

**EVALUATION OF COGNITIVE LEARNING IN
INTERMEDIATE AGE STUDENTS AT THE
CENTRAL WISCONSIN ENVIRONMENTAL STATION**

by

Judy K. Klippel

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APPROVED BY THE GRADUATE COMMITTEE OF:

Richard J. Wilke

Dr. Richard J. Wilke, Committee Chairman
Associate Professor of Environmental Education

Michael P. Gross

Dr. Michael P. Gross
Professor of Environmental Education/Interpretation

JR Price

Dr. Jay R. Price
Associate Professor of Education

ABSTRACT

During the 1983-84 academic year, a formal evaluation of cognitive learning was conducted at the Central Wisconsin Environmental Station. A modified pretest-posttest design was used to assess fourth, fifth, and sixth graders' achievement of performance objectives in ten of the center's 40 curriculum units. Comparisons were also made between student gain scores on the tests and their perceptions of the amount of fun they had and between gain scores and their perceptions of how much they learned in the onsite activity.

Test scores were compiled by curriculum unit and grade level for data analysis, resulting in a total of 19 cases on which t tests were conducted. In 14 of the 19 cases, treatment groups experienced significant gains without showing a pretest learning effect ($p \leq .05$). There were several uncontrolled variables which variously influenced gains in the units. These included classroom participation in unit-related pre- and post-activities, classroom instruction in other environmental education activities, onsite instruction in other units with some of the same concepts, and initial academic status of participants. In seven of the cases, significant gains could be attributed to treatment variables which included the study unit and pre- and post-activities. In the remaining seven cases, gains could be attributed to participation in treatment variables including the study unit, without pre- and post-activities.

The results imply that instruction provided by a large teaching staff at the Environmental Station is an effective means of assisting students achieve cognitive knowledge objectives. The results also indicate that learning is occurring whether or not students are exposed to the pre- and post-activities.

In two of the ten curriculum units there were significant differences in mean pre- to posttest gain scores between students who rated the activity as "really fun" and those who rated it "sometimes fun". In none of the curriculum units was there any significant difference in mean gain score between students who rated their participation in the activity as "discovered lots of new things", "discovered some new things", and "did not discover anything new".

Further inquiry is suggested to determine what aspects of activities students regard as having been fun and learned. Such information may have value for making decisions about program changes. A more complete program evaluation will require studies focusing on higher levels of cognitive thinking and on the affective and behavioral domains.

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CHAPTER I

INTRODUCTION

Since the early 1970's there has been considerable growth in the number of environmental education programs in the United States. Legislation such as the National Environmental Policy Act (1969) and the Environmental Education Act (1970) focused attention on the need for both environmental protection and an environmentally educated citizenry. Where 15 years ago environmental education was relatively unfamiliar to much of the public, today a multitude of opportunities exist for people to become involved in such programs through various institutions and organizations.

Agencies providing environmentally oriented programs endeavor to help people develop knowledge, attitudes, and skills that will help them to act as more environmentally aware and responsible citizens. If these programs are to continue to grow, improve, or perhaps even justify their existence, several questions need to be asked. How successful are the agencies in accomplishing their goals and objectives? Are they making optimal use of their human, financial, and program resources? Are they meeting the needs of their clientele? Are people becoming more environmentally educated?

These questions and similar ones are central to the process of evaluation, in which educators judge a program's value and worth toward the ultimate goal of providing learners with the best educational opportunities possible.

Passineau (1975) described evaluation as "...a logical process of analyzing the nature of an educational program and of making value judgments concerning its worth."

Inherent in evaluation are two processes--assessment and valuing. Assessment involves the measurement, description, or analysis of the program. Valuing involves making judgments about the program's worth or quality based on those assessments. Assessment and valuing must take place within the context of clearly defined program goals.

Evaluation is sometimes thought of as a process that occurs only at the conclusion of a program. Actually, it is utilized most effectively when employed throughout a program's existence, from the program's developmental stages to its conclusion.

Formative evaluation takes place during intermediate stages of a program, specifically, while it is under development or is ongoing. Its purpose is to provide immediate feedback so that personnel can make judgments regarding the program's successes and failures up to that point. Based on the information and insights gained, they can then make revisions to improve the program. Techniques that could be used in formative evaluation include, for

example, questionnaires, rating scales, observations, interviews, and simulation games.

Summative evaluation is employed at the completion of program development or the conclusion of a program's use. Its purpose is to provide information to be used in making judgments about the program's overall worth or effectiveness. These judgments provide a basis for making decisions regarding adoption and future support of the program. Techniques such as criterion-referenced tests, norm-referenced tests, and checklists are used in summative evaluation.

Formative evaluation is of great use to the program developer and to staff involved in teaching and coordinating the program. Summative evaluation is valuable to policy makers who will make decisions such as whether to continue or discontinue, expand or cut back, revise, or fund a program. Summative evaluation is also of value to potential users such as a school staff determining whether to involve their students in the center's program, or another facility deciding whether to adopt the center's program.

Environmental education programs can realize numerous benefits and meet various purposes through the use of a well-conducted evaluation study. Among them are the following, variously suggested by Passineau (1975), Disinger (1981), Lucko (1981), Wolanin (1983), and others:

1. It necessitates the clarification of the program's philosophy, goals, and objectives, and the development of a comprehensive program design.
2. It measures student achievement of objectives, which can serve as a basis for claiming program effectiveness, as well as provide direction for making changes to increase the amount of learning taking place.
3. It assists program personnel in determining how effectively they are meeting the needs of their clientele.
4. It provides information needed for making decisions about the program's future, such as whether to make revisions or expand it.
5. Through achievement of the goals named above, evaluation serves to promote the field of environmental education. Besides being of value in strengthening individual programs, it can serve to add credibility and validity to the entire field.

DEVELOPMENT OF AN EVALUATION PLAN

The introduction of an evaluation plan into an environmental education program requires the use of guidelines to help define the task. First, the program itself must follow a careful design. As stated by Bennett (1977), these facets of the program include:

1. "...the identification of needs or antecedent conditions to which the program is addressed."
2. "...the translation of needs into goals."
3. "...translation of goals into major behavioral objectives which may be used as a basis for developing a wide variety of programmes."
4. "...definition of major behavioral objectives as measurable objectives."
5. "...the development of the programme resources, content and activities, and identification of student and teacher roles."
6. "...the development of the evaluation plan."

Although the evaluation plan is the last thing to be developed, all other aspects of the program must be designed with evaluation needs in mind. Given a solid program design, the design of the evaluation can be addressed. Passineau (1975) suggests that educators consider the following questions to guide their design.

Why are we evaluating? It is necessary to first determine the rationale(s) for evaluating, in order to help define the scope of the project. Examples of goals follow: (Lucko, 1981; Childress, 1977; Wolanin, 1983)

- *to show educational accountability to the community, funding agencies, teachers, parents, and students

- *to acquire the information necessary for sound decision-making--for example, in matters of finance, personnel, or program

- *to provide a basis for claiming educational benefits (cognitive, affective, and/or psychomotor)

What are we evaluating? Program personnel should decide what aspects of the program need to be included. Potential foci include program goals; activity objectives and content; students' pre- and post-activity knowledge, attitudes, and skills; and student, staff, and parent satisfaction.

Whom should be evaluated? Everyone who shares in the responsibility for the program should be evaluated, again based on the rationale. Students, classroom teachers, program staff, and administrators could all be the subjects of various evaluation plans.

When should evaluation occur? Evaluation should be an ongoing process, permeating a program from its inception to its completion. Both formative and summative approaches should be used. For example, evaluation can take place after the development of the philosophy, goals, and objectives; during program use; and whenever program changes occur.

Where should we evaluate? The setting for the assessment procedures needs to be compatible with the rationale, type of evaluation (formative or summative), and techniques (for example, written test or observation of activities). If the program is undergoing summative evaluation with the intent of dissemination of curriculum materials to other facilities, the setting must be one which is generalizable to situations faced by potential users.

How should we evaluate? The selection of techniques and tools of evaluation depends on the answers given to all the previous questions. It is further determined by the availability of qualified personnel, adequate funds, time, and appropriate tools. Examples of techniques and tools that could be considered for use include:

criterion-referenced tests, norm-referenced tests, diagnostic tests, interviews, checklists, rating scales, questionnaires, systematic observation of behavior, observational schedules, colleague and student evaluation reports, simulation games, experimental choice situations, Q-sort, sociometry, projective techniques, role playing, attitude scales..., semantic differential technique, normal lifetime choice situations such as careers..., process-focused techniques..., and unobtrusive measures. (Passineau, 1975)

PROBLEM STATEMENT

Evaluation is vital to the credibility and maturity of the field of environmental education. It is central to the growth and improvement of all environmental education programs. Centers which wish to more objectively justify their claims of learning, more closely meet student needs, or expand or disseminate their program materials would do well to incorporate evaluation measures.

The goals of this study were to evaluate cognitive knowledge learning at an environmental center and to establish whether a relationship existed between students' perceptions of their learning and fun and their cognitive knowledge gains. This information could assist the staff at the center in making improvements for future programs, reviewing the role of the stated performance objectives, and interpreting more knowledgeably the results of the ongoing informal evaluation. Specifically, the questions asked were the following:

1. Are there significant pretest to posttest gains in intermediate students' scores on objective-referenced tests given before and after their participation in specially designed activities at the Central Wisconsin Environmental Station, if:
 - a. students have also participated in related classroom pre- and post-activities within the treatment time?
 - b. students have not participated in related classroom pre- and post-activities within the treatment time?
2. Are there significant differences in mean posttest scores between treatment group students who took both the pretest and the posttest and treatment group students who took the posttest only?

3. Are there significant differences in mean gain scores between the students who rated their participation in the treatment unit as "really fun" and those who rated it as "sometimes fun, sometimes boring", and between those groups and the students who rated it as "really boring or not fun"?
4. Are there significant differences in mean gain scores between the students who rated their learning in the treatment unit as "discovered lots of new things" and those who rated it "discovered some new things", and between those groups and the students who rated it as "did not discover anything new?"

STUDY DESIGN

The focus of this study was the environmental education program used with school groups at the Central Wisconsin Environmental Station in Amherst Junction, Wisconsin. Elements of program design outlined by Bennett and referred to on page 4 are evidenced in the Environmental Station's program. The program was developed to help meet the needs for environmental education of Central Wisconsin youth and to provide practicum teaching experiences for students of environmental education and interpretation at the University of Wisconsin-Stevens Point. "The Goals for Curriculum Development in Environmental Education" (Hungerford, Peyton, and Wilke, 1980) established the guidelines within which the curriculum was written. Major behavioral objectives were stated as theme categories in the **Teachers' Guide** and developed as curriculum units as found in the **Staff Guide** (1983). Units consist of performance objectives, onsite activities, and classroom pre- and post-activities. Copies of these materials may be found in Appendix A.

For the eight years of its programming prior to this study, the Environmental Station made use of informal, formative methods of evaluation. Sample copies of these evaluation forms may be found in Appendix A.

This study was designed to be a formal, summative evaluation. The Environmental Station's administrative staff and the researcher determined that it would focus on achievement of cognitive knowledge objectives. The accomplishment of affective and behavioral goals and other aspects of cognitive learning may be the emphases of future research, in order to more effectively and knowledgeably judge the program and make decisions about its future.

A test was written for each of ten curriculum units selected to be included in the study. Tests were administered at school to fourth, fifth, and sixth grade classes before and after their participation in a program at the Environmental Station. The posttest also asked students to rate how much fun their participation in the unit was and how much they felt they learned. Completed testing materials were scored and data analyzed by the researcher to provide answers to the research questions.

ASSUMPTIONS

The following assumptions were made for this study.

1. The performance objectives for each unit are valid reflections of concepts and processes taught therein, and are appropriate to the grade levels with which they are used.
2. Environmental Station instructors have copies of the objectives and lesson plans for each unit. Their

teaching reflects the components of the units in order to standardize instruction as much as possible.

3. Environmental Station instructors have at least a minimal college level background in natural science and environmental education and interpretation coursework.
4. Instrumentation was controlled by having a panel of professional environmental educators determine content validity of the tests.
5. Pre- and posttesting procedures were standardized as much as was feasible, through the use of written instructions to the teachers.
6. The time span between pre- and posttesting was limited to five days before and after treatment. This helped to control for maturation, mortality, and history as much as possible given the research questions and design.

LIMITATIONS

The following limitations were recognized in this study.

1. Written tests are only one form of measurement of cognitive knowledge. Time, money, and personnel considerations precluded this study from using other methods to more completely assess cognitive knowledge gains.
2. The successful accomplishment of pre- and posttesting depended in large part on the adherence to standardized procedures and follow-through by all the classroom teachers involved. The researcher was limited in the control which could be exercised over keeping procedures standardized and ensuring completion and return of testing materials.
3. The Hawthorne effect could not be completely controlled. Because observation involved pre- and posttesting, classroom teachers and students in both treatment and control groups were aware of the experimental situation. The staff at the Environmental Station was also aware that testing was occurring.
4. Due to time constraints, pilot tests were not conducted. For several tests, results of pilot testing may have resulted in the modification of wording on some questions.
5. Formal reliability assessments were not conducted. However, in pretest-posttest analysis of treatment

groups, significant gains were found in all 19 cases. In pretest-posttest analysis of control groups, no significant gains were found in 13 of the 19 cases. These findings help to support a claim that test-retest reliability was established. In two cases where control groups did experience gains, these results may help to explain why treatment groups, when compared with control groups, did not achieve significant gains. In the four remaining cases, treatment groups experienced significant gains, despite the gains of the control groups with which they were compared.

6. The system of program scheduling at the Environmental Station precluded complete randomization of sample selection and treatment.

DEFINITION OF TERMS

1. Central Wisconsin Environmental Station (CWES) instructors or staff: University of Wisconsin-Stevens Point (UWSP) juniors, seniors, and graduate students minoring in environmental education/interpretation; student interns from UWSP or other institutions; and trained volunteers. All have some background in natural history and environmental education methods, and they receive ongoing training from the assistant director at the Environmental Station.
2. Cognitive knowledge: The recall, comprehension, application, analysis, synthesis, and evaluation of factual information. (Bloom, Hastings, Madaus, 1971)
3. Curriculum of CWES: The 40 activities (units) which are available for use by schools participating in Environmental Station programs.
4. Environmental education: "...is process aimed at producing a citizenry that is: 1. knowledgeable about the biophysical and sociocultural environments of which man is a part, 2. aware of environmental problems and management alternatives of use in solving those problems, and 3. motivated to act responsibly in developing diverse environments that are optimal for living a quality life." (Lucko, Disinger, and Roth, 1982)
5. Evaluation: "...a logical process of analyzing the nature of an educational program and of making value judgments concerning its worth." (Passineau, 1975)
6. Formal evaluation: The collection and use of program information which is objective and quantifiable in nature.

7. Informal evaluation: The collection and use of program information which is subjective and qualitative in nature.
8. Objective-referenced test: Test designed to determine whether students have achieved the performance objectives of a unit.
9. Onsite activities: Those environmental education activities taking place at the Environmental Station.
10. Performance objective: A standard of achievement which is measurable.
11. Pretest/posttest: Objective-referenced test administered to students before and after their participation in an Environmental Station program.
12. Program: Participation in activities at the Environmental Station for a period of one day, two days and one night, or three days and two nights.
13. Pre- and post-activities: Learning activities for use by classroom teachers with their students at school. Pre-activities are designed to introduce the students to the concepts and vocabulary to be used onsite. Post-activities are a follow-up which extend the concept farther.
14. Study unit: Any one of the ten Environmental Station units selected to be included in the evaluation project. In this study they are also referred to as treatment and control units.
15. Unit: A lesson taught at the Environmental Station. A unit consists of a concept and objectives, warm-up activities, major concept-building activities, and a wrap-up. A unit is usually taught within a 50 to 75 minute time period. Up to three units are taught in a one day program, seven units in two days, and ten units in three days. Within a unit, the focus is on one major concept and two to six performance objectives.

CHAPTER II

THE STATUS OF EVALUATION IN ENVIRONMENTAL EDUCATION

Many facilities offering environmental education programs would not be able to provide quantitative answers to the questions of program effectiveness. The formal, systematic evaluation of environmental education programs has lagged behind the development of the programs themselves. Numerous factors have contributed to this slow evolution: the newness of the field of environmental education, the intense focus on program development, the interdisciplinary nature of the field, the lack of appropriate models, and insecurity with or fear of evaluation. The results of several surveys provide an indication of the number of facilities that have been engaging in evaluation procedures over the last several years.

Childress (1977) conducted a national survey of public school environmental education programs and projects. Of the 301 respondents, 43.2 percent said their programs "often" underwent formal evaluation, 50.5 percent "often" used informal evaluation, and 49.2 percent "often" used both formal and informal evaluation. Those indicating they "never" conducted evaluation procedures numbered 18.9 percent for formal, 13.6 percent for informal, and 17.3 percent for both formal and informal.

In a national survey of elementary and secondary school environmental education programs, Disinger (1981) found that in 49.6 percent of 284 programs there was no program evaluation. Forty-three percent utilized informal methods, and in 7.4 percent of the programs, personnel said they employed formal evaluation.

In a study of 17 outdoor environmental learning centers in Wisconsin, Korb (1977) found that 15 conducted objective-based activities for school classes, but none of those 15 took measures to quantitatively determine whether those objectives were being met. Ten of the 17 used qualitative measures; specifically, teacher, student, and/or self evaluation.

Wolanin (1983) did case study investigations of program development and evaluation at six Michigan and Ohio nature centers offering environmental education programs for schools. She found that three of the centers asked classroom teachers to evaluate their programs to obtain information on student and/or teacher satisfaction. One of those three centers also assessed student performance on tasks based on the program's objectives. One of the six centers employed pre- and posttesting.

These studies seem to indicate that program evaluation has not been a high priority at a majority of schools and centers that have been surveyed.

As stated in Chapter I, evaluation of environmental education programs serves many purposes. Its absence or

poor design and implementation makes the accomplishment of these benefits more difficult, if not improbable, to achieve. Beyond that, lack of evaluation jeopardizes a program and the field. O'Hearn (1982) warned of the situation.

...in a time of retrenchment and budgetary restraints, new programs are suspect and programs which lack enthusiastic informed political support are likely to be cut.

Much of that support may be based on the ability to demonstrate the achievement of educational goals. Korb (1977) expressed similar concerns about budget-related program cuts and specifically referred to the situation faced by agencies providing outdoor environmental education.

...anything which cannot justify an expenditure of funds as a sound educational investment will be subject to scrutiny and perhaps subsequent elimination. Funds for outdoor educational experiences could be reduced, appropriations for transportation might be eliminated, or possibly even the need to utilize the facilities of outdoor environmental learning centers may one day be questioned unless their necessity and value have been demonstrated.

Cook (1982) expressed the belief that:

Good evaluation of programs and materials will be a must in keeping the ground gained through education during the past 14 years.

The effectiveness and vitality of environmental education programs depend on our ability to determine their strengths and weaknesses and to make pertinent changes. The ability of programs to survive through tight fiscal times may be due in part to communication of their worth in accomplishing educational goals.

RELATED RESEARCH IN COGNITIVE LEARNING IN ENVIRONMENTAL EDUCATION PROGRAMS

Two research areas of direct interest for this study are those of the use of advance organizers prior to field instruction and the effects of novel settings on students. The Environmental Station's program uses advance organizers (pre-activities) and an orientation slide program to help teachers prepare students for their visit to the center.

Studies were conducted by Howie (1974), Gross (1977), and Gennaro (1981) in which advance organizers and field instruction were treatment variables. Their results each indicated significant levels of learning for treatment groups.

Research by Falk and associates (Falk, Martin, and Balling, 1978, 1981; Falk and Balling, 1982; Falk, 1983) found that children's learning, attitudes, and behavior are affected by the setting, and are dependent on their age, number of visits to the site, and perception of the novelty of the site. They suggested trip planning by teachers that capitalizes on the effects of novelty.

DIRECTIONS FOR ENVIRONMENTAL EDUCATION EVALUATION

In affirmation of the need for quality evaluation, much has been written regarding the direction that efforts for improvement should take.

Passineau (1975) defined numerous priorities for the field, including the following: development of a greater awareness of the importance of evaluation in environmental

educators, a change of image from "threatening" to "supportive, helpful, and necessary", greater competency in evaluators, better communication of results to decision makers, "the development of assessment instruments and evaluation methodologies", and promotion of improved evaluation by environmental education organizations.

Bennett's (1977) suggestions of needs concur with those of Passineau. He also elaborated on the need for the use of more exacting research methods.

Doran (1977) reviewed the disagreement between various environmental educators about whether cognitive or affective objectives should take precedence, suggesting that this created difficulty in making progress toward development of quality evaluation. In a review of evaluation research, Bennett (1977) noted a lack of evaluation of behavioral and higher cognitive thinking outcomes. As environmental education has become more widely taught, more attention has been paid to the cognitive, affective, and behavioral dimensions of its goals. There has been increased attention to developing instruments to assess all three. It is recognized that difficulties exist in accurately assessing accomplishment of affective and behavioral goals (Passineau, 1975; Doran, 1977) Efforts must continue to find valid and reliable means of meeting this need.

SUMMARY

Evaluation is an aspect of environmental education that must receive increased attention. The practice of

program evaluation can continue to improve and mature. It will require the development and use of appropriate models and instruments, the conduct of quality research and publication of results, and promotion of the need for and benefits of evaluation.

CHAPTER III

INTRODUCTION

This quasi-experimental study was designed to assess cognitive knowledge gains of intermediate age students participating in selected units at the Central Wisconsin Environmental Station. The relationship was also determined between pre- to posttest gains and students' perceptions of how much they learned and how much fun they had.

This chapter describes sample selection, development and scoring of the instruments, research design, data collection procedures, treatment of subjects, and data analysis procedures.

STUDY SAMPLE

The subjects for this study were fourth, fifth, and sixth grade students whose classes participated in programs at the Environmental Station during the 1983-1984 academic year. These three grade levels were selected since they constitute the most frequent user groups at the Station--involving 94.5 user days (68.0 percent) of a total of 139 days during the study year.

Initially, all fourth, fifth, and sixth grade classes scheduled to visit the Station were eligible to be part of the study sample--a total of 93 classes, representing 35

schools in 15 school districts across central Wisconsin. Various factors, listed in Table 3.1 and discussed in Chapter IV, served to reduce the number of classes actually involved in the study.

The final study sample included participants from 25 schools in nine districts. Their communities ranged from small rural towns (population of 950) to mid-sized cities (population of 59,000). Twenty-one public and three parochial schools were involved. Usable materials were returned by 55 teachers, representing 63 classes and 1304 students. Table 3.2 indicates the breakdown of participation by grade level.

INSTRUMENT DEVELOPMENT

Of the approximately 40 Environmental Station units, ten were selected for use in the study. These ten units were the ones most frequently used by school groups for the two years prior to the year in which the study was conducted.

The researcher wrote one test for each of the ten units. Test questions were derived from the performance objectives stated in the units. A short answer questioning format was chosen, with the belief that this type of question was less subject to students guessing and being correct by chance than were multiple choice, true-false, and matching questions. Another factor considered was that many of the unit objectives did not lend themselves well to

Table 3.1 Reasons for nonparticipation in study

Number of classes	Reasons
13	No testing materials returned to the Environmental Station
10	Returned materials incomplete or invalid (e.g., missing pretests, wrong students tested)
5	Insufficient time for teachers to administer pretests
2	First time at an Environmental Station program, not asked to participate in study
1	Units used were not part of study

Table 3.2 Study sample demographics

Grade	# of Districts	# of Schools	# of Teachers	# of Classes	# of Students
4	5	7	14	14/18*	302/392*
5	5	10	14	15	324
6	6	15	30	34/38*	678/786*
Totals	9	25	55	63/71*	1304/1502*

* Students who tested in two units were counted a second time, resulting in a second total.

the latter types of questions. Figure 3.1 presents the objectives and accompanying test questions for the Environmental Station unit **Energy Saver** as an example of test design.

Several other factors were taken into consideration in test construction. It was decided that the same tests would be used at all three grade levels, requiring selection of vocabulary that was as appropriate as possible for a wide span of reading abilities. Vocabulary specific to unit objectives was used in the tests, since this constituted an integral part of student comprehension of the units. Some examples of such vocabulary were "natural community", "insulate", and "food chain". Teachers were instructed to read tests aloud to students if they felt reading level was a concern; however, they were asked not to explain word meanings. To minimize the possibility of test fatigue, tests were designed to be completed in 15 minutes or less. On some tests, this required that students name or explain fewer items than the unit objectives specified. For example, an item on the test stating "name 4 examples of..." may have corresponded to "name 6 examples of..." in the unit objectives.

The pre- and posttests were identical, with one exception. The posttests for each unit included two subjective questions, dealing with how much fun the students had and how much they learned. An example of

Figure 3.1 Example of the objectives and accompanying test questions for one unit involved in the study

ENERGY SAVER

Objectives

Upon completion of this unit, students will be able to:

- ...describe two ways that nature's creatures reduce heat loss through insulation and behavior;
- ...after performing an experiment, list four insulation materials in order of their effectiveness;
- ...define R-value;
- ...list five features that can be incorporated in a building to help reduce heat loss;
- ...list five improvements that could be made to their own home to further reduce heat loss;
- ...list at least three ways that people conserve heat in their homes.

Test Questions

1. Name one thing an animal can do during cold weather to help it reduce the loss of its body heat.
2. Name 4 kinds of materials that can be used to insulate buildings like your home.
3. Name the material from question No. 2 that you think would be the most effective in reducing heat loss from the building.
4. What does R-value mean?
5. Name 5 features that could be made part of a building which would help reduce heat loss.
6. Name 3 things you can do during cold weather to help conserve the amount of heat energy you use at home.

these questions, as used in the **Energy Saver** unit, is provided below.

Please check the answer that best describes how you feel about the **ENERGY SAVER** activity.

Was the activity fun?

really fun

sometimes fun,
sometimes boring

really boring or not
fun

Did you discover anything new?

discovered lots of new things

discovered some new things

did not discover anything new

These two questions have been a part of the ongoing qualitative evaluation at the Environmental Station for several years. The usual procedure for their use requires the classroom teacher to tally students' responses to the questions when they return to school. The total number of students giving each response is reported to the Environmental Station. For the study, the researcher also attached these questions to the posttests so that relationships between individuals' change scores and their responses to the subjective questions could be determined.

Content validity of the tests was determined by a panel of three professional environmental educators who were integrally involved with the Environmental Station's programming. This panel consisted of the Environmental Station's director, associate director, and university coordinator.

RESEARCH DESIGN

Various aspects of this research presented a challenge in the selection of a design. The large number of school classes involved, the eight month duration of treatment and data collection, the inability of the researcher to assign treatments, and the selection of control groups from within treatment groups all contributed to the constraints placed on selecting a design. These factors are addressed later in this chapter.

The research design that was used is diagrammed in Figures 3.2 through 3.4. They provide hypothetical examples for two classes at the same grade level. Further explanation of the design is provided in the following section.

DATA COLLECTION PROCEDURES

During the study, the scheduling of classes for Environmental Station visits was conducted in the same manner as it has been in other years. Several weeks prior to their visit, classroom teachers are asked to submit a list of curriculum units in which they want their students to participate. They select three units for a one day visit, seven for two days, and ten for three days. During the year of the study, the researcher used these lists to determine which classes could participate in the testing. All classes choosing one or more of the ten study units were asked to help in the evaluation project. Numerous classes participated in as many as three to six of the study units

Figure 3.2 Research Design for Treatment Groups

Class 1	R	O ₁	X ₁	O ₁
		1	1	1
	R		X ₁	O ₁
			1	1
Class 2	R	O ₂	X ₂	O ₂
			X ₂	O ₂
	R		2	2

where:

Class n = each fourth, fifth, or sixth grade class participating in the pre- and posttesting

R = random assignment of half of the students within the treatment class to a testing group

O_n = administration of the test instrument for the given Environmental Station unit

X_n = onsite participation in the Environmental Station unit n and, optionally, classroom participation in pre- and post-activities

Figure 3.3 Research Design for Control Groups

Class 1	R			
	R	O	C	O
		3		3
Class 2	R			
	R	O	C	O
		4		4

where:

Class n = each fourth, fifth, or sixth grade class participating in the pre- and posttesting

R = same random assignment of students to a testing group as was used in treatment

O = administration of the test instrument for the given Environmental Station unit n

C = control; i.e., participation in an Environmental Station program that did not include involvement in the treatment unit for which they were acting as a control group

Figure 3.4 Combined Research Design for Treatment and Control Groups

Class 1	R	O	X	O
		1	1	1
	R	O	X	O
		3	1	1,3
Class 2	R	O	X	O
		2	2	2
	R	O	X	O
		4	2	2,4

during their visit; however, they were only asked to help with the testing of one or two.

At least two weeks prior to their Environmental Station visit, teachers were sent a packet of materials which included the following: an introductory letter, instructions for testing, a form for indicating students' composite percentile ranks on a standardized achievement test, a teacher questionnaire, a random number list, and pre- and posttests. Samples of materials are included in Appendix B.

The random number list was used by classroom teachers to divide their classes into two equal groups, groups 1 and 2, for the administration of the tests. Two sets of tests were included in the packet for their use. The first set consisted of pre- and posttests for one of the study units in which the class would be participating at the Environmental Station. Group 1 was instructed to take the pretest. Both groups took the posttest. (See Figure 3.2, **Research Design for Treatment Groups**.) The posttest scores of group 1 (the pretest/posttest group) were later compared with those of group 2 (posttest only group) to determine whether the pretest served as a learning tool for group 1. For group 1, a pre- to posttest change was determined for comparison with a control group.

A second set of tests was enclosed for a study unit in which the specified class would not participate while at the Environmental Station. These tests were administered as

pre- and posttests to group 2, so that they could serve as a control group for the testing of another unit. (See Figure 3.3, **Research Design for Control Groups**.) They received no instruction in the objectives of the control unit. Rather, they participated in the same units as group 1 did. Thus, the testing layout for each class was as follows:

<u>Group 1</u>	Treatment Pretest		Treatment Posttest
		CWES visit	
<u>Group 2</u>	Control Pretest		Treatment Posttest Control Posttest

(See Figure 3.4, **Combined Research Design for Treatment and Control Groups**.)

The purpose for the selection of control groups from within the experimental groups was threefold. The teachers involved in the study were aware of and had a vested interest in following through with the testing, assuring the researcher greater cooperation and accuracy. It was also recognized that it would be quite difficult to select and use a large number of schools that were not involved with Environmental Station programming, and equally difficult to ascertain all of the pertinent variables associated with their participation. Finally, the use of control groups from the same classes controlled a significant variable that would otherwise have been different between treatment and control groups--participation in any Environmental Station program.

Teachers were instructed to administer tests along specific guidelines to ensure as much standardization as

possible. Pretests were administered within five school days prior to a class's Environmental Station visit, and posttests within five school days following their visit.

Every Environmental Station unit has pre- and post-activities specially designed to complement the activities of the unit. They are provided to the classroom teachers as an optional classroom learning experience. This policy was continued during the study. Participating teachers who opted to use these activities were instructed to use them within the treatment time. The use of the activities resulted in the following timeline:

Time	Activity
Two weeks or more before Environmental Station visit	Mailing of program schedule, teaching materials, and testing information and materials to teacher
Five school days or less before visit	Treatment and control pretests
Any time after pretesting	Pre-activities (optional)
	Environmental Station visit of one, two, or three days
Five school days or less after visit	Post-activities (optional)
Any time after post-activities, up to five school days after visit	Treatment and control posttests

The teacher questionnaire was used to determine a class's use or nonuse of pre- and post-activities and their involvement in any other environmental education instruction as a class. Teachers were also requested to

supply students' composite percentile rank scores on their most recent standardized achievement test. These percentile ranks were used to develop a correlation with pretest scores, to determine whether previous learning had an effect on groups' initial statuses in the study. In keeping with the Family Educational Rights and Privacy Act (1974), students' names were not requested on this form. Teachers were asked only to separate group 1 scores from group 2 scores.

Teachers were asked to return materials to the Environmental Station upon their completion. Nonresponse or partial response was followed up with a letter from the researcher. Where necessary, second and third letters or telephone calls were employed.

TREATMENT

No changes were made in the normal instructional procedures used at the Environmental Station. The teaching staff during 1983-1984 consisted of 27 people, including five graduate students and 16 undergraduate students in environmental education and interpretation programs at the University of Wisconsin-Stevens Point, five interns, and one non-student volunteer. All instructors are required to have some training in environmental education/interpretation and natural history, and they participate in extensive training at the Environmental Station.

Due to the type of staffing used at the Environmental Station, the majority of instructors teach one day per week for one semester. During the study, approximately two-thirds of the teaching staff each semester was new to the program that semester. The five interns were the only instructors to teach five days per week, each for one semester. Eight of the 27 instructors taught both semesters. The research goal of ascertaining student achievement of cognitive objectives held special interest because of the presence of the high staff turnover rate and a diversity in teaching experience of those staff members.

It was recognized that the Hawthorne effect was unavoidable in this study, but that measures could be taken to provide the same information to all participants who would have similar involvement. The staff for each semester during the study was introduced to the research during their orientation. They were informed of the goals of the study and the method of data collection. They were also told the names of the curriculum units being tested. Because the data collection procedures were centered at the Environmental Station's office, it would have been difficult, if not impossible, to prevent staff members from inadvertently learning this information. Therefore, it was decided to provide all staff members with the same information. They were told that the tests were written from the performance objectives for each unit, but were never shown the tests. Instructions to the staff were to

concentrate on meeting objectives in all their teaching, which has always been a primary focus at the Environmental Station, and to proceed as they normally would in their teaching. Instructors were not informed by the researcher when they were teaching a unit that was being tested. Unless a student or classroom teacher mentioned the tests during their visit, staff members did not know whether a group they taught was undergoing testing.

Classroom teachers were instructed to inform their students before administration of both the pretest and the posttest that the Environmental Station staff wanted to test them to find out what and how much they knew about the subject of the test. Teachers were to proceed as they normally would in their handling of their Environmental Station visit, with the exceptions of test administration and completion of the requested forms.

The onsite instruction in the units was conducted in 50 to 75 minute time periods. A student-teacher ratio of approximately 10 to 1 or 12 to 1 was maintained. For most school groups, this meant that their program was conducted by at least four staff members, and that the same instructor may not have led all of the students from a class in any given unit.

SCORING OF INSTRUMENTS

A key was developed by the researcher and edited by the panel of environmental educators who determined the content validity of the tests. Point values of responses

were assigned according to the complexity of the responses required. One word responses were accorded one point, short phrases two points, and longer responses assigned three points. The total number of points for each test was converted to 100 percent. Student scores were reported as percents. Tests were scored by the researcher.

METHODS OF ANALYSIS

Data were analyzed using the **Statistical Package for the Social Sciences--Second Edition** (Nie, Hull, Steinbrenner, and Bent, 1975). Independent t tests were conducted to compare pre- to posttest changes in cognitive knowledge between treatment and control groups. Analysis of covariance was also utilized in cases where sufficient variation in independent variables existed. Independent t tests were conducted to compare posttest scores between the pretest/posttest and the posttest only portions of the treatment group. A significance level of .05 was established.

Kruskal-Wallis analysis of variance and t tests were used to analyze the relationships in treatment groups between level of enjoyment and pre- to posttest change score and between perceived level of learning and pre- to posttest change score.

Pearson Product-Moment correlation coefficients were calculated for each unit to determine the relationship between mean percentile rank scores and mean pretest

scores. The coefficients were used to help explain any initial differences between groups before testing.

CHAPTER IV

This chapter describes the results of data analysis related to the research questions and hypotheses.

ANALYSIS RELATED TO RESEARCH QUESTION 1

Research Question 1:

Are there significant pretest to posttest gains in intermediate students' scores on objective-referenced tests given before and after their participation in specially designed activities at the Central Wisconsin Environmental Station, if:

- a. students have also participated in related classroom pre- and post-activities within the treatment time?
- b. students have not participated in related classroom pre- and post-activities within the treatment time?

Research Hypothesis 1:

In each of the ten study units, and at each of the grade levels administered, the mean pretest to posttest gain for the treatment groups will be significantly higher ($p \leq .05$) than the mean pretest to posttest gain for the control groups.

H : Treatment group mean > Control group mean
1

Table 4.1 presents a summary of the results of t tests analyzing data for hypothesis 1. Nineteen t tests were conducted, reflecting grade level compilations of classes tested in each of the ten study units.

Initially it was the researcher's intent to conduct individual t tests for each participating treatment class and its corresponding control class. Repetition of favorable results in any given study unit over several classes would have added power to the hypothesis of significant gains. However, student absences from school during testing resulted in numerous samples that were small. Another consideration was that administrative problems with control testing resulted in fewer control groups than treatment groups. Therefore, scores for treatment groups and for control groups were compiled for t testing by grade level and by treatment unit.

In 15 of the 19 t tests, the null hypothesis of no difference was rejected. Significant gains had occurred in those 15 cases. The four t tests resulting in retention of the null hypothesis were divided among the three grades. In **Pond Study**, at both the fourth and fifth grade levels, no significant gains were found. **Predator Prey** in the fourth grade and **Web of Life** in the sixth grade also resulted in no significant gains.

As indicated in Chapter III, many of the samples varied greatly in size. To help adjust for this situation during data analysis, F ratios were calculated to determine whether

Table 4.1 t test results for Research Question 1

		n	\bar{X} gain	SD	t	DF	** prob	ret/ rej
<u>Colorful Confusion</u>								
Gr. 4	Treatment	16	.102	.207	2.06	39	.023	rej
	Control	25	-.050	.243				
Gr. 6	Treatment	40	.081	.150	2.61	72	.006	rej
	Control	34	-.018	.178				
<u>Energy Saver</u>								
Gr. 6	Treatment	66	.186	.188	3.68	74	.000	rej
	Control	10	-.040	.126				
<u>Forest Community</u>								
Gr. 5	Treatment	17	.329	.148	6.46	32	.000	rej
	Control	17	.010	.140				
Gr. 6	Treatment	4	.226	.081	3.23	14	.003	rej
	Control	12	.068	.086				
<u>How Birds Make a Living</u>								
Gr. 5	Treatment	30	.139	.125	1.69	47	.049	rej
	Control	19	.071	.155				
<u>Moving Water</u>								
Gr. 6	Treatment	35	.261	.184	7.66	60	.000	rej
	Control	27	-.063	.136				

		n	\bar{x} gain	SD	t	DF	prob	ret/ rej
<u>Pond Study</u>								
Gr. 4	Treatment	36	.099	.149	0.83	56	.206	ret
	Control	22	.062	.188				
Gr. 5	Treatment	29	.074	.172	0.08	57	.470	ret
	Control	30	.070	.166				
<u>Predator Prey</u>								
Gr. 4	Treatment	44	.191	.295	0.13	48	.450	ret
	Control	6	.175	.209				
Gr. 5	Treatment	36	.169	.331	2.14	77	.018	rej
	Control	43	.011	.328				
Gr. 6	Treatment	75	.102	.248	*3.19	56.4	.001	rej
	Control	22	-.036	.153				
<u>Skullduggary</u>								
Gr. 4	Treatment	43	.264	.261	3.41	57	.001	rej
	Control	16	.012	.227				
Gr. 5	Treatment	41	.355	.278	*6.04	21.3	.000	rej
	Control	9	-.051	.154				
Gr. 6	Treatment	36	.259	.296	1.79	66	.040	rej
	Control	32	.141	.241				

* separate variance t tests

		n	\bar{X} gain	SD	t	DF	prob	ret/ rej
<u>Snow Walkers</u>								
Gr. 4	Treatment	15	.310	.170	5.13	25	.000	rej
	Control	12	-.010	.148				
Gr. 6	Treatment	22	.128	.203	1.71	28	.050	rej
	Control	8	-.015	.201				
<u>Web of Life</u>								
Gr. 4	Treatment	23	.180	.141	1.92	34	.032	rej
	Control	13	.083	.152				
Gr. 6	Treatment	59	.209	.226	1.12	75	.134	ret
	Control	18	.142	.216				

**1-tailed probability

or not the two sample variances in each pair of test means were equal. Where the observed significance level of the F ratio was $>.05$, the hypothesis that the population variances were equal was retained, and pooled variance t tests were used. Where the observed significance level was $\leq .05$, the hypothesis was rejected, and separate variance t tests were used. These incidences were noted with an asterisk (*) next to the t values.

In the section **DISCUSSION OF QUESTIONS 1 AND 2**, consideration is given to the influence of pre- and post-activities on gain scores.

ANALYSIS RELATED TO RESEARCH QUESTION 2

Research Question 2:

Are there significant differences in mean posttest scores ($p \leq .05$) between treatment group students who took both the pretest and the posttest and treatment group students who took the posttest only?

Research Hypothesis 2:

In each of the ten study units, and at each of the grade levels administered, there will be no significant differences in mean posttest scores between the pretest/posttest groups and the posttest only groups.

H : Pre/Posttest group mean = Posttest only group mean
2

Table 4.2 presents a summary of the results of t tests analyzing data for hypothesis 2. In 15 of the 19 t tests, the null hypothesis of no difference was retained,

Table 4.2 t tests results for Research Question 2

		n	\bar{X}	SD	t	DF	** prob	ret/ rej
<u>Colorful Confusion</u>								
Gr. 4	Pre/Post	16	.645	1.77	-0.03	31	.487	ret
	Post only	17	.647	1.62				
Gr. 6	Pre/Post	40	.770	0.93	*1.49	69.5	.071	ret
	Post only	44	.723	1.64				
<u>Energy Saver</u>								
Gr. 6	Pre/Post	66	.469	4.60	0.84	117	.202	ret
	Post only	53	.442	4.22				
<u>Forest Community</u>								
Gr. 5	Pre/Post	17	.622	3.38	1.50	32	.072	ret
	Post only	17	.538	3.50				
Gr. 6	Pre/Post	4	.637	1.70	-0.80	11	.222	ret
	Post only	9	.698	2.99				
<u>How Birds Make a Living</u>								
Gr. 5	Pre/Post	30	.717	1.74	0.71	60	.241	ret
	Post only	32	.691	2.23				
Gr. 6	Pre/Post	35	.520	4.62	0.93	61	.177	ret
	Post only	28	.472	3.70				

* separate variance t test

		n	\bar{X}	SD	t	DF	prob	ret/ rej
<u>Pond Study</u>								
Gr. 4	Pre/Post	36	.461	4.01				
	Post only	39	.360	3.59	2.07	73	.021	rej
Gr. 5	Pre/Post	29	.563	3.81				
	Post only	32	.418	3.99	2.62	59	.006	rej
<u>Predator Prey</u>								
Gr. 4	Pre/Post	44	.610	2.90				
	Post only	45	.472	2.65	2.34	87	.011	rej
Gr. 5	Pre/Post	36	.506	2.62				
	Post only	43	.479	2.89	0.42	77	.337	ret
Gr. 6	Pre/Post	75	.716	2.37				
	Post only	74	.674	2.73	1.00	147	.161	ret
<u>Skullduggary</u>								
Gr. 4	Pre/Post	43	.658	3.13				
	Post only	50	.569	3.25	1.74	91	.043	rej
Gr. 5	Pre/Post	41	.629	3.53				
	Post only	39	.585	2.63	*0.82	73.9	.208	ret
Gr. 6	Pre/Post	36	.746	3.21				
	Post only	37	.677	3.54	1.13	71	.131	ret

* separate variance t test

		n	\bar{X}	SD	t	DF	prob	ret/ rej
<u>Snow Walkers</u>								
Gr. 4	Pre/Post	15	.557	3.66				
					-0.23	32	.408	ret
	Post only	19	.576	4.22				
Gr. 6	Pre/Post	22	.428	3.59				
					-0.58	30	.284	ret
	Post only	10	.476	4.12				
<u>Web of Life</u>								
Gr. 4	Pre/Post	23	.655	4.22				
					*-1.36	38.5	.092	ret
	Post only	22	.735	2.81				
Gr. 6	Pre/Post	59	.616	4.18				
					0.96	116	.169	ret
	Post only	59	.574	4.42				

* separate variance t test
 ** 1-tailed probability

suggesting that pretesting did not have a significant effect on posttest scores. Treatment group students taking both the pretest and the posttest scored significantly higher than the posttest only group in **Pond Study** in grades four and five, **Predator Prey** in grade four, and **Skullduggary** in grade four.

DISCUSSION OF QUESTIONS 1 AND 2

In order to have practical value, the findings for questions 1 and 2 must be considered in connection with each other. Favorable results in the testing of each study unit were indicated by a significant gain for the treatment group coupled with no significant difference between posttest scores for the two halves of the treatment group. This combination of results suggested that pretest to posttest changes in treatment group scores were probably due to treatment variables intervening between the administration of the two tests and not due to a learning effect of pretesting. In 14 of the 19 cases, this combination of results occurred. Table 4.3 summarizes these findings.

In seven of the 14 cases with favorable results, significant mean gains could be attributed mostly to student participation in the treatment unit and in pre- and post-activities. In the other seven cases, significant mean gains could be attributed in large part to student participation in the treatment unit without pre- and post-activities.

Table 4.3 Summary of t test results for Questions 1 and 2 combined

Cases with significant treatment group gains and no pretesting effect

Unit	Grade
Colorful Confusion	4
Colorful Confusion	6
Energy Saver	6
Forest Community	5
Forest Community	6
How Birds Make a Living	5
Moving Water	6
Predator Prey	5
Predator Prey	6
Skullduggary	5
Skullduggary	6
Snow Walkers	4
Snow Walkers	6
Web of Life	4

Cases with no significant treatment group gain and pretesting effect

Unit	Grade
Pond Study	4
Pond Study	5
Predator Prey	4

Case with no significant treatment group gain and no pretesting effect

Unit	Grade
Web of Life	6

Case with significant treatment group gain and pretesting effect

Unit	Grade
Skullduggary	4

Further interpretation of the results necessitates consideration of several independent variables which may have influenced outcomes. Appendix C presents a table for each unit which describes the variables and interprets their possible effects on learning. The findings are summarized in Table 4.4. The influence of other environmental education and related onsite units is rather evenly divided between the seven cases where the use of pre- and post-activities was a factor and the seven cases where it was not a factor. Instruction in other environmental education at school may have been an influence in three units where pre- and post-activities were a factor. It may have been an influence in one case where pre- and post-activities were not involved. Participation in other Environmental Station units with overlapping concepts may have been a factor in five cases for both situations--those influenced by pre- and post-activities, and those not influenced.

Significant differences in gains could also have been due to initial differences in scholastic achievement levels. This variable is discussed in Chapter V.

Because of the variables which could not be completely controlled in this research, the use of analysis of covariance (ANCOVA) would have provided a more sophisticated analysis of data. This test was attempted, and in 14 of the 19 cases the analysis could not be completed, due to insufficient variability of the covariates. Table 4.5 summarizes the results of the five cases for which ANCOVA

**Table 4.4 Factors which may have influenced gain scores
in cases with significant gains**

Cases in which the use of pre- and post-activities
influenced treatment group gains

Unit	Grade	Other possible influences on treatment group gains
Colorful Confusion	6	How Birds Make a Living unit
Predator Prey	5	
Predator Prey	6	other environmental education
Skullduggary	5	Beavercology unit
Skullduggary	6	other environmental education Beavercology unit
Snow Walkers	4	other environmental education Web of Life unit Lessons from Nature unit
Web of Life	4	How Birds Make a Living unit

Cases in which pre- and post-activities were not used or
were not determined to have affected treatment group gains

Unit	Grade	Other possible influences on treatment group gains
Colorful Confusion	4	How Birds Make a Living unit
Energy Saver	6	
Forest Community	5	Forest Apartment unit Web of Life unit Pond Study unit
Forest Community	6	Web of Life unit Pond Study unit
How Birds Make a Living	5	Web of Life unit Skullduggary unit
Moving Water	6	That's the Limit unit
Snow Walkers	6	other environmental education

Table 4.5 Analysis of covariance results for Research Question 1

Pond Study Grade 4

Source of variation	SS	DF	\bar{X} square	F	signif. of F
Covariates	0.111	3	.037	1.368	.262
Pre & post act.	0.032	1	.032	1.201	.278
Environ. educ.	0.031	1	.031	1.156	.288
Overlap units	0.003	1	.003	0.120	.730
Main effects	0.003	1	.003	0.128	.722
Treat. vs. Control	0.003	1	.003	0.128	.722
Explained	0.114	4	.029	1.058	.386
Residual	1.428	53	.027		
Total	1.542	57	.027		

Predator Prey Grade 4

Source of variation	SS	DF	\bar{X} square	F	signif. of F
Covariates	0.351	3	.117	1.473	.236
Pre & post act.	0.062	1	.062	0.779	.382
Environ. educ.	0.001	1	.001	0.008	.930
Overlap units	0.021	1	.021	0.266	.608
Main effects	0.042	1	.042	0.526	.472
Treat. vs. Control	0.042	1	.042	0.526	.472
Explained	0.393	4	.098	1.236	.310
Residual	3.578	45	.080		
Total	3.971	49	.081		

Predator Prey Grade 6

Source of variation	SS	DF	\bar{X} square	F	signif. of F
Covariates	0.387	3	.129	2.409	.072
Pre & post act.	0.007	1	.007	0.130	.720
Environ. educ.	0.310	1	.310	5.802	.018
Overlap units	0.029	1	.029	0.540	.464
Main effects	0.054	1	.054	1.016	.316
Treat. vs. Control	0.054	1	.054	1.016	.316
Explained	0.441	4	.110	2.061	.092
Residual	4.923	92	.054		
Total	5.364	96	.056		

Skullduggary Grade 6

Source of variation	SS	DF	\bar{X} square	F	signif. of F
Covariates	0.839	3	.280	4.988	.004
Pre & post act.	0.188	1	.188	3.355	.072
Environ. educ.	0.036	1	.036	0.634	.430
Overlap units	0.000	1	.000	0.002	.964
Main effects	0.740	1	.740	13.205	.001
Treat. vs. Control	0.740	1	.740	13.205	.001
Explained	1.579	4	.395	7.042	.000
Residual	3.530	63	.056		
Total	5.109	67	.076		

Web of Life Grade 6

Source of variation	SS	DF	\bar{X} square	F	signif. of F
Covariates	0.164	3	.055	1.087	.360
Pre & post act.	0.162	1	.162	3.231	.076
Environ. educ.	0.089	1	.089	1.765	.188
Overlap units	0.000	1	.000	0.006	.938
Main effects	0.019	1	.019	0.375	.542
Treat. vs. Control	0.019	1	.019	0.375	.542
Explained	0.183	4	.046	0.909	.464
Residual	3.620	72	.050		
Total	3.803	76	.050		

could be conducted using pre- and post-activities, other environmental education, and overlapping units as the covariates. In **Pond Study** and **Predator Prey**, both at grade four, the ANCOVA was conducted. In neither case were significant differences found between the adjusted mean gains of the treatment and control groups. These results reconfirmed the findings obtained through t testing, and showed that there was no differential user rate between treatment and control groups. In **Predator Prey** at grade six the covariate "other environmental education" was significantly related, but it did not adjust the means enough to result in significant differences between the treatment and control groups. t testing had resulted in significant differences between the groups. In **Web of Life** at grade six, the covariates "pre- and post-activities" and "other environmental education" were significantly related, but did not adjust the means enough to result in significant differences between the treatment and control groups. In **Skullduggary**, t testing had shown significant differences between treatment and control group gains. With the conduct of ANCOVA, the differences between the group gains increased rather than decreased with the addition of covariates, due to the differential rates of use between the two groups.

ANALYSIS RELATED TO RESEARCH QUESTION 3

Research Question 3:

Are there significant differences in mean gain scores between the students who rated their participation in the

treatment unit as "really fun" and those who rated it as "sometimes fun, sometimes boring", and between those groups and the students who rated it as "really boring or not fun"?

Research Hypothesis 3:

In each of the ten units, the mean gain score for students rating the unit as "really fun" (group a) will be significantly greater ($p \leq .05$) than that of students rating the unit as "sometimes fun, sometimes boring" (group b), and their mean gains will each be significantly greater than that of students rating the unit as "really boring or not fun" (group c).

$$H : \text{Mean Group a} > \text{Mean Group b} > \text{Mean Group c}$$

Tables 4.6 and 4.7 summarize the results of data analysis conducted to test hypothesis 3. One-way analysis of variance (ANOVA) would have been the most powerful test to use, had the students' ratings been fairly evenly divided between the three categories. A relatively even distribution did not occur in any of the ten study units. In nine of the units, four or less students rated the activity as "really boring". In those cases, the lowest rating was dropped for data analysis, and t tests were conducted between the groups indicating the two higher ratings. The nonparametric analysis of variance, Kruskal-Wallis, was utilized for the unit in which all three rating categories were retained.

Table 4.6 t test results for Research Question 3

	n	\bar{X} % gain	SD	t	DF	prob	ret/rej
<u>Colorful Confusion</u>							
Really fun	41	.081	.159	-1.74	52	.044	rej
Sometimes fun	13	.164	.107				
<u>Forest Community</u>							
Really fun	12	.316	.143	0.22	19	.416	ret
Sometimes fun	9	.302	.151				
<u>How Birds Make a Living</u>							
Really fun	20	.132	.113	-0.21	27	.418	ret
Sometimes fun	9	.143	.157				
<u>Moving Water</u>							
Really fun	15	.237	.101	*-1.02	24.67	.159	ret
Sometimes fun	18	.296	.222				
<u>Pond Study</u>							
Really fun	47	.093	.168	*1.21	44.12	.117	ret
Sometimes fun	16	.050	.101				
<u>Predator Prey</u>							
Really fun	84	.144	.284	0.26	149	.400	ret
Sometimes fun	67	.132	.289				

* separate variance t tests

	n	\bar{x} % gain	SD	t	DF	prob	ret/rej
<u>Skullduggary</u>							
Really fun	72	.293	.292	-0.15	115	.440	ret
Sometimes fun	45	.301	.263				
<u>Snow Walkers</u>							
Really fun	16	.261	.225	1.80	33	.041	rej
Sometimes fun	19	.136	.186				
<u>Web of Life</u>							
Really fun	43	.193	.197	-0.57	76	.284	ret
Sometimes fun	35	.220	.223				

**Table 4.7 Kruskal-Wallis one-way analysis of variance
results for Research Question 3**

	n	\bar{x} ranks	chi- square	signif	ret/rej
<u>Energy Saver</u>					
Really fun	28	29.41	3.61	.083	ret
Sometimes fun	31	37.56			
Really boring	6	26.17			

In seven of the nine t tests, the null hypothesis of no difference was retained. In **Colorful Confusion**, students who rated the unit as "sometimes fun" had a significantly higher mean gain than those who rated it "really fun". In **Snow Walkers**, students who rated the unit as "really fun" had a significantly higher mean gain than those who rated it "sometimes fun". In the Kruskal-Wallis test, the null hypothesis was retained. Although not of statistical significance, it is interesting to note that in four of the units the greater mean gain was experienced by those who rated the activity as "really fun". In six of the units the greater mean gain was experienced by those who rated it as "sometimes fun".

Following these analyses, an ANOVA was conducted. The limitations placed on interpretation of those results were recognized; they were only used for purposes of comparison with the results of t tests and Kruskal-Wallis tests. Unlike the procedure used in those tests, no groups were omitted from the analysis, despite low numbers of participants. In eight of the ten tests, no significant differences in means were found. These were the same units in which previous analysis showed no significant differences in means. In **Colorful Confusion**, significant differences in means were found ($p \leq .05$). Only two groups were compared, those responding "lots of fun" and those responding "some fun". No students had rated the activity as "really boring". In **Snow Walkers**, the null hypothesis of no

difference was again rejected. Conduct of the Scheffe' post hoc test resulted in a determination that no two groups were significantly different from each other.

ANALYSIS RELATED TO RESEARCH QUESTION 4

Research Question 4:

Are there significant differences in mean gain scores between the students who rated their learning in the treatment unit as "discovered lots of new things" and those who rated it as "discovered some new things", and between those groups and the students who rated it as "did not discover anything new"?

Research Hypothesis 4:

In each of the ten units, the mean gain score for students rating the unit as "discovered lots of new things" (group d) will be significantly greater ($p \leq .05$) than that of students rating the unit as "discovered some new things" (group e), and their mean gains will each be significantly greater than that of students rating the unit as "did not discover anything new" (group f).

$$H : \text{Mean Group d} > \text{Mean Group e} > \text{Mean Group f}$$

4

Tables 4.8 and 4.9 summarize the results of data analysis conducted to test hypothesis 4. t tests and Kruskal-Wallis tests were conducted, again because of a very uneven distribution of students' ratings. In all ten units, the null hypothesis was retained. There were no significant differences between mean gains.

Table 4.8 t test results for Research Question 4

	n	\bar{X} % gain	SD	t	DF	prob	ret/rej
<u>Colorful Confusion</u>							
Learned lots	18	.080	.162	-0.67	50	.253	ret
Learned some	34	.110	.152				
<u>Forest Community</u>							
Learned lots	11	.312	.137	0.57	17	.289	ret
Learned some	8	.277	.125				
<u>How Birds Make a Living</u>							
Learned lots	12	.110	.140	-0.90	26	.189	ret
Learned some	16	.154	.119				
<u>Moving Water</u>							
Learned lots	17	.280	.156	0.61	33	.274	ret
Learned some	18	.242	.209				
<u>Pond Study</u>							
Learned lots	34	.085	.161	0.09	59	.464	ret
Learned some	27	.081	.152				

Table 4.9 Kruskal-Wallis one-way analysis of variance results for Research Question 3

	n	\bar{X} ranks	chi- square	signif	ret/rej
<u>Energy Saver</u>					
Learned lots	26	34.46			
Learned some	34	32.79	.698	.353	ret
Learned nothing	5	26.80			
<u>Predator Prey</u>					
Learned lots	35	77.10			
Learned some	98	78.55	.741	.345	ret
Learned nothing	20	69.25			
<u>Skullduggary</u>					
Learned lots	60	61.79			
Learned some	52	57.75	2.315	.157	ret
Learned nothing	5	38.50			
<u>Snow Walkers</u>					
Learned lots	10	18.75			
Learned some	20	18.90	.032	.492	ret
Learned nothing	7	19.64			
<u>Web of Life</u>					
Learned lots	29	42.71			
Learned some	47	40.51	.430	.403	ret
Learned nothing	5	35.70			

Although not statistically significant, again it is interesting to note that in six of the units the greater mean gain was experienced by those who rated the activity as "discovered lots of new things". In three of the units the greater mean gain was experienced by those who rated it as "discovered some new things".

ANOVA was conducted for purposes of comparison with results of t tests and Kruskal-Wallis tests. No scores were dropped from analysis. In none of the ten units were significant differences in mean gains found, confirming earlier results of t testing and Kruskal-Wallis testing.

CHAPTER V

FINDINGS

In 14 of 19 total cases, results of t testing indicated that treatment groups achieved significant mean pre- to posttest gains without the presence of a pretest sensitization effect. In seven of the cases the gains could be attributed to treatment variables which included participation in pre- and post-activities. In the remaining seven cases, the gains could be attributed to participation in treatment variables which did not include pre- and post-activities.

In four of the five cases for which ANCOVA could be conducted, the analysis reconfirmed results of t testing. In the fifth case, t testing had indicated significant differences between treatment and control means; however, in ANCOVA the adjusted means were not found to be significantly different. The difference between the adjusted means for that case seemed to have been influenced by the covariate "other environmental education".

In two of the ten study units, there was a significant difference in mean gain scores between those students who rated the unit as "really fun" and those who rated it as "some fun". In none of the ten study units were there significant differences in mean gain scores between those

who rated the unit as "discovered lots...", "discovered some...", and "did not discover anything new."

DISCUSSION

Interpretation of Research Questions 1 and 2

The roles played by several variables must be recognized to better interpret the results of data analysis for the first two research questions. The use of pre- and post-activities, instruction in other environmental education prior to the Environmental Station visit, overlap with other curriculum units, and initial academic status are considered in the following pages. The tables found in Appendix C detail the influence these variables had on individual study units at the three grade levels.

Use of pre- and post-activities

The results are inconclusive regarding the importance of the use of pre- and post- activities. In seven cases where they were used, significant gains were achieved. In seven other cases, significant gains were achieved when they were not used. While the findings of this research show gains with and without the use of pre- and post-activities, the presence of an interaction between the treatment unit and use of the activities cannot be inferred from the data which were collected. The staff will probably continue to encourage teachers to use the activities, as tools of orientation to their visit and as potential sources of enhancement of their onsite learning.

During the study use of pre- and post-activities was not very extensive. Responses on the teachers' questionnaires indicate that 66% of the treatment group teachers made little or no use of the activities, 26% used some of them, and only 8% used them in full.

The role of the activities in the four cases with no significant gains is somewhat nebulous. In three of those cases, some use of pre- and post-activities was made, specifically, in **Pond Study** and **Predator Prey** at grade four and in **Web of Life** at grade 6. For **Pond Study** and **Web of Life**, the classes which used the activities had the highest and second highest gains within their treatment groups.

It may be that skewed results of control group testing were responsible for the findings of no significant treatment group gains. In each of the three cases, one control group class had mean gain scores that were unexpectedly high for control groups.

Instruction in Other Environmental Education Prior to the Environmental Station Visit

Many of the classes participated in environmental education activities at school which may have been directly or indirectly related to the content areas of their onsite instruction. The concepts and vocabulary contained in this instruction could have coincided with those of the units being tested and thus had an effect on test scores. While the researcher made no attempt to ascertain the content of

such instruction, the amount of time involved was noted and it was recognized as a variable.

In the majority of the cases with positive results, at least half the students in the treatment groups had other environmental education instruction prior to their Environmental Station visits. Many of the control group classes had also participated in environmental education at school, and in numerous cases, this acted to control the variable for the treatment group. In three cases with positive results, it was not a controlled variable. Therefore, it may have contributed to the achievement of significant gains in those cases.

Overlap with Other Curriculum Units

Many of the Environmental Station units have vocabulary, concepts, and activities that coincide with each other. Multiple onsite exposures of students to the subject matter of the tests could have enhanced their ability to perform well on the posttests. Program schedules for each class were reviewed to determine where overlaps existed and they were noted.

In numerous cases, both treatment and control group members participated in the same related units, thus serving to equate the two groups. In 13 of the cases with positive results, participation in these other curriculum units was not controlled and may have contributed to differences between the treatment and control group gains. In ten of the 13 cases the treatment group had the advantage of

participating in more related units, while in three of the 13 cases the control group had this advantage.

Initial Academic Status

It could be hypothesized that previous academic achievement could have influenced students' abilities to comprehend the curriculum units and to perform on the tests. Therefore, Pearson r correlation coefficients were calculated to determine what relationship existed between students' pretest scores and their composite percentile ranks on their most recent standardized achievement test. Treatment and control group scores were compiled for this analysis. Class means of each measure were used, rather than individual scores. This approach was used because the collection procedures for the percentile rank scores did not allow for individual identification of students. The correlations were determined separately for each unit across all participating grade levels. It was acknowledged that the averaging of percentile ranks is not a standard statistical practice. Nevertheless, it was conducted because it provided some means of assessing the prior academic status of each class and, thus, afforded alternative interpretation of the validity of t testing.

Table 5.1 presents the results of this analysis. Small sample sizes made several of the correlations less reliable than the others. The low coefficients obtained for half of the units help to argue against a claim of the importance of prior learning in determining pretest scores and the ability

Table 5.1 Pearson r correlation coefficients for the relationship between class pretest means and percentile rank means

Unit	n (groups)	Grades	r
Colorful Confusion	11	4,6	.003
Energy Saver	7	6	.133
Forest Community	5	5,6	.415
How Birds Make a Living	5	5	.226
Moving Water	6	6	.023
Pond Study	9	4,5	.474
Predator Prey	20	4,5,6	.315
Skullduggary	16	4,5,6	.086
Snow Walkers	6	4,6	.062
Web of Life	10	4,6	.308

Table 5.2 Mean percentile ranks listed by group for three cases with moderate correlation coefficients

Unit	mean percentile ranks		
	Pre/post treat. grp.	Control group	Post only treat. grp.
Pond Study	61.9	61.7	57.7
Predator Prey	64.5	67.4	64.6
Web of Life	64.4	76.1	62.1

to achieve pre- to posttest gains. Moderate coefficients suggest that in those units prior learning may have placed students at varying academic advantages for achieving gains.

The moderate correlations found for **Pond Study** ($r=.474$), **Predator Prey** ($r=.315$), and **Web of Life** ($r=.308$) are of interest because in those units significant gains were not found at every grade level. The mean percentile ranks for the pretest/posttest treatment group, control group, and posttest only treatment group were calculated for each of the three units to determine whether any group started out at an academic advantage. The results of those calculations are found in Table 5.2. In **Pond Study** and **Predator Prey**, no single group appeared to have a noticeably higher mean. However, in **Web of Life**, the control group students had a clear advantage over the treatment group.

This initial difference in prior achievement may help to explain why the treatment group, while achieving a 20.9% gain, still did not have a significantly greater gain than the control group.

Interpretation of Research Questions 3 and 4

Given the results of data analysis, it may seem at first that there is little value in surveying the students on questions regarding their perceptions of what they learned and how much fun they had, outside of simply ascertaining their perceptions and using those responses as informal feedback on teaching effectiveness. However, further interpretation of the results suggests that numerous

uncontrolled variables may have influenced the outcomes. The results do not recognize differences in levels of variables such as the amount of instruction in other environmental education and the use of pre- and post-activities. Perhaps there is a correlation between the amount of preparation students had for their program, their gains, and their perceptions of the activity. More difficult, and perhaps impossible, to ascertain is the influence on their perceptions of other variables such as time of day, length of visit, weather, novelty of the setting, and who the instructor was.

Finally, the test questions themselves were limiting. Students may have learned a great deal that was not reflected in the unit objectives. The aspects of the units that they enjoyed or did not enjoy may not have had anything to do with the items covered on the tests.

SUMMARY AND IMPLICATIONS

The results of data analysis for questions 1 and 2 are promising. In the majority of the testing situations, statistically significant amounts of learning occurred. Learning occurred in a variety of situations--when students were only exposed to the study unit, and when they were involved in one to several other pertinent learning experiences in addition to the study unit. It is likely that the other activities served as reinforcement for learning in the units for both treatment and control groups.

These results help support a claim that positive gains can occur in an environmental center's program in a situation where the instructor staff is a diverse and continually changing group. This finding is important in light of most teachers' and principals' desire to have all students from a class receive similar instruction and achieve the same objectives, even though they may be taught by several different instructors.

Students' responses to the questions of how much fun they had and how much they discovered were, in most cases, not related to how much they gained in cognitive knowledge. However, they may be related to other aspects of their visit, and the value of asking the questions should not be discounted without further investigation into what students mean by their responses.

RECOMMENDATIONS

In order to more completely assess learning and judge program effectiveness at the Environmental Station, further studies are needed. There are many unanswered questions which relate to the learning taking place. How do the social and physical settings affect learning and attitudes? Can students apply offsite what they learn onsite? How do they feel about the natural areas they explore? Do they change any of their attitudes about environmental problems and solutions? Do they talk more about environment and issues? Does their behavior show greater comprehension of environmental protection? These are not easy questions to

deal with; nevertheless, they are appropos to the questions of program effectiveness.

Follow-up studies several months after class visits could be valuable in determining what students remember about their visit. Would they remember a snake that slithered across a trail, a campfire program, concepts of predator and prey relationships discovered in a game, or perhaps the excitement of being away from home overnight for the first time? Where is the program's impact? Such information could be capitalized upon in the preparation of future programs, to maximize possibilities of learning and positive experiences.

To make the survey questions about learning and fun more useful to the Environmental Station staff, it may be desirable to temporarily change their use for the purpose of study. Students could be asked to specify what they learned and what aspects of the units they did or did not like. Such information could serve as a guide to the staff in determining what aspects of units leave impacts on students, and therefore help staff make decisions about possible changes to make in the future.

During a two-year involvement with the Environmental Station's program, the researcher became aware of limitations of the objectives in mirroring the substance and content of the study units. For the most part, the objectives require lower level cognitive thinking; specifically, recall, comprehension, and application. The Environmental Station staff may wish to review the

objectives to determine whether any changes would be advised. Do they want to include any higher level thinking skills? Should the objectives be more inclusive in their reflection of unit activities? Perhaps the objectives should stand as they are, and the units could be modified to better fit them.

Future researchers may find it to their advantage to deal with a narrower scope and a smaller sample size than the author of this study did. The parameters of this project prohibited the researcher from administering the tests to classes herself, a task which may have resulted in a higher percent of usable responses. Smaller sample sizes may have made it possible to control more variables with the assistance of participating teachers. Pilot testing to determine readability would also have allowed opportunities for changes in vocabulary and structure.

A continued good relationship with classroom teachers should be carefully nurtured. The teachers involved in this research were very cooperative and positive about the study. However, the conduct of numerous studies requiring the same teachers' participation may have diminishing returns, due to the amount of time and effort requested in their participation. The possibility of reduced student interest in providing careful assistance should not be overlooked either.

CONCLUSIONS

George O'Hearn (1982) observed that in the implementation of program evaluation "the 'value' [and] 'worth' [of the program] are subjective indices dependent in part on the audience which is on the receiving end....you need to establish the context and speak to the audience." So it is with this evaluation of the Environmental Station's program. A variety of assessments were made and interpreted, and the findings potentially have varied uses for different groups. The steering committee, administrators, program staff, and classroom teachers and their administrators may each have differing interests in and uses for the information obtained through this study.

There is value in putting into perspective the achievement of cognitive objectives at the Environmental Station. Such learning is but one aspect of a program that also has affective and behavioral goals. The Environmental Station visit is one experience for children in what should be life-long education. However, because of the unique setting, hands-on approach, and opportunities for interaction, perhaps the Environmental Station program can serve as a "seed" experience for children. If the visit stands out in children's minds as a positive and happy learning experience, it may bear fruit at a later time, through increased sensitivity to the natural environment, interest in other opportunities for environmental education, or participation in environmental action. The evaluation of

effectiveness in achieving those goals is an ongoing process. Our ultimate purpose is to continue to find ways to provide more effective learning experiences for our students.

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APPENDIX A

ELEMENTS OF PROGRAM DESIGN

USED AT THE

CENTRAL WISCONSIN ENVIRONMENTAL STATION

GOALS FOR CURRICULUM DEVELOPMENT IN ENVIRONMENTAL EDUCATION

The Superordinate Goal:...to aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment.

Level I. Ecological Foundations Level

This level seeks to provide the receiver with sufficient ecological foundations knowledge to permit him/her to eventually make ecologically sound decisions with respect to environmental issues.

Level II. Conceptual Awareness Level--Issues and Values

This level seeks to guide the development of a conceptual awareness of how individual and collective actions may influence the relationship between quality of life and the quality of the environment and, also, how these actions result in environmental issues which must be resolved through investigation, evaluation, values clarification, decision making, and finally, citizenship action.

Level III. Investigation and Evaluation Level

This level provides for the development of the knowledge and skills necessary to permit receivers to investigate environmental issues and evaluate alternative solutions for remediating these issues. Similarly, values are clarified with respect to these issues and alternative solutions.

Level IV. Environmental Action Skills Level--Training and Application

This level seeks to guide the development of those skills necessary for receivers to take positive environmental action for the purpose of achieving and/or maintaining a dynamic equilibrium between quality of life and the quality of the environment.

(Hungerford, Peyton, and Wilke, 1980)

**THEME CATEGORIES (I.E., MAJOR BEHAVIORAL OBJECTIVES)
OF THE CURRICULUM AT THE
CENTRAL WISCONSIN ENVIRONMENTAL STATION**

1. **Environmental Sensitivity Themes** incorporate activities designed to provide your class with a variety of experiences which will help your students acquire a sensitivity to, and feeling of concern for, the environment. Most sensitivity activities are geared for lower elementary classes. Most units found within the sensitivity theme focus on the students' use of one or more of their five senses.
2. **Ecological Foundations Themes** are designed to assist you in developing within your class sufficient ecological foundations knowledge to assist them in making ecologically sound decisions with respect to environmental issues. Each of the Ecological Foundations Themes units focuses on a specific ecological concept. Follow-up activities for the units found within Ecological Foundations Themes usually related the knowledge gained regarding the concept to one or more environmental issues.
3. **Environmental Awareness Themes** are designed to assist you in developing within your class a conceptual awareness of how individual and collective actions may influence the relationship between quality of life and the quality of the environment...also, how these actions result in environmental issues which must be resolved through investigation, evaluation, values clarification, decision making, and finally, citizenship action. Follow-up activities for units found within the Environmental Awareness Themes often focus on the investigation and evaluation of issues and the clarification of values related to the issues.
4. **Issue Investigation Themes** are designed to assist you in developing within your class the knowledge and skills necessary to permit them to investigate environmental issues and evaluate alternative solutions for remediating these issues. Similarly, values are clarified with respect to these issues and alternative solutions. Follow-up activities for units found within the Issue Investigation Theme often focus on strategies for taking positive environmental action for the remediation of issues.
5. **Environmental Action Themes** are designed to assist you in developing within your class those skills necessary for them to take positive environmental action for the purpose of achieving and/or maintaining a dynamic equilibrium between quality of life and the quality of the environment.

(Central Wisconsin Environmental Station Teachers' Guide)

SKULLDUGGERY

In a Nutshell

Blindfolded students will be introduced to a diversity of mammal skulls. A variety of different skull adaptations will be discussed, especially those relating to the structures and functions of different types of teeth.

Objectives

Following the activity the students will be able to:

- ...define the terms herbivore, omnivore, and carnivore.
- ...give two examples of mammals that are herbivores, omnivores, and carnivores.
- ...describe the purpose or functions of incisors (cutting, canines or fangs (ripping and tearing), and molars (grinding or shearing).
- ...distinguish between herbivores and carnivores by the teeth adaptations (canines-carnivores; molars overlap for shearing surface - carnivores; molars come together flat for grinding - herbivores).
- ...explain how omnivores have tooth adaptations of both herbivores and carnivores (eg. bears have canines for ripping and tearing like carnivores, but the molars come together for grinding like herbivores with only a small overlap).
- ...classify humans as herbivores, carnivores, or omnivores based on teeth adaptations.

Learning Station

Any area where the students will comfortably sit for approximately one hour. At the CWES, use Becker Lodge during cold or rainy weather.

Materials

A set of skulls including herbivores, carnivores, and omnivores. Preferably labels should be removed and skulls should be numbered for identification by the leader.

materials cont'

For each student:

- 1 blindfold
- 1 skull (could use lower jaws as well if skulls are limited in supply).

New word cards.

Preparation by Leader

Become familiar with the basic skull adaptations of herbivores, carnivores, and omnivores. In particular, note adaptations of tooth structures, patterns, and functions (see insert). Be able to separate the three groups by sight if possible (usually it is easiest to remember the omnivores). Find a suitable learning station. Place all the skulls in a closed box so the skulls are not visible to the students.

Warm-up

Have the group form a tight circle with shoulders touching, then sit down in place. Tell them they are going to explore some natural object using their senses. What are the five senses? Have them "wake-up" their senses by cleaning out one sense at a time. Clean out your eyeballs by pulling them out one at a time and sticking them in your mouth. Clean the wax out of your ears and listen for a moment. Blow your nose, then take a deep breath. Wipe off your tongue. Connect your fingertips up to your brain. What other parts of your body can you touch with? Finally connect your "sense of humor". Ask the students which sense we use the most? "We are going to temporarily chop out that sense and become blind. What will happen to your other senses?"



Activity

Pass out the blindfolds. Have the students put them on -- no peeking! Give a different skull to each student. Emphasize careful handling of the object, since they are very fragile. Have each student explore their "object" without saying anything about it. Ask a series of questions to lead them. "How big is it? Does it fit in the palm of your hand? How heavy is it? How much does it weigh (compare to familiar objects)? Rub it against your cheek. Is it smooth or rough? Do some parts feel different than others? Smell it. Can you think of anything it smells like? You probably would not care to taste it. Shake it gently and listen. What shape does it remind you of? Are there any caves in it or places where spiders could hang out?" They should get to know the object so well they could tell it apart from all other similar objects. Now go around the circle having each student in turn verbally describe his or her object to the rest of the group. They should try to paint a verbal picture of the object, but they cannot use the name of the object, the name of any of its parts, or tell what it is made of. (Students that normally might be shy about talking, will often open up more when they know the other students are blindfolded.)

Give everyone "one last feel" of their objects, then collect the skulls. Place them in a pile in the center of the circle with any extra skulls and all lower jaws that were not handed out. Have the students remove their blindfolds and, just from where they are sitting, try to see which skull is theirs. Then turn them loose and let them pick up their skulls. Suggest closing their eyes to check for positive identification of their own skulls.

Once everyone has found theirs, demonstrate how the lower jaws fit into the upper sockets. Have the student match up all the lower jaws with the respective skulls. As each jaw is matched collect the skulls and sort them into three rows corresponding with herbivores, carnivores, and omnivores. Once all the skulls are

sorted, tell the students that you have sorted them out on the basis of similar adaptations. "What are adaptations? What type of adaptations could they be sorted by? What are the adaptations for?" Bring out the idea of herbivores, carnivores, and omnivores, as animals with adaptations for different types of feeding habits. Discuss the various adaptations of each group concentrating on types and functions of teeth (cutting, grinding, ripping and tearing, shearing, and any other adaptations appropriate. Omnivores have teeth that combine function from both herbivores and carnivores. Sorting the carnivores (order Carnivora) further into the three main families, the dog family (Canidae), cat family (felidae), and the weasel family (Mustelidae), will allow the students to see their common ancestry more clearly. It is probably best to leave identifications for last. Once we have a name for things we generally stop thinking about them.

Pulling Things Together

Have the students form a sharing circle and discuss these questions:

How do the skull adaptations help the animal fit into its habitat?

What would happen if the animal's food source disappeared? Could a carnivore eat plants? What about an omnivore?

What other types of adaptations do animals have besides skull adaptations?

How do scientists come up with groupings and names for all the animals?

Ask the children to feel their jaws and teeth. Have the group decide:

What type of teeth do humans have? What are they adapted for? How does this reflect our diet? If we had a human skull, which group of all the mammals would it most closely resemble?

Let the students review what they learn

OPTIONS

Popcorn/Peanut Warm Up

As an option to the warm-up, the student's senses may be warmed up by investigating a type of food which is small and can be handled easily. Popcorn or peanuts both work well.

For example, begin with hearing (objects should be contained in a brown sack). Shake the bag and have them guess the contents (keep taking guesses even if the right answer is given). Smell - what room in the house or place does it smell like? Go through the senses and, last of all, have them eat the object.

IMPORTANT: as practice for the activity, stress that they must never name the object or any part of it directly. Rather, they should describe it by texture, shape, size, weight, etc.

Extra Time?

Introduce the students to the Field Guide to the Mammals by Burt and Grossenheider as a reference they can use to look up skulls they may find. Give each student a different skull (mix them up again) to look up and match with the skull pictures in the back of the guide. Use the list of dental formulae following the pictures to assist with the identification (count the different types of teeth). Once the skull has been identified have them look up the picture of the animal itself, and then try to find out just what it eats (generally found in the text descriptions of the species or sometimes the family). "Is it a carnivore, herbivore, or omnivore? What other adaptations does it have for feeding (camouflage, long legs or neck, speed, strong muscles, etc.)?"

SKULDUGGERY

Pre-Activity

Vocabulary list

This list includes words that should be introduced to the students prior to their CWES experience so they will be able to get the most out of the chosen activity.

Herbivore - an animal that eats plants.

Carnivore - an animal that eats meat (other animals).

Omnivore - an animal that eats both plants and meat.

Adaptation - an evolutionary change over time that makes an organism better suited for surviving in its environment.

Habitat - the place where an animal lives and all of its needs for life are met.

Mammals - a class (Mammalia) of warm-blooded vertebrate animals possessing mammary glands, hair, and two sets of teeth, as well as other characteristics.

Species - a population of naturally reproducing organisms.

Performance Objectives

Students will draw an imaginary animal that is adapted for catching or gathering and eating specific kinds of food.

Students will classify each invented animal as a herbivore, carnivore, or omnivore.

Activity

Students should be introduced to the idea of adaptations as specialized body parts or behaviors that make an organism better able to survive in a particular environment. Give them some examples of familiar animals: a giraffe's long neck for browsing on trees, the speed of the cheetah, the hands and reasoning power (minds) of humans, the tails of some monkeys, wings of bats. See how many more they can come up with. Now tell the students that they are going to invent their own animals with adaptations for getting food in specific ways. Each student (or small group of students) should be given a type of food their animal should be adapted for getting. Some suggestions are listed below, but you can easily invent others! The students should draw the animal, then describe its adaptations to the rest of the class. Many adaptations can be related to adaptations real animals have. Next introduce the ideas of carnivores and herbivores, and let the students classify each invented animal into the appropriate group. Some animals might be adapted for eating more than just that one thing - What else could they eat? Some of these animals might be omnivores.

Activity cont'

Some suggestions could be to invent an animal that could -

- ..catch and eat a large, fast swimming fish.
- ..swallow an egg whole.
- ..hunt night crawlers at night.
- ..catch a flying butterfly.
- ..catch and eat a skunk.
- ..break open hard-shelled animals.
- ..get at animals that live in rotten logs and stumps.
- ..peel off and eat the kernels from a cob of corn.
- ..climb a tree, collect pine cones, and eat the seeds.
- ..break open acorns.
- ..get at animals that live in burrows or tunnels underground.
- ..dig up bulbs from wild onions.
- ..climb up a tree, peel off its tough outer bark, and eat the softer inner bark.
- ..find insects that live in holes in trees.
- ..gather wheat seeds and grind them into powder before swallowing.
- ..eat anything (can such a thing be made?)

SKULDUGGERY

FOLLOW-UP

Objectives

Students will distinguish between endangered, extinct, and extirpated animals.

Students in small groups will research into the natural history background of endangered mammals, and present their findings to the class.

Students will develop a list of possible causes for the decline of these endangered species.

Activity

Endangered species are animals whose reproduction and survival are in danger. Extinct species are those no longer found on the earth. Extirpated species are those no longer found in a given area (ex. state or country). The Wisconsin Department of Natural Resources Endangered Species Committee has a publication available entitled Endangered Animals in Wisconsin (1973) that describes the extirpated and endangered animals in the state, as well as those that are being watched that may or may not be holding their own. Assign small groups of students and give each group one of the mammals from the following list.

<u>Endangered</u>	<u>Watched</u>	<u>Extirpated from the State</u>
Marten	White-tailed Jack	Wolverine
Canada Lynx	Rabbit	Cougar
Timber Wolf	Fisher	Elk
	Bobcat	Woodland Caribou
	Moose	Buffalo

Have the students research these mammals to provide short summary descriptions of the following information: 1) its size and weight, 2) its preferred type of habitat, 3) what it eats, and 4) the size of a typical home range (teacher should define). Home range is the area an animal will normally live in and restrict its movements to for hunting or feeding. This area may or may not change during breeding season. The students should also try to find a picture of the animal to share with the class. Each group should give a short presentation of their summary to the class. The Field Guide to the Mammals has much of this information, but don't overlook magazines (Audubon, National Wildlife), DNR publications or other resources. For each mammal the class should decide if it is an herbivore, carnivore, or omnivore. The teacher could make a list of these on the board. After each presentation the class could come up with a list of adaptations that animal has for surviving the way it does (how it gets its food, where it stays, how it avoids being eaten, etc.). Endangered species in general have adapted to their environment so specifically that they can't survive with the changes humans have made to their environment. Have the class come up with a list of ways humans could affect these animals, and try to decide which reasons may be responsible for causing these animals to be endangered (habitat destruction - altering by farming, logging, fencing, clearing, reducing the size of suitable habitat; over-hunting, over-trapping, reduction of their prey species, poisoning in predator-control programs, etc.) What are people doing now to help these mammals? What can you do?



STAFF EVALUATION

NAME _____ GROUP _____ DATE _____

Please rate the following on a 1-5 scale (round to nearest half):

1 = excellent 2 = very good 3 = good 4 = adequate 5 = poor NA = Not Applicable

1. Students' grasp of the major concept and objectives of each unit you taught.

___ a) unit name: _____

___ b) unit name: _____

___ c) unit name: _____

2. Students' reaction to each unit you taught.

___ a) unit name: _____

___ b) unit name: _____

___ c) unit name: _____

3. ___ Students' academic preparation for the units.

4. ___ Students' preparation with clothing.

5. ___ Students' behavior and observance of rules.

Comments:

6. ___ Classroom teacher's interest in the program.

___ a) teacher's name: _____

___ b) teacher's name: _____

7. ___ Program Director's leadership.

Comments:

8. ___ Your reaction to the program schedule.

Comments:

10. ___ Unifying effect of the theme to the units taught.

Comments:

11. ___ My perception of the effectiveness of my teaching.

Comments:

12. ___ My preparation for the units taught.

Comments:

13. ___ Station food and food service.

Comments:

Problems with Station equipment and facilities.

Improvements which could be made to the units you taught.

Other comments or suggestions regarding today's program. Be as specific as possible.

Thank you for helping to improve our program!

02/84 = PR02



PROGRAM DIRECTOR'S EVALUATION

PROGRAM DIRECTOR _____ DATE _____
GROUP _____ NUMBER OF STUDENTS _____
TEACHER('S) _____

Please be as complete as possible. This information is passed on to the teacher(s) to facilitate communications between the classroom and the Station. Make two copies of page 1 and 2.

A. Program theme:

Description of opening activity.

Description of closing activity.

B. Any scheduling changes needed during the program.

C. General comments regarding the school group and their visit.

D. Suggestions for any changes that could improve the program.

E. The staff has rated the program on a 1 to 5 scale. The ratings shown below are an average of their responses.

1 = excellent 2 = very good 3 = good 4 = adequate 5 = poor NA = not applicable

1. Students' grasp of the major concept and objectives of each unit.

- | | |
|-------------------------|-------------------------|
| ___ a) unit name: _____ | ___ e) unit name: _____ |
| ___ b) unit name: _____ | ___ f) unit name: _____ |
| ___ c) unit name: _____ | ___ g) unit name: _____ |
| ___ d) unit name: _____ | ___ h) unit name: _____ |

2. Students' reaction to each unit:

- | | |
|-------------------------|-------------------------|
| ___ a) unit name: _____ | ___ e) unit name: _____ |
| ___ b) unit name: _____ | ___ f) unit name: _____ |
| ___ c) unit name: _____ | ___ g) unit name: _____ |
| ___ d) unit name: _____ | ___ h) unit name: _____ |

3. ___ Students' academic preparation for the units.

4. ___ Students' preparation with clothing.

5. ___ Students' behavior and observance of rules.

Comments:

6. ___ Program Director's leadership.

Comments:

7. ___ Staff reaction to the program and schedule.

Comments:

8. ___ Unifying effect of the theme to the units taught.

Comments:

9. ___ Staff's perception of their teaching effectiveness.

Program Director

Page 3 - PROGRAM DIRECTOR'S EVALUATION

In-house evaluation of program. (Make one copy to be kept in school file.)

1. General evaluation of group and their visit.
2. Specific problems occurring during the visit.
3. General evaluation and comments about classroom teachers.
4. Any problems with Station equipment and facilities.
5. Suggested changes or comments about today's program.
6. Comments on food service.
7. Please evaluate your staff on these non-instructional aspects of the program:
1 to 5 (1 = excellent; 5 = poor)

<u>Name</u>	<u>Program Preparation</u>	<u>Cooperation</u>	<u>Weekly Planning Involvement</u>	<u>Over-all Attitude</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

8. General evaluation of the staff's teaching effectiveness with this group:
9. Your performance and effectiveness as Program Director.
10. Other comments that you feel are of value may be placed on the back of this sheet. Be as specific as possible.

TEACHER'S EVALUATION OF PROGRAM

TEACHER _____ SCHOOL _____

ADDRESS _____ GRADE OR CLASS _____

DATE(S) OF PROGRAM _____

Please rate each aspect of your program below by placing the appropriate number in the blank before each question. Please feel free to comment on any of these questions on the next page; written comments are extremely valuable in helping us to improve our program.

1=excellent 2=very good 3=good 4=fair 5=poor NA=not applicable

- ___ Usefulness of the Teacher's Guide to you in planning your visit.
- ___ Availability of units for your grade level.
- ___ Application of the units to your regular class curriculum.
- ___ Value of the student orientation slide/tape program.
- ___ Your preparation of your students for their visit.
- ___ Overall teaching skills of our staff.
- ___ Leadership shown by the program director.
- ___ Your involvement in the program.
- ___ Your students' attitude towards the program.
- ___ Your students' behavior during the program.
- ___ Our staff's effectiveness in helping your students achieve on site objectives.
- ___ The evening activities.
- ___ Our physical facilities (classrooms, cabin/dorm, dining room).
- ___ Our program equipment (materials and supplies).
- ___ Quality of the food and food service.
- ___ Organization of your program and schedule.
- ___ Your reaction to the opening and closing activities.
- ___ Your reception by the staff.
- ___ Your feelings about bringing the class back next year.

Please give an overall rating of your visit:

Teacher eval. of program--2

How could we improve our services to you (eg. additional information you would like to have, unit topics, student material, etc):

Your comments and suggestions are appreciated. Please be as specific as possible:

Upon receipt of this evaluation, we will send you a copy of the staff's evaluation of your program.

STUDENT'S EVALUATION OF PROGRAM

TEACHER _____ SCHOOL _____

CLASS _____ # OF STUDENTS _____

DATE OF VISIT _____ DATE OF EVALUATION _____

Please list the units your students participated in below. Ask them to respond as a group to two aspects of each activity (one aspect at a time): "Was the activity fun?" and "Did you discover anything new?" Count the number of student votes in each category and fill in the appropriate number below.

UNIT	NUMBER OF VOTES					
	Really Fun	Sometimes fun Sometimes boring	Really boring or not fun	Discovered lots of new things	Discovered some new things	Did not discover anything new

Other comments:

APPENDIX B

TESTING INFORMATION

SENT TO TEACHERS

CENTRAL WISCONSIN ENVIRONMENTAL STATION

1983-84 Evaluation of Units

During the past eight years, evaluation of our school program has been through the written comments of teachers, students, and station staff. This feedback has been of great value in helping us determine our strengths and needs. During the 1983-84 school year, a new phase of evaluation efforts will take place. We will be formally testing several of our units with 4th, 5th, and 6th grade classes. Our purpose is to determine how much students are learning from the units and to use that information for future planning.

When we receive your completed Program Planner stating your choice of units, we will be able to clarify your class's involvement. Briefly, the role which we are asking you to assume includes these steps:

1. Prepare for and follow-up on your Station visit as you normally would.
2. Administer short tests to your class prior to and following their Station visit. We will mail the tests to you along with your master schedule. You do not need to grade these tests.
3. Complete a short questionnaire.
4. Mail all evaluation materials back to the Environmental Station.

The results of testing your class will be sent to you after we have had an opportunity to compile and analyze your data. This information will be kept confidential; no one other than Station staff associated with this study will have access to results identified as associated with your school. The final report will be summarized in the Sunset Gazette during the 1984-85 school year.

Your help is very important to the success of this study. Please feel free to contact the Station if we can be of service in clarifying any information about the evaluation process.

The coordinator for this project is Judy Klippel, a candidate for an M.S. degree in environmental education at UW-SP. Judy has 8 years teaching experience in 5th and 6th grades. She served as summer camp director at the Station this year and will be a program director during the 1983-84 academic year.



university of wisconsin/stevens point • stevens point, wisconsin 54481

Dear

Enclosed please find the master schedule for your group's visit to the Central Wisconsin Environmental Station. Along with the schedule I have enclosed copies of the instructional units you chose, an orientation packet (with equipment lists and sample permission blanks), and information on how you can be involved in the program during your visit.

We strongly urge teachers to utilize the pre and post activities as tools to enhance the learning experience at the Station. The units are much more effective if the students have had some preparation.

Also enclosed you will find a packet of evaluation materials. The cover letter to this packet will explain how these materials are to be used. Judy Klippel is coordinating this evaluation project.

When you arrive at the Station, you will be met by who will serve as the Program Director during your visit.

Everything is ready for your class, and we are really looking forward to seeing you! Please call if you have any questions or need to make changes.

Sincerely,

Bill Chiat, Assistant Director
and Program Coordinator
Central Wisconsin
Environmental Station

BC/ak

Enclosures



Thank you for assisting us in evaluating the effectiveness of the Environmental Station's curriculum. In order to help make this study of most value to us, please follow these steps in the order shown.

1. Pretests - Administer pretests to your class according to the attached instructions. Please do not grade the tests.

*If you use the pre-activities, administer the pretests one or two school days before you teach the activities.

*If you do not use the pre-activities, administer the pretests one or two school days prior to your Station visit.

2. Pre-activities - Please use them only if you were already planning such use. When the data are analyzed, the use or nonuse of these activities will be taken into account.

3. Environmental Station visit

4. Post-activities - Please use these only if you have planned on such use.

5. Posttests - Administer the posttests to your class according to the attached instructions. Please do not grade the tests.

*If you use the post-activities, administer the posttests one or two school days after completing the activities. Please complete the posttests within one week after the Station visit, regardless of whether the post-activities are finished.

*If you do not use the post-activities, administer the posttests one or two school days after your Station visit.

6. Teacher questionnaire - Please answer this as completely as you can. Your responses will help us to better interpret the data we receive from your class.

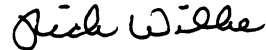
7. Mailing - Send packs of pretests and posttests and the teacher questionnaire to the Environmental Station in the enclosed envelope as soon as possible.

Thank you again. We appreciate your help and cooperation in this study.

Sincerely,



Judy Klippel
Evaluation Project
Coordinator



Richard Wilke
Director, Central Wisconsin
Environmental Station



William Chiat
Associate Director

Enclosures:

Instructions for administering tests
Experimental group pretests (for $\frac{1}{2}$ of class)
Control group pretests and posttests (for $\frac{1}{2}$ of class)
Random number list
Posttests (for entire class)
Teacher questionnaire and list for standardized test
Stamped return envelope

INSTRUCTIONS FOR ADMINISTERING THE TESTS

Please follow these procedures. It is important that we standardize the testing process for all participating schools. Please read all directions before testing.

EXPERIMENTAL GROUP PRETEST (yellow paper) *To be administered 1 - 2 school days prior to your Station visit or to use of pre-activities (if applicable)*

1. Half of your class will take a pretest for the unit being evaluated with them.
2. Explain the test purpose to your class: to help the Environmental Station teachers find out how much students know about the subject of the test before they visit the Station. Explain that they should do their best, but should not be upset if they do not know all the answers. We don't expect them to know everything on the test.
3. Read items aloud to students if reading level is a concern.
4. Pronunciation of words may be clarified, but please do not explain questions, concepts, or vocabulary.
5. Allow a maximum of 15 minutes for completion of tests.
6. Test questions may allow for several correct responses.
7. Make sure each student signs his/her name to the test.
8. Students may be told there will be a posttest, but please *do not* indicate that it consists of the same questions as the pretest.
9. Staple or rubberband all the experimental group pretests together.

CONTROL GROUP PRETEST (yellow paper) *To be administered 1 - 2 school days prior to your Station visit or to use of pre-activities (if applicable)*

1. The remaining half of your class will take a test that is *not* for a unit in which they will participate at the Station. This testing will allow us to make a comparison with another school which will use the specified unit.
2. It is important that those who take this control test be randomly chosen. A list of random numbers is attached to the packet of control group tests. Match those numbers with your class list to determine who will be part of the control group.
3. Administer the test at the same time as the pretest which is given to the experimental group.
4. The directions for administering this test are the same as those for the experimental group (as shown above).

5. Make sure each student signs his/her name to the test.
6. Staple or rubberband all the control group pretests together. Do not grade them.

EXPERIMENTAL GROUP POSTTEST (green paper) and CONTROL GROUP POSTTEST (yellow paper) *To be administered 1 - 2 school days following your Station visit or use of post-activities (if applicable)*

1. The entire class will take the experimental posttest. The students who took the control pretest should also take the control posttest.
2. Explain the tests' purpose to your class: to help Environmental Station teachers find out what students learned from activities they participated in at the Station.
3. Administer the same as the pretest.
4. Make sure each student signs his/her name to the test(s).
5. Staple or rubberband all the posttests together. Do not grade them.

Name _____

Grade level _____

Today's date _____

TEACHER QUESTIONNAIRE

Please respond to the following questions as they apply to you. Questions No. 2 and 3 may require description of either 1 or 2 units, depending on the number of units you are helping us to evaluate. All responses will be regarded as confidential.

1. What was the length of your class's stay at the Environmental Station?

_____ 1 day

_____ 2 days

_____ 3 days

2. Did you use the pre-activities for the unit(s) being evaluated?

_____ no

_____ yes

*If yes, please list the activities and estimate the number of hours of instruction devoted to them.

Unit _____ number of hours _____

Pre-activities used _____

Unit _____ number of hours _____

Pre-activities used _____

3. Did you use the post-activities for the unit(s) being evaluated?

_____ no

_____ yes

*If yes, please list the activities and estimate the number of hours of instruction devoted to them.

Unit _____ number of hours _____

Post-activities used _____

Unit _____ number of hours _____

Post-activities used _____

4. Estimate the number of hours your students have spent this year on ecology or environmental education prior to their Station visit. Do not include time spent in the pre- and post-activities.

_____ 0 - 10

_____ 11 - 20

_____ 21 - 50

_____ other (e.g., infused into curriculum) Please explain.

5. Complete the attached sheet pertaining to standardized test scores.

Name _____

STANDARDIZED TEST PERCENTILE RANKS

On this sheet, please indicate each student's most recent composite or total percentile rank on a standardized achievement test. List students' scores in the order they appear on your class list. Please do not include students' names.

These scores are vital for helping us interpret scores on the pre- and posttests. All information on this sheet will be kept confidential.

Please indicate the name of the achievement test and the date it was administered.

(test name)	(month)	(year)
1. _____	19.	_____
2. _____	20.	_____
3. _____	21.	_____
4. _____	22.	_____
5. _____	23.	_____
6. _____	24.	_____
7. _____	25.	_____
8. _____	26.	_____
9. _____	27.	_____
10. _____	28.	_____
11. _____	29.	_____
12. _____	30.	_____
13. _____	31.	_____
14. _____	32.	_____
15. _____	33.	_____
16. _____	34.	_____
17. _____	35.	_____
18. _____	36.	_____

**(Circled numbers designate the students from your class list who were given the control group pre- and posttests.)



Name _____

Grade _____

Teacher _____

Date _____

FOREST COMMUNITY

1. Explain 2 ways in which a forest community is similar to a human community.

2. Name 4 different members of a forest community.

3. What does interdependence mean?

4. Give an example of interdependence found in a forest community.

5. What does habitat mean?

6. What does niche mean?

7. Name a member of a forest community and state its niche.

member - _____

niche - _____

8. What would happen if all insects were removed from the forest community?



Name _____

Grade _____

Teacher _____

Date _____

FOREST COMMUNITY

1. Explain 2 ways in which a forest community is similar to a human community.

2. Name 4 different members of a forest community.

3. What does interdependence mean?

4. Give an example of interdependence found in a forest community.

5. What does habitat mean?

6. What does niche mean?

7. Name a member of a forest community and state its niche.

member - _____

niche - _____

8. What would happen if all insects were removed from the forest community?

9. Please check the answer that best describes how you feel about the FOREST COMMUNITY activity.

Was the activity fun?

___ really fun

___ sometimes fun, sometimes boring

___ really boring or not fun

Did you discover anything new?

___ discovered lots of new things

___ discovered some new things

___ did not discover anything new



FOREST COMMUNITY

In a Nutshell

Students will discover the habitat and niche of plants and animals that make up the forest community. By comparing the forest to their own community they discover ways the citizens of the forest interact and are interdependent. Grade Levels 4-8, warm months.

Objectives

- Upon completion of this unit, students will be able to:
- ...explain four ways in which a forest community is similar to a human community.
 - ...identify five members of a forest community and state how they are dependent on each other.
 - ...define and give examples of the terms interdependence, habitat and niche.
 - ...describe the habitat, niche and interrelationships of one forest citizen.
 - ...describe the implications of removing a citizen from the forest community.

Learning Station

Any forested area with a diversity of plants and animals, preferably with some upland and lowland areas. At the Station, use the areas near Minister and Skunk lakes.

Materials

- For each pair:
- Binocular
 - Clip board
 - Pencil
 - Data Sheet
- For the Group:
- Newsprint
 - Markers
 - Ball of Yarn
 - Word cards: interdependence, niche habitat

materials cont'

Field guides to trees, flowers, birds mammals, animal foods, insects, etc. for the leaders use plus extra copies to pass around the group.

Preparation by Leader

Plan a route through a forested area where your group will see a diversity of plants, animals and animal signs.

Warm-Up

In a circle, ask the students to define community. In what ways is their hometown a community? On a board or newsprint, list the occupations their parents have in the community. Add a few, if necessary for diversity. Have the students decide how the different citizens in the community are connected or dependent on one another. As each interrelationship is stated, draw a line connecting the citizens. After all possibilities are exhausted, ask what would happen if one of the community members were removed. Illustrate results and implications with several examples on your chart. Introduce the word INTERDEPENDENCE, and explain that members of a human community are interdependent on each other for survival.

Point out to the students that there are many kinds of communities other than human communities. Explain that today they are going to examine a forest community and seek out the citizens that live there, and try and determine how they may be interdependent.

Activity

Divide the group into pairs, and explain that their first task will be to become familiar with the citizens that make up the forest community. They will have about 10 minutes to explore the forest, and list as many members as they can find. Encourage them to search for producers, consumers and decomposers. Distribute boards, pencils and data sheets. Define the study area, and let them go to work. (OPTION: this investigation could also be done as part of a group hike through the forest, rather than investigating one single area. Encourage the pairs to work separately.)

After a variety of organisms have been observed, form a sharing circle and have the students discuss the forest citizens they discovered. Encourage them to think about where the organism is found, and what role it might play in the community (i.e. provide food, decompose dead things, spread plant seeds, control insects, etc.). Explain that when scientists or resource managers study citizens in the community, they often refer to the organism's habitat (or place where it lives) and its niche (or job it does in the community). Have the group figure out one or two examples of habitat and niche, first with members of the human community discussed earlier, then with citizens observed in the forest community.

Ask each pair to select one forest citizen from their list which they would like to investigate. Insure that there are no duplications. Explain that the students are to find their organism and determine its habitat and niche. Encourage them to be as specific as possible. They are to also decide what citizens their organisms are dependent on for survival and what citizens may depend on their organism for survival. This data may be based on both field observations and information from you and the field guides. Allow about 10 minutes for the pairs to fill out their data sheets. Circulate and help the teams.

Again form a circle and share results. Emphasize interdependence during the discussion. "How many citizens are interdependent? Are there any citizens that are not dependent on other forest citizens? What would happen if one or more citizens were removed from the community

(NOTE: this part of the activity may be modified or eliminated if time is short) Seat the students in the circle and ask them to each select an organism from the community. Insure that there are no duplications. You may want to write the citizen on a sheet of paper to give the student so everyone knows who is what. Emphasizing interdependence, tell the group that "we are going to create a forest community Web!" Take out the ball of yarn and hand it to any student. Ask that student how his or her citizen is connected to other forest community members represented by the group. Remind them of what they learned about habitat and niche. This citizen may be dependent on another to provide its food, shelter protection, shade, etc. When the student thinks of a relationship, have them hold the end of the yarn, and toss the ball to the citizen they're dependent on. Continue the activity until everyone is connected, and a web is weaved.

Have the group hold the yarn above their heads so they can look up and admire their work. Ask the group what would happen if one of the citizens were removed, such as the trees? Ceremoniously cut or drop all connections to the trees. Ask what happens to some of the other citizens when the trees are removed? For any citizens that cannot survive without trees also "cut" them from the web. Ask whether the forest community can survive without the trees? Examine importance of other forest community members.

Pulling Things Together

In a sharing circle discuss the following questions:
..Could any forest citizen live alone?
..Can people live alone without other living things?
..What are you dependent upon?
..Are you dependent upon forests?

pulling things together cont'

- ..How are you a part of the forest community?
- ..Could the forest community survive without humans?
- ..Could the human community live without the forest community?

References

Martin, Zim, Nelson. American Wildlife and Plants: A Guide to Wildlife Food Habits.

DATA SHEET

Forest Community

I. List the organisms you observed in the forest community:

PRODUCERS	COMSUMERS	DECOMPOSERS

II. Select one organism and determine its' habitat, niche and how it is interdependent with other citizens of the forest.

Organism _____

Habitat _____

Niche _____

What it is dependent on _____

What is dependent on it _____

APPENDIX C

SUMMARY OF EVALUATION RESULTS

COLORFUL CONFUSION GRADE 4

The treatment group had a significantly higher mean gain than the control group did. Pretesting had no significant effect on the treatment group posttest mean.

	Treatment		Control	
<u>Pre- to posttest change</u>	%	n	%	n
Total mean	10.2%	(16)	-5.0%	(25)
Class means	4.2%	(9)	-6.3%	(13)
	17.9%	(7)	-3.9%	(12)

Pre- and post-activities

Little or no use	44%	(7)	100%	(25)
Some use	56%	(9)	-	(0)
Total use	-	(0)	-	(0)

Other environmental education

0 to 10 hours	44%	(7)	52%	(13)
11 to 20 hours	56%	(9)	48%	(12)
21+ hours	-	(0)	-	(0)

Related onsite units

56% (9)	100% (25)
Web of Life	Web of Life Pond Study

44% (7)
How Birds Make a Living

Additional Explanation

The significantly greater mean gain score for the treatment group can probably be attributed to their participation in the **Colorful Confusion** unit. 44% of the treatment group participated in another unit with overlapping concepts, **How Birds Make a Living**. This could also have influenced the gain scores for that portion of the treatment group. The portion of the treatment group participating in pre- and post-activities had a lower gain than those who did not participate in the pre- and post-activities. Participation in other environmental education activities and the **Web of Life** unit seemed to have no positive effect on results, since in both cases the control group had higher participation than the treatment group.

COLORFUL CONFUSION GRADE 6

The treatment group had a significantly higher mean gain than the control group did. Pretesting had no significant effect on the treatment group posttest mean.

	Treatment		Control	
<u>Pre- to posttest change</u>	%	n	%	n
Total mean	8.1%	(40)	-1.8%	(34)
Class means	9.9%	(17)	-2.8%	(11)
	7.8%	(12)	4.7%	(7)
	5.7%	(11)	-2.1%	(8)
			-7.1%	(8)

Pre- and post-activities

Little or no use	27%	(11)	100%	(34)
Some use	73%	(29)	-	(0)
Total use	-	(0)	-	(0)

Other environmental education

0 to 10 hours	27%	(11)	-	(0)
11 to 20 hours	73%	(29)	-	(0)
21+ hours	-	(0)	100%	(34)

Related onsite units

70%	(28)	100%	(34)
Web of Life		Web of Life	
30%	(12)		
How Birds Make a Living			

Additional Explanation

The significantly greater mean gain score for the treatment group can probably be attributed to their participation in the **Colorful Confusion** unit and in pre- and post-activities. 30% of the treatment group participated in another unit with overlapping concepts, **How Birds Make a Living**. This could also have influenced the gain scores for that portion of the treatment group.

ENERGY SAVER GRADE 6

The treatment group had a significantly higher mean gain than the control group did. Pretesting had no significant effect on the treatment group posttest mean.

<u>Pre- to posttest change</u>	Treatment		Control	
	%	n	%	n
Total mean	18.6%	(66)	-4.0%	(10)
Class means	21.3%	(12)	-4.0%	(10)
	19.6%	(10)		
	15.1%	(14)		
	1.1%	(9)		
	23.4%	(13)		
	31.3%	(8)		
<u>Pre- and post-activities</u>				
Little or no use	100%	(66)	100%	(10)
Some use	-	(0)	-	(0)
Total use	-	(0)	-	(0)
<u>Other environmental education</u>				
0 to 10 hours	18%	(12)	-	(0)
11 to 20 hours	21%	(14)	-	(0)
21+ hours	61%	(40)	100%	(10)
<u>Related onsite units</u>				
	46%	(30)	100%	(10)
	Snow Walkers		Snow Walkers	

Additional Explanation

The significantly greater mean gain score for the treatment group can be attributed to their participation in the Energy Saver unit.

FOREST COMMUNITY GRADE 5

The treatment group had a significantly higher mean gain than the control group did. Pretesting had no significant effect on the treatment group posttest mean.

	Treatment		Control	
<u>Pre- to posttest change</u>	%	n	%	n
Total mean	32.9%	(17)	1.0%	(17)
Class means	34.1%	(12)	1.0%	(17)
	30.0%	(5)		
 <u>Pre- and post-activities</u>				
Little or no use	100%	(17)	100%	(17)
Some use	-	(0)	-	(0)
Total use	-	(0)	-	(0)
 <u>Other environmental education</u>				
0 to 10 hours	100%	(17)	100%	(17)
11 to 20 hours	-	(0)	-	(0)
21+ hours	-	(0)	-	(0)
 <u>Related onsite units</u>				
	71%	(12)	100%	(17)
	Forest Apartment		Snow Walkers	
	100%	(17)		
	Web of Life			
	Pond Study			

Additional Explanation

The significantly greater mean gain score for the treatment group can probably be attributed to their participation in the **Forest Community** unit. 77% of the treatment group participated in another unit with overlapping concepts, **Forest Apartment**, and 100% participated in the **Web of Life** and **Pond Study** units. Involvement in those activities could also have influenced the gain scores for those portions of the treatment group. All of the control group members participated in another unit, **Snow Walkers**, which also had overlapping concepts.

FOREST COMMUNITY GRADE 6

The treatment group had a significantly higher mean gain than the control group did. Pretesting had no significant effect on the treatment group posttest mean.

<u>Pre- to posttest change</u>	Treatment		Control	
	%	n	%	n
Total mean	22.6%	(4)	6.8%	(12)
Class means	22.6%	(4)	6.8%	(12)

Pre- and post-activities

Little or no use	100%	(4)	100%	(12)
Some use	-	(0)	-	(0)
Total use	-	(0)	-	(0)

Other environmental education

0 to 10 hours	-	(0)	-	(0)
11 to 20 hours	-	(0)	100%	(12)
21+ hours	100%	(4)	-	(0)

Related onsite units

100%	(4)	100%	(12)
Pond Study		Snow Walkers	
Web of Life			

Additional Explanation

The significantly greater mean gain score for the treatment group can probably be attributed to their participation in the **Forest Community** unit. All of the treatment group members participated in two other units with overlapping concepts, **Pond Study** and **Web of Life**. This could also have influenced their gains. All of the control group members participated in another unit, **Snow Walkers**, that also had overlapping concepts.

HOW BIRDS MAKE A LIVING GRADE 5

The treatment group had a significantly higher mean gain than the control group did. Pretesting had no significant effect on the treatment group posttest mean.

<u>Pre- to posttest change</u>	Treatment		Control	
	%	n	%	n
Total mean	13.9%	(30)	7.1%	(19)
Class means	18.3%	(15)	7.4%	(13)
	3.6%	(7)	6.5%	(6)
	14.7%	(8)		
<u>Pre- and post-activities</u>				
Little or no use	77%	(23)	100%	(19)
Some use	23%	(7)	-	(0)
Total use	-	(0)	-	(0)
<u>Other environmental education</u>				
0 to 10 hours	100%	(30)	100%	(19)
11 to 20 hours	-	(0)	-	(0)
21+ hours	-	(0)	-	(0)
<u>Related onsite units</u>				
	73%	(22)	32%	(6)
	Web of Life		Web of Life	
	100%	(30)	68%	(13)
	Skullduggary		Skullduggary	

Additional Explanation

The significantly greater mean gain score for the treatment group can be attributed to their participation in the **How Birds Make a Living** unit. The portion of the treatment group participating in pre- and post-activities had a lower gain than those who did not participate in the activities. A greater portion of the treatment group than the control group participated in the **Web of Life** and **Skullduggary** units, which had overlapping concepts. This could also have influenced the gain scores for those portions of the treatment group.

MOVING WATER GRADE 6

The treatment group had a significantly higher mean gain than the control group did. Pretesting had no significant effect on the treatment group posttest mean.

<u>Pre- to posttest change</u>	Treatment		Control	
	%	n	%	n
Total mean	26.1%	(35)	-6.3%	(27)
Class means	35.7%	(12)	-10.6%	(11)
	19.8%	(10)	-11.1%	(6)
	22.0%	(13)	1.4%	(10)

Pre- and post-activities

Little or no use	100%	(35)	100%	(27)
Some use	-	(0)	-	(0)
Total use	-	(0)	-	(0)

Other environmental education

0 to 10 hours	34%	(12)	37%	(10)
11 to 20 hours	37%	(13)	22%	(6)
21+ hours	29%	(10)	41%	(11)

Related onsite units

66% (23)	none
That's the Limit	

Additional Explanation

The significantly greater mean gain score for the treatment group can be attributed to their participation in the **Moving Water** unit. 66% of the treatment group participated in another unit with overlapping concepts, **That's the Limit**. This could also have influenced the gain scores for that portion of the treatment group.

POND STUDY GRADE 4

There was no significant difference between treatment and control group gains. Within the treatment group, those who took the pretest and the posttest had a significantly higher mean posttest score than those who took the posttest only.

<u>Pre- to posttest change</u>	Treatment		Control	
	%	n	%	n
Total mean	9.9%	(36)	6.2%	(22)
Class means	12.5%	(12)	11.4%	(10)
	12.6%	(11)	1.9%	(12)
	5.1%	(13)		

Pre- and post-activities

Little or no use	36%	(13)	100%	(22)
Some use	64%	(23)	-	(0)
Total use	-	(0)	-	(0)

Other environmental education

0 to 10 hours	100%	(36)	55%	(12)
11 to 20 hours	-	(0)	45%	(10)
21+ hours	-	(0)	-	(0)

Related onsite units

64%	(23)	45%	(10)
Forest Community		Chain of Life	
36%	(13)		
Chain of Life			

Although no significant gains were found in this case, it is interesting to note that the two classes which used the pre- and post-activities had the higher mean gain scores (12.5% and 12.6%.)

POND STUDY GRADE 5

There was no significant difference between treatment and control group gains. Within the treatment group, those who took the pretest and the posttest had a significantly higher mean posttest score than those who took the posttest only.

	Treatment		Control	
<u>Pre- to posttest change</u>	%	n	%	n
Total mean	7.4%	(29)	2.3%	(23)
Class means	10.6%	(18)	.6%	(14)
	5.4%	(11)	4.9%	(9)
 <u>Pre- and post-activities</u>				
Little or no use	100%	(29)	100%	(23)
Some use	-	(0)	-	(0)
Total use	-	(0)	-	(0)
 <u>Other environmental education</u>				
0 to 10 hours	38%	(11)	61%	(14)
11 to 20 hours	-	(0)	39%	(9)
21+ hours	62%	(18)	-	(0)
 <u>Related onsite units</u>				
	100%	(29)	100%	(23)
	Beaverology		Beaverology	
	38%	(11)	100%	(23)
	Forest Community		Forest Community	

POND STUDY GRADES 4 AND 5

Additional Explanation

Question content	Total points possible	4th grade \bar{x}	5th grade \bar{x}
Names of pond animals	4	3.4	3.78
Pond food web			
Names of plants & animals	4	1.34	1.55
Arrows showing feeding relationships	4	1.11	1.43
Human activities affecting pond	2	1.04	1.48
Effects of human activities	4	1.28	1.90

In general, students could name pond animals, but had difficulty applying that knowledge to the construction of a food web. They were more successful at naming human activities related to a pond than describing the impacts of those activities on the pond. Several possibilities of interpretation exist. In this unit exploring the pond and finding animals often takes priority--in excitement level and/or time commitment. This might account for differences in responses between questions on identification and concepts. The questions on concepts involved recall, application, or synthesis of information, depending on whether students were exposed to them previously. It is also possible that the questions about food webs and human activity were worded in ways that were difficult for students to understand.

In grade four, the unexpectedly high gain for one control group class may have been partially responsible for the lack of significant treatment group gains.

PREDATOR PREY GRADE 4

There was no significant difference between treatment and control group gains. Within the treatment group, those who took the pretest and the posttest had a significantly higher mean posttest score than those who took the posttest only.

<u>Pre- to posttest change</u>	Treatment		Control	
	%	n	%	n
Total mean	19.1%	(44)	17.5%	(6)
Class means	9.1%	(11)	17.5%	(6)
	16.4%	(11)		
	14.4%	(9)		
	33.1%	(13)		

Pre- and post-activities

Little or no use	50%	(22)	100%	(6)
Some use	50%	(22)	-	(0)
Total use	-	(0)	-	(0)

Other environmental education

0 to 10 hours	80%	(35)	-	(0)
11 to 20 hours	20%	(9)	100%	(6)
21+ hours	-	(0)	-	(0)

Related onsite units

70%	(31)	100%	(6)
Web of Life		Web of Life	
20%	(9)		
Colorful Confusion			

PREDATOR PREY GRADE 4

Additional Explanation

Question content	Total points possible	\bar{x} points scored
Events causing wildlife population decrease	4	2.57
Other population dynamics	1	.72
Other population dynamics	1	.73
Events causing wildlife population increase	4	1.98

All four questions involved similar thinking skills, requiring the transfer and application of knowledge to new situations. A game is used as the vehicle for introducing concepts. Discussion and population graphing are used to expand on and reinforce the concepts. Excitement and high energy are common during the game; lower levels of involvement are present in dealing with the concepts. It is feasible that many students paid less attention to the discussion than to the game or that many were unable to apply the concepts to abstract situations. Numerous students made references to foxes, rabbits, and carrots in their answers, perhaps revealing a lack of ability to deal with the concepts abstractly.

An unexpectedly high control group gain may have been partially responsible for the lack of significant treatment group gains.

PREDATOR PREY GRADE 5

The treatment group had a significantly higher mean gain than the control group did. Pretesting had no significant effect on the treatment group posttest mean.

<u>Pre- to posttest change</u>	Treatment		Control	
	%	n	%	n
Total mean	16.9%	(36)	1.1%	(43)
Class means	2.9%	(7)	-13.7%	(19)
	20.0%	(9)	25.5%	(11)
	20.5%	(20)	1.9%	(13)

Pre- and post-activities

Little or no use	-	(0)	56%	(24)
Some use	100%	(36)	44%	(19)
Total use	-	(0)	-	(0)

Other environmental education

0 to 10 hours	100%	(36)	56%	(24)
11 to 20 hours	-	(0)	-	(0)
21+ hours	-	(0)	44%	(19)

Overlapping onsite units

none	56%	(24)
	Web of Life	
	Colorful Confusion	

Additional Explanation

The significantly greater mean gain score for the treatment group can probably be attributed to their participation in the **Predator Prey** unit and in pre- and post-activities. The portion of the control group that participated in the pre- and post-activities and other environmental education had the lowest pre- to posttest change (-.137). The remainder of the control group participated in other units with overlapping concepts, **Web of Life** and **Colorful Confusion**, which may have influenced their gains.

PREDATOR PREY GRADE 6

The treatment group had a significantly higher mean gain than the control group did. Pretesting had no significant effect on the treatment group posttest mean.

	Treatment		Control	
<u>Pre- to posttest change</u>	%	n	%	n
Total mean	10.2%	(75)	-3.6%	(22)
Class means	2.9%	(12)	-3.6%	(11)
	20.0%	(13)	-3.6%	(11)
	-3.3%	(12)		
	12.3%	(13)		
	13.8%	(8)		
	14.6%	(11)		
	13.3%	(6)		
<u>Pre- and post-activities</u>				
Little or no use	67%	(50)	100%	(22)
Some use	33%	(25)	-	(0)
Total use	-	(0)	-	(0)
<u>Other environmental education</u>				
0 to 10 hours	33%	(25)	100%	(22)
11 to 20 hours	33%	(25)	-	(0)
21+ hours	33%	(25)	-	(0)
<u>Related onsite units</u>				
	33%	(25)	100%	(22)
	Web of Life		Web of Life	
			Colorful Confusion	

Additional Explanation

The significantly greater mean gain score for the treatment group can probably be attributed to their participation in the **Predator Prey** unit and in pre- and post-activities. 66% of the treatment group participated in other environmental education at school. This could also have influenced their gain scores. All of the control group members participated in another unit, **Colorful Confusion**, which had overlapping concepts.

SKULLDUGGARY GRADE 4

The treatment group had a significantly higher mean gain than the control group did. Within the treatment group, those who took the pretest and the posttest had a significantly higher mean posttest score than those who took the posttest only.

	<u>Treatment</u>		<u>Control</u>	
<u>Pre- to posttest change</u>	%	n	%	n
Total mean	26.4%	(43)	1.2%	(16)
Class means	21.3%	(11)	1.2%	(16)
	5.1%	(9)		
	30.2%	(13)		
	46.2%	(10)		

Pre- and post-activities

Little or no use	-	(0)	100%	(16)
Some use	56%	(24)	-	(0)
Total use	44%	(19)	-	(0)

Other environmental education

0 to 10 hours	77%	(33)	100%	(16)
11 to 20 hours	-	(0)	-	(0)
21+ hours	23%	(10)	-	(0)

Overlapping onsite units

none

none

Additional Explanation

Although there was a pretesting learning effect, interpretation of treatment/control results is offered. The significantly greater mean gain score for the treatment group can probably be attributed to their participation in the **Skullduggary** unit and in pre- and post-activities. Participation by 23% of the treatment group in other environmental education at school may have influenced their gain scores. That portion of the treatment group also made the greatest use of of pre- and post-activities and had the highest mean gain score (46.2%).

SKULLDUGGARY GRADE 5

The treatment group had a significantly higher mean gain than the control group did. Pretesting had no significant effect on the treatment group posttest mean.

<u>Pre- to posttest change</u>	Treatment		Control	
	%	n	%	n
Total mean	35.5%	(41)	-5.1%	(9)
Class means	34.3%	(14)	-5.1%	(9)
	33.7%	(13)		
	38.2%	(14)		

Pre- and post-activities

Little or no use	34%	(14)	100%	(9)
Some use	66%	(27)	-	(0)
Total use	-	(0)	-	(0)

Other environmental education

0 to 10 hours	68%	(28)	-	(0)
11 to 20 hours	32%	(13)	100%	(9)
21+ hours	-	(0)	-	(0)

Related onsite units

66% (27)	none
Beaverology	

Additional Explanation

The significantly greater mean gain score for the treatment group can be attributed to their participation in the **Skullduggary** unit and in pre- and post-activities. 66% of the treatment group participated in another unit with overlapping concepts, **Beaverology**. This could also have influenced gain scores for that portion of the treatment group.

SKULLDUGGARY GRADE 6

The treatment group had a significantly higher mean gain than the control group did. Pretesting had no significant effect on the treatment group posttest mean.

<u>Pre- to posttest change</u>	<u>Treatment</u>		<u>Control</u>	
	%	n	%	n
Total mean	25.9%	(36)	14.1%	(32)
Class means	13.8%	(12)	35.4%	(10)
	12.5%	(4)	2.1%	(11)
	25.9%	(11)	6.6%	(11)
	47.9%	(9)		

Pre- and post-activities

Little or no use	75%	(27)	100%	(32)
Some use	-	(0)	-	(0)
Total use	25%	(9)	-	(0)

Other environmental education

0 to 10 hours	25%	(9)	31%	(10)
11 to 20 hours	-	(0)	69%	(22)
21+ hours	75%	(27)	-	(0)

Related onsite units

69% (25)
Beaverology

Additional Explanation

The significantly greater mean gain score for the treatment group can probably be attributed to their participation in the **Skullduggary** unit and in pre- and post-activities. The portion of the treatment group that used pre- and post-activities had the highest gain (47.9%.) 69% of the treatment group participated in another unit with overlapping concepts, **Beaverology**. This could have influenced the gain scores for that portion of the treatment group. A higher level of participation in other environmental education at school may have influenced gain scores for 75% of the treatment group. Control group members participating in other environmental education had the lower mean gain scores (2.1% and 6.6%.)

SNOW WALKERS GRADE 4

The treatment group had a significantly higher mean gain than the control group did. Pretesting had no significant effect on the treatment group posttest mean.

<u>Pre- to posttest change</u>	Treatment		Control	
	%	n	%	n
Total mean	31.0%	(15)	-0.1%	(12)
Class means	36.8%	(4)	-0.1%	(12)
	28.9%	(11)		

Pre- and post-activities

Little or no use	-	(0)	100%	(12)
Some use	100%	(15)	-	(0)
Total use	-	(0)	-	(0)

Other environmental education

0 to 10 hours	-	(0)	100%	(12)
11 to 20 hours	100%	(15)	-	(0)
21+ hours	-	(0)	-	(0)

Related onsite units

100%	(15)	none
Web of Life		
73%	(11)	Lessons from Nature

Additional Explanation

The significantly greater mean gain score for the treatment group can be attributed to their participation in the **Snow Walkers** unit and in pre- and post-activities. All of the treatment group members participated in another unit with overlapping concepts, **Web of Life**, and 73% participated in **Lessons from Nature**. Participation in these activities could also have influenced their gain scores.

SNOW WALKERS GRADE 6

The treatment group had a significantly higher mean gain than the control group did. Pretesting had no significant effect on the treatment group posttest mean.

<u>Pre- to posttest change</u>	Treatment		Control	
	%	n	%	n
Total mean	12.8%	(22)	-1.5%	(8)
Class means	11.3%	(12)	-1.5%	(8)
	14.7%	(10)		
<u>Pre- and post-activities</u>				
Little or no use	100%	(22)	100%	(8)
Some use	-	(0)	-	(0)
Total use	-	(0)	-	(0)
<u>Other environmental education</u>				
0 to 10 hours	45%	(10)	100%	(8)
11 to 20 hours	-	(0)	-	(0)
21+ hours	55%	(12)	-	(0)
<u>Related onsite units</u>				
	none		100%	(8)
			Web of Life Mark Your Territory	

Additional Explanation

The significantly greater mean gain score for the treatment group can be attributed to their participation in the **Snow Walkers** unit. 55% of the treatment group participated in other environmental education at school. This could also have influenced the gain scores for that portion of the treatment group. All of the control group members participated in two other units, **Web of Life** and **Mark Your Territory**, that had overlapping concepts.

WEB OF LIFE GRADE 4

The treatment group had a significantly higher mean gain than the control group did. Pretesting had no significant effect on the treatment group posttest mean.

<u>Pre- to posttest change</u>	Treatment		Control	
	%	n	%	n
Total mean	18.0%	(23)	8.3%	(13)
Class means	14.8%	(12)	8.3%	(13)
	21.5%	(11)		

Pre- and post-activities

Little or no use	-	(0)	100%	(13)
Some use	100%	(23)	-	(0)
Total use	-	(0)	-	(0)

Other environmental education

0 to 10 hours	100%	(23)	-	(0)
11 to 20 hours	-	(0)	100%	(13)
21+ hours	-	(0)	-	(0)

Related onsite units

100% (23)
**How Birds Make
a Living**

Additional Explanation

The significantly greater mean gain score for the treatment group can be attributed to their participation in the **Web of Life** unit and in pre- and post-activities. All of the treatment group members participated in another unit with overlapping concepts, **How Birds Make a Living**. This could also have influenced their gain scores.

WEB OF LIFE GRADE 6

There was no significant difference between treatment and control group gains. Pretesting had no significant effect on the treatment group posttest mean.

<u>Pre- to posttest change</u>	Treatment		Control	
	%	n	%	n
Total mean	20.9%	(59)	14.2%	(18)
Class means	25.3%	(17)	6.8%	(9)
	25.9%	(12)	21.6%	(9)
	19.2%	(13)		
	12.9%	(11)		
	16.7%	(6)		

Pre- and post-activities

Little or no use	71%	(42)	-	(0)
Some use	29%	(17)	100%	(18)
Total use	-	(0)	-	(0)

Other environmental education

0 to 10 hours	71%	(42)	-	(0)
11 to 20 hours	29%	(17)	100%	(18)
21+ hours	-	(0)	-	(0)

Related onsite units

29% (17)	100% (18)
Beaverology	Beaverology
42% (25)	How Birds Make a Living
Forest Apartment	

Although no significant gains were found in this case, it is interesting to note that the class which used the pre- and post-activities and other environmental education at school had the second highest mean gain score (25.3%).

WEB OF LIFE GRADE 6

Additional Explanation

Question content	Total points possible	\bar{X} points scored
Definition of ecology	2	.93
Name of a natural community	1	.71
Names of community members	5	3.5
How people change communities	2	1.75
Natural change in a community	2	1.24
Example of competition in a community	2	1.46
Example of a bird adaptation	2	.63
How a rotting log & a mushroom are interrelated	2	.88

Students had relatively high success in answering questions 2, 3, and 4. These questions involved recall or simple application of previous learning, perhaps not even dependent on participation in the activity. The structure of this unit allows for greater freedom in choosing activity options than do other units. The questions reflect the concepts to which all students should have been exposed. However, the specific questions on the test were not likely to have been asked of students, resulting in them needing to apply the concepts.

The unexpectedly high gain for one control group class may have been partially responsible for the lack of significant treatment group gains.