to “switch gears” between the Survey and the other unrelated biology lessons without problems. We are studying cell membranes and cells during the regular class time.

Guest Speaker

Rich Hoppe Maine Inland Fish & Wildlife Regional Biologist

“Where is Ashland Wildlife Spending the Winter?”

March 10, 2011

Period 2 College Biology Class ~8:45 am to 9:30am

Presentation is given in my classroom using my “Smart Board”

All 11 students are present and attentive.

Beyond the set-up of the Smart Board, I consider myself to be a passive observer.

Rich came into the classroom carrying a stuffed mount of an adult Canada Lynx, an example of a rare local “snow loving” cat. Students immediately came up, touched the fur, and got an “up close” look. This was a great way to get students interested and awake! Then Rich started off with a variety of vocabulary words associated with wildlife. in a PowerPoint Presentation on the Smart Board. Using a Q & A format, Rich discussed “habitat” and the need for all wildlife to have food, water, cover, and space. “Carrying Capacity” and “Limiting Resource” are defined- some of the terms have been covered in class while others are new to the students; I think there may be terms on the Wildlife / Aquatic section questions which students will answer again as a post-treatment assessment. My choice of questions and the general topic I have asked each presenter to cover have not been connected together- its random whether the speakers will happen to discuss the questions the students are answering- this is exactly the way it works with the Envirothon contest- the areas covered in the Envirothon are so broad, its impossible to predict what questions will be on the tests so students can never study for an exact set of questions, but instead learn as much as possible about each topic. I hope to have a very honest re-creation of teaching with Envirothon methods, and I’m curious to see how the students will do in the post-treatment assessment and to hear their comments as they give feedback on the activities in upcoming focus groups.

Rich and I had discussed which types of wildlife to talk about with the students, and he chose white-tail deer, moose, Canada Lynx vs. Bobcat, Red Fox, Coyote, Snowshoe hare, Red vs. Grey Squirrel, turkeys, + mentioning a few more. Rich and the students talked about how the survey was showing many people were seeing a lot of deer and turkeys, and he stated some people were feeding them. Rich really emphasized that this was not helping the wildlife since its making them dependent on people and also bringing them close to roadways where they were being run over; students seemed to take this information very seriously. Now that the snow is so deep, deer are having a very hard time moving around; Rich discussed the importance of deeryard areas and how the weather is now affecting the deer herd. Rich also talked about the Lynx compared to the Bobcat and pointed out visual clues to identify Lynx using the mounted specimen. He asked whether students had ever seen a Lynx in the wild, and several students shared their experiences.

Some specific information students found interesting-

White tail deer are on the northern edge of their range while Lynx are on the southern edge of their range. Also, Rich's advice – "don't come back in another life as a snowshoe hare because it's a favorite meal on lots of predators' diets!" Why are eagles being killed on the Interstate? – eagles are eating roadkill deer on the side of the road, and they can't fly high enough fast enough to avoid being hit by the big tractor trailer trucks.

Throughout the talk, students answered Rich's questions- they had a few questions of their own, but seemed to do best when Rich asked the questions and they answered them. Rich has a very comfortable speaking style, and he is extremely knowledgeable about the local wildlife. I thought it was an excellent presentation, even though there were no specific "hands on" activities. Rich was the final presenter for my "Envirothon Teaching Methods" AR project, and I'm again curious to find out the students' reactions. His presentation was indoors, and he did not do any "hands on" activities; however, he brought in a very interesting prop- the Canada lynx, and he spoke about local topics with an interactive question and answer style. Rich, a long time regional Envirothon wildlife judge, specifically told me he believes that learning increases as sensory stimulation increases; it was his idea to bring the stuffed mount in for students to not only look at, but also touch. I think he took the extra time and effort to make his presentation "above and beyond" a normal classroom experience; I think he did a great job!

APPENDIX K

STUDENT ANSWERS TO TEACHER ADAPTED TESTS-FORESTRY & SOILS

Student Answers to Teacher Adapted Tests-Forestry & Soils

KEY for student answers to all Teacher Adapted Tests:

Orange question numbers = questions based on vocabulary or basic concepts

Green question numbers = questions based on higher order thinking skills

Students $a_1 - k_1$ = Pre-treatment answers

! = correct response

X = incorrect response

+ indicates student is confident answer selected is correct

? indicates student has no idea of correct answer, and answer is a complete guess

Students $a_2 - k_2$ = Post-treatment answers

	No change from pre-treatment
	Negative change from pre-treatment
	Positive change from pre-treatment

Appendix K

Data from Teacher Adapted Test– Knowledge of Forestry N = 10

FORESTRY QUESTIONS	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Total # correct	Question 11	Question 12	Question 13	Question 14	Question 15	Question 16	Question 17	Question 18	Question 19	Question 20	Total # correct
Student a ₁	X ?	X ?	!	! +	!	X ?	!	X ?	!	X ?	5	X ?	X	!	! +	! +	X +	!	!	X +	X ?	5
Student a ₂											7											6
Student b ₁	Absent – no pre-treatment data available																					
Student c ₁	! ?	X ?	! ?	! +	! ?	X ?	X +	X ?	X ?	X +	4	X ?	X ?	X ?	! +	! +	X ?	X ?	X ?	! ?	X ?	3
Student c ₂											3											3
Student d ₁	X ?	X ?	! +	! +	X ?	X ?	X ?	!	X ?	X ?	3	X +	X	X ?	! ?	X +	X ?	X ?	! +	X ?	X ?	2
Student d ₂											5											5
Student e ₁	X ?	X ?	! +	! +	! +	X +	X +	X	X	!	4	X	!	X ?	! +	! +	X	!	!	X +	!	6
Student e ₂											7											8
Student f ₁	X ?	X +	! +	! +	X ?	!	!	!	X ?	!	6	X	!	!	!	!	X +	X	X	X	!	5
Student f ₂											7											6
Student g ₁	X	!	!	! +	!	!	!	X ?	X ?	X	6	!	!	X +	! +	! +	X	!	!	!	X ?	7
Student g ₂											8											9
Student h ₁	X +	X	! +	! +	! +	X +	!	X ?	!	!	6	!	!	X ?	! ?	! +	X	!	!	!	X ?	7
Student h ₂											9											7
Student i ₁	X ?	X ?	! ?	! ?	X +	X ?	X ?	!	!	X ?	4	X ?	X ?	! ?	! ?	! +	X ?	X ?	!	X ?	X ?	4
Student i ₂											6											5
Student j ₁	X ?	X ?	! ?	X ?	X ?	X ?	X ?	X ?	!	X ?	2	!	X ?	X ?	! ?	! ?	!	!	X +	!	X ?	6
Student j ₂											5											8
Student k ₁	!	X	!	! +	X +	X +	!	X	!	X	5	!	X	X	! +	! +	X	X	!	X	X	4
Student k ₂											6											8
TOTALcorrect pre-treatment	2	1	1 0	9	5	2	5	3	5	3	4 5	4	4	3	1 0	9	1	5	7	4	2	4 9
TOTALcorrect posttreatment	4	2	1 0	1 0	7	7	7	3	9	4	6 3	5	4	9	1 0	1 0	1	6	9	4	7	6 5

Data from Teacher Adapted Test – Knowledge of Soils N=10

SOILS QUESTIONS	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Total # correct	Question 11	Question 12	Question 13	Question 14	Question 15	Question 16	Question 17	Question 18	Question 19	Question 20	Total # correct
Student a ₁	! +	!	X ?	X +	! +	! +	! +	! ?	X +	X +	6	X ?	X ?	!	!	X +	!	X ?	!	!	X ?	5
Student a ₂											9											9
Student b	Absent – no pre-treatment data available																					
Student c ₁	! +	X +	!	X +	!	X +	!	X +	X +	X +	4	!	X ?	!	!	X +	X ?	X ?	X ?	!	X ?	4
Student c ₂											6											3
Student d ₁	! +	!	!	!	!	!	!	!	X ?	X +	8	X ?	!	X ?	X ?	X ?	X ?	X ?	X ?	X ?	X ?	1
Student d ₂											8											6
Student e ₁	! +	X +	!	X +	X ?	!	!	!	!	!	7	X ?	X ?	!	X ?	!	X ?	X ?	!	!	!	5
Student e ₂											8											7
Student f ₁	! +	X +	X	X +	!	X +	!	!	X ?	X ?	4	X ?	X ?	!	!	X ?	X ?	X ?	X ?	X ?	X ?	2
Student f ₂											7											6
Student g ₁	!	!	!	!	!	!	!	X ?	X +	!	8	!	X	!	X	X	X	X ?	X	X ?	X	2
Student g ₂											9											9
Student h ₁	! +	!	!	!	!	!	!	X	X	X ?	7	!	!	!	X	!	X ?	!	!	X ?	X	6
Student h ₂											7											8
Student i ₁	! +	!	!	!	!	!	!	X ?	X ?	X +	8	X ?	X ?	!	!	X +	X ?	X +	X +	!	X	3
Student i ₂											9											4
Student j ₁	!	X ?	!	X ?	!	X ?	X ?	!	!	X ?	5	X	X	!	X ?	X ?	X ?	X ?	X ?	X ?	!	2
Student j ₂											7											5
Student k ₁	!	X	X ?	!	X	!	!	X	X	X	4	X ?	X ?	X	!	!	X	X	X	X ?	X ?	2
Student k ₂											6											5
TOTALcorrect pre-treatment	¹ ₀	5	7	5	8	7	9	6	2	2	⁶ ₁	3	2	8	5	3	1	1	3	4	2	³ ₂
TOTALcorrect posttreatment	¹ ₀	7	8	8	9	8	9	8	1	8	⁷ ₆	5	6	9	8	7	2	3	7	8	7	⁶ ₂

APPENDIX L

STUDENT ANSWERS TO TEACHER ADAPTED TESTS – AQUATICS &
WILDLIFE

Data from Teacher Adapted Test–Knowledge of Aquatics N = 10

AQUATICS QUESTIONS	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Total # correct	Question 11	Question 12	Question 13	Question 14	Question 15	Question 16	Question 17	Question 18	Question 19	Question 20	Total # correct
Student a ₁	!	!	!	X	X	X	X	X	!	!	5	!	!	!	!	X	!	!	!	!	!	9
	+	+	+	?	?	?	?			?		+	+	+	+	+	+	+	+	+		
Student a ₂											6											9
Student b ₁	!	X	!	!	X	X	X	X	!	!	5	!	!	!	!	X	!	!	X	X	!	7
		?		?	?	?	?			?			?						?	?	?	
Student b ₂											7											7
Student c ₁	X	!	X	!	X	X	X	X	X	!	3	X	X	X	X	X	!	!	X	X	X	2
	+	+	?		?	?	?	+	+	?		+	?	?	?	?	+		?	+		
Student c ₂											5											5
Student d ₁	X	X	!	!	X	X	X	X	X	!	3	X	X	!	X	!	!	X	X	X	!	4
	?	?	+	?	?	?	?	?	?	?		?	?	+	?	?	?		?	?	+	
Student d ₂											4											5
Student e	Absent no pre-treatment data available																					
Student f ₁	X	X	X	!	X	X	X	X	X	X	1	X	X	!	X	X	!	X	X	X	X	2
			?																			
Student f ₂											3											5
Student g ₁	!	X	!	!	!	!	!	X	!	!	8	!	!	!	!	X	!	X	!	!	!	8
	?		+			?			+	+		+	+	+					+	?	?	
Student g ₂											6											9
Student h ₁	!	X	!	!	X	!	X	X	X	!	5	!	!	!	!	X	!	!	X	X	!	7
				?	?	?	?												?		?	
Student h ₂											6											7
Student i ₁	X	X	!	!	!	X	X	X	!	!	5	X	!	!	!	X	X	X	X	X	X	3
		?	?	?	?	?	?		?	?			?		?	?	?	?	?	?	?	
Student i ₂											5											5
Student j ₁	!	X	X	X	X	!	X	X	X	X	2	X	X	!	X	!	!	X	X	!	!	5
		?	?	?	?	?	?	?		?		?	?	+	?	+	?	?		?	?	
Student j ₂											2											4
Student k ₁	!	!	!	X	X	!	X	!	!	!	7	!	X	!	!	X	!	X	X	!	X	5
		?	+			+						?		+	?		?			?		
Student k ₂											7											5
TOTALcorrect pre-treatment	6	3	7	7	2	4	1	1	5	8	4	5	5	9	6	2	9	4	2	4	6	5
TOTALcorrect posttreatment	6	3	9	3	2	3	4	5	7	9	5	6	6	1	8	1	1	6	2	6	6	6
											1			0		0						1

Teacher Adapted Test Knowledge of Wildlife N = 10

FORESTRY QUESTIONS	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Total # correct	Question 11	Question 12	Question 13	Question 14	Question 15	Question 16	Question 17	Question 18	Question 19	Question 20	Total # correct
Student a	Absent – no pre-treatment data available																					
Student b ₁	! +	! +	X +	! ?	X ?	! +	X +	! ?	X ?	! +	6	X ?	X +	X +	X ?	X ?	X ?	X ?	X +	X +	!	1
Student b ₂											7											6
Student c ₁	X	X	X	X	X	!	X	X	!	X	2	X	X	X	X	!	X	!	X	X	X	2
Student c ₂											1											
Student d ₁	X	! +	X ?	X ?	! ?	X ?	X ?	X ?	X ?	! +	3	X ?	! ?	X ?	X +	X ?	X ?	! ?	X ?	! +	X	3
Student d ₂											9											2
Student e ₁	! +	! +	! ?	X +	! +	! +	! ?	X ?	! ?	! ?	8	X ?	! ?	X ?	! ?	X ?	! ?	! +	! ?	! ?	X +	6
Student e ₂											7											8
Student f ₁	X	X	X	!	X	!	X	X	!	!	4	!	!	!	!	X	!	!	X	!	X	7
Student f ₂											9											7
Student g ₁	!	!	X	!	!	! ?	X	!	!	!	8	X	!	X	!	! +	!	!	X	!	X ?	6
Student g ₂											9											7
Student h ₁	X	!	X	X	!	!	!	!	!	!	7	X	!	X	!	X	!	!	! ?	! ?	! ?	7
Student h ₂											8											6
Student i ₁	X +	! +	X +	! +	X ?	X +	X	! ?	X ?	! +	4	! ?	! ?	X ?	X +	X +	X ?	! +	X ?	X ?	! ?	4
Student i ₂											7											5
Student j ₁	!	X	X ?	!	! ?	X ?	! ?	X ?	X ?	! ?	5	X ?	X ?	X ?	X ?	X ?	X ?	X ?	X ?	X ?	X ?	0
Student j ₂											6											3
Student k ₁	X ?	X ?	X ?	!	!	X	X	X	X	!	3	X ?	X	X	X	X	!	X ?	X	!	X	2
Student k ₂											5											3
TOTALcorrect pre-treatment	4	6	1	6	6	6	3	4	5	9	50	2	6	1	4	2	5	7	2	6	3	38
TOTALcorrect posttreatment	8	9	4	8	8	8	8	4	4	7	68	4	5	5	4	3	6	9	2	6	6	50

APPENDIX M

METEOROLOGIST/WILDLIFE BIOLOGIST PRESENTATIONS

Meteorologist/Wildlife Biologist Presentations:

Please Rank the Value of the Information given in the presentation:

1 is useless, 2 is fair, 3 is “average”, 4 is very good, 5 is excellent

1 2 3 4 5

Why did you choose this ranking?

Please Rank the Presenter for Quality of Presentation:

1 is extremely boring, 2 is fair, 3 is “average”, 4 is very good, 5 is excellent

1 2 3 4 5

Why did you choose this ranking?

Was the presentation worthwhile as a “stand alone” topic or would it have been more useful if given within the ecology unit?

Useful as a “stand alone” presentation

More useful if connected to abiotic conditions during the Ecosystem Unit

No Preference – either way is fine

What was the most important information learned during this presentation- please give example(s)