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Signature Milton Glenn Parsons

Date August 8, 1972

A CONCEPTUAL PLAN FOR AN ENVIRONMENTAL EDUCATION CURRICULUM FOR THE THIRD AND FOURTH GRADES

by

MILTON GLENN PARSONS

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Approved:

Robert J. Theriault
Head, Major Department

Dr. Greg Hlasnick
Chairman, Examining Committee

Henry L Parsons
Graduate Dean

MONTANA STATE UNIVERSITY
Bozeman, Montana
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ABSTRACT

This investigation measured the impact of a two-week environmental unit developed by the researcher on the cognitive and affective experiences of third and fourth grade children of the Whittier Elementary School, Bozeman, Montana. The control and the experimental groups were pre-tested prior to the introduction of the environmental unit. The experimental group was post-tested after completing the two-week environmental unit and experiencing a field trip. The control group was post-tested after completing the two-week environmental unit and lessons related to the material the experimental group covered on the field trip. Elements in the child's intellectual and socio-economic life such as parents' occupation, number of siblings, experience with pets, etc., were compared with pre-test, post-test, and difference scores to determine if they could be used to predict the effect of this unit on a student in the cognitive and affective domains. Questionnaires were given to both students and parents for the purpose of gathering data on attitudes and feelings about the environmental unit.

The sample consisted of 63 students, 32 boys, and 31 girls in the control group and 77 students, 35 boys and 42 girls, in the experimental group. One hundred and twenty-seven sets of parents were sent questionnaires.

Analysis of covariance was used as the test statistic for analyzing the pre-test, the post-test, and difference scores of members of the experimental and control groups. The partial r was used as the test statistic to determine significance of elements in a child's intellectual and socio-economic life relative to the pre-test, the post-test, and difference scores.

Summary of the findings:

1. Statistical results indicated that students in the experimental group showed no significant improvement over the control group in the cognitive domain of the test.

2. Statistical results indicated that students in the experimental group showed highly significant improvement over the control group in the affective domain of the test.

3. The only independent variable that reoccurred with enough consistency to indicate some value as a predictive variable was the cumulative raw score on the vocabulary and reading comprehension of the Iowa Tests of Basic Skills.

4. Returns of student and parent questionnaires indicated a great deal of excitement and interest was present within the students. Ninety-two percent of the students and ninety-three percent of the parents wanted the program to be continued.

Chapter 1

INTRODUCTION

Urbanization in the United States within the past sixty years has created a predominately man-made or cultural environment. The small farm, rural oriented living that characterizes our social and political heritage is no longer a dominant influence. As a result of this change there is a very limited natural environment in urban centers. The interrelationships and interdependencies that man experienced with natural environment in our society have frequently become experiences of the past.

Yet our civilization's future is very dependent on the utilization of the resource segment of the environment. If man is to survive, the environment must be maintained as a balanced harmonious whole. Consequently, it is in the best interest of our society that man understands the importance of his role both individually and collectively in helping to resolve environmental resource problems.

Statement of the Problem

The purpose of this study was to develop an environmental education curriculum using a stream community and to measure the impact of the two week environmental unit on the cognitive and affective experiences of third and fourth grade children of the Whittier Elementary School, Bozeman, Montana.

Independent variables such as sex, parents' occupation, number of siblings, experience with pets, farm experience, and interests in activities such as hunting and fishing were investigated to determine to what extent they are related to a child's:

a). Affective and cognitive background in environmental education.

b). Final achievement level in the cognitive and affective domain in environmental education.

c). Change in knowledge of the environment and attitude towards the environment.

Need for the Study

The failure of the public to realize they are a part of the total ecosystem has resulted in the vast deterioration of our physical environment. Education has failed to develop a unified approach that emphasizes the importance of a close relationship between man and his cultural-physical environment. President Nixon in his written introduction to the first annual report of the Council on Environmental Quality recognized this educational shortcoming and expressed it in the following manner:

> It is also vital that our entire society develop a new understanding and a new awareness of man's relation to his environment--what might be called "environmental literacy." This will require the development and teaching of environmental concepts at every point in the educational process. (Office of Education, DHEW, 1970:5)

If the educational system is going to change the behavioral attitudes of our students, which is the challenge of environmental education, new curricula must be developed. This curricula must emphasize the relationship between man, resource and culture (the total environment). By designing an education program that stresses environmental characteristics, interrelationships, and understanding at the elementary level (1-6) and stresses environmental problems, solutions, management, and policy at the secondary level (7-12) this objective could be accomplished.

The Bozeman Elementary Schools have not begun to meet the challenge of environmental education and an environmental curriculum is nonexistent.

Questions to be Answered

Research techniques attempted to answer the following questions about the environmental stream curriculum and the independent variables:

1. Did the environmental unit affect the cognitive learning of the student?

2. Did the environmental unit affect the child's attitude toward his environment?

3. Were there elements in the child's intellectual and socio-economic life which could predict the effect of this unit on the cognitive experiences of a child?

4. Were there elements in the child's intellectual and socio-economic life which could predict the effect of this unit on the affective experiences of a child?

General Procedures

This study included three third and three fourth grade classes of the Whittier Elementary School located in School District Number Seven of Bozeman, Montana. Two fourth grade classes and one third grade class were randomly picked to be the experimental group. The two remaining third grade classes and the remaining fourth grade class were designated as the control group. A total of 77 students were in the experimental group and a total of 63 students were in the control group. The following represents a breakdown in the number of students by grade level of the two groups at Whittier School:

Grade	Control Group	Experimental Group
Third	38	23
Fourth	25	54
Total	63	77

Each group was pre-tested on April 29, 1972 prior to the introduction of the environmental unit on May 1, 1972. The experimental group was post-tested on May 16, 1972 after completing the two week environmental unit and experiencing a three hour field trip to a stream community. The control group was post-tested on May 17 after completing the two week environmental unit and lessons related to the material the experimental group covered on the field trip. On May 18, the control group was taken on a field trip to the stream community. Time spent in instruction for both groups was equal.

Student evaluation questionnaires were completed by the experimental group on May 16 and they were completed by the control group on May 19. On May 20 a questionnaire was mailed to the parents of the students in both the control and experimental groups in order to obtain an independent evaluation on their child's response to the environmental unit.

Limitations

The following limitations are placed on this study:

1. The experimental and control groups did not represent randomized individuals but rather randomized classes.

2. The results and conclusions of this study are limited to the elementary students of the third and fourth grades of the Whittier Elementary School.

3. The results of this study did not deal with the length of time for which the instructional treatment was effective.

Definition of Terms

Environmental Education--". . . means the educational process dealing with man's relationship with his natural and man-made surroundings, and includes the relation of population, pollution, resource allocation and depletion, conservation, transportation, technology and urban and rural planning to the total human environment." (Ayers, 1972:3)

Stream Community--plants and animals that live together and make up the biological part of the ecosystem occupying that given area.

Integrated Day--"The process or practice of combining different school subjects and presenting them as aspects of one unifying project or activity, for example, including the teaching of art, history, geography, English, and arithmetic in a study of the Panama Canal." (Carter, 1959:292)

Kay Bags--A paper bag with objects such as string, nails, rubber bands, etc., which students make a dicotomus key for.

Tree Puzzles--Limbs and branches sawed into three inch sections and used as an activity by students for learning external characteristics of trees. (Elementary School Science, 1966:13)

Live Cages--Cages which fish can be placed in and kept alive in a stream with.

Summary

A major course of concern for society today is the increasing deterioration of our physical environment. Problems that are degrading the quality of the environment are too frequently tolerated by apathetic citizens who too often submit to undesirable conditions because of their unfamiliarity or insensitivity to the extent of the problem. The traditional educational process is in part to blame for this increasing disassociation by man from his physical environment. This study will attempt to show that an environmental education curriculum designed to involve the individual elementary student can give him a better understanding of his environment.

Chapter 2

REVIEW OF RELATED LITERATURE

Introduction

The growing realization in our society that man is a part of the environment rather than the "dominant" has created interest in environmental education programs in the schools. Our society has turned to education in the past to solve complex social problems, and the recent development of environmental education curricula is a direct response to the public's concern over the deterioration of our physical environment. Glen Robinson, Director of the Research Division of the National Education Association writes the following:

> Although in the past curriculum of some school systems has included such topics as outdoor education, nature study, or conservation education, current attention to environmental problems has given fresh impetus to the development and expansion of programs in this area. Through such programs, it is hoped, children and young people will gain appreciation of their environment and understanding of the appropriate utilization of all resources, natural and cultural, which will better equip them to deal with the environmental problems facing society. (National Education Association, 1970)

Senator Gaylord Nelson, in introducing the Environmental Quality Act in Congress, recognized that the problem of checking environmental deterioration is largely a behavioral one. He made the following statement:

> Education, I believe, is the only proper way to influence values, attitudes, and basic assumptions in a democratic society. Behavior, in the long run, can best be changed through the process of education. (Ames, 1971:1)

If we are to change the behavior of children through formal education, which is the challenge of environmental education, we must understand and change some basic aspects of the school environment. The review of literature has been organized into two sections: the underlying philosophies of environmental education, and a brief review of environmental curricula in use today.

Philosophies of Environmental Education

Our present educational system does not reflect the tie to our environment in its structured system. The traditional concept of self-contained classrooms, with the rigid schedule of assigned disciplines enforced with periodic bells, does not lend itself easily to the underlying concepts of environmental education. In developing an educational strategy for an environment of quality, the term environmental education has been coined. With its conception a new philosophy for education has been developed. The National Environmental Education Act includes the following definition:

> Environmental education means the educational process dealing with man's relationship with his natural and man-made

> surroundings, and includes the relation of population, pollution, resource allocation and depletion, conservation, transportation, technology and urban and rural planning to the total human environment. (Ayers, 1972:3)

Environmental Education becomes a lifelong process. It is a way of looking at life, recognizing man's interdependence with all life, and learning to recognize the affects--both good and bad--we have on our physical surroundings. It is acceptance of life values and ways of living that minimize destruction and maximize those relationships that enhance life. It is a learning process in which children develop awareness, understanding, and respect for their environment. It also fosters concern for the environment and for what is happening, and fosters a growing sense of personal and group responsibility. (Office of Education, DHEW, 1970)

The line of attack being taken to meet the desired solution is the breaking down of the traditional concept of the self-contained classroom. Inroads are being made by schools experimenting with team teaching, open-structure, and with the integrated day. The significance of the integrated day for environmental education is profound. It places emphasis on what is found in the immediate environment and involves children in an open-ended exploration. The teacher can create an atmosphere that is noncompetitive, for everyone has the satisfaction in finding out something he did not know. Each individual is allowed to pursue and create interests and

satisfy his or her curiosities. Children can work in teams on problems that interest them and the learning then begins to approximate the child's actual perception of his environment. (Ames, 1971:3)

In effect the teaching is done through the environment, integrating all disciplines into a meaningful real life curriculum. Environmental Education goes beyond and incorporates the philosophies of outdoor education and conservation education. The National Conference of the Conservation Education Association (1970:2-3) outlined the following characteristics which compose and point out the difference between outdoor education, conservation education, and environmental education:

Philosophy	Characteristics
Outdoor Education	1. Education Outdoors 2. A Teaching Method
Conservation Education	1. Resource Oriented 2. Technology, Management and Treatment 3. Rural and Small Town 4. Science Centered
Environmental Education	1. Problem Oriented 2. Urban and Community (where people live) 3. Political and Citizen Action 4. Spans the Curriculum

The scope and sequence of course content is based on human needs for living in the contemporary world. It is with this idea of linking subject areas, placing the learner in an active role in

the learning process, and allowing the students to develop their own dynamic methods of inquiry that makes the environmental education's philosophy revolutionary.

Environmental Curriculum

The main thrust in environmental curriculum development has been to teach children about the natural environment through interpretation of the landscape and the processes which change it. This ecological emphasis, even though it is important, has been developed outside the school system and seldom comes to grip with the broader social issues. The type of curriculum needed is one that involves students in the critical analysis of the social values and interactions that underlie environmental degradation. Ames (1971:3) expresses this idea in the following quote:

> It is far easier to teach about the environment as a generalized subject with the support of textbooks and films than it is to conduct an open-ended inquiry into the specific problems of an actual community. It is also easier to relegate the entire responsibility for environmental education to specialists from outside the school system, perhaps at the end of a bus ride at a local nature center, than it is to embrace environmental education as a fundamental aspect of the overall curriculum.

Stapp proposed an environmental encounter curriculum (K-12) that would focus the attention of elementary and secondary youth on their environment in a manner that would link relevant ecological,

economic, social, and political information. Each encounter would expose the learner to the following problem solving procedure:

1. Define the environmental problem or issue.
2. Become informed about the problem.
3. State the alternative solutions.
4. Develop a plan of action.
5. Implement the plan of action.

In the earlier grades the emphasis in this type of curriculum would be toward developing interest, awareness, understanding, and respect for the environment. The encounter would provide the opportunity at each grade level for the learner to become personally involved in positive action toward the solution of the environmental problem in which he had been exposed. Appendix A is an example of a series of activities that constitutes an environmental encounter. (Stapp, 1970:35-41)

To sum up what Dr. Stapp has presented: environmental programs consist of two levels--one of awareness where a student becomes sensitized to environment and another of action where a student becomes involved in developing solutions.

New elementary science programs developed during the decade from 1960 to 1970 have become more available and have focused on developing awareness. Dr. Allen writes:

> Major characteristics of these new curricula were the large amount of involvement of children with science materials,

> the utilization of the classrooms as laboratories and the functioning of the student as primary investigator. An important aspect of at least two of the major new elementary science programs is an increasing emphasis upon environmental education, particularly as it relates to the basic concepts of ecology. One of these programs, Science Curriculum Improvement Study (SCIS), makes an important contribution to children's understanding of the ecosystem through its six year life-science program. (Allen, 1972:9)

The SCIS program exposes the child to one physical science and one life science unit a year. The units in the life science sequence pay continuing attention to organism-environment interactions. The six units, Organisms, Life Cycles, Populations, Environments, Communities and Ecosystems, make use of the scientific and process-oriented concepts, but add the special considerations appropriate to the study of life.

The National Park Service has developed a "man-centered" approach to environmental education designed to help elementary and high school students understand their relationship with environment. The program has been coined the National Environmental Education Development (NEED) program. Corollary to the NEED program is the National Environmental Study Area (NESA) program. NEED is the actual curriculum that park service personnel help teachers develop. The curriculum can be in various disciplines--math, history, English, as well as the sciences. The class visits an environmental study area (ESA) for the purpose of observing concrete examples of patterns

or behavior, similarities or differences, change and continuity, etc. The list of possibilities is long. Through the elementary and secondary education years NEED weaves environmental strands through every subject toward the creation of an environmental ethic. In the primary grades, children learn to become aware of their home environment, and later, of the special environment of the National Park Service area they visit. (National Park and Conservation Magazine, 1970:16)

The NEED system and interpretive teaching materials are being developed under the direction of Dr. Mario Menesini at the University of California. Basic to the program is the premise that environmental awareness requires not only classroom work, but experience out of doors. The programs are written so they are sufficiently flexible for adaptation to a wide variety of sites. (Roth, 1972:47) A students book, a teachers guide, and an outdoor book for the sixth grade has been completed and is available through the Silver Burdett Company.

An increasing number of schools are integrating field studies into their instructional program. These studies vary in length from a few hours to several weeks. In Montana a number of schools are involved in such environmental education programs. Great Falls School District No. 1 implemented an environmental education project in 1967 under Title III Funding. The program has been such a

success that field trips are taken clear from high school level down to second grade where the youngsters visit a farm to study the energy cycle.

Missoula County High School adopted an "outdoor program" in environmental education to supplement the high school curriculum. Saturday field trips involve a total of fifteen teachers and approximately one thousand students who travel by bus to the study areas.

The Alberton grade school has established a week's program at their outdoor school which is run during the last week in April. School time is used for this project so that all the students in the sixth grade can attend and benefit from the natural area experience. In this program each student has an ecology plot which includes a pond shoreline with surrounding fields and woodland area. The students are introduced to techniques for studying geology, soils, forestry, plants, and animals. With this information they determine answers to questions and problems discovered in conjunction with their own plots.

The Cut Bank Public Schools have used Glacier National Park as an outdoor laboratory for its Environmental Awareness Program. The first year the program was a voluntary one for sixth grade students, but it has now been incorporated in the regular school curriculum as a part of the Science and Physical Education programs. The program includes one field trip a month, September through December, to the

Park. Glacier National Park naturalists and rangers have assisted with these trips which combine ecology, physical education and recreation. (Anonymous, 1971:1-4) These are just a few examples of environmental curricula in schools of Montana.

Four professors at Eastern Montana College, Billings, Montana co-authored an environmental education handbook for students called Exploring the World. This handbook was prepared initially for the Environmental Education Program of School District No. 2 of Billings, but is now being made available to all who are interested. The authors write to the student in the preface:

> In this handbook are many activities to give you the skills you need in order to learn how this old world works. With these skills you can explore the world, by carrying on studies and investigations of various natural ecosystems or communities of plants and animals. You can start to learn what affects man has on natural communities, how man's own communities too are "human ecosystems", and how the same biological and physical principles apply to both. With this knowledge and ability, plus knowledge of man's social and economic systems, you can then logically and sensibly attack and help solve, as an active citizen, many of today's environmental problems. (Schoenthal, et.al., 1972:1)

This handbook of experiments, investigations and field studies is written on the 5th to 7th grade levels.

On the higher education level, the University of Wisconsin-Green Bay may be the only university in the country planned from its inception as an institution consciously focusing in all of its

parts on problems of the environment and actually practicing environmental education in its entirety. The academic plan with its pervasive ecological emphasis became operative the fall of 1969, but its formulation began three years earlier.

At UWGB disciplines and professions are secondary--ecological problems are primary. A student selects an environmental problem that forms the center of his intellectual interests. It may be a problem of the biophysical environment, or it may be a problem associated with the social environment such as urban decay, but regardless of the choice it then becomes the central point for the student's education. The student chooses courses in the various disciplines and various professions that contribute to thinking, problem-solving, and decision making in regard to the particular environmental problem. The many academic disciplines become alive; they are a means to a social end. The world outside the University becomes just as relevant to the student as the classroom. This environmental theme takes its place as a fundamental aspect of the curriculum. (Weidner, 1970:41-42)

Dartmouth's College Course I "Introduction to Policy Formation" is a more classical example of how colleges are approaching environmental education. The course was designed to give undergraduates from varied academic backgrounds (no prerequisites required) the opportunity to arrive at solutions to real problems. The students

were divided into groups and asked to select and study aspects of the Connecticut River Basin for the purpose of formulating public policy that best satisfied needs which they identified. To facilitate the group's operations, a budget of $100.00 was provided for each group to cover mileage, phone calls, and reproduction services. For guidance and evaluation, groups met each week with their advisors for two hours. (Converse, 1970:13-17)

The role of the teacher in all of the environmental curricula discussed is one of guiding and encouraging children to explore, question, and formulate conclusions based on their experiences. Skills for learning about the environment are best acquired when children are allowed to explore, inquire, and observe for themselves.

Summary

Due to an increasing public awareness and understanding of the resource limitations in the environment, a necessity for a balanced relationship between man, resource and culture (the total environment) has become essential. Today, a predominately urbanized society has changed the basis of environmental thinking from a resource to a man-made or cultural setting. The vastness of this man-made environment often narrows the individual's concern to his own micro-niche, inside of which he fails to comprehend his place and basic dependency in the macro-environment of which he is a

fundamental part. The philosophy of environmental education has been designed to teach students at all levels that all life is part of a vast and complex "Web of Life". The key to such an educational approach and to preserving an environment in which man can live is inescapably dependent upon the collective behavior of individual citizens. In the final analysis, the success of environmental education will be measured in terms of its ability to change the behavior of society.

Chapter 3

PROCEDURES

Introduction

In this chapter procedures for collecting, organizing, and presenting data obtained in this investigation are discussed.

Population Description and Sampling Procedure

The population of this study included 155 elementary students which comprised all the third and fourth grade classes of the Whittier Elementary School and the 136 sets of parents of these children. The difference between the number of children and sets of parents was explained by families having more than one child in these classes. Subsequently the population was composed of three groups: the control group, the experimental group, and the parent group. Tables 1 and 2 present the population in tabulated form.

Table 1. Control Group and Sets of Parents

Class Grade	Boys	Girls	Students per Class	Sets of Parents
third	10	11	21	20
third	13	9	22	21
fourth	15	16	31	29
Total	38	36	74	70

Table 2. Experimental Group and Sets of Parents

Class Grade	Boys	Girls	Students per Class	Sets of Parents
third	8	15	23	20
fourth	13	16	29	23
fourth	15	14	29	23
Total	36	45	81	66

The assignment of classes to either the experimental or control group was based upon random selection.

Sample Description

Fifteen students were eliminated from the original study population of 155 students. Eleven were eliminated from the control group and four were eliminated from the experimental group. These individuals were eliminated because they did not participate in all phases of the study. A student was required to take both the pre-test and the post-test and if the student was part of the experimental group the student had to have attended the field trip. Any questionnaires received from the adults of these children were also eliminated. Tables 3 and 4 present the sample population in tabulated form.

Table 3. Control Group and Sets of Parents -- Sample Population

Class Grade	Boys	Girls	Students per Class	Sets of Parents
third	7	11	18	16
third	12	8	20	20
fourth	13	12	25	23
Total	32	31	63	59

Table 4. Experimental Group and Sets of Parents -- Sample Population

Class Grade	Boys	Girls	Students per Class	Sets of Parents
third	8	15	23	20
fourth	13	14	27	25
fourth	14	13	27	23
Total	35	42	77	68

Experimental Treatments

Each of the three groups of this population were treated differently. The following is an outline of the treatments administered to each group:

1. Control group--This group completed a personal data questionnaire and was pre-tested on April 28 prior to the introduction of the two week environmental unit. The environmental unit began on Monday, May 1, and ended on Wednesday, May 17, of the third

week. One hour a day was allotted for this instruction. Course content covered was the same as that covered in the experimental group. This group received three hours of classroom instruction during the third week in order to cover the material the experimental group received on its field trip. A post-test was administered on Wednesday, May 17. This group was then allowed to receive the field trip experience on Thursday, May 18. Student evaluation questionnaires were completed by this group on Friday, May 19.

2. Experimental group--This group completed a personal data questionnaire and was pre-tested on April 28 prior to the introduction of the two week environmental unit. The environmental unit began on Monday, May 1 and ended on Monday, May 15, of the third week after completing a three-hour field trip to a stream community. One hour a day was allotted for instruction in the classroom and the course content covered was the same as that covered in the control group. A post-test was administered on Monday, May 15, after the field trip. Student evaluation questionnaires were completed by this group on Tuesday, May 16.

3. Parent group--This group was mailed coded environmental curriculum questionnaires on Saturday, May 20, in order to obtain an independent evaluation on their child's response to the environmental unit. Those parents having more than one child were mailed questionnaires for each child.

Method of Collecting Data

The data of this study was collected by three questionnaires, a pre-test and a post-test. The following is a description of these instruments and the data they provided.

1. Personal data questionnaire (see Appendix B)--This questionnaire was developed and verified by Dr. Ralph Allen, professor of elementary education at the University of Montana. He used this instrument to collect data on a sample of 324 elementary school children in Missoula, Montana. Dr. Allen's questionnaire was used in this study and administered to both the control and experimental groups. The questionnaire provided data on seventeen independent variables. The sum of the raw scores on the reading and vocabulary parts of the Iowa Tests of Basic Skills was added as an eighteenth independent variable. These variables were then examined to determine to what extent they were related to the pre-test, post-test, and the difference of the two scores for both the control and experimental groups.

2. Pre- and post-test (see Appendix F)--This test was given as a pre- and a post-test to the control and experimental groups. Parts I, II, and III of the test made up the cognitive score the students received on the test. Part IV made up the affective score the students received on the test. Parts I, II, and III were designed by the researcher and checked by the researcher's committee for

validity. All the questions asked in these three sections were based upon the environmental curriculum taught during this study. Part IV of this test was modified by the researcher from an instrument developed by Dr. Ralph Allen, professor of elementary education at the University of Montana. The test provided all the data on differences between the means of the performances in the control and experimental groups.

3. Student evaluation questionnaire (see Appendix G)--This questionnaire was administered to both the experimental and control groups after completion of the environmental unit for the purpose of gathering data on students' attitudes and feelings about the environmental unit.

4. Environmental curriculum questionnaire (see Appendix J)--This questionnaire was sent to all parents who had children participating in either the control or experimental groups. The data obtained was used to evaluate what the parents perceived to be their child's reaction to the environmental unit and if the parents wanted to see such a program continued.

The instruments described were designed to collect information applicable to the basic questions of the study, as outlined in Chapter 1, and were evaluated by members of the researcher's committee and by the principal of the Whittier Elementary School,

Bozeman, Montana. This helped establish validity and to increase the worth and value of the information obtained.

Scoring of Personal Data Questionnaire (Independent Variables)

The scoring of the independent variables (Personal Data Questionnaire, Appendix B) is presented in Appendix C. The numbers in parentheses below the category represent the number used for the computer in treating the data. Responses from the Questionnaire (Appendix B) were placed in the format (Appendix C) by the researcher of the study and verified by his wife. Differences of agreement were resolved by a discussion among the two raters.

Scoring of Pre- and Post-test

Parts I, II, and III of the pre- and post-test (Appendix F) were considered to be factual representations of the cognitive information taught during the two week environmental unit. The highest number of points a student could score on the cognitive portion of the test (parts I, II, and III) was 77 points. Each question was worth one point and the test was scored right minus wrong with questions left blank not counting against the student.

On part IV (the affective test) the students were asked to answer each question based upon their feelings at the time of the test. The example question was used as a guide. Directions for the

example question were: If you really like spinach--circle the big YES. If you sort of like spinach--circle the small yes. If you don't know if you like it or not--circle the question mark. If you don't like spinach--circle the small no. And if you really hate spinach--circle the big NO.

The questions of part IV were considered to be attitudinal and value laden questions. The "ideal" or "correct" answers to the questions are those answers circled for the questions in part IV of the pre- and post-test (Appendix D). These answers were given a score of five points. Other answers were scored four, three, two, or one points, respectively, as to their distance from the "correct" response. For example, a circled answer of no for item IV-2 (Should we never kill any elk in Yellowstone Park) would be scored as four points. All the question marks (?) were scored as three points. Another example is that a circled answer of YES for question IV-8 (Would the world be better off if there were no people?) would be scored as one point. A yes response for the same question (II-3) would be scored as two points. The highest number of points a student could score on this test was 75 points.

The differences between the scores of the pre-test and the post-test in both cognitive and affective domains were found by subtracting the lowest from the highest. For example if a student scored a +10 on the pre-test in the cognitive portion of the pre-test

and a +40 on the cognitive portion of the post-test, the student's difference in the cognitive domain would be +30. If the same student had scored a +40 on the affective portion of the pre-test and a +20 on the affective portion of the post-test, the student's score in the affective domain would be -20.

Methods of Organizing Data

Data obtained in this study was presented in the following manner:

1. Summary tables were used to represent the data obtained from the pre- and post-tests administered to the control and experiment groups.

2. Percentages of distribution were used to represent data collected from the personal data questionnaires.

3. Contingency tables were used to represent the data obtained from the student evaluation questionnaire and the environmental curriculum questionnaire sent to the adult group.

Statistical Hypotheses

The following statistical hypotheses were advanced for this study:

Hypothesis A

H_o There was no difference between the difference of the pre- and the post-test scores on the cognitive test of the experimental

group that had a field experience as compared to the control group who did not encounter a field experience.

H_1 There was a difference between the difference of the pre- and the post-test scores on the cognitive test of the experimental group that had a field experience as compared to the control group who did not encounter a field experience.

Hypothesis B

H_o There was no difference between the difference of the pre- and the post-test scores on the affective test of the experimental group that had a field experience as compared to the control group who did not encounter a field experience.

H_1 There was a difference between the difference of the pre- and the post-test scores on the affective test of the experimental group that had a field experience as compared to the control group who did not encounter a field experience.

Hypothesis C

H_o There was no significant correlation between pre-test scores, post-test scores, and difference scores in regard to the following independent variables:

Sum of the raw scores on the reading and vocabulary parts of the Iowa Tests of Basic Skills

sex

number of siblings

father's occupational strata

mother's occupational strata

school subject preference

food type preference

indoor activity type preference

outdoor activity type preference

indoor vs. outdoor activity preference

hunting frequency

hunting partner

hunting target

fishing frequency

fishing partner

experience with pets

farm life experience

farm vs. city living preference

H_1 There was significant correlation between pre-test scores, post-test scores, and difference scores in regard to the following independent variables:

Sum of the raw scores on the reading and vocabulary parts of the Iowa Tests of Basic Skills

sex

number of siblings

father's occupational strata

mother's occupational strata

school subject preference

food type preference

indoor activity type preference

outdoor activity type preference

indoor vs. outdoor activity preference

hunting frequency

hunting partner

hunting target

fishing frequency

fishing partner

experience with pets

farm life experience

farm vs. city living preference

Analysis of Data

The analysis of covariance was used for testing the difference between the students' performance on a pre- and post-test. This statistical treatment was based on four assumptions:

1. The means of the two groups were equal.

2. Moderate departure of the sample from a normal population would not seriously affect distribution and confidence interval of the test statistic.

3. The samples were independent of one another.

4. The two population variances were approximately equal. The level of significance necessary for rejection of the null hypothesis was set at the 0.05 level.

A number of independent variables (see hypothesis C p. 30) were examined to determine to what extent they were related to the pre-test score, the post-test score, and the difference score. The partial r was used as the test statistic. The level of significance necessary for rejection of the null hypothesis for this test was also set at the 0.05 level. A significant partial r does not mean to imply a cause and effect relationship between x and y.

The comparison between student and parent reaction to the environmental unit was made by comparing percentages of response.

Summary

A sample of 140 elementary students of the third and fourth grades from Whittier Elementary School, Bozeman, Montana, were used in this study. A personal data questionnaire and a pre-test and a post-test were used by the researcher to collect data for testing three sets of hypotheses advanced for this study. Statistical methods used to analyze the data was the analysis of covariance and partial r.

Chapter 4

THE ENVIRONMENTAL CURRICULUM

Introduction

This curriculum was designed to sensitize students to the environment and make them aware of its components and how it changes. The scope and sequence of lesson content is based on human needs in the contemporary world. The objectives of the curriculum were the following:

1. to move the learning experience from an entirely artificial setting in the classroom to the real life environment.

2. to provide learning experiences that cannot be structured in the classroom.

3. to acquire the use of the power of observation and curiosity about natural phenomena as an avenue of learning.

4. to realize that interrelationships exist between living organisms and their physical environment.

5. to promote a desire and will to protect living and nonliving resources important to man and to use them wisely.

6. to provide learning activities by which students will associate school experiences with their external environment.

Sequence of Lessons

The environmental unit had ten lessons that were taught to both the control and experimental groups. These are listed as lessons one through ten. Lessons eight, nine, and ten were taught on the field experience to the experimental group and the same three lessons were taught to the control group in the classroom. It was from these ten lessons that the cognitive portion of the test was developed.

The rest of the environmental unit consisted of activities on the field trip that both the control and experimental group received that were not included in the evaluation of the study. These short lesson plans were designated as stations one through seven and are included so the reader may see how an environmental field trip may be structured.

Lesson 1

Title: Tuning In On The World

Purpose: The objective of this lesson is to tune in, i.e., to look at the world around us as a detective looks for clues. To get the students interested in things they can see, hear, feel, and touch.

Time: One class period

Materials: overhead projector, picture puzzles, diverse pictures from magazines

Development: An important function of this lesson is to excite your class about the trip or trips they will be making with you into several environments. The lesson should prepare them to think of such trips as occasions for communication and sources of things they can discuss, write about, or draw pictures of. Experience precedes communication.

If a child is to enjoy speaking or writing, he must have experienced something that excites him. It will help if he has something he wants to share because he has discovered it. Trips can be a source of motivation for communicating because they afford opportunities for individual discovery. To be a successful discoverer, the child must have the confidence to explore and the feeling that his explorations have meaning. He must be alert and open to new experiences. (National Environmental Education Development, Teachers Guide, 1971:1)

Methods:

1. Begin by establishing the point that people often do not really see things that are right in front of them. Ask the students to tilt their heads back so they see nothing but the ceiling. See if they can tell what color of shirt or dress the student sitting in front of them is wearing.

2. A. Project picture puzzle one on the screen and ask the students to write what they see on a piece of paper. In the

picture are eight human faces and three hidden animals. The lamb is hidden at the lower left, the horse is at left of the fox's head, and the boar is located directly under the horse.

B. Project picture puzzle two on the screen and repeat the exercise. Hidden objects in this picture are a man's face, a deer, a duck, a broom, a leaf, a man fishing, a seal, and a woman's face.

3. Show the class six or seven different pictures and pass them around for inspection. Give them the following instructions. "These pictures are of a variety of places you may never actually visit but your eyes and your imagination can take you there. Try putting yourself into each of the scenes. Imagine what senses you would be using if you were actually there. What's happening? What messages might you be getting? Use your imagination--your ability to create a world inside your own head." After everyone has looked at the pictures collect them and explain that even though the students are somewhat the same, that each is also somewhat different. As a result of this difference each will receive something quite different from the pictures.

The following exercises can be used: (1) Ask for a show of hands from students who can remember pictures in which there is something one could smell. Next, ask who can remember something in the pictures that could be heard, felt, or tasted. (2) Ask the

students to imagine what kinds of feelings the signals you get from pictured scenes would call forth from you. Do some scenes make you feel good or bad? Do some scenes excite you? Do some scenes depress you? (3) Ask the students to name five different actions or interactions that are going on in the pictures shown. (4) Select one picture and try to figure out the kinds of animals or insects that would fit into the particular area. (5) Have the class close their eyes and think of one picture and try drawing that picture and then compare the two.

Summary: Point out that man doesn't always see the whole picture in the world, and that it is important to use our senses to see the whole picture.

References: National Environmental Education Development, Adventure in Environment: Classroom Book, Teacher's Guide, Outdoor Book

Lesson 2

Title: Concept of Environment

Purpose: This lesson has two objectives. The students are to grasp the concept that environment is the sum of all external forces or influences that affect an organism and to get an idea what the inquiry process is.

Time: One class period

Materials: construction paper, crayons, writing paper, and pencils

Development: The stage has been set for keen observation. Take the students for a twenty minute walk around the school grounds. Have them smell the grass, have them look carefully at a tree, have them look at any insects encountered or any interesting plants and animals seen. Have them get on their hands and knees and look closely at a small individual section of grass. Have them look at the sky, and take notice of the houses and the air around Bozeman. When this has been accomplished, return to the classroom.

Method:

1. This lesson is logically related to the first lesson in that it moves from observation to perceiving what they see in the world around them. Have each student draw a picture of what they saw including all details like the ground, insects, sunlight, etc. Have them pick one object though such as a bush they saw or an insect in the grass or a bird in a tree or a person walking on the sidewalk or a house across the street. After you have done this, have volunteers to explain what they have drawn in the picture. When this has been done ask them what environment means. Make comparisons between the bird's environment and the grass's environment and show them how all external forces or influences affect an organism. Examples of how winter and spring affect plants and animals would be a good verbal illustration.

2. The students' ability to formulate positive attitudes about the environment and to have positive effects upon the environment depends in large measure on their skill in the interrelated tasks of reading, thinking, and writing. When children write from the heart, they are likely to reveal their true attitudes about the world around them. When they do this it sharpens and develops their awareness of how their feelings have been affected by their environment. Have them now make a word picture as long or as short as they like, but make certain that the whole story is told. For example: You are the bush in front of the building, it is noon on Saturday, the sun is shining. It is summertime. You are the school. It is five o'clock on a Friday afternoon in winter. Try and get them to let you know what is happening inside them. The purpose is to show them that the variety and similarities they saw in the pictures their classmates drew is not just an idea that describes the environment outside them but one that describes them, too.

Summary: Review the concept of environment stressing that similarities and variety exist not only in the environment but in how we see it as individuals.

Lesson 3

Title: The Food Chain

Purpose: The objective of this lesson is to study the flow of energy from the sun, through the green plant into the life of the herbivore, (first consumer) the carnivore (second consumer), and the decomposer. The series of organisms through which food energy moves before it is completely expended is called the food chain.

Time: Two class periods

Materials: construction paper, crayons

Development: While an understanding of facts and relationships is a major goal of this lesson, consider also the possibilities for changing attitudes and inspiring action. Knowing that trees and leaves are sources of oxygen may change students attitudes toward them; they should begin to value them more highly. This could lead into other positive values of trees, such as shade, beauty, and economic value as fiber.

As the students explore these concepts their attitudes toward wild animals and plants should become more scientifically objective and, for some at the same time more positive.

Thinking of insects or rodents as links in food chains or as vital components in the web of life in a pond or woodland will tend to overcome prejudices that detract from pleasure in the outdoors. In other words, curiosity and understanding diminish fear

and revulsion. The teacher will do well to set an example by refraining from expressing disgust at "bugs", from referring to reptiles as "slimy", or from coloring cautionary instructions regarding poisonous snakes, biting insects, etc., with emotional language.

This lesson and the one that follows should do much to prepare students for their environmental trips.

Method:

1. Give the following brief introduction: Energy from the sun is used by plants and conserved in their tissues. This plant trapped energy is passed around from organism to organism in the form of food. One important relationship for us to understand is who eats whom. When this is understood, you can then see how food energy is passed around in nature. Use the discussion of the food chain to show man's dependency on plants--first, as the ultimate source of man's food needs and second, as a source of oxygen. In regard to the latter point, consider pointing out to your class that the plankton of the sea are the most important creators of oxygen.

2. Ask the class if they have thanked a green plant today. Then present them with the following problems and ask them to identify what is the producer, first consumer (herbivore), and higher consumer (carnivore), and decomposers.

A. Suppose you went to the supermarket with your brother to get this list of things: 1 quart of milk, 1 dozen eggs, 2 pounds of hamburger, 1 box of salt, 5 pounds of sugar, 1 pound of margarine, 1 loaf of bread, 1 chicken. You have been told to have the groceries put into two bags. One bag is to contain all the items that can be traced back to green plants. The other bag is to contain the remaining items. Which would you choose to carry home?

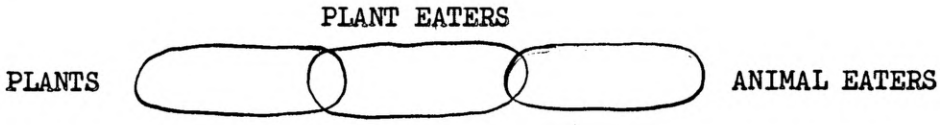
If you choose the bag with the items that cannot be traced back to green plants, your task would be easy. All you would have to carry is the box of salt. (National Environmental Education Development, Teachers Guide, 1971:6)

What about the hamburger and chicken? or the eggs? Did you ever think of milk as some kind of connection between you and the world? Did you ever think of yourself as a link in a chain of food?

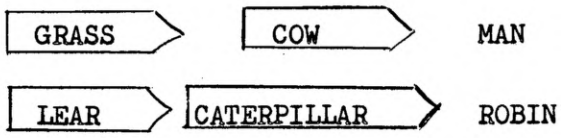
B. One of the things you may have eaten for breakfast was cornflakes. Cornflakes come from corn, which is a green plant. It was raised by a farmer, who eats plants and animals, which eat plants. It was packed by other people who are connected, as is the farmer, to green plants, and it was delivered and sold by other people. The box was made of cardboard, which is a form of paper, which comes from trees, which are green plants. The wax on the wax paper may come from animals or plants. The gasoline and other fuels

that gave all the machines energy are fossil fuels, which are dead plants changed by time and pressure. A possible exception is that some of the machines may have received power produced by nuclear energy.

3. Biologists use the idea of a food chain to describe the flow of energy from plants through animals by the process of eating and being eaten.



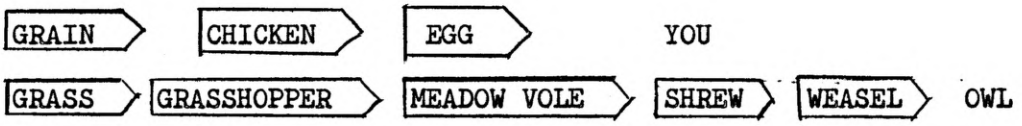
More often, arrows are used to show the direction that the food energy moves.



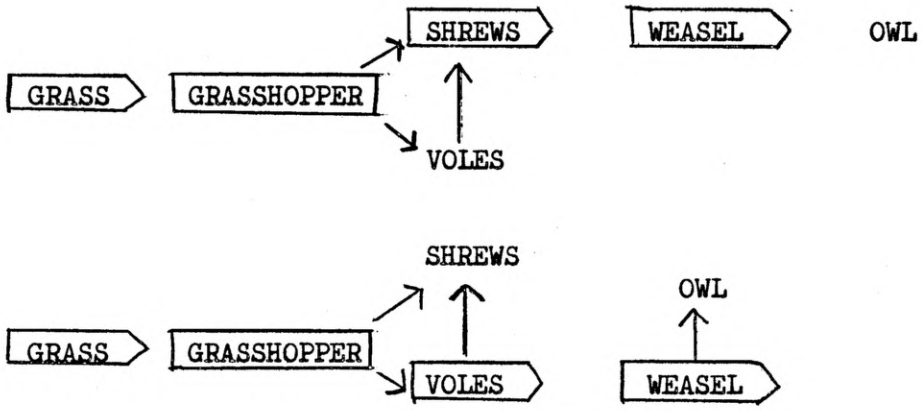
In a food chain, energy is usually passed through more than just three links. But food chains always begin with green plants (living or dead). In any one chain, the last animal is the one that is not eaten.

4. Using arrows have the class draw some simple food chains identifying the different parts. Then go into some more difficult food chains that are more complex. The food-chain chart published by the National Audubon Society will be of help to you in identifying

which plants eat which plants or animals. The following are examples of chains: (National Environmental Education Development, Classroom Book, 1971:15)



Nature's food chains are not very often that simple. Suppose the grasshoppers are eaten by both voles and shrews. Such a possibility is shown in this way:



Summary: Review the food chain, emphasizing the importance of plants and how man is a part of this food chain.

References: Adventure in Environment: Classroom Book, Outdoor Book, Teacher's Guide

FOOD CHAIN CHART

PRODUCERS	HERBIVORES	OMNIVORES	CARNIVORES	DECOMPOSERS
Green plants			Predators Scavengers Insectivores	
	deer		Venus's-fly-trap	fungi
trees	*muskrat	skunk	sundew	mushroom
herbs	beaver	bear	pitcher plant	toadstool
grasses	song sparrow	oppossum	weasel	mildew
			fox	
shrubs	porcupine	raccoon	badger	bacteria
ferns	moose	deer mouse	shrew	
mosses	rabbits	crow	bat	
algae	hares	blue jay	robin	
	*field mice (voles)	pig	hawk	
		chicken	owl	
	snails	rat	heron	
	tadpoles	man	alligator	
	earthworms		wolf	
	sowbugs		seal	
	cardinal		snake	
	*box turtle		lizard	
	cow		frog	
	goose		spider	
	pigeon		vulture	
			kingfisher	
			snapping turtle	
			cougar	
			*coyote	
			mosquito	
			sunfish	
			house cat	

*Some animals usually classified as either a herbivore or carnivore will occasionally eat something that would put them in the other category. In other words, a few of the animals named here in column 2 or 4 could be placed in column 3, Omnivores. (National Environmental Education Development, Teachers Guide, 1971:7)

Lesson 4

Title: The Web of Life

Purpose: The objective of this lesson is to show that the food chains become complicated and interconnected when more plants and animals are added to it. The pattern that emerges is called a food web. When you combine these food webs you have a web of life. All living things in the world are tied into the web of life.

Time: Two class periods

Materials: film strip projector, film strip: The Web of Life, overhead projector, track game transparencies, food web transparencies

Development: This lesson is an extension of the last; however, this is where you can really demonstrate how man is tied to the web of life. This is when you should demonstrate how man has broken food chains and what the consequences have been. Let the students bring in the good and bad effects of how man has shortened food chains to feed and clothe himself.

Method:

1. Show frames 41-48 of the film strip the web of life. The whole strip is much too complicated for grade school children. However, these 7 frames can be used to review the previous lesson "The Food Chain" and lead into the concept of a web of life.

2. After discussing this concept with them read to them the short essay "January Thaw". (Leopold, 1966:3) The animals

mentioned in this short essay could very easily be in the Gallatin Valley. Next project the oak forest food web on the screen and ask the class to study it for a couple of minutes. Then ask them to think about this valley and to create a food web from the plants and animals they can remember seeing (Draw this web on the board.). As you are doing this ask them to think about how many of one kind of plant or animal are eaten to produce one of the animals that are eating the other. The point to be made is a predator (second consumer) must consume ten pounds of flesh in order to produce one pound of growth; therefore the predator must have many animals to feed on. It would take hundreds of mice to keep a hawk alive for a year.

3. The track games can be used as a method of getting the class interested in the relationships that exist in a food web. Track game transparency one shows nature's predatory relationships. Track game transparency two shows man being a predator. From these games you can further explore man's relationship in the food web. Instructions are attached with the lesson explaining how to conduct an inquiry session with the track games.

4. The next part of the lesson is to show how man has broken food chains and discuss the consequences. The following are a list of possible questions and answers to be used:

QUESTIONS

(1) If rats were a problem in your community, what are some different ways you might try to cut down on their population?

(2) Are human chains simpler, or more complicated, than natural food chains? What are some dangers to the human food chain that result from shortening and speeding it up?

(3) Would a disease of the corn crop have more effect on the end of the human food chain than it would on the end of a natural food chain? (You or hawk?)

(4) How does the way we dispose of left-over food (sewage and garbage) and food wrappers (trash) contribute to air and water and land pollution?

ANSWERS

(1) Some possible answers to the first question are as follows: poison chemicals (gas, poisoned food pellets or bait, etc.); building of rat-proof food-storage facilities; keeping streets, alleys, and parks clean; closing up of rat burrows, holes, and hiding places in buildings; better garbage handling.

(2) Farmers simplify natural food chains by wiping out whole populations that are "irrelevant" to feeding human beings. The enormous areas planted to corn, wheat, or some other single food item must therefore be carefully protected by artificial measures against insects, plant diseases, and loss of soil fertility. Under

this gigantic simplification, the sturdiness that variety gives the natural food chain breaks down.

(3) A disease of corn when corn covers square miles of land to the exclusion of almost all other plant life has a much more devastating effect than the disease of any species (or link) in a natural food chain, which has numerous links in it.

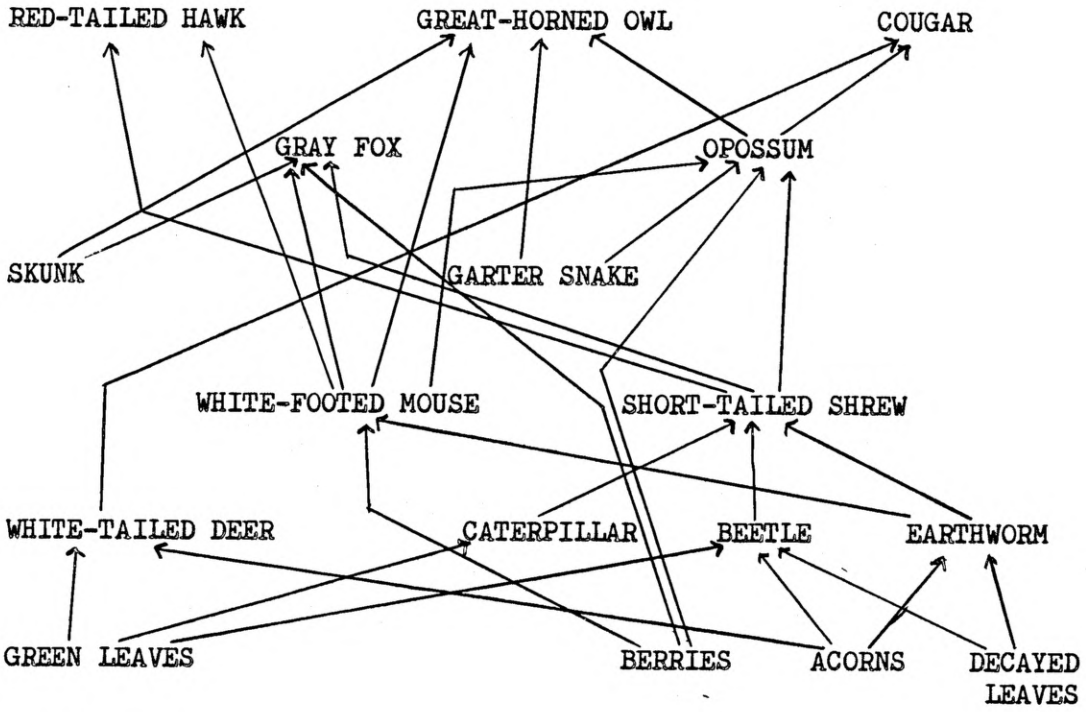
(4) This question may lead to a discussion of population problems. Some students may want to consider why people have to burn, or dump, or wash away in rivers their left-over food. Natural forest or pond communities don't have to. Nature is in balance there; it doesn't get ahead of the predators and decomposers. How can people do as well?

5. A game assigning members of class roles in a food web could illustrate the points of this lesson. String could be used to dynamically indicate what happens when just one plant or animal is eliminated. A larger area like the gym would probably be necessary to demonstrate this concept.

Summary: Review the concept of food chains making up a web of life and emphasize how man is so much a part of it.

References: Aldo Leopold, A Sand County Almanac

OAK FOREST FOOD WEB



(National Environmental Education Development, Classroom Book, 1971:15)

Lesson 5

Title: Communities

Purpose: The objective of this lesson is to explore what a community is and how each animal occupies a space or habitat and has a role (a niche) in the community. A community can be as simple as one plant and one associated animal on which it feeds plus their inorganic surroundings or as complex as a forest community with its many different plant and animal associations. Each animal in a community

occupies a space, or habitat. The role of an animal or plant in a community is its niche. Dr. Eugene Odum (1959:27), a famous ecologist, describes habitat as the animal's address and niche as his profession.

Time: Two class periods

Materials: Film strip projector, film strip: "Life in Ponds, Lakes, and Streams," large pond poster

Developments: By drawing parallels between man-made communities and communities of life such as woodlands and ponds, this lesson develops the understanding that living things of any habitat are interrelated and sometimes interdependent as well. Students should begin to realize that if something in a community is removed, destroyed, or greatly changed, many other things in that community also are affected--very often in ways that no one expected or even considered. This understanding can be the beginning of the development of skills for analyzing their own home community or environment.

The pond community as seen in the film strip is small enough for your students to begin to comprehend the totality of a community, with all its many, varied parts and functions. When well-documented and easily understood communities have been grasped, more complicated communities can become the subject of inquiry and study. Eventually, even the world can be approached in a general way as a community.

In addition to showing the interrelatedness of living things, this lesson provides an opportunity to understand that diversity is desirable--that it makes for stability. This element of stability is sometimes referred to as "the broad base of the pyramid of life." Presumably man is at the top of this pyramid. Each member of a community, whether an individual or a species, makes at least one contribution, and probably several, to the community. Beyond this, each community is interrelated with other communities. (National Environmental Education Development; Teacher's Guide, 1971:8)

Here, too, is an opportunity to explore with your students the effects of man's alterations of his own and other communities and to observe the results that follow these changes. In some cases these "alterations" can be seen as "improvements" and in other cases, they may be judged as "tampering."

Methods:

1. The pond in the film strip is particularly good for viewing as a natural community because it can readily be grasped as an entity. Generally, there is a variety of animal life, in and around the pond. Life interactions are easily seen in ponds. You may see a bird catching a mosquito, or a fish searching for food. Frogs, toads, earthworms, and plant life of various sorts are not uncommon.

Point out that there are animals in the pond that can't leave it to go for food or oxygen anywhere else. Some insects must swim on the surface to get air; others, such as the water skater, can stay underwater as long as six hours at a time.

Interject these comments in the film strip and get student comments.

2. Discuss the different parts of the pond community.

A. The edge, where the water meets the land, is a distinct environment. Frogs sit around the edge of the pond, almost motionless. The trout and the other fish usually swim in the open water hour after hour. And the chipmunks wander around the dry land. Ask the students why the frogs don't do these things. They can swim and hop, and they are good at both. Think about why the frog usually stays near the edge of the pond. How does it relate to

a large hungry trout in the pond?
a mink wandering along the shore?
hatches of mayflies hovering among the cattails?
its own nonliving environment?

The edge of the pond has things the frog needs. The pond's edge offers safety, concealment, food, and a place to lay eggs. It is a place for tadpoles to live. The marsh is a fine place. A frog can go easily from there into the water. Or it can go to the dry land.

See if the students can see a similarity of living in the suburbs, compared to the frog? Perhaps a bit. Certainly food and shelter are available in the suburbs. You can also go readily to two separate environments--the city and country--to satisfy your needs. Both you and the frog live on the edge of two very different worlds. An edge community offers a large variety of food and shelter.

B. Open water--The open water of the pond is another distinct environment. It has many life-giving properties. Some of these change as the seasons change. At times, open water supports a great deal of microscopic plant and animal life. Fish feed on the tiny things. Larger fish, perhaps trout, will eat the small fish as well as an occasional frog.

Also, ducks, such as the red-breasted merganser, fly from one pond to another to feed on the small fish. They are not tied forever to the pond as the trout is. The trout must stay and live with whatever the pond has to offer.

3. Try and relate the idea of habitat and niche to the students.

Each animal in a community occupies a space, or habitat. Each animal feeds upon certain things and is fed upon by other animals. In various ways, each one helps to maintain or change the physical environment.

The mosquito wriggler, for example, feeds upon minute water plants, and is fed upon by small fishes. The adult mosquito lays its eggs on the surface of the pond. The adult is preyed upon by dragonflies, bats, swallows, and other pond residents and visitors.

The role of the mosquito in the community is its niche. In other words, the niche of an animal is its relationship to food and enemies. The students should think of "habitat" as the animal's address, and "niche" as his profession.

Each plant, too, fills a certain niche. Algae and other green plants produce oxygen used by water-dwelling animals. In the process, they use carbon dioxide given off by the animals.

You already think of certain people as "your teacher," "the Mayor," "the Scoutmaster"--not just as Mrs. Jones or Mr. Smith. If you do the same with natural communities, it will help you understand and remember how the community operates. The name, "rabbit" or "vulture" is not so important as the niche. A rabbit is a mammal that eats green plants and is fed upon by large predators. A vulture is the community garbage collector.

Think of the niches (jobs, professions) filled by people in your community. How would your community get along if all garbage collectors, for example, were eliminated?

An important difference between man and other animals is man's special ability to adapt to many roles. In his communities

he has been able to fill many niches. But in the woodland community each species fills only one.

For example, the hawk is a daytime predator on rodents and other small animals. The owl is a nighttime rodent-hunter. If the bus driver in your town quit, the teacher or the grocer could drive the bus. But the hawk wouldn't stay up nights to fill in for an owl.

4. To conclude this lesson a number of hypothetical questions could be asked to the class.

A. Can you think of a community?

B. How would you describe this community?

5. When a community has been defined have the students in the class play members of this community. Have the rest of the class decide how this community could be altered by change. Let these students play the roles of these change agents. A simple example would be a pond that had swampy area around it. A road is being constructed across the swampy area; a park is going to be placed beside the pond. With this such problems as heavy use by people might change the pond by pollution. The draining of swamp would take away the habitat and niches of all types of plants to animals.

Summary: Review the meaning of the terms community, habitat, and niche. Emphasize the relationship between plants and animals in the community.

References: National Environmental Education Development, Adventure in Environment, Classroom Book, Outdoor Book, Teacher's Guide

Eugene P. Odum, Fundamentals of Ecology

Lesson 6

Title: Interrelations Between Communities

Purpose: The objective of this lesson is to show how communities are dependent upon each other for some of their life needs.

Time: One class period

Materials: 16 mm motion picture projector, film--"Rock Creek"

Development: This lesson ties all of the previous lessons together. The film "Rock Creek" brings out food chains, food webs, communities, and talks about how these are in danger of being destroyed. The film tells how the fish population in Rock Creek is dependent upon the surrounding forest community for its proper environment of cold, clear water.

Method:

1. Before showing the film, ask the students to be thinking about how the plants and animals in the stream Rock Creek are interrelated to the surrounding forest area.

2. Show the film and afterwards discuss the interrelationships revealed in the film with the students.

Summary: Review the concepts of the past five lessons and tie them in with the Rock Creek film.

Lesson 7

Title: Construct a Key

Purpose: This lesson has two objectives. At the end of this exercise the students should be able to observe differences in color, shape, and physical characteristics of objects. They also should be able to construct a key to the 10 objects in the paper bag based on differences in physical characteristics.

Time: One class period

Materials: Key bags, 1 per 3 students

Developments: The idea of this exercise is to get the students to recognize that differences in objects enable us to tell them apart. By looking for differences we can tell plants and animals apart. Make a key using the class to explain how it is done. Then let the students construct their own key. Then allow the students to exchange bags and keys with another group and see if both groups can key the objects.

Method:

1. Let's make a key to the students in the third grade at Whittier School. We will divide the students into two groups based

on some characteristic. How about dividing them into boys and girls? That's easy, but now we must describe the characteristics that we used to separate the boys and girls.

1a. Student with long hair, usually covering the ear; knees not covered by clothing.

1b. Student with short hair, usually some of the ear showing; knees covered by clothing.

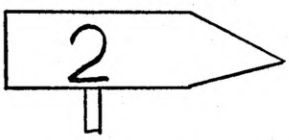
We now divided the class into two separate groups. We used two characteristics for separating the students. For example, Kirk has long hair while Jane has short hair and this is why you always need two characteristics. Now we will separate the girls in the Whittier third grade room.

2a. Student with red hair; freckles across nose

2b. Hair various colors but not red, freckles sometimes present

Now we will go back to 1a. and put up a road sign for others to follow

1. Student with long hair, usually covering the ear; knees not covered by clothing Note the 2 at the end of the line is the road sign



all girls go to two

Now put a road sign at the end of line 2a. to direct traffic

3a. Student with braces on teeth; feet large, size 8 Mary

3b. Student without braces on teeth; feet small, size 4 Shelly

We have now separated Mary and Shelly from all the other students in the Whittier third grade room. Let's use Mary for an example. Mary is a girl so she would fit the 1a. group and would be sent on to the group 2 separation. Since Mary has red hair and freckles she would fit the 2a. group and be sent on to the group 3 separation. Now most of the time Mary has her mouth open yakking away, but for those rare moments when her mouth is closed we can still separate her from Shelly based on the size of her feet. (Schoenthal et al., 1972:5)

2. Give a key bag to three students and have them construct a key. After they have constructed the key have them exchange their key and key bag with another group.

Summary: Review the concept of a key as an arrangement of characteristics to facilitate identification.

References: Norman Schoenthal and others, Exploring the World--An Environmental Education Handbook for Students

Lesson 8

Title: Where Do Insects Live and Why?

Purpose: The purpose of this lesson is to demonstrate how animals adapt to a particular niche in their environment and how they have developed characteristics that fit that niche.

Time: One class period

Materials: 1 glass jar per student, magnifying glass

Development: The whole group of the world's known animals may be divided into sixteen phyla. One of these includes all animals having segmented bodies and jointed appendages. They are known as Arthropods and include such animals as the crawfish, crabs, centipedes, millipeds, spiders, ticks, and insects. The insects differ from these others in having just six legs, and they constitute the most abundant form of animal life. In fact there are more known species of insects than there are of all other animals and plants put together. Because there are so many insects close to the school and their characteristics can be identified with places they are found by the students you can relate the concept of niche quite easily. (Jaques, 1947:2)

Method:

1. Take the class out to the vacant lot near the school and divide the class into three groups of equal numbers. Give the first group the task of finding insects that are crawling on the ground only. Give the second group the task of finding insects that are under rocks, sticks, and other objects on the ground. Give the third group the task of finding insects that are on grass, leaves, and higher leafy vegetation.

2. To make the hunt more interesting tell the students they have to find at least three insects or they will starve to death as they are an insect eating bird that must have energy.

3. Return to the classroom and have each group compare the insects they have found. This can be done by lining up the jars to see how many different kinds of insects they have. Have each group explain where they found their insects and if they can, see any characteristics that perhaps makes it more suitable for that niche.

4. Examples: (a) Grasshoppers with their chewing mouth parts are adapted to live on the leafy green plants. (b) Butterflies, moths, flies, true bugs have their mouthparts specialized so as to form a hollow tube through which liquid foods may be drawn. These are adapted to living close to the flowers and higher portions of the plants. (c) Ants are adapted to live on the ground, in trees, and many places. The ones you find on the ground are adapted to make nests and tunnels in the earth, under rocks, etc.

Summary: Review the different places where the insects were found and how these insects developed special adaptations to live in their own niches.

References: H. E. Jaques, How to Know the Insects

Lesson 9

Title: Protective Coloration

Purpose: The purpose of this lesson is to demonstrate that color is a method by which animals protect themselves from their natural enemies, and are able to blend in with their environment.

Time: One class period

Material: five boxes of different colored toothpicks

Development: This exercise further explores the idea that living things plants, animals, and insects are adapted to occupy certain areas of the habitat. Before demonstrating how protective coloration works ask the students questions about animals they are familiar with. Why are jackrabbits brown in the summer and white in the winter? Why do fawn deer have spots on them when they are born? Why are some praying mantes brown and some green? Why are butterflies colored? When you have their interest tell them you are going to demonstrate how important protective coloration is.

Method:

1. Divide the group up into twos and give one child fifty toothpicks (ten toothpicks of five different colors). Have five students turn their backs while the other five students place their fifty toothpicks in a 1½' by 1½' grassy area. The toothpicks should be pushed into the grass about one half of its length. Make sure they are placed randomly.

2. After the toothpicks are hidden have the other five students turn around and each take one square. They have one minute

to find as many toothpicks as they can, but this must be done by sight and not by feeling in the grass. After the exercise have them count how many toothpicks they found and of what color. Reverse the exercise with the other students.

3. After the completion of the exercise compare colors and quantity found. Most likely the green and black colored toothpicks will be the smallest quantity found.

4. Equate this game with fifty colored pheasants and ask them which colors they would expect to find in the lot after two years. Probably the bright colored pheasants would be killed by natural enemies.

5. Discuss some examples from pages 9-11 from Concealing Coloration in the Animal Kingdom by Gerald H. Thayer.

Summary: Quickly review the idea that color is a method by which animals adapt to their environment and they do this as a means of protection and survival.

References: Gerald H. Thayer, Concealing Coloration in the Animal Kingdom

Lesson 10

Title: Soil

Purpose: 1. To show them that soil is made up of rock material (sand, gravel and/or clay) and humus (decayed plants and animals).

2. To show that soils occur in layers forming a soil profile.

Time: One class period

Materials: paper cups
water
two Hellige-Trvog Soil Reaction (pH) Testers
one Binocular microscope

Development: Soil is mainly composed of two types of substances: rock materials and humus. The rock materials are produced by chemical and physical weathering. Such weathering results in sand, gravel, and/or clay accumulation. However, the mixture may not be correctly called soil until it contains humus. Humus is composed of decaying and rotted plants, plant parts, and small animals.

Soils are composed of mixtures of mineral and biological substances, but are classified according to the size of their mineral particles. The three main texture groups are sandy, silty, and clay. Sandy soil contains particles that can be seen with the naked eye and feels gritty when rubbed between the thumb and forefinger. Sandy soils will generally not stick together when wet. Silty soil contains particles which are smaller than sand particles but larger than clay-sized particles. Silt feels powdery when rubbed between thumb and forefinger. Silty soil sticks together when wet, but will not hold its shape after it is dry. Clay soil contains the smallest sized particles. Clay-sized particles form a sticky soil when wet. Clay will generally hold a shape after drying. Soils are rarely composed of just sand, silt, or clay. They are

usually a mixture of the three with a larger percentage of one size of particles.

Soils occur in layers forming a soil profile. The top layer in a soil profile contains humus and decaying organic matter. The humus makes the top layer, or topsoil, darker in color. The subsoil is the layer of soil below the topsoil. It is lighter in color than topsoil and is composed of clay, sand, and minerals. The subsoil is usually the thickest layer in a soil profile. When the topsoil is removed or eroded away, the subsoil is gradually changed into topsoil. Below the subsoil is a layer of rock fragments and weathered rock materials. Further weathering changes the rock fragments and weathered rock material to subsoil. The bottom most section of a soil profile is bedrock, or solid rock.

Soil profiles may be seen at building excavations, roadcuts, or stream banks. If the roadcut or stream bank is not recent, dirt may have to be removed before the profile may be seen.

Topsoil, as other sections of the profile, varies in thickness from place to place and from one section of the country to another. (Southard, 1969:9-13)

Method:

1. Divide the group into twos or threes and give each group a certain layer of soil from a profile to study. Have each student look carefully and examine his sample dry. Give them two

minutes to do this and then discuss what they see. Next have them pour a little water into their cups and feel the consistency of their soil. Some may feel sticky because of the clay or some may feel sandy. Discuss this with them.

2. Talk about how each layer is different. Point how important decomposed plants and animals are to soil.

3. Demonstrate with the soil kits how different soils have different chemical properties. This demonstration is outlined in the soil kit cards.

Summary: Review the concept that soil is composed of two types of substances: rock material and humus. Review the idea the sand, gravel, and clay are rock material and briefly review the idea that soil is found in layers.

References: A. R. Southard, Soils of Montana

Station 1

Title: Temperature as a Limiting Factor

Purpose: 1. To observe that temperature of air, water, and soil is different depending upon the location.

2. To understand that plants and animals are often limited in their environment because conditions exist that prohibit them from expanding their range. These limiting factors could be temperature, moisture, soil conditions, competition, predators, and

lack of tolerance for direct sunlight. These are just a few of the many limiting factors.

Time: Twenty minutes

Materials: Thermometers

Development: If a plant or animal is growing and reproducing in a certain location, there is no better indication that the particular environment lies within the tolerance range of that plant or animal. The tolerance range of an individual plant is that range of environmental conditions in which the plant or animal will grow and reproduce. A number of examples from Fundamentals of Ecology by Eugene P. Odum (1959:89-104) illustrate this concept.

Method:

1. Give each student a thermometer and divide the group into pairs with assigned tasks. Have one pair measure stream temperatures along the shore and in the open water. Have one pair measure temperatures in the shadows. Have one pair measure temperatures in the sun. These measurements should include spots in the valley and on the hill. Have one student take soil temperature readings near the stream and in the valley area.

2. Students should record the information collected and after 10 minutes return to the central location and discuss what has been recorded. Use this information to describe the concept of limiting factors.

Summary: Give a brief review of what took place and how temperature could be a limiting factor.

References: Eugene P. Odum, Fundamentals of Ecology

Station 2

Title: Panning Gold

Purpose: 1. Introduce the students to the historical method of finding gold-panning.

2. Introduce history to them in an environmental situation.

Time: Twenty minutes

Materials: one shovel

five pans

Development: Panning gold is a type of placer mining. Basically it entails taking advantage of the high density of gold to separate it from the much lighter siliceous material with which it is found. Alluvial deposits, which are mined by placer methods, are the gold-bearing sands and gravel that have been deposited by rapidly moving streams and rivers where they widen or, for some other reason, lose speed. As the current slows, the sediment being carried downstream has an opportunity to settle.

During the great American gold strikes of California, Colorado, Alaska, and Montana, placer mines were almost exclusively the source of gold, and the panning method was one technique utilized by the individual miners. In this method, the miner employed a pan

or a batea (a pan or basin with radial corrugations) in which he placed a few handfuls of dirt and a large amount of water. Through circular motion of the pan, the siliceous material was washed over the side; the denser material remained in the centre of the pan. After many of these washings, only the gold and other heavy minerals were left. At this point, if the gold particles were large enough, it was comparatively easy to separate them from other materials. If not, further concentration was needed. (Encyclopedia Britannica, 1969 Vol 10:536)

Method:

1. Discuss with the students how gold is deposited in sandbars like the one they are sitting on. Explain to them how gold was mined by using the panning technique.

2. Discuss the history of gold development in Montana as described in Ho! For the Gold Fields, pages 17 through 20. (White, 17-20)

3. Let each student try to pan in the stream.

Summary: Review how gold is deposited and how the weight of gold makes it possible to use panning as a technique of separating it from alluvial materials.

References: "Gold", Encyclopedia Britannica, 1969
Helen McCann White, Ho! For the Gold Fields

Station 3

Title: Water Chemistry

Purpose: To demonstrate that water has physical properties and can be described by these properties.

Time: Twenty minutes

Materials: Hach kit

P.H. meter

Development: Water is one of the most abundant, widely distributed, and essential substances on earth. It occurs in nature in the solid, liquid, and gaseous states as ice or snow, water and steam (water vapor), respectively. Snow is probably the purest natural source of water and rain the next purest, although the latter contains dissolved gases of the air as well as traces of carbon dioxide, chlorides, sulfates, nitrates and ammonia. Water from streams and lakes in mountainous districts is relatively free from impurities. Ordinarily the water should be safe to drink; attractive in appearance, taste and odor; and usable for a variety of household and industrial purposes. However, water will often have chemical properties similar to those of the surrounding soil and geological formations. Chemical properties are acquired in the passage of water through the atmosphere, over the earth's surface, or through the pores and channels of the ground. Impurities that cause pollution originate principally from the uses man makes of water, in particular from the waste waters

that are discharged into natural ways. Important among the impurities of water are: 1) toxic substances from industrial wastes, 2) turbidity, soil particles generally carried into suspension by erosion, 3) carbon dioxide which enables water to take calcium, magnesium and in some instances lead into solution, 4) iron and manganese which are taken into solution in the absence of dissolved oxygen, and 5) algae which release characteristic odors and tastes. (Encyclopedia Britannica, 1969 Vol 10:270)

Method:

1. Ask the students if they would drink the water in the creek? Encourage them to tell you why they would or would not drink the water in the creek.

2. Discuss with them how water does take on chemical properties as a result of the surrounding soil and rock formation. Demonstrate this by placing a few drops of HCl on limestone covered rock.

3. Perform the water quality tests to determine p.H., oxygen, and alkalinity.

4. Discuss what these tests mean in the terms of ecological terms. (See attached information)

Summary: Review the concept that water has physical properties that can be identified.

References: "Water" Encyclopedia Britannica, 1969

Station 4

Title: Aquatic Organisms: Plants and Animals

Purpose: 1. To acquaint the students with the diversity of life in a stream: both plants and animals

2. To demonstrate how animals adapt to a particular niche in their environment and how they have developed characteristics that fit that niche.

Time: Twenty minutes

Materials:
two dissecting scopes
one window screen (approximately 2 feet by 3 feet)
two dip nets
one seine for fish
two enamel pans
one tub

Development: Animals should be collected from various places within the sample area. Try to have the students obtain specimens from along the shore, in open running water, on the surface of the water, and on the bottom of the stream. The students may collect along the shoreline with a dip net or with their hands. Have them try to catch large organisms as well as the small ones. The window screen net is held by one student in the water while another student turns over rocks and debris in the water above the window screen. Insect larva, etc., will float downstream and cling to the screen. Use the seine for collecting in the open stream. With a student on each end, move upstream for a distance of eight

to ten yards. Have one student upstream splashing and making noise. This is so the fish will not go upstream and escape. Have the students keep their finds divided into two categories -- shoreline and open water. When the plants and animals have been collected discuss what they have found and how the characteristics of each relate to where they were found.

Method:

1. Assign the students tasks; there is not enough time for each student to try everything. After ten minutes tell them to gather around and look at what has been collected.

2. Let each student look at a few insects and some algae under a dissecting scope. Discuss the special features of each.

Summary: Review the different places where the insects were found and how these insects developed special adaptations to live in their own niches.

Station 5

Title: Fish Management

Purpose: 1. To observe differences in physical characteristics of various species of fish native to Montana streams.

2. To relate differences in physical characteristics of fish species to specialized niches in the stream habitat.

3. To determine what within a stream makes good habitat for fish.

4. To talk about spawning and what conditions are necessary for spawning to take place.

Time: Twenty minutes

Materials: two live cages
1 metal tub
1 bucket
5 dissecting trays
1 vial of fish eggs
5 species of fish native to Montana streams

Development: The trout species most common to the streams of Montana are the cutthroat, rainbow, brown, dolly varden, and brook trout. These species all have identifying taxonomic features such as color, different shaped fins, variation of scales on the lateral line, difference in numbers of gill rakers, etc. Comparing these fish with members of sucker family and the sculphin family is an easy way to show differences in physical characteristics and to relate this to niches within the stream habitat.

Habitat is the "home" of a fish. It must contain all the items necessary for life and in sufficient quantity to maintain the fish population from generation to generation. Pools, riffles, undermined banks, bank vegetation all contribute to the productivity of a trout stream. A combination of many factors go together to make good habitat. Temperature of the water is one of the more important components. Others are: gradient of a stream, distribution of pools and riffles, stream bottom materials, stability

of water level, cover, fertility, turbidity and alkalinity or acidity of the water.

The stream trouts characteristically spawn in clear moving water of shallow depth on cleaned gravel. The eggs hatch under several inches of this bottom material and the fry make their way up to the open water. Brown trout and Brook trout are fall spawners, while cutthroat and rainbow spawn in the spring and early summer. The suckers spawn from April to early July and spawn in loose gravel beds in riffle areas. (Lagler, 1956:30-33)

Method:

1. Have a different species of fish on each dissecting tray for the students to examine. Have the students relate these differences to specialized niches in the stream habitat.

2. Have the students observe the stream and the land area around the stream. Relate the two to the habitat of the stream.

3. Have the students observe the vial of trout eggs and then discuss with them how fish spawn.

Summary: Review the fact that good habitat provides many niches for fish to occupy and the result being a larger number of different species.

References: Karl F. Lagler, Freshwater Fishery Biology

Station 6

Title: Bud and Leaf Characteristics

Purpose: 1. To observe differences in the characteristics of buds and leaves.

2. To understand how these differences could be used to tell plants apart from one another.

Time: Twenty minutes

Materials: Twigs with leaves and buds

Tree puzzles

Development: The idea of this exercise is to get students to recognize that differences exist in bud and leaf characteristics. By looking for differences we can tell flowers, bushes, and trees apart. Also examine the rings that can be seen on cut limbs. Discuss with them the idea that age of a tree or bush could be determined by counting the rings. Also look at the position of buds on and leaves on the twigs cut.

Method:

1. Distribute a number of cut twigs and leaves. Have them locate with the help of a handout the different types of buds and arrangements of buds and leaves. (Elementary Science Study, 1966:33-37)

2. Have them look at some cut sections of limbs and to count the rings that can be seen.

3. Have the students take their handouts and look at the trees and shrubs in the area and to try and find as many different types of leaves and buds types they can.

Summary: Review the concept that different characteristics exist in plants such as bud and leaf shapes that enable us to tell them apart.

References: Elementary Science Study, "Teachers Guide for Budding Twigs"

Station 7

Title: Ecology Observation

Purpose: To discuss with the students what they see around them and below them as they look across the valley. This station should be used to discuss and recognize the different communities below them and just how they are interrelated.

Time: Twenty minutes

Materials: binoculars

Development: Today man is concerned with the protection of the environment more than at any time in past history, and the reasons for concern are real. Some problems such as hunger and disease have always been present in the history of mankind. Others, covered by the broad term, "pollution", are of relatively recent importance and resulted from the greatly increased technological developments of the Twentieth Century which enabled man to exploit the earth at a much greater rate than ever before. One American is considered to be the equal of twenty natives of India--as measured by the consumption of natural resources during his lifetime. Our industries, commerce, and households annually dump millions of tons of solid wastes and chemical pollutants into the water and air. As a result

some rivers are so polluted that they have caught fire, and many persons with respiratory ailments have had their doctors recommend that they move from certain cities with bad air pollution conditions. In recent years many new plants and animals have had their names added to the list of endangered species. This includes the blue whale, the largest animal which has ever lived on earth; and some biologists have even added man himself.

Why, then, study a stream to learn how to take care of our environment? Plants and animals are not randomly scattered around the earth but exist in highly complex communities which are determined by geology and climate. These communities can be classed as aquatic or terrestrial and then further subdivided into various land or water habitats. Life on land occurs from below sea level in such places as Death Valley and the Dead Sea to regions above timberline on our highest mountains. It ranges from tropical rainforests, which have the greatest variety of species of organisms of any place on earth, to the Artic tundra where only a few highly specialized plants and animals can live. Aquatic life is found in Antartic seas so cold that some fish do not have red blood cells for the transport of oxygen while, at the other extreme, brightly-colored algae live in Yellowstone Park pools hot enough to cook flesh. But, in spite of the wide range of conditions under which life can exist, all habitats have a basic pattern in the composition of the life forms present. They consist of three interrelated groups of organisms essential to the maintenance of a balanced environment. These are the producers, the consumers, and the decomposers. A favorable habitat will have many species in each group; a severe one will have very few, but all three will be represented. (Black, 1971:2)

Method:

1. Ask the students what type of animals they think are living in the valley, along the stream, and in the surrounding mountains. This should lead to an open discussion.

2. If animals are noticed use the binoculars to create interest.

Summary: Review the concept that environment is made of inter-related communities of plants and animals.

References: Dan Black, The Study of a Pond Environment

Chapter 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

A summary of the findings of Hypotheses A, B and C (Chapter 3), a summary of student and parent evaluation questionnaires, conclusions and recommendations are presented in this chapter.

Summary of Hypothesis A

Hypothesis A states there was no difference between the difference of the pre- and the post-test scores on the cognitive test of the experimental group that had a field experience as compared to the control group who did not encounter a field experience. A summary of the findings is presented in Table 5. The null statement was accepted as the F value 1.54 did not exceed the F value 3.92 required to be significant at the .05 level of significance.

An explanation of the statistic used (analysis of covariance) to calculate the F value is presented in Appendix L.

Table 5. Summary of F Test Scores for Hypothesis A

Group	Number of Students	Independent Variable	Mean Score	F Test Score
Experimental	77	pre-test	21.38	3.75
Control	63	pre-test	19.04	
Experimental	77	post-test	41.31	2.35
Control	63	post-test	41.95	
Experimental	77	difference	19.90	1.54
Control	63	difference	22.90	

Discussion of Hypothesis A

From the mean scores in Table 5 it can be seen that both the experimental and control groups did increase their mean scores in the cognitive domain. The control group showed a change from a mean score of 19.04 to 41.95 an increase of 22.90 points. The experimental showed a change from a mean score of 21.38 to 44.31 an increase of 19.04 points. Although a similar gain in achievement in the cognitive domain was found for both groups there was a significant difference in the affective domain in favor of the experimental group. This is covered later in this chapter. The researcher feels that both cognitive gains and the comfort and

enjoyment of the students must be considered in the educational process. Therefore a curriculum revision in favor of the experimental procedure seems to be warranted.

Summary of Hypothesis B

Hypothesis B states there was no difference between the pre-test and the post-test scores on the affective test of the experimental group that had a field experience as compared to the control group who did not encounter a field experience. A summary of the findings is presented in Table 6. The null statement was rejected as the F value 19.59 far exceeded the F value of 7.08 required to be significant at the .01 level of significance.

An explanation of the statistic used (analysis of covariance) to calculate the F value is presented in Appendix L.

Table 6. Summary of F Test Scores for Hypothesis B

Group	Number of Students	Independent Variable	Mean Score	F Test Score
Experimental	77	pre-test	55.24	* 7.28
Control	63	pre-test	57.52	
Experimental	77	post-test	59.10	3.00
Control	63	post-test	57.07	
Experimental	77	difference	4.02	*19.59
Control	63	difference	- .46	

* F Test significant at the .01 level

Discussion of Hypothesis B

From the mean scores in Table 6 it can be seen that the control group scored higher in the affective domain on the pre-test and that the F Test was significant at the .01 level in favor of the control group. On the post-test the experimental group scored higher than the control group but the F Test did not show a significant difference at the .05 level. However, on the difference score a significant difference was found at the .01 level in favor of the experimental group.

It is for that reason the researcher feels this study indicates that environmental curricula designed to stress environmental

characteristics, interrelationships and understanding at the elementary level can change the behavioral attitudes of students. Specifically what the researcher suggests is that each school should develop its environmental curriculum around those topics that have direct meaning to the students, where success is easily attainable, and interaction with their environment is natural.

The affective domain centers on values, judgments, appreciations and emotions and it was the affective domain that was significantly changed in this study.

Summary of Hypothesis C

The null statement of Hypothesis C states that there was no significant correlation between pre-test scores, post-test scores and difference scores in regards to the eighteen independent variables listed on page 30 of Chapter 3. A multiple regression analysis between each of the eighteen independent variables and the dependent variables pre-test, post-test and difference scores indicated that some of the independent variables were significant on the cognitive and affective tests at the .05 level of confidence. However, multiple regression analysis revealed that no reliable model for predicting a subject's performance on the tests could be developed from the independent variables investigated.

The partial r was used as the test statistic to determine significance of the independent variables tested. The value of the partial r to be significant at the .05 level of confidence for the control group was .2480 and for the experimental group was .2250. These values were derived in the following manner (Bailey, 1959:85):

$$t = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}} \qquad t \text{ required at 60 df} = 2.00$$

$$2.00 = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}}$$

$$r = \frac{4}{(N+2)}$$

		.05 level	.01 level
if N = 63	r =	.2480	.3181
if N = 77	r =	.2250	.2887

Tables 7, 8, 9, 10 summarize the independent variables that were found to test significant in this study.

Table 7. Experimental Group Cognitive Domain

Independent Variable	Dependent Variable	Partial r
The cumulative raw score on the vocabulary and reading comprehension of the Iowa Tests of Basic Skills	pre-test score	* .5642
Outdoor activity type preference	pre-test score	.2874
The cumulative raw score on the vocabulary and reading comprehension of the Iowa Tests of Basic Skills	post-test score	* .5326
School subject preference	post-test score	-.2372

* partial r significant at the .01 level

Table 8. Control Group Cognitive Domain

Independent Variable	Dependent Variable	Partial r
sex	pre-test score	.2995
The cumulative raw score on the vocabulary and reading comprehension of the Iowa Tests of Basic Skills	pre-test score	* .3186
The cumulative raw score on the vocabulary and reading comprehension of the Iowa Test of Basic Skills	post-test score	* .3711
Indoor Activity Type Preference	difference score	-.2565
Hunting Frequency	difference score	-.3065

* partial r significant at .01 level

Table 9. Experimental Group Affective Domain

Independent Variable	Dependent Variable	Partial r
The cumulative raw score on the vocabulary and reading comprehension of the Iowa Tests of Basic Skills	pre-test score	* .3565
Father's occupational strata	pre-test score	* .3448
Hunting Frequency	pre-test score	*-.3639
Father's occupational strata	post-test score	.2682
School Subject Frequency	post-test score	-.2652
Farm Life Experience	post-test score	-.2546
Hunting Frequency	difference score	.2435
Hunting Target	difference score	-.2604

* partial r significant at .01 level

Table 10. Control Group Affective Domain

Independent Variable	Dependent Variable	Partial r
The cumulative raw score on the vocabulary and reading comprehension of the Iowa Tests of Basic Skills	post-test score	.2561
Food type preference	difference score	.2555

These independent variables were found to be related to the dependent variable in this fashion:

1. In the cognitive domain for the experimental group the following was noted:

a. As the cumulative raw score on the vocabulary and reading comprehension of the Iowa Tests of Basic Skills increased the students were more likely to have higher scores on the pre-test and/or the post-test.

b. As outdoor activity increased the students were more likely to score higher on the pre-test.

c. If the student's preference in school subjects was in favor of math or science, the student was more likely to score higher on the post-test.

2. In the cognitive domain for the control group the following was noted:

a. Girls were more likely to score better than boys on the pre-test.

b. As the cumulative raw score on the vocabulary and reading comprehension of the Iowa Tests of Basic Skills increased the students were more likely to have higher scores on the pre-test and/or the post-test.

c. Students who engage in non-physical activities are more likely to be affected to a greater extent in the treatment as shown by the difference score.

d. Greater hunting frequency correlated with a greater effect on the student by the environmental unit as shown by the difference score.

3. In the affective domain for the experimental group the following was noted:

a. As the cumulative raw score on the vocabulary and reading comprehension of the Iowa Tests of Basic Skills increased the students were more likely to have higher scores on the pre-test.

b. Those students whose fathers were a non-professional were more likely to have better scores on the pre-test and post-test.

c. Those students who did not hunt were more likely to acquire better scores on the pre-test.

d. If the student's preference in school was in favor of math or science the student was more likely to show a higher score in the post-test.

e. The more farm experience a student had the more likely the student would acquire a better score on the post-test.

f. Greater hunting frequency correlated with a greater effect on the student by the unit as shown by the difference score.

g. Students who hunted game species were affected more by the environmental unit as shown by the difference score.

4. In the affective domain for the control group the following was noted:

a. As the cumulative raw score on the vocabulary and reading comprehension of the Iowa Tests of Basic Skills increased the students were more likely to have higher scores on the post-test.

b. Students who preferred meat as a food type preference were more likely to be affected by the unit and indicated a greater improvement on the test as shown by the difference score.

Discussion of Hypothesis C

The only independent variable that reoccurred with enough consistency to indicate some value as a predictive variable was the cumulative raw score on the vocabulary and reading comprehension of the Iowa Tests of Basic Skills. This variable appeared on both

the pre-test and the post-test as significant at the .05 level in the cognitive domain for both groups. The same variable also appeared twice in the affective domain; once on the pre-test in the experimental group, and once on the post-test in the control group.

Summary of the Student and Parent Evaluation Questionnaire

Appendix H gives the distribution of responses to the student evaluation questionnaire and Appendix K gives the distribution of parent responses to the environmental curriculum questionnaire. The researcher had a 100% return on the Student Evaluation Questionnaire with 140 questionnaires returned. The parents returned 115 environmental curriculum questionnaires of the 140 mailed for an 82.1% return.

Both the students and parents felt the program should be continued with 92.1% of the students saying yes and 93.1% of the parents saying yes. The researcher found that seven of the 11 students that said "No, the subject should not be taught next year," were from the same class.

One of the researcher's main goals in sending out these questionnaires was to receive some feedback as to the excitement or interest that was experienced by the participating students. This was not a comparison between the control group and the experimental

groups and no effort was made to determine which elements generated the excitement.

Returns indicate a great deal of excitement and interest was present within the students. Ninety-four and six-tenths percent of the parents said that their child talked with either a great deal or moderate amount of interest and excitement about the field trip portion of the course. Eighty and eight-tenths percent of the parents said that their child talked with either a great deal or moderate amount of interest and excitement about the environmental unit discussed in class. Fifty-nine and three-tenths percent of the students in turn said that they got interested in the environmental unit and either really talked about it at home or talked more about it than they usually did about school. Sixty-nine and nine-tenths percent of the parents also indicated that this environmental experience had positively affected their child's interest and/or performance in school.

Conclusions

The statistical results of Hypothesis A indicate that students in the experimental group showed no significant improvement over the control group in the cognitive domain of the tests. However, that was not the case on the affective domain of the tests. It is for that reason the researcher feels this study indicates that environmental curricula designed to stress environmental

characteristics, interrelationships and understanding at the elementary level can change the behavioral attitudes of students. And, as stated in Chapter 1, that is the challenge of environmental education -- to change the behavioral attitudes of students and to develop a new awareness of man's relation to his environment.

The fact that the null statement of Hypothesis B was rejected with an F value far exceeding that required to be significant at the .01 level of significance supports the researcher's claim that behavioral attitudes of students can be changed with proper environmental curriculum.

The researcher believes this environmental unit had a very definite impact on both the attitude of students and teachers of the Whittier Elementary School.

The following are comments from an article about the environmental unit that appeared in the Bozeman Daily Chronicle on Sunday, May 28, 1972.

> Don Rummell, fourth grade teacher, gave his reaction to the program.
>
> "We had already finished the textbook when we started this. I think the reason the thing went over so well was that we involved the kids in learning outside of the classroom. They discovered things for themselves instead of just reading about them. If this type of education is to be effective we have to see that it runs through the entire school system. It isn't enough to expose them to it one time and hope they will remember it the rest of their lives."

Linda Hurless, a third grade instructor, disagreed, "I think that the children will remember this even if it is the only time they are involved in something like it. I can't believe the enthusiasm that they have shown. When we were coming down from the ranch one little girl walked up to me and said, 'wasn't that a good way to spend the morning?'

"Now that we have done something like this I think that the teachers will be able to keep it going and keep on making improvements in it. Already we have figured out better ways to operate the program in the short time we have been working on it."

Robert Kaufmann, school principal said, "This isn't the end but the beginning of an environmental education program. We don't intend to replace anything with it, but we do expect to add it on a regular basis to our science curriculum. It is amazing how well the students responded to it. One little girl, who was always the squeamish type before, had to be forced to let go of a fish on the field trip. We are giving these kids an experience that they would probably never get otherwise."

In an effort to make next year's environmental program better, the school district is sending Kaufmann and a yet unpicked representative from the junior high school to Deer Lodge to see the program that has been established there.

The following are some of the comments that parents wrote on the questionnaires they returned and give some insight into how the environmental unit affected their child.

She told us about a mouse that some boy had killed in the field near the school when the class was on an excursion. She informed us that he had no business doing this because the mouse was in his own environment.

The crawfish she brought home is still being cared for. She was amazed when it shed its skin in order to grow.

Her attitude and achievement in school seems to have improved -- especially when doing things for school at home.

Scott did a little experiment out-of-doors with a bug, 3 ants and a dead fly. Ants and bug ate the dead fly.

Mickey said he learned a lot from the field trip and when answering my questions I found he had too! He thought this would be a good thing for students to do next year.

My child really enjoyed the environmental unit and bubbled with excitement.

Field trips have been sadly neglected in the past few years and I believe they are important to a child's learning.

The only negative comment on any of the returns was the following:

Save your money for teaching ABC's.

The researcher concludes that a great deal of interest and excitement was present during the teaching of the environmental unit. Comments by students, parents and teachers indicate that this high level of interest and excitement was not a common occurrence.

Recommendations

The following recommendations from this study are presented.

1. The conclusions reached by the study are limited to a small population of grade school children in Bozeman, Montana. It is entirely possible that an environmental unit of this nature could

have lesser or perhaps greater impact upon children from a different geographical area or population belt. It would be worthwhile to repeat the study in both a rural setting and in a variety of urban schools from different sections of the nation.

2. Whether or not the effects of this environmental unit on students are temporary or of lasting duration is not answered in this study and should be investigated.

3. This study should be expanded to include the first through the sixth grades.

4. A linear method should be developed to represent the answers to the personal data questionnaire for better statistical comparisons.

APPENDIXES

Appendix A

ENVIRONMENTAL ENCOUNTER

An example of an environmental encounter recommended for a sixth grade class, is as follows: (Stapp, 1970:40)

INVESTIGATING A POND COMMUNITY

"An Environmental Encounter

for a Sixth Grade Class"

Behavioral Objectives:

In the completion of a successful encounter, the student should be able to:

1. Draw an accurate map of the drainage area of the pond community.

2. Describe in writing four ways that the land in the drainage areas affects the pond community.

3. Draw two (2) food chains illustrating organisms observed in the pond community.

4. List (number) major problems affecting the pond community.

5. Describe in writing the major steps in solving one (1) of the problems noted in question 4.

Activity:

1. What is the bottom of the pond community like: How does the type of bottom affect the kinds of plants and animals found in the pond community?

2. As you look from the center of the pond community toward the shore, are there plants growing under water, on the surface, and out of the water? Why are plants important to the pond community?

3. Dip a small jar into the pond and note if there are small organisms (these are probably plankton organisms). Why is plankton important to the pond community? What would cause plankton to increase or decrease?

4. Make or obtain a dip net and sample around the edge of the pond community. How are the animals you have caught important to the pond community? Draw a food chain linking some of the plants and animals you have noted in and around the pond community.

5. On a map of your community color in the land area that drains toward the pond. How has the use of this land changed over the past 15 years? What changes are occurring at the present time? How does the use of this land affect the pond community?

6. Do both children and adults visit the pond community? What do people do when they visit the pond community?

7. Do you see any problems that are affecting the pond community? Who is responsible for creating the problems? What could

your class do to help solve one of the problems noted above (define the problem, become informed about the problem, state alternative solutions, develop a plan of action, implement the plan)? Is your class motivated and concerned about <u>one</u> of the problems to the degree that they desire to work toward its solution?

Appendix B

PERSONAL DATA QUESTIONNAIRE

NAME_____ SEX: Check one: _____boy
_____girl

Please answer the questions as honestly as you can. If you do not know the answer to a question simply write: "I do not know" or "I do not wish to answer this question." This is not a test and your answers will not be read by anyone but this researcher. Thank you very much for your patience and cooperation.

Mit Parsons

1. How many brothers and sisters do you have? _____brothers
_____sisters

2. What kind of work (employment) do your parents do?

Father_____ Mother_____

3. What are your three favorite subjects in school?

1._____ 2._____ 3._____

4. What are your three favorite foods? 1._____

2._____ 3._____

5. What are your three favorite indoor activities?

1._____ 2._____ 3._____

6. What are your three favorite outdoor activities?

1._____ 2._____ 3._____

7. Check the one you prefer - outdoor activity _____
indoor activity _____

8. How many times a year do you go hunting? _____
Who do you go hunting with? _____
What do you hunt? _____

9. How many times a year do you go fishing? _____

   Who do you go fishing with? _____

10. What kinds of pets have you had? _____

    What kinds of pets do you now have? _____

    Do you feed and water your own pets? _____

11. Have you ever lived on a farm? _____

    How long did you live on a farm? _____

    Check where you would rather live -

    on a farm _____

    in town _____

Appendix C

COMPUTER FORMAT

Sex: female (1) male (2)

1. Siblings: 0 (1) 1-2 (2) 3-4 (3) 5 or more (4)

2. Father's work role:

professional (1) semi-professional (2) non-professional (3)

no parent (5) don't know (6)

Mother's work role:

professional (1) semi-professional (2) non-professional (3)

housewife (4) no parent (5) don't know (6)

3. School Subject Preference:

science (1) math (2) language arts (3) social studies (4)

arts (5) PE (6) don't know (7)

4. Food Type Preference:

fruit and vegetables (1) sweets (2) starches (3)

meats (4) don't know (5) all types (6)

5. Indoor Activity Preference:

non-physical (mental)	non-physical (non-mental)	physical	don't know
(1)	(2)	(3)	(4)

6. Outdoor Activity Preference:

non-physical (mental)	non-physical (non-mental)	physical	don't know
(1)	(2)	(3)	(4)

7. Indoor vs. Outdoor Preference:

indoor	outdoor	don't know
(1)	(2)	(3)

8. Hunting Frequency:

more than four	3-4	1-2	0
(1)	(2)	(3)	(4)

9. Hunting Companion:

family	non-family relative	non-peers	peers
(1)	(2)	(3)	(4)

none	self
(5)	(6)

10. Hunting Target:

game species	non-game species	none
(1)	(2)	(3)

11. Fishing Frequency:

more than four	3-4	1-2	0
(1)	(2)	(3)	(4)

12. Fishing Companion:

family	non-family relative	non-peers	peers
(1)	(2)	(3)	(4)

none	self
(5)	(6)

13. Pet Experience:

much	some	none
(1)	(2)	(3)

14. Farm Experience:

much	some	none
(1)	(2)	(3)

15. Farm vs. City Living Preference:

farm	city
(1)	(2)

Appendix D

EXPERIMENTAL GROUPS' DISTRIBUTION OF
THE PERSONAL DATA QUESTIONNAIRE

	Number	Percent
1. Sex:		
A. Female	42	54.5
B. Male	35	45.5
2. Siblings:		
A. zero	2	2.6
B. 1-2	41	53.2
C. 3-4	29	37.7
D. 5 or more	5	6.5
3. Father's Work Role:		
A. Professional	32	41.5
B. Semi-professional	21	27.3
C. Non-professional	21	27.3
D. No parent	2	2.6
E. Don't know	1	1.3
4. Mother's Work Role:		
A. Professional	10	13.0
B. Semi-professional	6	7.7
C. Non-professional	25	32.5
D. Housewife	35	45.5
E. No parent	0	00.0
F. Don't know	1	1.3
5. School Subject Preference:		
A. Science	4	5.2
B. Math	26	33.8
C. Language arts	8	10.4
D. Social Studies	0	00.0
E. Arts	20	26.0
F. Physical education	19	24.6
G. Don't know	0	00.0

	Number	Percent
6. Food Type Preference:		
A. Fruit and vegetables	10	13.0
B. Sweets	6	7.8
C. Starches	23	29.8
D. Meats	38	49.4
E. Don't know	0	00.0
F. .All types	0	00.0
7. Outdoor Activity Preference:		
A. Non-physical (mental)	0	00.0
B. Non-physical (non-mental)	3	3.9
C. Physical	74	96.1
D. Don't know	0	00.0
8. Indoor Activity Preference:		
A. Non-physical (mental)	20	26.0
B. Non-physical (non-metal)	24	31.2
C. Physical	33	42.8
D. Don't know	0	00.0
9. Indoor vs. Outdoor Preference:		
A. Indoor	7	9.1
B. Outdoor	69	89.6
C. Don't know	1	1.3
10. Hunting Frequency:		
A. More than four	22	28.6
B. 3-4	6	7.8
C. 1-2	14	18.2
D. 0	35	45.4
11. Hunting Companion:		
A. Family	40	51.9
B. Non-family relatives	0	00.0
C. Non-peers	0	00.0
D. Peers	1	1.3
E. None	35	45.5
F. Self	1	1.3

	Number	Percent
12. Hunting Target:		
A. Game species	40	51.9
B. Non-game species	3	3.9
C. None	34	44.2
13. Fishing Frequency:		
A. More than four	56	72.7
B. 3-4	6	7.8
C. 1-2	11	14.3
D. 0	4	5.2
14. Fishing Companion:		
A. Family	63	81.8
B. Non-family relatives	1	1.3
C. Non-peers	1	1.3
D. Peers	6	7.8
E. None	3	3.9
D. Self	3	3.9
15. Pet Experience:		
A. Much	27	35.1
B. Some	46	59.7
C. None	4	5.2
16. Farm Experience:		
A. Much	9	11.7
B. Some	13	16.9
C. None	55	71.4
17. Farm vs. City Living Preference:		
A. Farm	73	94.8
B. City	4	5.2

Appendix E

CONTROL GROUPS' DISTRIBUTION OF THE PERSONAL DATA QUESTIONNAIRE

	Number	Percent
1. Sex		
A. Female	31	49.2
B. Male	32	50.8
2. Siblings		
A. zero	1	1.6
B. 1-2	35	55.6
C. 3-4	25	39.6
D. 5 or more	2	3.2
3. Father's Work Role		
A. Professional	30	47.6
B. Semi-professional	23	36.6
C. Non-professional	4	6.3
D. No parent	1	1.6
E. Don't know	5	7.9
4. Mother's Work Role		
A. Professional	10	15.9
B. Semi-professional	13	20.6
C. Non-professional	6	9.5
D. No parent	33	52.4
E. Don't know	1	1.6
5. School Subject Preference		
A. Science	0	00.0
B. Math	26	41.3
C. Language arts	6	9.5
D. Social studies	1	1.6
E. Arts	20	31.7
F. Physical education	10	15.9
G. Don't know	0	00.0

	Number	Percent
6. Food Type Preference		
A. Fruit and vegetables	5	7.9
B. Sweets	13	20.6
C. Starches	20	31.7
D. Meats	21	33.3
E. Don't know	1	1.6
F. All types	3	4.8
7. Outdoor Activity Preference		
A. Non-physical (mental)	0	00.0
B. Non-physical (non-mental)	2	3.2
C. Physical	60	95.2
D. Don't know	1	1.6
8. Indoor Activity Preference		
A. Non-physical (mental)	12	19.0
B. Non-physical (non-mental)	29	46.0
C. Physical	18	28.6
D. Don't know	4	6.4
9. Indoor vs. Outdoor Preference		
A. Indoor	5	7.9
B. Outdoor	57	90.5
C. Don't know	1	1.6
10. Hunting Frequency		
A. More than four	15	23.8
B. 3-4	4	6.3
C. 1-2	10	15.9
D. 0	34	54.0
11. Hunting Companion		
A. Family	28	44.4
B. Non-family relatives	0	00.0
C. Non-peers	1	1.6
D. Peers	0	00.0
E. None	33	52.4
F. Self	1	1.6

	Number	Percent
12. Hunting Target		
A. Game species	27	42.9
B. Non-game species	3	4.8
C. None	33	52.4
13. Fishing Frequency		
A. More than four	51	81.0
B. 3-4	5	7.9
C. 1-2	6	9.5
D. 0	1	1.6
14. Fishing Companion		
A. Family	58	92.0
B. Non-family relatives	0	00.0
C. Non-peers	1	1.6
D. Peers	2	3.2
E. None	1	1.6
F. Self	1	1.6
15. Pet Experience		
A. Much	12	19.0
B. Some	48	76.2
C. None	3	4.8
16. Farm Experience		
A. Much	2	3.2
B. Some	8	12.7
C. None	53	84.1
17. Farm vs. City Living Preference		
A. Farm	47	74.6
B. City	16	25.4

Appendix F

PRE-TEST -- POST-TEST

Name_____

Grade_____

Directions: Please answer the questions below. Listen carefully to the instructions. The teacher will explain how to answer the questions. Do not guess! If you do not know the answer leave it blank. Please ask questions if you do not understand. Thank you very much for your cooperation.

Part I: (25 points)

Circle T if the statement is true, and circle F if the statement is false.

	True	False	
1.	(T)	F	Deer provide food for more than one animal.
2.	(T)	F	Soil occurs in layers.
3.	T	(F)	Birds will eat grasshoppers but fish will not eat grasshoppers.
4.	(T)	F	Keys are made by recognizing differences in colors, shapes and other identifying marks.
5.	T	(F)	Man is not part of the food web.
6.	(T)	F	All living things are dependent upon each other for life.
7.	(T)	F	Your environment is the sum of all your surroundings.
8.	T	(F)	Food chains always begin with animals.
9.	T	(F)	You cannot see, feel, smell, or taste your environment.
10.	T	(F)	A dragonfly can live anywhere.
11.	(T)	F	Fish living in a stream depend on the forest to keep the water clear and cold.
12.	(T)	F	All energy for plants and animals comes from the sun.

	True	False	
13.	(T)	F	The food chain is a process of eating and being eaten.
14.	T	(F)	Not every animal has a special place in the world.
15.	(T)	F	The plants and animals living in a stream and the plants and animals living around the stream are part of a community.
16.	T	(F)	Soils found near the school are the same as those found on a mountain.
17.	(T)	F	Green plants provide food for all living things.
18.	(T)	F	If we did not have green plants we would not have air to breathe.
19.	T	(F)	Insects do not have special jobs.
20.	(T)	F	For an animal to live a successful life his environment must be stable.
21.	T	(F)	A cow eating grass and a boy drinking milk is not a simple food chain.
22.	T	(F)	In order to be a community lots of plants and animals must be living together.
23.	(T)	F	All living things in the world are tied together like a spider's web.
24.	T	(F)	Partially decayed plants and animals are not found in soil.
25.	T	(F)	Pictures are needed in order to identify plants.

Part II: (45 points)

The following questions have more than one answer. Circle those answers which are correct.

1. Insects make their homes

(A.) on rocks in streams
(B.) in bark of trees
(C.) on other insects
D. in cement
(E.) in mud of ponds

2. Which of the following are examples of food chains?

(A.) grass-grasshopper-robin-hawk
B. rabbit-fox-car
(C.) algae-insect-fish-man
(D.) little fish-bigger fish-biggest fish
(E.) bush-deer-mountain lion-man

3. Insects eat

A. rabbits
(B.) grass
(C.) other insects
(D.) wheat
(E.) flowers

4. If a whole valley was planted with wheat and sprayed with chemicals to kill insects and mice what animals would probably die?

(A.) foxes
B. mountain lions
(C.) hawks
D. deer
(E.) insect eating birds

5. What materials are part of soil?

(A.) sand
B. gold
(C.) partially decayed plants
(D.) partially decayed animals
(E.) clay
F. plastic
(G.) large rocks

6. What can be members of a food chain?

A. rocks
(B.) leaves
(C.) flowers
D. cars
(E.) robins
(F.) whales
G. icicles
(H.) snakes
(I.) man
J. rifle
(K.) fox

7. Which of the following are plant eaters?

A. tigers
(B.) cows
(C.) horses
D. sparrows
(E.) man

8. Which of the following are part of a fish's environment?

(A.) oxygen
(B.) water
C. cows
D. fish hooks
(E.) insects
(F.) algae

9. Which of the following are part of your environment in Bozeman?

(A.) hot summers
(B.) schools
(C.) boys
(D.) snow
(E.) mountains
(F.) grass
G. oceans
H. banana trees
(I.) bicycles
(J.) girls
K. eskimoes

10. Examples of animals that have protective coloration are

(A.) grasshoppers
B. pink dragonflies
(C.) black beetles
D. red winged black birds
(E.) rabbits
F. white house cats
G. black angus cows

Part III: (7 points)

Circle the answer which you believe is correct.

1. If you killed all the mice in the Bozeman valley would many other animals die? (YES) NO

2. If you took a bulldozer and filled in a pond would you be destroying a community? (YES) NO

3. Could a stream that is muddy be in some way connected with the trees in the forest being cut? (YES) NO

4. Are fish a member of your school community? YES (NO)

5. Are garbage collectors a member of a city community? (YES) NO

6. Do people kill pheasants to eat? (YES) NO

7. When you eat meat are you eating an animal that was killed for you to eat? (YES) NO

Part IV: (75 points)

Example Question:

Do you like spinach? YES yes ? no NO

If you really like spinach--circle the big YES.
If you sort of like spinach--circle the small yes.
If you don't know if you like it or not--circle the question mark.
If you don't like spinach--circle the small no.
If you really hate spinach--circle the big NO.

1. Is environment important to people? (YES) yes ? no NO

2. Should we never kill any elk in Yellowstone Park?
YES yes ? no (NO)

3. Are deer more important than hawks and mice in the world?
YES yes ? no (NO)

4. Is it all right for man to dump sewage in the rivers?
YES yes ? no (NO)

5. Should man always think of himself first?
YES yes ? no (NO)

6. Should people kill pheasants to eat? (YES) yes ? no NO

7. Are people important animals? (YES) yes ? no NO

8. Would the world be better off if there were no people?
YES yes ? no (NO)

9. Is it all right for animals to kill and eat other animals?
(YES) yes ? no NO

10. Is it all right for people to kill and eat other animals?
(YES) yes ? no NO

11. Would you like to go hawk hunting? YES yes ? no (NO)

12. Do you like grasshoppers? (YES) yes ? no NO

13. Do you like pheasants? (YES) yes ? no NO

14. Do you like hawks? (YES) yes ? no NO

15. Do you like people? (YES) yes ? no NO

Appendix G

STUDENT EVALUATION QUESTIONNAIRE

Please read the following questions carefully and circle what you think is the best answer.

Name_____

1. How well did you like the three week environmental unit?

   A. It was great.
   B. It was pretty good.
   C. It was OK.
   D. It stunk.

2. How well did you like the field trip to the stream area?

   A. It was great.
   B. It was pretty good.
   C. It was OK.
   D. It stunk.

3. What part of the course did you like the best?

   A. Studying about how people affect the environment.
   B. Studying about how animals specialized and adapt to one small part of the environment.
   C. Studying about the physical make up of the environment like the chemistry of the water.
   D. Studying about the relationships of food chains (fish-eating insects, insects eating plants, etc.).
   E. Studying about how all these things are interrelated and affect each other.

4. Did you get interested and talk about this environmental unit at home?

   A. I really talked about it at home.
   B. I talked more about it than I usually do about school.
   C. I didn't talk much about it.
   D. I didn't talk at all about it.

5. Do you think students next year should be taught this subject?

A. yes
B. no
C. no preference

Appendix H

DISTRIBUTION OF RESPONSES TO
THE STUDENT EVALUATION
QUESTIONNAIRE

	Number	Percent
1. How well did you like the two week environmental unit?		
A. It was great	92	65.7
B. It was pretty good	27	19.3
C. It was OK	19	13.6
D. It stunk	2	1.4
2. How well did you like the field trip to the stream area?		
A. It was great	114	81.4
B. It was pretty good	13	9.3
C. It was OK	9	6.4
D. It stunk	4	2.9
3. What part of the course did you like the best?		
A. Circled one choice	79	56.4
B. Circled two choices	3	2.2
C. Circled three choices	0	00.0
D. Circled choice E	58	41.4
4. Did you get interested and talk about this environmental unit at home?		
A. I really talked about it at home.	36	25.7
B. I talked more about it than I usually do about school.	47	33.6
C. I didn't talk much about it.	48	34.3
D. I didn't talk at all about it.	9	6.4
5. Do you think students next year should be taught this subject?		
A. Yes	129	92.1
B. No	11	7.9
C. No preference	0	00.0

Appendix I

COVER LETTER

Whittier School
511 North 5th Avenue
Bozeman, Montana 59715
May 22, 1972

Dear

The School of Education at the Montana State University and the Whittier Elementary School are sponsoring a cooperative study to determine the results of a pilot environmental course that was taught in the elementary school the past two weeks. Since your child was involved, we think you might like to participate in the evaluation of the project. It would be very much appreciated if you would provide the information requested by the enclosed questionnaire. The information obtained will be used to determine how this program will be improved and expanded next year.

The purpose of this study is to learn whether exposing the child to an activity centered environmental field encounter affected the learning experience. The information that you provide will help us to determine the ways in which this change in the learning atmosphere may have affected your child. The findings of the study might also be of interest to you. I would certainly be willing to send a summary of the completed study to you if you indicate on the questionnaire that you would like to receive these results.

The number on the bottom of the questionnaire is a code number to help us identify your responses with your child. It will take five to ten minutes of your time to answer the questions. All information you provide will be kept in the strictest confidence.

Thank you very much for your time and consideration in providing this information.

Sincerely,

Milton G. Parsons

Appendix J

ENVIRONMENTAL CURRICULUM QUESTIONNAIRE

Please read the following statements carefully, then respond to each by circling the one or two statements which most accurately describe your child's response to the environmental course. Any additional comments may be added below the questions or on the back of this questionnaire.

1. How did your child talk about the <u>environmental field trip</u> portion of the course?

   A. With a great deal of interest and excitement.
   B. With a moderate amount of interest and excitement.
   C. With very little interest or excitement.
   D. Did not talk about it at all.

2. How did your child talk about the environmental unit <u>discussed in class</u> the last three weeks?

   A. With a great deal of excitement and interest.
   B. With a moderate deal of interest and excitement.
   C. With very little interest or excitement.
   D. Did not talk about it at all.

3. What evidence has your child given of his or her awareness of the interrelationships between living organisms (including man) and their physical environment?

   A. He or she has talked about the relationships of food chains (fish-eating insects, insects eating plants etc.).
   B. He or she has talked about the chemistry of water.
   C. He or she has talked about the importance of environment for living things.
   D. He or she has talked about man's relationship with other living things.
   E. He or she has talked about all of the above.
   F. He or she has not talked about any of these things.

4. To what extent do you think this environmental experience has affected your child's interest and/or performance in school?

   A. A greater enthusiasm for school has been demonstrated.
   B. A greater interest in other subjects has been created.
   C. He or she has been motivated to study the subject further.
   D. No effect has been noticed.

5. Would you recommend that this project be attempted or provided again?

   A. Yes
   B. No
   C. No preference

Appendix K

DISTRIBUTION OF PARENT RESPONSES TO THE ENVIRONMENTAL CURRICULUM QUESTIONNAIRE

	Number	Percent
1. How did your child talk about the environmental field trip portion of the course?		
A. With a great deal of interest and excitement.	73	64.0
B. With a moderate amount of interest and excitement.	36	31.6
C. With very little interest or excitement.	4	3.5
D. Did not talk about it at all.	1	0.9
2. How did your child talk about the environmental unit discussed in class the last two weeks?		
A. With a great deal of excitement and interest.	18	15.6
B. With a moderate deal of excitement and interest.	75	65.2
C. With very little interest or excitement.	10	8.7
D. Did not talk about it at all.	12	10.5
3. What evidence has your child given of his or her awareness of the interrelationships between living organisms (including man) and their physical environment?		
A. Circled one choice	42	36.8
B. Circled two choices	30	26.3
C. Circled three choices	6	5.3
D. Child talked about all the choices	22	19.3
E. Child talked about none of the choices.	14	12.3

	Number	Percent
4. To what extent do you think this environmental experience has affected your child's interest and/or performance in school?		
A. A greater enthusiasm for school has been demonstrated.	32	28.3
B. A greater interest in other subjects has been created.	32	28.3
C. He or she has been motivated to study the subject further.	15	13.3
D. No effect has been noticed.	34	30.1
5. Would you recommend that this project be attempted or provided again?		
A. Yes	107	93.1
B. No	2	1.7
C. No preference	6	5.2

Appendix L

FORMULAS USED IN TESTING HYPOTHESES A AND B

$$F = \frac{MS'_{by}}{MS'_{wy}} \quad \text{with df} = (k - 1), \quad (N - k - 1)$$

The total sum of products: $$SP_t = \sum_{j=1}^{k} \sum_{i=1}^{n_j} X_{ij} Y_{ij} - \frac{T_x T_y}{N}$$

The sum of products between groups: $$SP_b = \sum_{j=1}^{k} \frac{T_{xj} T_{yj}}{n_j} - \frac{T_x T_y}{N}$$

The sum of products within groups: $$SP_w = SP_t - SP_b$$

The adjusted total sum of squares: $$SS'_{ty} = SS_{ty} - \frac{(SP_t)^2}{SS_{wx}}$$

where SS_{ty} is total sum of squares for Y.

The adjusted sum of squares within groups: $$SS'_{wy} = SS_{wy} - \frac{(SP_w)^2}{SS_{wx}}$$

where SS_{wy} is sum of squares within for Y.

where SS_{wx} is the sum of squares within for the X-measures.

the adjusted sum of squares between groups may be calculated as a residual:

$$SS'_{by} = SS'_{ty} - SS'_{wy}$$

where:

$$MS'_{by} = \frac{SS'_{by}}{(K-1)}$$

$$MS'_{wy} = \frac{SS'_{wy}}{(N-K-1)}$$

(Roscoe, 1969:256-257)

Appendix M

FORMULA USED TO CALCULATE PARTIAL r FOR HYPOTHESIS C

$$t = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}}$$

where:

t = "students" t

r = partial r

$N - 2$ = degrees of freedom (Bailey, 1959:85)

REFERENCES CITED

REFERENCES CITED

Allen, Ralph E. (1972). A study of the effects of viewing a single topic 8mm. film of a simplified biological food chain upon elementary school children. Unpublished doctor's dissertation, University of Oregon.

Ames, Edward A. (1971). Schools and the environment. Journal of Environmental Education 2(3), 1-3.

Bailey, Norman T. J. (1959). Statistical Methods in Biology. London: English Universities Press.

Black, Dan. (1971). The study of a pond environment. Prepared at the University of Montana for a class under Dr. Roy White. (Mimeographed).

Carter, Good V. (1959). Dictionary of Education. New York: McGraw-Hill Book Co.

Converse, Alvion O. (1970). Dartmouth's college course I: an experiment in undergraduate education for environmental policy formulation. Journal of Environmental Education 2(2), 13-17.

Dewolf, Jim. (May 28, 1972). Pupils visit nature--and learn. Bozeman Daily Chronicle, Sec. II, p. 6.

Elementary Science Study. (1966). Teacher's guide for budding twigs. New York: Webster Division, McGraw-Hill Book Co.

Environmental education programs in Montana. (1971). Prepared by a student at the University of Montana for a class under Dr. Roy White. (Mimeographed).

Gold. (1969). Encyclopedia Britannica 10, 536.

Jaques, H. E. (1956). How to Know the Insects. Dubuque, Iowa: Wm. C. Brown Co.

Lagler, Karl F. (1956). Freshwater Fishery Biology. Dubuque, Iowa: Wm. C. Brown Co.

Leopold, Aldo. (1966). A Sand County Almanac. New York: Oxford University Press.

National Conference of the Conservation Education Association. (August, 1970). Definition: Conservation Education, Environmental Education, Outdoor Education. LaFayette, Louisiana.

National Education Association. (1970). Environmental Education in the Public Schools. Washington, D.C.

National Environmental Education Development. (1971). Adventure in Environment: Classroom Book, Outdoor Book, Teacher's Guide, New Jersey: Silver Burdett Co.

National Park Service educational programs. (July, 1970). National Parks and Conservation Magazine 44(274), 16.

Odum, Eugene P. (1959). Fundamentals of Ecology. Philadelphia and London: W. M. Saunders Co.

Office of Education (DHEW). (1970). Environmental Education -- Education that Cannot Wait. Washington, D.C.

Roscoe, John T. (1969). Fundamental Research Statistics. New York: Holt, Rinehart and Winston.

Roth, Robert E. (1972). The environment and man. Journal of Environmental Education 3(3), 44-48.

Schoenthal, Norman, Wilson Clark, Elmer Anderson and Roland Grant. (1972). Exploring the world -- an environmental education handbook for students. Billings. (Mimeographed).

Southard, A R. (February, 1969). Soils of Montana. Montana Agriculture Experiment Station, Bulletin 621.

Stapp, William B. (1970). Environmental encounters: a strategy for curriculum development and implementation (K-12). Journal of Environmental Education 2(1), 35-41.

Thayer, Gerald H. (1909). Concealing Coloration in the Animal Kingdom. New York: Macmillan Co.

Water. (1969). Encyclopedia Britannica 23, 270.

Weidner, Edward W. (1970). A whole university goes environmental. Journal of Environmental Education 2(2), 41-42.

White, Helen McCann. (1966). Ho! For the Gold Fields. St. Paul: Minnesota Historical Society.