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AUTHOR   Bennett, Dean B.
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ABSTRACT
        This guide, designed for teacher use, focuses on the
evaluation of environmental education experiences. The guide, which
is based on a doctoral study, is structured around three basic
evaluation questions: (1) What kinds of environmental education
learning experiences can you evaluate?; (2) What outcomes of
environmental education learning experiences can you look for?; and
(3) How can you determine the extent to which the outcomes have been
achieved? This guide is divided into three sections which deal with
the evaluation questions. The first section considers the goals of
environmental education. The three phases of the environmental
education process (discovery and inquiry; evaluation and problem
identification; and problem solving) are considered. The relationship
between what a person knows and feels in relation to his value
system, and how environmental education can affect and change this
relationship is discussed to answer question 2. Section three deals
with the third question; behavioral objectives as tools for
evaluating skills in discovery and inquiry, evaluation and problem
identification, and problem solving are examined. Sample test items
are included. The appendices include evaluation considerations, a
unit outline example, and the results of an evaluation. (TK)

G U I D E L I N E S

for

EVALUATING STUDENT OUTCOMES

in

ENVIRONMENTAL EDUCATION

Maine Environmental Education Project
TITLE III,   E.S.E.A.

by

Dean B. Bennett

Director

Yarmouth, Maine
1973

Introduction

This guide is intended for the teacher, the curriculum developer, the administrator and others who wish to examine, critically, the results of educational experiences. It is based upon a doctoral study designed to develop and test a model for evaluating student outcomes in environmental education.*

To increase the usefulness of the guide, it is structured around three basic evaluation questions:

1. What kinds of environmental education learning experiences can you evaluate?

2. What outcomes of environmental education learning experiences can you look for?

3. How can you determine the extent to which the outcomes have been achieved?

The answers to these three questions should provide helpful suggestions to those concerned with meaningful evaluation.

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* Dean Birchard Bennett, "The Development of a Model to Evaluate the Attitudinal and Behavioral Goals of K-12 Environmental Education," Unpublished Doctoral Dissertation. The University of Michigan, 1972.

I. What kinds of environmental education learning experiences can you evaluate?

Within recent years there has been an increased recognition of the need for environmental planning and decision-making responsibility on the part of all citizens. This, coupled with the current emphasis on the reappraisal of American education and on curriculum reform, has given impetus to the establishment of education programs which relate to man and his environment.

The Goals of Environmental Education

It is clear today that environmental education, as it is called, is directed towards the development of attitudes and behavioral skills in the area of environmental decision-making and problem solving. Accordingly, the Maine Environmental Education Project defines environmental education as a process aimed at producing a citizenry that is knowledgeable concerning the total environment and the role of man, able to participate in activities for maintaining and improving the quality of the environment while meeting human needs, and motivated to do so.

Derived from this goal and definition are the following subgoals:

1. (Affective Subgoal)

   To help individuals acquire strong feelings fundamental to developing a concern for the environment and a motivation to participate in activities for maintaining and improving the quality of the total environment.

2. (Cognitive Subgoal)

   To help individuals acquire basic understanding of the total natural and man-made environment, their relationship with this environment, and common environmental problems.

3. (Behavioral-Skill Subgoal)

   To help individuals develop the necessary thinking and behavioral skills for the prevention of environmental degradation, the correction of environmental

abuses, and the alteration and use of natural re-
sources to enhance the function and quality of the
environment to meet ecological including human needs.

Environmental Education As A Process

Environmental education is viewed as a process in which
the student participates in three levels of learning
experiences:
1) discovery and inquiry,
2) evaluation and problem identification, and
3) problem solving.
Problem identification and problem solving as used here
involve not only the recognition, prevention, and
resolution of environmental problems but the activities
in which students alter and create components in their
environment to enhance its function and quality.
Students may either act directly on the environment or
communicate a concern to others to encourage their
participation.

The environmental education learning process emphasizes
first-hand experiences focusing on the total environment
of the community and immediate surroundings of the student,
for example, the school site or neighborhood. The three
phases of the process also include classroom experiences.

This approach to environmental education provides an
interdisciplinary means of developing values, attitudes,
conceptual understandings, critical thinking and
behavioral skills.

The process may be carried out by students participating
in studies relating to the components of the total natural
and man-made environment and related social, political
and economic aspects. Figure One suggests how the envir-
onmental education process may relate to the study of a
natural component of the environment. Figure Two is an
outline for the study of walkways and pathways as
examples of a man-made environmental component. It
should be stressed that it is not particularly important
which of the many environmental components is studied
nor that all the components be studied. Rather, it is
the process and associated cognitive, affective and skill
outcomes which should be emphasized and which will carry
over with the student.

FIGURE 1

THE PROCESS OF
ENVIRONMENTAL EDUCATION

Natural Environment Example: Trees (plants)

Discovery - Inquiry	Evaluation - Problem Identification	Problem Solving
Classroom activities - Learn about the characteristics, interrelationships, changes, and uses of trees through lessons, books and publications, resource people, films, and other instructional aids.	Group or independent development of criteria to assess: 1) how well trees meet ecological needs, e.g., hold soil, prevent erosion, provide homes for wildlife, etc., and 2) how well trees meet human needs, e.g., physical needs, shade, etc.; psychological needs, aesthetics, etc.; social needs, gathering places, etc. Evaluate how well trees meet these needs in a real or hypothetical situation to identify environmental improvement opportunities.	Select a hypothetical problem, e.g., landscape a small park with trees. 1. Investigate the problem - needs, kinds of trees, etc. 2. Develop alternative solutions, plans for different plantings in a variety of locations. 3. Choose a solution after considering effects of each. 4. Develop plan of action - list steps and items needed. 5. Present plan for evaluation by others.
On-site activities - Investigate the trees on the school site and map and describe the kinds present on the site, their locations, sizes, condition, environmental effects, etc.	Develop evaluative criteria as above and assess extent present trees on the school site meet criteria. Identify: 1) existing conditions which need to be corrected - diseased trees, storm damaged trees, etc., 2) conditions which could be enhanced by planting trees, and 3) conditions threatening trees which should be prevented.	Select a tree problem to resolve on the school site; for example, white pine blister rust, etc. 1. Investigate causes, effects. 2. Develop alternative solutions. 3. Choose a solution. 4. Develop a plan of action. 5. Carry out plan. 6. Evaluate results.

FIGURE 2

THE PROCESS OF ENVIRONMENTAL EDUCATION

Man-Made Environment Example:

Walkways and Pathways (transportation-circulation areas)

Discovery - Inquiry	Evaluation - Problem Identification	Problem Solving
Classroom activities -	Individual and group development of criteria to assess: 1) effects of walkways and pathways on the natural ecosystem - altering drainage patterns, changing microclimate, removing vegetation, etc., and 2) how well walkways and pathways meet human needs: physical - safety, etc., psychological - aesthetics, etc., and social - bringing people together, etc.	Select a hypothetical problem, e.g., develop a plan for a new pathway.
Learn about the kinds, locations, functions, and characteristics of walkways and pathways through lessons, books and publications, resource people, films, and other instructional aids.		1. Investigate the problem - needs, kinds of pathways, etc.
		2. Develop alternative solutions - routes, kinds of pathways, etc.
	Evaluate walkways and pathways in a real or hypothetical landscape design plan.	3. Choose a solution after considering effects of each.
		4. Develop plan of carrying out solution.
		5. Present plan for evaluation by others.
On-site activities - /	Apply evaluative criteria as suggested above to walkways and pathways being assessed on site.	Select a walkway or pathway problem to help resolve on the school site or in the community.
Investigate walkways and pathways on the school site or in the community. Map and describe the kinds, locations, characteristics, conditions, and human and environmental effects.	Identify: 1) existing conditions which need to be corrected - erosion, potholes, rerouting, etc., 2) conditions which should be prevented - footwear erosion from overuse, encroachment of vegetation, etc., and 3) conditions which could be enhanced by creating new pathways, signs, etc.	1. Investigate causes and effects.
		2. Develop alternative solutions.
		3. Choose a solution.
		4. Develop a plan of action.
		5. Carry out plan.
		6. Evaluate results.

II. What outcomes of environmental education learning experiences can you look for ?

SKILL OUTCOMES

The outcomes of environmental education may be stated as behavioral objectives which reflect the three phases of the learning process described in Section I.

1. DISCOVERY AND INQUIRY

    The student will be able to and will continually seek to discover and investigate the components and characteristics of his total environment and the relationship of man with this environment.

    This includes the following skills:

    a. Recognizing the structure, components and processes in natural and human ecosystems.

    b. Investigating the components and processes.

2. EVALUATION AND PROBLEM IDENTIFICATION

    The student will be able to and will continually develop and apply criteria to evaluate the data related to his total environment and associated human processes and to identify opportunities for maintaining and improving his environment.

    This includes the following skills:

    a. Developing criteria and evaluating how well ecological — human needs are being or are likely to be satisfied by environmental components and processes.

    b. Identifying opportunities for environmental maintenance and improvement.

3. PROBLEM-SOLVING

    The student will be able to and will continually participate in selecting and successfully carrying out environmental problem-solving activities involving the prevention and resolution of environmental problems and the alteration or creation of components to enhance the function and quality of the environment.

This includes the following skills:

a. Selecting and defining an issue or problem.

b. Inquiring to become informed about the problem through investigation.

c. Determining alternative solutions to the problem.

d. Evaluating the consequences of solutions and choosing a solution.

e. Developing a plan of action.

f. Implementing the plan of action.

g. Evaluating the process and results.

Each of the above three behavioral outcomes represent skills which may be developed through the "process" learning experiences.

In addition, since a person's behavior is influenced by how he feels and what he knows, related affective (feelings) and cognitive (knowledge) outcomes should also be identified.

KNOWLEDGE AND FEELING OUTCOMES

It was suggested in the previous paragraphs that feelings and knowledge motivate and guide behavior. According to popular theory these are two components of attitudes. An attitude is thought of as an inclination to be motivated by, to experience and to act toward objects. Objects may be either concrete, physical objects or abstract ideas. It is further theorized that the tendency to act towards an object is the third component of an attitude and is produced by the other two - feeling and knowledge. Attitudes in turn form values which group to form a value system. Values are basic and enduring motivations to act toward or with respect to what an individual prizes. In this way they may be thought of as clusters of action tendencies necessary for self-motivated behavior. Since action tendencies are produced by knowledge and feelings, it follows that values and subsequent behavior may be developed by helping students acquire feelings and knowledge.

Knowledge in today's curriculum is thought of in terms of basic concepts. The conscious mental processes of interplay and development of values and attitudes and their components are called thinking.

The development of attitudes, values and thinking skills can lead to the occurrence and guidance of overt behavior which in turn may reinforce these variables.

See Figure 3 for a schematic of this theory.

Figure 3:   Attitude - Behavioral Model
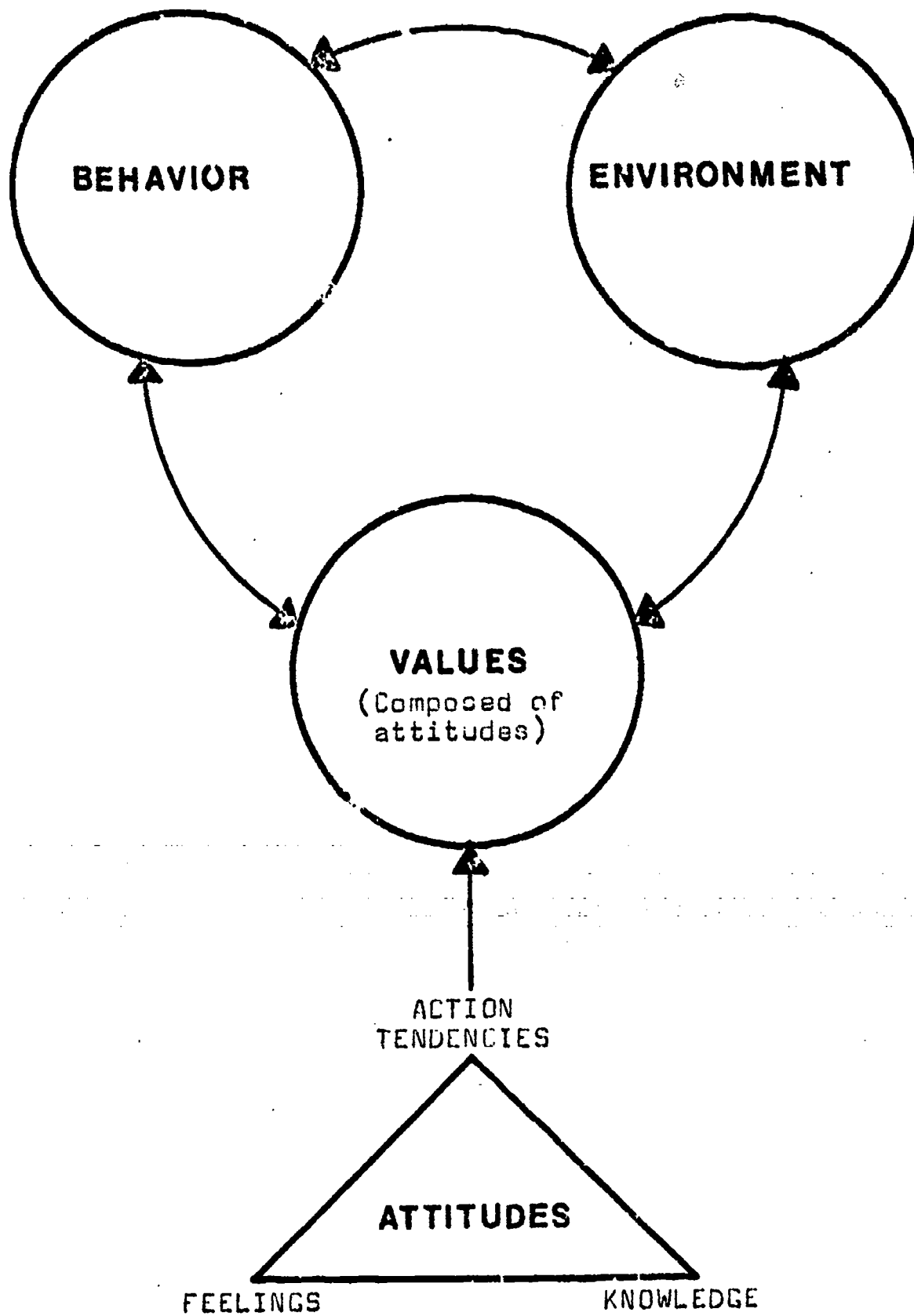
The goal of environmental education suggests that it aims to help individuals acquire an ecologically oriented value system composed of the following two values with their associated attitudes and identified cognitive and affective components. Again, it is stressed that it is the cognitive components (concepts) and affective components (feelings) that this guide focuses on for evaluation. The following scheme is presented as a way of showing how they were derived from the goal of environmental education.

An ecologically oriented value system is composed of:

1. **Value of Nature**

    A value of nature consists of attitudes toward nature. Attitudes toward nature are composed of:

    a. **Affective Components**

        These components are characterized by an awareness, appreciation and concern for the existing and future aspects of the natural environment.

    b. **Cognitive Components**

        These components are characterized by the following ecological concepts:

        1) **Natural Ecosystem - Structure and Function**

            The natural environment of the Earth is essentially a closed and finite system composed of natural ecosystems having:

            a) **Structure and Components**

                Structure is related to the diversity of plants and animals, including producers, consumers, decomposers, and transformers which utilize matter - land, water, air - and energy.

            b) **Function**

                Energy flows and matter cycles through plants and animals at varying rates.

2) <u>Natural Ecosystem - Characteristics, In-</u>
<u>terrelationships, and Changes</u>

The characteristics, interrelationships
and changes of the components relate to
the functioning of natural ecosystems in
a process tending ideally toward stability.

a) <u>Characteristics</u> of location, diversity,
quantity and quality of components are
involved in the functioning of the
natural environment.

b) <u>Interrelationships</u> between components
provide for use and cycling of matter
and the use and flow of the sun's
energy.

c) <u>Changes</u> occur continually in both the
structure and function of natural
ecosystems.

3) <u>Natural Ecosystem Stability</u>

Stability is a measure of a healthy and
lasting environment and results from
natural ecosystems possessing <u>character-</u>
<u>istics</u>, <u>interrelationships</u> and <u>changes</u>
which reflect:

a) <u>Structure</u>

(1) A complex network of diverse
species with balanced populations.

(2) Availability of matter.

b) <u>Function</u>

(1) Efficient utilization of energy.

(2) Efficient cycling of matter.

2. <u>Value of the Role of Man as a Steward and Creator</u>
<u>of His Environment</u>

A value of the role of man consists of attitudes
toward the role of man as a steward and creator,
attitudes toward oneself (self-concept) and at-
titudes towards others (social concept).

a. <u>Attitudes Toward the Role of Man</u>

1) <u>Affective Components</u>

These components are characterized by a positive feeling that man should be both a steward and creator of a quality environment now and for the future.

2) <u>Cognitive Components</u>

These components are characterized by the following human ecosystem concepts:

a) <u>Human Environmental Dependency and Needs</u>

Man is the linking component between the natural environment upon which he is dependent and of which he must be a steward and the man-made environ-- ment which he creates to help provide for physical, psychological, and social needs: (The following are needs which provide criteria for environmental evaluation.)

(1) Human <u>physical</u> needs are pro-vided for by environmental components which function and possess characteristics related to:

(a) Convenience and efficiency

(b) Safety and health

(c) Durability or lastingness

(2) Human <u>psychological</u> needs are met by components which are pleasur-able to the senses.

(3) Human <u>social</u> needs are met by components which assist people to live in harmony together, to interact, and to gain a measure of individual and group recognition.

b) <u>Human Ecosystem - Structure and Function</u>

Man exercises stewardship and provides
for his needs by working on the natural
environment through an institutional
system of man-to-man relationships and
a technological system of man-to-
environment relationships to produce
and manage the following components
of the man-made environment:

(1) Production areas

(2) Human settlement areas

(3) Open space areas

(4) Transportation and circulation
     areas

(5) Recreational areas

(6) Community service and utility areas

c) <u>Associated Environmental Problems</u>

Environmental issues and problems
are often associated with the size,
concentration, physical characteris-
tics of the human population and
result from the lack of effective
individual citizen, institutional,
and technological response to exist-
ing and future effects of ecological
and human demands upon the environ-
ment.

b. <u>Attitudes Toward Oneself</u> (self-concept)

1) <u>Affective Components</u>

These components are characterized by
a feeling of individual worth and
potential.

2) <u>Cognitive Components</u>

These components are characterized by an
understanding or knowledge of one's needs,
abilities, limitations, and potential.

c. <u>Attitudes Toward Others</u> (social concept)

1) <u>Affective Components</u>

These components are characterized by a
sensitivity to and concern for the needs
of others including future generations.

2) <u>Cognitive Components</u>

These components are characterized by an
understanding or knowledge of the needs
of others including future generations.

III. How can you determine the extent to which the outcomes have been achieved?

On the following pages the cognitive, affective and skill outcomes previously identified have been re-written and described as basic observable and measurable behaviors. These behavioral statements or objectives describe what the student should do, to what extent and under what conditions to indicate that each outcome sought has been achieved. In addition, the desired skills, concepts and feelings are written to relate to each of the three environmental education experiences

   1) discovery-inquiry

   2) evaluation and problem identification, and

   3) problem-solving.

Using the basic behavioral objectives for skills, concepts and feelings as a guide the teacher can develop courses, units, independent studies, presentations, field trips and any number of educational experiences to achieve the identified outcomes. In designing these learning experiences, the teacher might first choose those skills, feelings and concepts he or she wishes to develop. For each of these a basic behavioral objective is suggested. Using these as a guide, the teacher may then write behavioral objectives which describe what the student will do while participating in the unit, presentation, field trip, etc. These are called process or learning activity objectives since they occur while the students are in the process of being involved in the learning experience. Actually, they describe what the teacher should look for during class activities which indicates that students are progressing satisfactorily.

A second kind of behavioral objective can also be developed from each basic behavioral statement. This behavioral objective is used to guide the formal testing of the skills, concept or feeling both before and after the learning experience. In this kind of evaluation students might be asked to take a pencil-and-paper test. Such a test is particularly suited for evaluating skills and knowledge.

A third kind of behavioral statement can be developed
from the basic behavioral objective. This is one
especially related to evaluating feelings. It is called
an unobtrusive evaluation technique because the student
is not aware that he is being tested. It is an advan-
tage for the evaluator when determining the presence of
certain feelings that the student is not biased by the
knowledge that he is being observed by the teacher.

On the next few pages examples of these three evalua-
tive techniques are given. These examples relate to
behavioral objectives developed for a junior high
school unit on the school environment (see Appendix B
for description of the unit). Three unit behavioral
objectives, i.e., learning activity, pencil-and-paper,
and unobtrusive, in turn have been drawn from the basic
behavioral objectives. These describe what a student
should do to indicate that he possesses skills, concepts
or feelings.

It should be noted that each of the concepts and feelings
identified in this booklet may be developed through any
of the three learning experiences - discovery-inquiry,
evaluation-problem identification, or problem-solving.
Therefore, basic behavioral objectives for each concept
and feeling may be written which relate to the three
activities. In this guide, however, only one basic
objective related to one of the three activities has
been written as an example.

SKILLS

DISCOVERY - INQUIRY SKILLS

(Written to be developed through discovery - inquiry
learning experiences)

1. SKILL IN RECOGNIZING AND SELECTING TOPICS TO INVESTIGATE.

Basic Behavioral Objective: The student will more
completely identify and select topics for study re-
lated to all the major components of the natural and
man-made environment.

Example: Related Process or Learning Activity

Behavioral Objective (what the student

will do during the learning experience)

The student will identify the major components and
related topics of the total natural and man-made
environment of the school site and select one for
study.

Example: Related Formal Evaluation Behavioral

Objective

The student will, while observing a series of
slides of a school site, complete a list of broad
environmental topics and components which should be
investigated to gain an understanding of the total
natural and man-made environment.

Sample Test Item:

Assume that you wish to improve the environment of your school site. First, you decide to learn as much about the total surroundings of your school as you can. This will help you to discover improvement opportunities you can work on.

What are the major natural things in our environment?

As you view the slide, check the list below carefully to see if it includes all the major natural parts of our total environment. If you feel the list is complete, check the space at the top. If incomplete, add to the list.

Major Natural Parts

The list below is complete _____

    Land (soils, rocks, minerals, etc.)
    Energy (sunlight)
    Plants
    Animals

If list is incomplete, add here:_____

_____

_____

2. SKILL IN CARRYING OUT AN INVESTIGATION

Basic Behavioral Objective: The student will develop more complete plans and draw upon an increasing number of different sources of relevant and accurate information in his investigation of the components and characteristics of his total environment and man's role in meeting ecological and human needs.

Example: Related Process or Learning Activity

Behavioral Objective

The student will plan the objectives and steps of his investigation and identify and utilize a number of sources of information including first-hand study on-site.

Example: Related Formal Evaluation Behavioral

Objective

The student will, while observing a slide of a component of a school site select the most important kinds of information to gather and arrange a series of investigative steps in a logical order to carry out the gathering and compiling of information.

Sample Test Items:

You have been asked to gather information on the school site which will help identify improvements for the movement of people and vehicles. Included are facilities for walkways, streets and drives and parking areas as shown in the slide.

a. Listed below are some of the different kinds of in-formation you should gather to help you in finding improvements which could be made for the movement of people and vehicles on the site.

Check the five most important kinds of information you would need.

_____   Who maintains the facilities?

_____   How long have the facilities been in existence?

_____ What kinds of facilities exist?

_____ What is the condition of the facilities?

_____ Where are the facilities located?

_____ What are the effects of the facilities on people and nature?

_____ How are the facilities maintained?

_____ What are the future needs for movement of people and vehicles on the site?

b. Number the steps below in the way you would go about investigating the traffic and pedestrian facilities on the school site.

_____ Complete a detailed map of the site's transportation and circulation facilities upon which to show problem areas.

_____ Prepare a written report on your findings.

_____ Interview the school maintenance department personnel to determine how well the facilities are meeting needs and record areas where improvements could be made.

_____ Study and observe the facilities in operation to confirm problems and discover new areas of improvement.

_____ Take a walk around the site to find out, sketch and note the kinds, sizes and locations of existing facilities.

3. SKILL IN COMPILING INFORMATION

Basic Behavioral Objective: The student will, with an increasing degree of skill, accuracy, and completeness compile and organize collected information in both written and graphic (maps, graphs, etc.) form.

Example: Related Learning Activity Behavioral

Objective

The student will completely and accurately compile information in both written and graphic form.

Example: Related Formal Evaluation Behavioral

Objective

The student will, while observing a series of slides of a school site, correct and complete a map of the site showing the location, shape, and relative size of major components.

Sample Test Item:
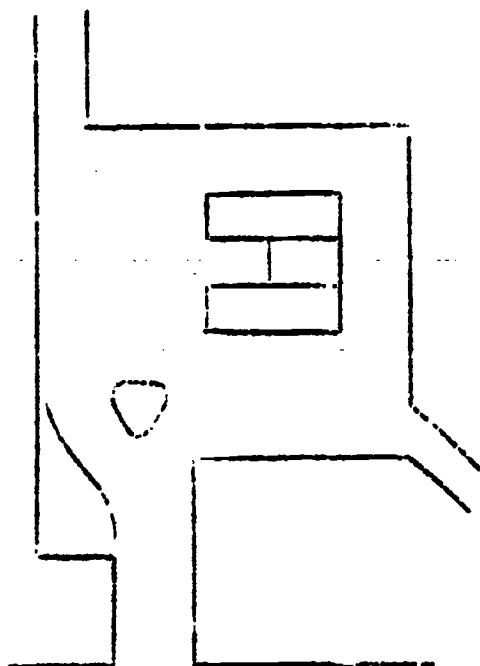
Here is a sketch map of your school. Locate your classroom with an X. Change any of the features which are not located properly if this is needed. Add and locate the school flagpole on the map.

EVALUATION - PROBLEM IDENTIFICATION SKILLS

(Written to be developed through evaluation-problem identification learning experiences)

4. SKILL IN DEVELOPING EVALUATIVE CRITERIA

Basic Behavioral Objective: The student will in-
crease in his ability to develop meaningful criteria
based upon fundamental natural and human needs and
processes for the purpose of seeking meaning from
collected data.

Example: Related Learning Activity Behavioral

Objective

The student will develop criteria based upon natural
and human needs and processes for the purpose of
judging the degree to which selected natural and
man-made components meet the identified needs.

Example: Related Formal Evaluation Behavioral

Objective

The student will, while observing a slide showing
an unstable and more stable natural environments,
select accurate definitions of natural ecosystem
stability.

Sample Test Items:

A healthy and lasting natural environment is one which:
(Circle four statements which are more likely to describe
a stable environment.)

1) contains many different kinds of plants with
   balanced numbers

2) contains only a few kinds of plants but each
   kind in large number

3) has much matter (plant nutrients) available

4) has little matter (plant nutrients) because
   it has been used

5) a small amount of the sun's energy is being
   used by plants and animals

6) a large amount of sunlight is being used but
   it is not being recycled

7) matter (nutrients) is being recycled and re-
   used

5. SKILL IN EVALUATING THE ENVIRONMENT AND IDENTIFYING

   OPPORTUNITIES FOR MAINTAINING AND IMPROVING THE

   ENVIRONMENT

   Basic Behavioral Objective: The student will
   evaluate data against criteria and identify and
   define existing and potential environmental issues
   and problems in increasing number and complexity.

   Example: Related Learning Activity Behavioral

   Objective

   The student will evaluate collected data against
   criteria and identify and define opportunities to
   help prevent environmental abuses, correct exist-
   ing detrimental conditions and alter the environ-
   ment to enhance its function and quality.

Example: Related Formal Evaluation Behavioral

Objective

The student will, while observing a series of slides showing selected natural and man-made environmental features, indicate for each feature shown the most important need it doesn't meet by writing its number opposite the appropriate response.

Sample Test Item:

For each of the next five slides, answer the following questions.

To the right is a list of needs which the environment should meet. As you view each environmental feature or condition shown by a slide, select from the list at the right the most important need not being met. Place the number of the need in the blank space after the letter of the slide.

Need Which is NOT Being Met	Needs Which the Environment Should Meet
SLIDE A _____	1. A variety of healthy trees and plants
SLIDE B _____	2. Matter (soil nutrients) available and not being lost
SLIDE C _____	3. Man-made things are convenient and efficient to use
SLIDE D _____	4. Man-made things are safe and healthy
SLIDE E _____	5. Parts of the environment are pleasing - enjoyable to look at

PROBLEM - SOLVING SKILLS

(Written to be developed through problem-solving
learning experiences)

6.   SKILL IN PROBLEM-SOLVING

Basic Behavioral Objective: The student will in-
crease in his ability to select and define issues
and problems and efficiently, completely and
successfully think through and help carry out the
environmental problem-solving processes with
selected issues and problems:

a.   Investigate the issue or problem to become
     informed.

b.   Determine alternative solutions and their
     consequences.

c.   Evaluate the consequences of solutions and
     choose appropriate ones.

d.   Develop a plan of action.

e.   Implement the plan of action.

f.   Evaluate the process and results.

(Included in the above are skills related to critical
thinking, change strategy and political efficacy.)

Example: Related Learning Activity Behavioral

           Objective

The student will successfully participate in the
process of selecting, planning, and carrying out
an environmental problem-solving activity.

Example: Related Formal Evaluation Behavioral

Objective

The student will, given a series of slides and descriptive information related to environmental problems:

a.   define central issues,

b.   correct, complete, and logically arrange a
     list of problem-solving steps,

c.   identify most likely sources of information,

d.   select the best alternative solutions from
     several possibilities described,

e.   select the most logical rationale for the
     alternative solution chosen,

f.   choose a logical plan of action from several
     described, and

g.   choose the best evaluation procedure from
     several described.

Sample Test Items:

1.   This is a marker along a nature trail which was
     built near a school to give both students and visitors
     an opportunity to walk around the site and enjoy it
     as well as to learn about it. The marker locates
     and describes for the visitor a special area where
     certain kinds of wildlife may live.

     Imagine you are going to help a class build a nature
     trail on the school site as these students are doing.
     Below is a listing of some of the important things to
     be done.

     Number these in the order which you think they should
     be carried out numbering your first step as one (1).

_____ Make a map of the locations of different things found on the site.

_____ Study how the trail is being used and what people think about it so that if changes are needed they can be made.

_____ Investigate the area which will be used for a nature trail. Find out, study, and describe what is there.

_____ Choose the one best route to take after considering the problems which might occur with each one planned.

_____ Make a plan of how the trail will be built; who will do what, when to do it, what is needed for equipment, etc.

_____ Draw several different routes the trail might take so the visitor will have an enjoyable and educational experience.

2. Here is a stunted and diseased tree un the parking area and playground of a school. The tree is the only one near the school, it provides shade, attracts wildlife, and the students have a great deal of fun playing on it. Some say the tree should be removed because it is obviously sick and dying, falling dead limbs could be a hazard - "a sick tree is a dangerous tree," it takes time to plow around it in winter, and it is in the way for needed parking during most of the year. Others say it is not dying and it's health can be restored by breaking away the tar from around its base so it can get more air and water, its dead limbs can be cut off, a new parking area should be found, and the tree should be left on the site.

Check the statement below which you believe to be correct.

_____ The main issue here is finding a parking area.

_____ The main issue here is whether the tree is going to die or not.

_____ The main issue here is whether or not there should be a tree in the school yard. •

CONCEPTS

(COGNITIVE DOMAIN)

NATURAL ENVIRONMENT CONCEPTS (Natural Ecosystem)

1. NATURAL ECOSYSTEM - STRUCTURE AND FUNCTION CONCEPT

> (This example is written to be developed through Discovery-Inquiry Learning Experiences)

Basic Behavioral Objective: The student will describe and explain with increasing completeness and accuracy the components and ecological characteristics of his total natural environment giving evidence of an understanding of the following basic ecological concept:

a. Natural Ecosystem - Structure and Function

The natural environment of the Earth is essentially a closed and finite system composed of natural ecosystems having:

1) Structure and Components

Structure is related to the dieversity of plants and animals, including producers, consumers, decomposers, and transformers which utilize matter-land, water, air and energy.

2) Function

Energy flows and matter cycles through plants and animals at varying rates.

Example: Related Learning Activity Behavioral

Objective

The student will gather and compile information in both written and graphic form which gives evidence

of an understanding of natural ecosystem structure and function.

Example: Related Formal Evaluation Behavioral

Objective

The student will, while observing a series of slides of environmental components, correctly designate descriptive statements as true or false giving evidence of an understanding of natural ecosystem structure and function.

Sample Test Items:

T   F   Soil is limited in amount on Earth and this is different from water which is unlimited in amount.

T   F   In nature the minerals in soil are picked up and used by plants. If nature is working properly they will be re-used.

T   F   Without green plants like these on this school site, matter from land and the energy from the sun cannot be used by animals.

2. NATURAL ECOSYSTEM - CHARACTERISTICS, INTERRELATION-

SHIPS AND CHANGES CONCEPT

(This example is Written to be Developed Through Discovery-Inquiry Learning Experiences)

Basic Behavioral Objective: The student will des-
cribe and explain with increasing completeness
and accuracy the components and ecological charac-
teristics of his total natural environment giving
evidence of an understanding of the following
basic ecological concept:

Natural Ecosystem - Characteristics, Inter-
relationships, Changes

The characteristics, interrelationships, and
changes of components relate to the function-
ing of natural ecosystems in a process tending
ideally toward stability:

1) Characteristics of location, diversity,
   quantity and quality of components are in-
   volved in the functioning of the natural
   environment.

2) Interrelationships between components pro-
   vide for use and cycling of matter and the
   use and flow of the sun's energy.

3) Changes occur continually in both the
   structure and function of natural ecosystems.

Example: Related Learning Activity Behavioral

           Objective

The student will gather and compile information in
both written and graphic form which gives evidence
of an understanding of natural ecosystem character-
istics, interrelationships, and changes.

Example: Related Formal Evaluation Objective

The student will, while observing a series of slides
of environmental components, correctly designate
descriptive statements as true or false giving evi-
dence of an understanding of natural ecosystem
characteristics, interrelationships, and changes.

Sample Test Items:

T   F   Keeping track of the kinds and members of
          animals on the site will not help us find out
          about natural changes that may be occurring
          on the site.

T   F   All animals, including this frog, depend upon
          plants for food and energy.

T   F   The amount of soil is likely to change more.
          quickly here because of water rather than
          because of air, plants, or animals.

3.. NATURAL ECOSYSTEM - STABILITY CONCEPT

        (This Example is Written to be Developed Through
         Evaluation-Problem Identification Learning
         Experiences)

        Basic Behavioral Objective: The student will develop
        evaluative criteria and identify and define an in-
        creasing number of existing and potential issues and
        problems of increasing complexity giving evidence of
        an increasing understanding of the following natural
        ecosystem concept:

            Natural Ecosystem Stability

            Stability is a measure of a healthy and lasting
            environment and results from natural ecosystems
            possessing characteristics. interrelationships,
            and changes which reflect:

            a.   Structure

                1)   a complex network of diverse species
                     with balanced populations.

                2)   availability of matter.

b. Function

    1) efficient utilization of energy

    2) efficient cycling of matter

Example: <u>Related Learning Activity Behavioral</u>

        <u>Objective</u>

The student will develop evaluative criteria and
identify and define existing and potential issues
and problems which are based upon and give evidence
of an understanding of the concept of natural eco-
system stability.

Example: <u>Related Formal Evaluation Behavioral</u>

        <u>Objective</u>

The student will, while observing a series of slides
showing a variety of natural ecosystem environmental
conditions, give evidence of an understanding of
natural ecosystem stability by identifying features
or conditions which meet or do not meet this need.

<u>Sample Test Item:</u>

A stable natural environment is one which is healthy
and lasting - that is, it tends to resist changes which
might be harmful to it.

a. In the slide, which of the areas is most stable?
   (Circle the number of your choice.)

    1) the area with trees

    2) the grassy lawn area

    3) the bare ground

b. Which is least stable? (Circle the number of
    your choice.)

    1) the area with trees

    2) the grassy lawn area

    3) the bare ground area

MAN AND ENVIRONMENT CONCEPTS (Human Ecosystem)

1. ## HUMAN ECOSYSTEM - STRUCTURE AND FUNCTION CONCEPT

    (This Example is Written to be Developed Through
    Discovery-Inquiry Learning Experiences)

    Basic Behavioral Objective: The student will
    describe and explain with increasing completeness
    and accuracy the past, present, and future role
    of man as a steward and creator of his environment
    giving evidence of an understanding of the follow-
    ing basic human ecosystem concept:

    ### Human Ecosystem - Structure and Function

    Man experiences stewardship and provides for his
    needs by working on the natural environment
    through an institutional system of man-to-man
    relationships and a technological system of
    man-to-environment relationships to produce and
    manage the following components of the man-
    made environment:

    1) Production areas

    2) Human settlement areas

    3) Open space areas

    4) Transportation and circulation areas

5) Recreational areas

6) Community service and utility areas

Example: Related Learning Activity Behavioral

        Objective

The student will gather and compile information
in both written and graphic form which gives
evidence of an understanding of the structure and
function of the human ecosystem.

Example: Related Formal Evaluation Behavioral

        Objective

The student will, while observing a series of
slides of environmental components, correctly
designate descriptive statements as true or false
giving evidence of an understanding of human eco-
system concepts.

Sample Test Item:

T   F   The safe operation of a circulation area, such
        as the one shown here, requires only a good
        design using lasting materials.

2. HUMAN ENVIRONMENTAL DEPENDENCY AND NEEDS CONCEPT

> (This Example is Written to be Developed Through
> Evaluation-Problem Identification Learning
> Experiences)

Basic Behavioral Objective: The student will
develop evaluative criteria and identify and define
an increasing number of existing and potential
environmental issues and problems of increasing.
complexity giving evidence of an increasing under-
standing of the following concept:

Man is the linking component between the natural
environment upon which he is dependent and
of which he must be a steward and the man-made
environment which he creates to help provide
for physical, psychological and social needs:

a. Human physical needs are provided for by
environmental components which function and
possess characteristics related to:

1) convenience and efficiency

2) safety and health .

3) durability or lastingness

b. Human psychological needs are met by com-
ponents which are pleasurable to the senses.

c. Human social needs are met by components
which assist people to live in harmony to-
gether, to interact and to gain a measure of
individual and group recognition.

Example: Related Learning Activity Behavioral

Objective

The student will develop evaluative criteria and
identify and define existing and potential issues
and problems which are based upon and give evidence
of an understanding of the concept of human envir-
onmental dependency and needs.

Example: Related Formal Evaluation Behavioral

Objective

The student will, while observing a series of slides
of man-made environmental conditions, give evidence
of an understanding of the concept of human environ-
mental dependency and needs by correctly designating
descriptive statements as true or false.

Sample Test Item:

T   F   The major human needs which areas such as the
one pictured here must meet are:

1) our mental needs for a pleasing
environment, and

2) our social needs to get along well with
people

3. ASSOCIATED ENVIRONMENTAL PROBLEMS CONCEPT

(This Example is Written to be Developed Through
Problem-Solving Learning Experiences)

Basic Behavioral Objective: The student will in-
creasingly select existing and potential issues and
problems and choose, plan and help carry out solu-
tions to problems which reflect an understanding of
the following concept:

Environmental issues and problems are often
associated with the sizes, concentration,
physical characteristics and mental character-
istics of the human population and result from
the lack of effective individual citizen,
institutional and technological response to
existing and future effects of ecological and
human demands upon the environment.

Example: <u>Related Learning Activity Behavioral</u>

<u>Objective</u>

The student will select a problem and help in-
vestigate and report on the causes and effects of
the problem, determine alternative solutions, choose
a solution, develop and carry out a plan of action
and plan and implement an evaluation procedure
which give evidence of an understanding of concepts
related to the role of man and the total environment.

Example: <u>Related Formal Evaluation Behavioral</u>

<u>Objective</u>

The student will, given a series of slides, select
environmental problems and choose alternative
solutions with appropriate rationales which demon-
strate a knowledge of basic concepts related to the
role of man and the total environment.

<u>Sample Test Item:</u>

Here is an example of litter on the school site. Which
of the steps below do you think best to use to help
solve the problem? (Circle the number of your choice.)

1) Tell those responsible that the problem exists on
    the school site.

2) Hold a school assembly and give a slide presenta-
    tion showing the causes, effects, and solution to
    the problem followed by a discussion of what each
    individual can do.

3) Gather a list of signatures on a petition to have the
    school adopt a law which will require each person
    responsible for the problem caught to be fined or to
    clean up the area.

SELF - CONCEPT

(This Example is written to be Developed Through Discovery-Inquiry Learning Experiences)

Basic Behavioral Objective: The student will demonstrate an increasing knowledge of his needs, abilities, limitations, and potential by independently selecting, efficiently and skillfully carrying out, and successfully completing appropriate environmental investigations of an increasing complexity and challenge.

Example: Related Learning Activity Behavioral

Objective

The student will work independently in selecting, efficiently and skillfully carrying out and successfully completing investigations and will select and successfully complete challenging optional assignments related to his selected topic for study.

Example: Related Formal Evaluation Behavioral

Objective

The student will accurately indicate whether or not he has correctly answered selected test questions.

Sample Test Item:

Of the five true and false questions you answered, how many do you think you answered correctly? _____

SOCIAL   CONCEPT

(This Example is Written to be Developed Through
Evaluation - Problem Identification Learning
Activities)

Basic Behavioral Objective: The student will demon-
strate an increasing knowledge of the needs of others
including future generations by the way he works
with others, by developing and applying evaluative
criteria which accurately reflect their needs and
by identifying important issues and problems.

Example: Related Learning Activity Behavioral

Objective

The student will work harmoniously and successfully
with others and will develop criteria which accurately
and completely reflect a knowledge of the needs of
others including future generations and will identify
issues and problems which reflect a knowledge of the
needs of others.

Example: Related Formal Evaluation Behavioral

Objective

The student will indicate a concern for environmental
issues and problems which demonstrates a knowledge of
the environmental needs of others including future
generations.

Sample Test Item:

For each problem which you have identified indicate
how much you care or are concerned that the problem be
solved by circling a number.   Use the key below:

I am:

        strongly unconcerned   = 1

        unconcerned   =, 2

        undecided   = 3

        sure   = 4

        strongly concerned   = 5

FEELINGS

(AFFECTIVE DOMAIN)

1. ## FEELINGS TOWARD NATURE

(This Example is Written to be Developed Through
Discovery-Inquiry Learning Activities)

Basic Behavioral Objective: The student will, through
discussion, writing, reading, audio-visual media, and
firsthand experiences create and utilize an increasing
number of opportunities to explore past, present, and
future aspects of his natural environment.

Example: Related Learning Activity Behavioral Objective

The student will select and complete optional assign-
ments related to his selected topic for study.

Example: Related Formal Evaluation Behavioral Objective

The student will indicate a high degree of interest on
a Likert scale in learning about environmental components.

Sample Test Item:

Circle the number of your choice to make the sentence
complete.

I am:

strongly not interested	not interested	undecided neutral	interested	strongly interested
1	2	3	4	5

in learning about the natural environment including land,
water, air, plants, animals and energy.

Example: Related Unobtrusive Evaluation Behavioral

Objective

(The student is unaware that he is
being evaluated)

The student will indicate on an optional take-home
questionnaire for a community organization an
interest in investigating natural environmental
components.

Sample Test Item:

Below are listed a variety of topics related to the
environment about which information is needed. Indicate
the extent of your interest in the topics by circling
one of the numbers according to the key below.

strongly not interested = 1

not interested = 2

undecided/neutral = 3

interested = 4

strongly interested = 5

a. Land - soils, rocks,   1   2   3   4   5
minerals, surface
features

b. Etc.

2. <u>FEELINGS TOWARD THE ROLE OF MAN</u>

(This Example is Written to be Developed Through
Problem-Solving Learning Activites)

<u>Basic Behavioral Objective</u>: The student will in-
creasingly select existing and potential issues
and problems and choose, plan, and help carry out
solutions which place man in the role of steward
and creator of a quality environment.

<u>Example</u>: <u>Related Learning Activity Behavioral</u>

<u>Objective</u>

The student will select an issue or problem and
help choose and carry out solutions which relate to
man's role as a steward and creator of a quality
environment and will select and complete optional
assignments which reflect a positive feeling towards
the role of man as a steward and creator of a quality
environment.

<u>Example</u>: <u>Related Formal Evaluation Behavioral</u>

<u>Objective</u>

The student will, given a series of slides, select
environmental problems and choose alternative solu-
tions with appropriate rationales which demonstrate
a high value towards the role of man as a steward
and creator of a quality environment.

Sample T. . . Item:

Following are six slides of six environmental problems. After viewing the problems and reading the brief description and the possible solutions to each one, select the solution you best agree with by circling the number of your choice.

Problem Five: Broken outfield fence on the school baseball field. The school only has enough money to repair the fence, not to replace it which will need to be done eventually.

Solutions:

1. Students should repair the fence replacing broken boards with the money. This would require some of your time.

2. Save the money until more is raised by the town to remove the fence and build a better one. This wouldn't require any of your time. It would mean, however, that it would be some time before the fence is repaired.

3. Students should conduct a campaign to raise money to have a new fence placed on the site. This would require more of your time.

4. Do nothing with the fence - it isn't necessary for the game.

Example: Related Unobtrusive Evaluation Behavioral

Objective

The student will, on a field trip introduced to him as a survey of the school site in preparation for a course, refrain from littering when given the opportunity and will pick up litter planted along the field trip route.

3. FEELINGS TOWARD ONESELF

(This Example is written to be Developed Through Problem-Solving Learning Activities)

Basic Behavioral Objective: The student will demonstrate an increasing belief in his own abilities by attempting to participate in an increasing number of environmental problem-solving activities, by working independently where assistance from others is unnecessary and by continuing in cases where his self-image may be threatened.

Example: Related Learning Activity Behavioral

Objective

The student will participate in problem-solving activities electing to work independently where assistance from others is unnecessary and attempting to continue in challenging situations selecting challenging optional assignments.

Example: Related Formal Evaluation Behavioral

Objective

The student will indicate on a Likert scale a high confidence in his ability to successfully participate in environmental problem-solving activities.

Sample Test Item:

Following are four slides of four environmental problems.
First, after viewing the problems and reading the brief
description, answer the questions.

Secondly, indicate by circling a number from one to
five how much you feel you can help solve each problem.
Use the following key:

I am:

strongly not confident	= 1
not confident	= 2
undecided	= 3
confident	= 4
strongly confident	= 5

that I can help and contribute to solving the
problem.

Example: Related Unobtrusive Evaluation Behavioral

Objective

The student will indicate on an optional take-home
questionnaire for a community organization a strong
belief in his ability to successfully participate in
environmental problem-solving activities.

Sample Test Item:

Indicate by circling a number on the scale below the
extent to which you feel you could actually help contri-
bute to the solution of those problems you are concerned
about.

I am:

strongly not confident	not confident	undecided	confident	strongly confident
1	2	3	4	5

that I could actually help contribute to the solution of environmental problems I am concerned about.

4. FEELINGS TOWARD OTHERS

(This Example is Written to be Developed Through
Evaluation - Problem Identification Learning
Activities)

Basic Behavioral Objective: The student will demonstrate an increasing sensitivity and concern for the needs of others including future generations by the way he works with others and by reflecting their needs in the criteria and values he attaches to the issues and problems he identifies and defines.

Example: Related Learning Activity Behavioral

Objective

The student will attempt to work harmoniously with others and develop criteria which relate to the needs of others including future generations.

Example: Related Formal Evaluation Behavioral

Objective

The student will arrange a series of problems in an order of concern which places a high priority on maintenance and improvement of the environment for the benefit of all people including future generations.

Sample Test It. :

Number the following problems in the order of your concern with the highest number (5) representing your strongest concern (how much you care) that the problem should be corrected and the lowest number (1) your weakest concern.

_____ The open burning community dump with its problems of air pollution, pests, and unsightliness.

_____ The planting of flowers and shrubs to beautify your home tuday.

_____ The building of a pond to provide water for recreation within a short time.

_____ The planting of trees as a screen and windbreak 30 years into the future.

_____ The picking up of litter around your home to beautify it.

_____ The removal of sources of river pollution which will still take 10 years for the river to clean itself.

Example: Related Unobtrusive Evaluation Behavioral

Objective

The student will indicate on an optional take-home questionnaire for a community organization a high concern for evaluating problems affecting the welfare of others including future generations.

Sample Test Item:

Indicate the extent of your interest in the evaluation tasks listed below by circling one of the numbers (using the key as given in Question 1).

a. Carrying out studies near   1   2   3   4   5
   your own home for projects
   of immediate benefit to
   your neighborhood

b. Carrying out studies which   1   2   3   4   5
   will benefit the whole
   community

c. Carrying out investigations   1   2   3   4   5
   to find areas which can be
   set aside and developed to
   benefit people in the
   future.

APPENDIX A

EVALUATION CONSIDERATIONS

EVALUATION CONSIDERATIONS

The following are major considerations guiding the design of evaluation techniques.

1. Applicability and Reproducibility

The ultimate contribution of evaluation techniques is, in a large measure, dependent upon applicability and reproducibility. Applicability refers to the usefulness of the evaluation techniques in measuring selected variables, i.e., skills, concepts and feelings. By reproducibility is meant the ease with which teachers can repeat the evaluation procedures in their own teaching situations. Researchers have long encouraged others to repeat their experiments and tests. In education this is essential if wide-spread use of procedures is to occur. To meet this criterion evaluation instruments and techniques must be logical in development, easy to administer directly and subject to straight-forward analyses.

2. Types of Evaluation Techniques

Three types of evaluation techniques are considered in this booklet: the formal pencil-and-paper instrument; unobtrusive measures; direct observation of the student participating in the learning process.

Formal Pencil-and-Paper Evaluation

First to be considered are the pencil-and-paper tests which are popular among researchers. These are predominantly of the questionnaire design.

Among major considerations of traditional pencil-and-paper tests are the following:

a. Probably a primary shortcoming is one which
has been aptly called the "guinea pig effect"
which is the awareness of being tested. This
may cause the respondent to try to guess what
the researcher is looking for and answer
accordingly, or he may choose to answer in
ways deliberately invalidating the test.
However, according to Webb, et al., "The
threat of subjects' awareness of being tested[6]
is less an issue in educational research..."

b. Lack of motivation may also occur with these
kinds of tests. In this case the test might
be viewed by the respondents as having little
relevance. The difference between conditions
surrounding the testing situation and the
"real world" could contribute to this feeling.

c. A pencil-and-paper test may weigh the instru-
ment in favor of those with verbal, reading,
and writing skills. Thus, it may differentiate
according to capacity to use language and ability
to communicate. For some tests these may be
variables to measure, however.

d. These kinds of tests may not be an appropriate
version of the phenomenon under consideration
and, thus, contribute to respondent uncertainty
and lack of familiarity with the problem.

e. Concerning the area of attitudes and values,
there are several considerations. For example,
questionnaires intrude into the social setting
and can create as well as measure attitudes.
Still, according to Raths, Harmin, and Simon,
pencil-and-paper tests which obtain what
respondents say they value have been most used
to measure values. Action based on choices,
according to them, should be a major criterion
for a value. But, they concluded, "A pencil-
and-paper instrument validated on behavior would,
of course, be as useful as it would be difficult
to perfect....."[3] And so, perhaps, this explains
the continued use of written attitude tests such
as Thurstone's, Likert's, Guttman's and Osgood's.
These are built upon two assumptions: (1) sub-
jective attitudes can be measured quantita-
tively and (2) each test item has the same
meaning for everyone.

Concerning the Likert scale, Selltiz, et al.,
referred to the relative ease in constructing
it and wrote that "...pragmatically the scores
... often provide the basis for a rough order-
ing of people on the characteristic being
measured." They also believe that "The fact that
different patterns of response may lead to
identical scores...is not necessarily as serious
a drawback as it may at first appear."[5] With
this scale techniquie it is common to total the
individual ratings of related objects or items
to find a person's attitude score.[7] Such scale
techniques have also been reported by Robinson
and Shaver to measure values.[4] Finally, tradi-
tional attitude tests should be supported and
augmented wheiever possible with other methods
for no method is without bias. Again according
to Webb, et al., "If a proposition can survive
the onslaught of a series of imperfect measures,
with all their irrelevant errors, confidence
should be placed in it."[6] In the area of
attitude and value measurement, therefore, it is
urged that consideration be given to using un-
obtrusive measures for data collection in
particular.

Unobtrusive Evaluation Techniques

Unobtrusive measures are techniques which aim to
avoid intrusion into the social setting and the
chance that subject reactions will invalidate a
test. These measures consist of contrived and
simple observation of behavior during which the
subject is unaware that he is being evaluated. As
pointed out above, techniques of this kind are
particularly useful when measuring in the affective
domain. If a subject is aware of being tested, his
feelings are likely to be affected, thereby short-
circuiting the chance of getting a true measure of
feeling, e.g., interest or concern. For this reason
unobtrusive measures should be included in the
evaluation design if possible.

Process Evaluation

A third technique to be included here is the direct
observation of students involved in the learning
processes. The important considerations here are
to specify the kinds of behavior which will give

evidence that the learner is likely to have ac-
quired desired feelings, concepts, and skills and
to consciously look for their occurrence during
the learning process. Such a technique is con-
sistent with the generally accepted idea that
evaluation should be an on-going process.

3. Effects of Extraneous Learning Experiences

If environmental education is but an emphasis in
the curriculum and is concerned with the total
human ecosystem, it follows that it must be
interdisciplinary. Like the ecologist who is
needed because he brings a knowledge and per-
spective to the relationships between many
specialized sciences and contributes to an under-
standing of the whole, so does the strength of
environmental education lie in its linking of all
parts of the curriculum. It brings the knowledge
and skills associated with many disciplines to bear
on the task of helping individuals investigate the
environment and recognize and help resolve environ-
mental problems. Both the rapid increase in
specialized knowledge and the increase in social
and environmental problems call for an approach
specializing in breadth of understanding which
environmental education brings to the curriculum.
In view of the foregoing, then, all learning
experiences in the curriculum are justifiably with-
in the scope of environmental education. However,
since environmental education has adopted the
specific goal of clarifying man's environmental
relationships and helping him to achieve a quality
environment - an ethical aim which has been repeatedly
validated by widespread expressions of concern through-
out the Country - specific learning experiences
associated with this aim may be identified and
judgements made concerning degree of relatedness.
The point to be made is that one cannot expect
clear-cut, sharply differentiated learning effects
attributable only to environmental education learn-
ing experiences. The boundaries between environmental
education and the disciplines is fuzzy at best. In
evaluating these effects probably the best that can
be done is to emphasize the degree and probability
of their relationships to the learning experiences.

The problem this booklet deals with is to develop
methods which will show that environmental education
learning experiences can contribute to the education
of youth. With a scope of effort as broad as

environmental education's, this is admittedly diffi-
cult to accomplish. However, to overcome this
problem, a clear identification of two broad out-
comes has been suggested: (1) value areas related
to the ecological view or value realm and (2)
thinking and behavioral skills necessary for not
only value development (valuing) but for bringing
values to bear on problem resolution. In develop-
ing and validating an instrument, it is suggested
that timing be a major way of factoring out
extraneous learning experiences. A pretest is suggested
given immediately before working with a class in-
volved in the process phases of environmental
education to gather base-line data and a post-test
given immediately following to provide assessment of
learning experiences.

4. Pretest - Post-test Contamination

Pretest - post-test designs are useful for evalu-
ating the effects attributable to exposing subjects
to experimental variables. In education they pro-
vide an opportunity to assess the worth of teaching
methods and learning experiences. However, the
problem with such designs is one of contamination,
often called testing sensitization. Briefly, this
refers to the danger that the pretest may become
in itself a change agent by influencing the subject's
attitudes and affecting the measurement results of
the post-test. The shift in measurement or artifact
produced by the pretest may cloud the amount of
change that might be attributed to the learning
experiences prior to the post-test. This particularly
affects the internal validity of the test or how
well it measures what it purports to measure as well
as the external validity - how generalizable the
results are. In view of the foregoing the following
design considerations have been identified:

a. A pencil-and-paper instrument should present a
    variety of problems and call for choices re-
    flecting value judgements and critical thinking
    skills. The value oriented nature of such a
    test may then contribute to the difficulty of
    the respondent to perceive correct answers and
    anticipate the intent of questions. Thus the
    problem of contamination may be somewhat
    diminished.

b.   A study may utilize a research design where
     a portion of a participating class receives
     the pretest, learning experiences, and all
     receive the post-test. Such a design is
     diagrammed below:

         S = subjects

         P = pretest and post-test

         L = learning experience

Experimental   S   P   L   P

   Group   S   L   P

Control Group   S   P   P

                    S   P

Of this design Kerlinger wrote that for the
following reasons it is "...a design with
potent controls.": (1) comparisons can be
effectively carried out, (2) randomization
assures statistical equivalence, (3) history
and maturation are controlled, (4) possible
interaction effect due to possible pretest
subject sensitization can be controlled, and
(5) possible temporary contemporaneous effects
can be controlled.[2] Campbell has also written
that this design has become the new ideal for
social scientists.[1]

c.   Care should be taken to avoid administration
     inconsistencies between the pretest and
     post-test. This refers to differences in
     instructions, time length, distractions,
     time of day, etc.

d.   In addition, consideration should be given to
     utilizing one or more unobtrusive measures
     designed to be used for pre-test and post-
     test evaluations. A variety of unobtrusive
     information sources may be explored, including
     public address announcements over the school
     intercom system, classroom bulletin board
     bulletins, handouts from community organizations,
     and the introduction of visible problems on the
     school grounds or in the community. The number

of students responding and nature of their
responses may be correlated with the timing
of environmental education learning experi-
ences and other measuring techniques.

5. Reliability and Validity

Perhaps the above considerations may be best summed
up in a brief discussion of reliability and validity
including related design techniques. Reliability
refers to the extent to which variations in
evaluation scores is due to inconsistencies in
measurement. It may be checked by comparing test
scores with scores from other tests for consistency.

Validity refers to the extent to which the techniques
and instruments actually measure the variables being
examined. Some considerations are:

a. The research experimental-control design suggested
    earlier is such that significant effects of
    extraneous variables may be detected using
    statistical analysis. This involves: (1)
    comparing the pretests of the experimental
    pre-post-test group with the pretests of the
    control pre-post-test group to detect differ-
    ences at the beginning of the experiment and
    (2) comparing the post-test scores of the
    combined experimental and control pre-post-
    test groups with the combined experimental
    and control post-test groups to detect differ-
    ences attributable to the effects of the pre-
    test on the post-test or other intervening
    extraneous variables.

    Zimbardo and Ebbesen reported that this design,
    which they identified as the Solomon four-
    group design, is one of several highly sophis-
    ticated experimental designs which minimize
    sources of invalidity. They indicated that the
    design removes all the following sources of
    internal invalidity: (1) external artifacts,
    (2) subject changes, (3) testing sensitization,
    (4) problems with equipment, (5) subject
    selection biases, and (6) attrition. Concerning
    external sources of invalidity, they indicated
    removal of: (1) reactive measurements and (2)
    multiple treatment effects. Only a maybe was
    given for interaction of selection biases and

experimental variable and for reactive effects
of experiment.[7]

b. Content validity may be assessed by having a
panel independently rate each question in an
instrument according whether it is likely or
unlikely to test the variable towards which it
is directed or whether it should receive an
undecided vote.

c. Predictive validity or pragmatic validity
refers to the usefulness of the instrument
as an indicator or predictor of some other
behavior or characteristic. It may be pre-
dicted that those who score high in possess-
ing an ecological value system would be more
apt to engage in activities involving acting
on such a value system. As a check on pre-
dictive validity, unobtrusive test measures
may be designed.

d. Construct validity refers to the degree the
instrument reflects constructs or abstract
characteristics which cannot be identified
with some specific kind of behavior. This
may be assessed to an extent by having a
panel independently place each of the questions
or test items in categories according to test
variables with one undecided category.

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APPENDIX B

Example

of a

UNIT OUTLINE

TWO-WEEK JUNIOR HIGH SCHOOL ENVIRONMENTAL EDUCATION UNIT

THE SCHOOL SITE ENVIRONMENT

PILOT UNIT TESTED AT FREEPORT, MAINE JUNIOR HIGH SCHOOL 1972

One 80 Minute Period Per Day

Developed by The Maine Environmental Education Project and
The Regional Environmental Education Program

WEEK 1

MONDAY: UNIT PRETEST - Formal Pencil-and-Paper Test
                          with slides

            UNOBTRUSIVE - Citizen Questionnaire and
                          School Site Survey

TUESDAY: PHASE I: Discovery - Inquiry

            A. Introduction to the Unit
                1. The need for environmental quality
                2. The roles of citizens

            B. Presentation with slides
                1. Natural & man-made components of
                    the environment
                2. Natural and human ecosystem concepts

            C. Student development of chalkboard map of
                school site
                1. Map of shape and size of site
                2. Identification of natural and man-
                    made features - location, shape,
                    size, amount, characteristics

WEDNESDAY: A. Student discussion and listing of
                important information to gather about
                components
                1. Kind
                2. Location
                3. Size - Shape
                4. Amount
                5. Characteristics

B. Demonstration of equipment and techniques for environmental investigation

C. Student selection of topics to investigate

D. Guidelines for compiling and mapping information

THURSDAY: Student field investigation of natural and man-made environmental components

---

FRIDAY: A. Student compilation of information, writing of reports, development of maps

PHASE II: Evaluation - Problem Identification

B. Presentation with slides
   1. Criteria for evaluating the natural environment
   2. Criteria for evaluating the man-made environment

WEEK 2

MONDAY: A. Review of environmental evaluation concepts

B. Introduction to environmental evaluation assignment sheets

C. Student field environmental evaluation of the school site

D. Class discussion - identification of opportunities for environmental improvement

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TUESDAY: A. Introduction to kinds of environmental problems

B. Student field identification and listing of problems for student involvement

PHASE III: Problem Solving

C. Introduction to the problem-solving process

WEDNESDAY: A. Student selection of problems to help
                      resolve

                  B. Student preparations for problem-solving

                        1. Description of the problem (why a
                              problem, etc.)

                        2. Listing of alternative solutions

                        3. Selection of best solution - reasons,
                              etc.

                        4. Planning for action

                        5. Listing of tools, equipment and
                              supplies needed

THURSDAY: A. Student field problem-solving activities

                  B. Review of projects

                  C. Review of unit phases

FRIDAY: UNIT POST-TEST (same as pretest)

APPENDIX   C

RESULTS of an EVALUATION

RESULTS OF AN EVALUATION

During April and May of 1972, a study was conducted
utilizing the methods and techniques outlined in this
handbook. Approximately seventy-five (75) students were
involved representing grades six through eight in the
Freeport, Maine, Junior High School. The students had
elected to take a two-week course in environmental
education meeting eighty minutes per day, five days per
week. The students were divided into three classes of
approximately twenty-five each and scheduled according
to school group divisions for three two-week classes
covering a time span of six weeks.

Using the basic behavioral objectives presented in this
booklet as a guide, a two-week unit was developed focus-
ing on the environment of the school site. Unit
behavioral objectives and learning activities were
planned which would involve the students in classroom
and firsthand investigations, evaluation-problem identi-
fication and problem solving. These three kinds of
learning experiences represented the process of environ-
mental education or independent variable. The unit
behavioral objectives in addition provided guidelines
for observations of the students while engaged in the
process.

Following the development of the teaching unit, behavioral
objectives were written for the formal pencil-and-paper
test. These were also drawn from the basic behavioral
objectives. Using the formal evaluation behavioral
objectives as a guide, test items were then devised for
the pencil-and-paper instrument. Since all behavioral
objectives followed Mager's suggestions that they state
what the students would be expected to do as well as the
extent and under what conditions, the development of
test items from the objectives was facilitated. During
this part of the design process, slides were selected
to accompany the questions. Several hundred were reviewed.
The slides served two purposes: (1) for some questions
the slides provided a visual image about which students
were asked to react and (2) for other questions the slides
served merely as stimuli for the students concerning the
topic of the question.

Following the development of the first draft of the
instrument it was pretested with twenty-five students
participating in the first two-week unit. Also during
the two-week time period the unit was refined.

Upon completion of the pretest of the formal instru-
ment's first draft, the test was evaluated and revised
to increase its validity, sensitivity, and time
appropriateness.

Prior to the administration of the final version of the
instrument, the names of students participating in the
experimental group were procured. This group was the
second class of twenty-five students receiving the unit
during the middle two weeks of the six-week time span.
Each student in the experimental group was then assigned
a number from one to twenty-five. Using a list of
random numbers, thirteen students were randomly selected
to receive the formal pretest. All were to receive the
formal post-test.

At the same time, the names of students who were to
receive the unit during the last two weeks were procured.
These students became the control group during the middle
two-week period. As with the experimental group, thirteen
students were randomly selected to receive the formal
pretest. This group was to receive the pretest at the
same time as the experimental group. All students of the
control group were to receive the formal post-test.

All pretests were administered during the first class
session of the unit. The post-tests were administered
during the last session with the exception of the control
group. For this group the post-test was administered
following a weekend three days later during their first
class session. This was convenient in that no special
scheduling was required.

Following the administration of the formal test instru-
ment, data were tabulated for pre and post-test results.

Both descriptive and inductive statistical analyses were
used. The inductive statistical analysis consisted of
a series of five t-tests run on the nine sub-tests of
the instrument. These tests were two-tailed and run at
the .05 ALPHA level. The tests sought to answer the
following research questions:

1. Were experimental and control groups equal at the
   beginning of the two-week experiment on the nine
   areas of the instrument?

2. After two weeks in the program, did the Experimental
   Pre-Post-test Group score higher on the post-test
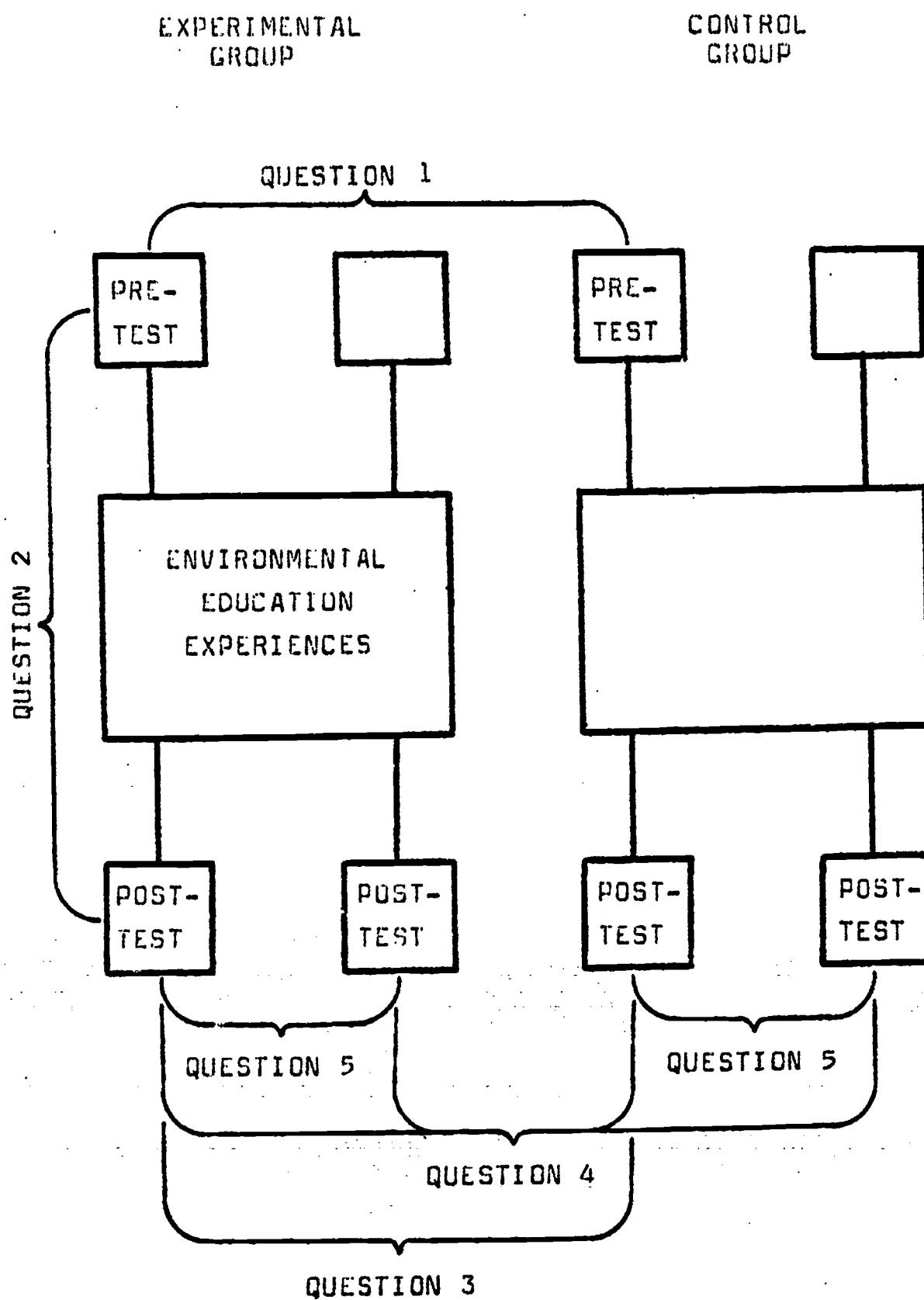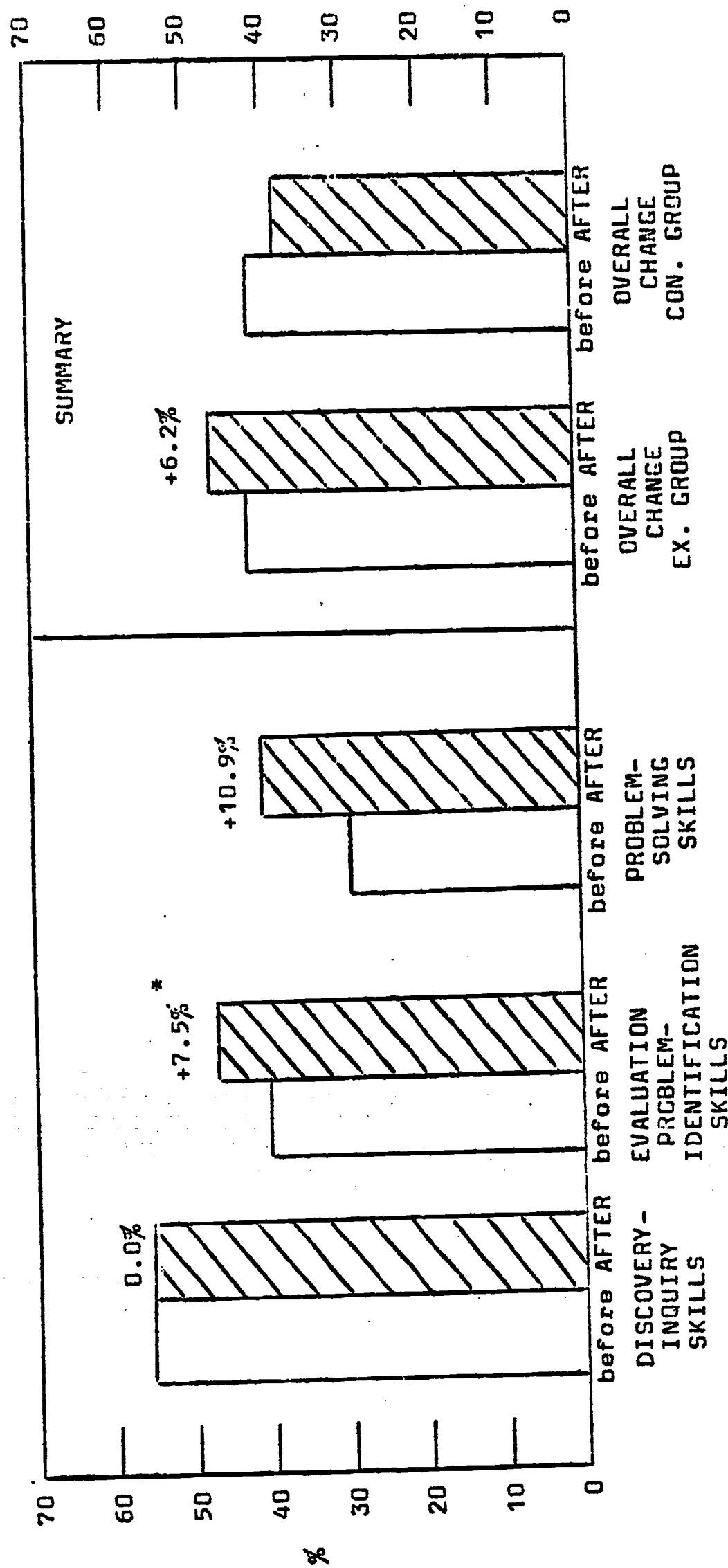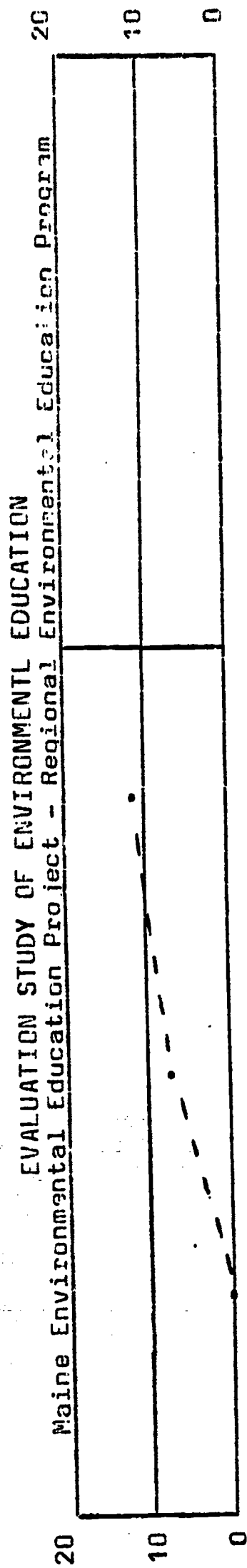   than on the pretest in any of the nine areas?

3. After two weeks in the program, was the gain made
   by the Experimental Pre-Post-test Group greater
   than the gain made by the Control Pre-Post-test
   Group in any of the nine areas?

4. After two weeks in the program, were the post-test
   results of the combined experimental groups (Pre-
   Post-test Experimental Group and Post-test Experi-
   mental Group) greater than the post-test results of
   the combined control groups (Pre-Post-test Control
   Group and Post-test Control Group) in any of the
   nine areas?

5. Did taking a pretest affect results on a post-test
   taken two weeks later in any of the nine areas?

Figure 1 is a diagram of the relationship of the questions
to the research design.

One set of results is of particular interest. Within
the variable Ability to Act on an Ecological Value
System are three sub-variables. The first ~ these,
Discovery - Inquiry, showed no descriptive change ou... ~
pre and post-tests of the Experimental Group. The
second, Evaluation - Problem Identification, revealed a
7.5 mean percent increase while the third, Problem
Solving, showed a 10.9 mean percent increase. An inter-
pretation of this might be based on the fact that the
first sub-variable is related strongly to traditional
methods of education whereas the latter two represent
areas to which students are not normally exposed.
Therefore, one might expect greater learning to occur
with respect to them. See Figure 2.

Figure 1. Relationships of research questions
to research design

EVALUATION STUDY OF ENVIRONMENTL EDUCATION

Maine Environmental Education Project – Regional Environmental Education Program

SUMMARY

+6.2%

+10.9%

+7.5% *

0.0%

before AFTER   before AFTER   before AFTER   before AFTER   before AFTER   before AFTER

DISCOVERY-   EVALUATION   PROBLEM-   OVERALL   OVERALL
INQUIRY   PROBLEM-   SOLVING   CHANGE   CHANGE
SKILLS   IDENTIFICATION SKILLS   EX. GROUP   CON. GROUP
                SKILLS

%

*STATISTICALLY   ABILITY TO HELP MAINTAIN AND IMPROVE A QUALITY ENVIRONMENT
SIGNIFICANT   EFFECT OF ENVIRONMENTAL EDUCATION LEARNING EXPERIENCES
.05 LEVEL   Two-Week Unit Focused on the School Site Environment – 80 Min. Per Day
                 Freeport Junior High School   FIGURE 2