The Development and Validation of an Assessment Instrument to Measure Environmental Education Competencies for Level III of the Elementary Teacher Training Program at Utah State University

Francine Fukui

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THE DEVELOPMENT AND VALIDATION OF AN ASSESSMENT INSTRUMENT TO MEASURE ENVIRONMENTAL EDUCATION COMPETENCIES FOR LEVEL III OF THE ELEMENTARY TEACHER TRAINING PROGRAM AT UTAH STATE UNIVERSITY

by

Francine Fukui

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in Elementary Education

Approved:

UTAH STATE UNIVERSITY
Logan, Utah

1979
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ABSTRACT
The Development and Validation of an Assessment Instrument to Measure Environmental Education Competencies for Level III of the Elementary Teacher Training Program at Utah State University

by
Francine Fukui, Master of Science
Utah State University, 1979

Major Professor: Dr. Donalr R. Daugs
Department: Elementary Education

Purpose and Procedures
The purpose of this study was to construct and validate an assessment instrument which could effectively measure the impact of implementing an environmental education component to the Level III program of the elementary teacher training program at Utah State University. It was the hope of this researcher that the test would also be administered to Level III students upon completion in subsequent quarters to indicate individual competence in environmental education.

Care was taken in the construction of the instrument to assure content validity of concepts considered important by local, university, and state environmental education reviewers. A preliminary form of the instrument constructed in the study was administered to a pilot group. An item analysis was performed to determine the level of difficulty as well as the ability of the distractors to distract. The final form of the test consisted of 36 multiple-choice items. The final form was
administered twice to a second group of Level III students. Data from these two administrations were used to establish the internal reliability of the instrument by using the Marshall-Haertel reliability formula. The reliability of stability between administrations was established by using the test-retest formula.

Results

Using the Marshall-Haertel reliability formula, the reliability coefficient of the instrument for the first testing was .81. The variance of this administration was 10.96, resulting in a standard deviation of 3.31. The second testing had a reliability coefficient of .78. This second administration had a variance and standard deviation of 11.42 and 3.38 respectively. In examining the test results of the first and second administrations, the mean raw scores show a positive impact in learning gains occurring between the two testings. Using the test-retest reliability formula, the Pearson-product-moment correlation was .8191.

A content validity was established through a review of the items by critical reviewers who had background in environmental education. Each reviewer was given a copy of the objectives of the environmental education component and a copy of the item pool. Based on individual judgment, each reviewer matched test items to the objective in which they felt it was testing. The final test form consisted only of those items receiving a 100% agreement in the item pool review.
CHAPTER I
INTRODUCTION

Background of the Study

The elementary education teacher training program at Utah State University is designed around levels of competencies. The name given to this program is SODIA. This acronym is derived from the initial letter of the descriptive words (Self, Others, Disciplines, Implementation, and Associate teaching), which represent the emphasis that is placed at each level of the program.

Level I is designed to develop competencies as SELF—a person with possible personal qualities. Level II develops skills related to dealing with OTHERS, particularly with students, with the focus of developing skills for helping the student become a better learner. In Level III, students develop knowledge, understanding, and teaching skills in the subject areas or DISCIPLINES which make up the school's curriculum. Level III experiences are followed by student teaching or Level IV. Level IV allows the student to IMPLEMENT all the skills he/she has acquired thus far in his/her study. Following Level IV, is Level V, ASSOCIATE TEACHING. This level is optional. This permits students to be intern teachers under the direction of a regular teacher.

At the methods level, Level III, emphasis is on the five disciplines—language arts, mathematics, science, reading, and social studies. At the present time, there are no stated objectives for Level III that are directly related to environmental education. Environmental
education is an evolving educational endeavor. At present the trend in environmental education is away from traditional nature study, ecology, and conservation. As this trend progresses, content is becoming increasingly less familiar to those who teach and those who are preparing to teach science. Because of this current trend, plans for an experimental environmental education component to be inserted in the discipline component of the Level III teacher training program have been initiated. The proposed environmental education component will establish a philosophy, objective framework, activities, and evaluation plan for a team taught approach to environmental education, language arts, science, and social studies for Level III preservice teacher training. This component is intended to strengthen the student's background knowledge in science and emphasize environmental education competencies.

Before the environmental education component can be evaluated, objectives must be determined for environmental education in the Level III component of the teacher training program. The objectives were established through a combined effort by university, state, and local environmental education reviewers. Once the objectives have been determined, an assessment instrument can be developed to measure those objectives. The assessment instrument will measure the effect of environmental education instruction on Level III students. This study will deal with the development of the environmental education assessment instrument designed to measure the objectives of the Level III environmental education component.
Statement of Purpose

The purpose of this project is to develop an assessment instrument that will measure the cognitive domain of environmental education for Level III of the Elementary Teacher Training Program at Utah State University. The intended use of this instrument will be to measure the competencies in environmental education of Level III students upon completion of the Level III component.

In order to define the stated purpose, the following objectives have been stated:

1. To develop an assessment instrument to measure the cognitive domain of environmental education for Level III of the Elementary Teacher Training Program at Utah State University.

2. To determine the instrument's reliability and validity.

Definition of Terms

Competency-Based Teacher Education (CBTE). A movement in teacher education where emphasis is placed on defining the teaching objectives or competencies individuals need to learn to do to be "competent" teachers (Reilly, Barclay, & Culbertson, 1977).

Condition. One of the three main parts of an objective. It tells: (a) what the student has to work with, (b) the environmental circumstances under which the performance must be demonstrated, (c) what the student must work on, (d) his starting points, and (e) any limitations (Swezey & Pearlstein, 1975).

Convert main intent. A main intent of an objective that is not directly observable. It requires an indicator. A covert main intent indicates the unobservable performance which the objective is about,
while its indicator tells how to measure whether the individual can perform it (Swezey & Pearlstein, 1975).

**Criterion-Referenced Test (CTT).** A test that measures what an individual can do or knows compared to an external criterion or performance standard stating what is necessary to successfully perform a task (Klein, 1973).

**Environmental education.** A process that establishes an understanding that man and other ecosystems are an inseparable part of the environment. It develops decision-making skills to solve environmental problems, and develops attitudes which will foster positive action relative to the environment (U. S. Office of Education, 1974).

**Indicator.** The action verb of the objective's performance statement through which the ability to perform the main intent is inferred (Swezey & Pearlstein, 1975).

**Marshall-Haertel Index of Reliability.** A split-half coefficient measure for reliability for CRT that results in the coefficient beta. This coefficient splits the scores into masters and nonmasters (Marshall, 1976).

**Overt main intent.** A main intent of an objective that is observable and measureable (Swezey & Pearlstein, 1975).

**Performance.** One of the three main parts of an objective. It includes an action verb that states precisely what must be done. The verb may be the performance itself or an indicator of the performance (Swezey & Pearlstein, 1975).

**Reliability.** Synonymous with consistency. The level of consistency of the results of the measuring device (Borg & Gall, 1971).
Standard. The third main part of an objective which specifies the criteria by which the performance is evaluated (Swezey & Pearlstein, 1975).

Validity—(Content). One of the four types of validity. Content validity is the degree to which the test items represent the content that the test is designed to measure (Borg & Gall, 1971).
CHAPTER II
REVIEW OF LITERATURE

Background in the areas of competency-based teacher education, environmental education, and test construction was considered necessary to give direction to this researcher. The results of this survey of literature will be presented here as follows: (a) studies conducted on competency-based teacher education, (b) environmental education, and (c) a discussion on test construction.

Competency-Based Teacher Education

Because of the increased emphasis being placed on accountability, competency-based education is becoming more prevalent. Competency-based teacher education (CBTE) or performance-based approaches to teacher education specify objectives in explicit form and holds prospective teachers accountable for meeting them. Prospective teacher competencies and measures for evaluating them are specified and made known in advance of instruction.

The degrees of competence in future teachers may be developed and assessed through different types of criteria, such as knowledge, performance, and consequences. Reilly, et al. (1977) indicated that a competency-based program would probably include: (a) individualized instruction--some choice of what is relevant, (b) instruction modules--sets of activities, (c) time as a variable--rates of progress determined by students' progress, (d) field-centered instruction--performance in
real settings, with more and earlier field work, and (e) emphasis on exit rather than entrance criteria—admission less rigid, but demonstration of competence necessary for certification.

Edwards (1976) stated that there has been a phenomenal increase in the number of teacher preparation institutions which have adopted competency-based teacher education (CBTE) in the past five or six years. Because of this widespread movement, a careful examination on the positive and negative aspects of CBTE was conducted. After a study of a CBTE science program, Edwards concluded that before CBTE can be a viable alternative for training professional teachers, a number of problems will have to be attended to.

Enos (1975) revealed that even though the evaluation of competency-based teacher education programs is still in the embryonic state, CBTE training programs can constitute a significant improvement over traditional programs of teacher education. His study to compare the cost effectiveness of a competency-based teacher education program with a non-competency-based teacher education program generated information to support competency-based teacher education.

Gertrude Moskowitz (1976) indicated that much more research on teacher effectiveness and teacher behavior is necessary to be able to substantiate CBTE programs. Although competency-based programs are intended to enhance teaching and learning, much more time will be needed to fulfill their manifold promises. Appropriate research and measuring instruments will have to be developed to help assess whether CBTE is on the right tract. Moskowitz stated:
If CBTE is to be effective and not merely another fad, we will have to eradicate the instant laundry lists of "competencies" now circulating. We must understand that it will take some years to truly uncover these competencies and to conduct experiments to determine what it is that such programs should be based on. (1976, p. 23)

Reilly, et al. (1977) stated that there are four different levels in professional development at which competencies may be assessed.

Level 1 refers to assessments of the training experience the professional has had, courses, internships, etc.

Level 2 refers to assessments of the professional's behavior while he/she is attempting to fulfill his/her professional role.

Level 3 refers to assessments of the behaviors of pupils under guidance of the professional.

Level 4 refers to the assessments of the desired outcomes of the pupils. (p. 70)

Each higher level is influenced by those preceding it. The effects of training experiences on pupil behaviors are subject to the immediate effects of Level 2 and Level 3. Therefore, the effects of training experiences are subject to attenuation and are difficult to establish.

The problem of measurement in competency-based teacher education programs is critical and is supported by the following two positions:

The overriding problem with CBTE before which the others pale to insignificance is that of the adequacy of measurement instruments and procedures. (Elam, 1971, p. 21)

I assume that even small progress made in assessing teacher competencies will be of great improvement over our present evaluations. (McDonald, 1974, p. 21)

As the above two positions stress, all efforts which are put into devising valid, reliable assessment and evaluation systems are steps leading to effective teacher training programs.
Environmental Education

Protection of the environment has become a case that reaches everyone's life whether they are aware of it or not, and as usual with causes, calls upon schools to equip the oncoming citizens to prevent disaster. Teacher training institutions are now making an attempt to satisfy this added responsibility. A study conducted by John H. Trent (1973) shows that there was a significant increase in the number of colleges offering courses in methods of teaching environmental education.

Since the earliest efforts to get environmental education "off the ground" environmental education has been defined in a variety of ways. In the past four to five years some definitions and unity have evolved. The following major objectives seem to be widely agreed upon.

1. To obtain a clean understanding that man has an inseparable relationship with his environment.

2. To obtain a broad understanding of the interrelationships among ecosystems and natural resources.

3. To develop an understanding of man's environmental problems and the decision-making skills to solve them.

4. To develop attitudes which will foster positive action relative to the environment. (Sale, 1974, p. 8)

Determining desired outcomes of environmental education is a necessary first step. The next logical step is the establishment of the nature of program likely to achieve the objectives of environmental education. A source of insight to this problem can be found in the guidelines prepared by the Office of Environmental Education in the U. S. Office of Education.
Thus the environmental education process is multifaceted, multi-disciplinary and issue or problem oriented. Otherwise worthwhile but specialized and narrowly defined educational approaches, such as areas of conservation, and resource use, environmental science, nature study, etc., which normally tend to exclude consideration of mutually reinforcing social, physical, cultural, and policy implications of these concerns do not adequately meet the scope of this purpose of the act. (1974, Part II)

Creager, Davis, and Hawkins (1975) supported the U. S. Office of Education in saying that environmental education should be an interdisciplinary program. This program consisted of a three-point position:

(a) Integrated design--this consists of the understanding of a natural integrated design encompassing all of the components of the human being--environment relationship. (b) Interrelationship of environmental education--effort needs to be directed at both problems themselves and to motivating students to commit themselves to coping with environmental questions and issues. (c) Interdisciplinary solutions--representatives of disciplines, experts in their own fields, need to be capable of communicating and working with experts in other fields--visualize the whole as clearly as they see the parts.

Linsky (1971) indicated that American education provides a perfect opportunity to develop programs aimed at inculcating an environmental ethic. Programs seeking to foster attitudes should begin in kindergarten and continue through the graduate level. In support of Linsky, Nelson stated that:

Education is the most effective means available to us of changing values and attitudes to create a new environmental citizenship, in which man will come to understand his role and responsibility as a custodian of life on this earth. (1970, pp. 2-3)
Once an environmental education program is established, an essential step towards achieving the goals of environmental education is to produce teachers who are willing to teach environmental education in their classrooms. Klein and Kosecoff (1973) generated a crucial question:

If elementary and middle school teachers do not have positive attitudes towards teaching, then it would seem that very little instruction in this subject would take place in their classrooms. The students would, therefore, have little opportunity to achieve the major goals of environmental education, i.e., acquisition of both positive environmental attitudes and knowledge. (p. 79)

Klein and Kosecoff (1973) designed a study that found that teachers possess positive attitudes toward teaching subjects in which they have received training. He conducted a study to ascertain the effectiveness of 30 hours of environmental education instruction on elementary and middle school teachers' attitudes towards teaching this subject to their classrooms. Fifty-one elementary and middle school inservice teachers were randomly assigned to two graduate level science methods classes. Both groups received the same instruction during the first 10 days. The experimental group, however, received instruction in environmental education. Following this treatment, both groups were administered an attitude instrument designed by Klein to measure their attitudes toward teaching environmental education. The content validity of this test was judged by five professors of science education and two professors of social science. The reliability was established using the test-retest method. Pearson-product-moment correlation coefficient was calculated as .88. Data from both groups indicated that they both had positive attitudes toward teaching environmental education.
However, the mean score on the individual statement, "I plan on teaching environmental education to my students" was significantly higher for the experimental group. The experimental group had a mean of 4.82 (with 5.00 being the highest, correlating with Strongly Agree) and the control group had a mean of 1.85. Also a significant difference was found on the statement score "I plan on spending a good deal of time teaching environmental education to my students." The experimental group had a mean of 4.25 and the control group's mean was .81.

Both groups felt that environmental education has a valid place in the K-8 curriculum, but possibly their inadequate background in environmental education caused the control group to disagree on statements involving a personal commitment to teach environmental education in their classrooms. The above statement is supported by the results of a study conducted by Mirka (1973) which used 244 elementary teachers. The teachers listed their reasons for teaching or not teaching environmental education. Those teachers who did not teach environmental education listed the lack of knowledge in the discipline and the lack of knowledge of environmental education instructional activities as the major reason for not teaching environmental education. These same teachers, however, believed environmental education experience would be valuable to children.

Studies carried out by the National Education Association Research Division (1970), Gillemwater (1969), and Donaldson (1972) illustrated the magnitude of concern for increasing research effort centering on environmental education interests and attitudes. They provide evidence of scholarly support for conducting such research and acknowledge the
role that instrument development must play in the research and evaluation effort associated with areas depended on input from both cognitive and affective domains. Through the development of instruments derived from simultaneous consideration of conceptual framework and a data base, the status of environmental education movements can be assessed and the influence of variables on growth and changes can be studied. With this information available, judgments can be made as to the effects of various educational programs on changing those movements in favor of a quality environment (National Education Association Research Division, 1970).

Fleetwood and Hounshell (1976) directed a study to develop a valid and reliable instrument capable of assessing the degree to which high schools involved in environmental education programs have assimilated specific environmental concepts and attitudes. The instruments developed were the Environmental Science Test and Environmental Attitude Inventory. Content validity was based on the results of a judge panel of measurement and environmental education experts. The use of the Kuder-Richardson Formula 20 resulted in a reliability coefficient of .83. Results of the study indicated that instruments can be developed to measure both cognitive and affective outcomes of instruction in environmental education.

Hounshell and Liggett (1976) implemented a four-phased program of environmental education. The thrust of all activity was to bring about cognitive and affective change in their teachers and the students of the teachers through an in-service program. Their study revealed that student learning was influenced by "treatment" of their teachers through in-service programs.
Test Construction

Because of the abundance of literature dealing with test development, the Landeen Descriptor Matrix (1976) was used as a guide to information on criterion-referenced test development. Landeen's study focused upon developing a reference source that would meet the information and decision-making needs of educators in the selection, development, and utilization of criterion-referenced measurement systems. The Descriptor Matrix was selected as the medium for presenting the data collected in the study.

Most test construction in the past focused upon a relatively few kinds of assessment instruments—such as college entrance examinations. Comparatively little help has been given to the classroom teacher to diagnose individual student needs or assess outcomes of particular instruction programs (Klein & Kosecoff, 1973). Now, however, there is growing desire to individualize programs and assess validly the outcomes of instructional programs and to hold teachers and the administrators responsible for actual gains in student performance. These trends have increased the demand on test developers for appropriate tools to facilitate the measurement process. It is within this context of increased need for and reliance on valid test results that the movement toward criterion-referenced tests has been given new impetus.

Popham and Husek (1969) distinguished between criterion-referenced measures and other forms of measurement in their definition.

Criterion-referenced measures . . . are used to ascertain an individual's status with respect to some criterion; i.e., performance standard. It is because the individual is compared with some established criterion rather than other individuals, that these measures are criterion-referenced . . . We want to know what the individual can do, not how he stands in comparison with others. (p. 9)
These measures are not new to education. What is new is the range of importance of the decision areas for which they are being employed or emphasized. The decisions that are made and the focus of criterion-referenced testing include:

1. Planning decisions. These are decisions relating to the organization of an instructional program.

2. Research category. These are decisions based on additional investigations of the instruction program.

3. Certification decisions. These are decisions that validate the quality and competency of a program (Klein & Kosecoff, 1973, p. 2).

Pressures for educational progress place a high priority on measurement and evaluation of student learning and educational procedures. In the development of a criterion-referenced test, Swezey and Pearlestein (1975) outline several basic steps. The procedure of each, however, may be varied. The steps are:

Defining test content and objectives. These are the purposes for which criterion-referenced tests are developed. Clearly defined educational objectives are essential to the foundation of criterion-referenced tests. Using objectives raises the problem of the extent of each objective's coverage—how broadly or narrowly the objective is stated. The statements may be further delineated by defining conditions under which the measurements are to be made and the standards of performance to be reached in order for the objective to be achieved.

Klein and Kosecoff (1973) state that there are four procedures that may be used to develop objectives. They are: (a) Expert
judgments--this is the most common approach. A small group of experts
within the area to be assessed meet and on the basis of their knowledge
and experience in the field, jointly decide which objectives are the
most important to measure. (b) Consensus judgments--this is where
various groups, such as community representatives, curriculum experts,
teachers, and school administrators, decide which objectives they con-
sider most important. (c) Curriculum analysis--in curriculum analysis
a team of curriculum experts analyze a given set of curriculum materials,
such as textbooks, in order to identify and, where necessary, infer the
objectives that are the focus of these materials. (d) Analysis of the
area to be tested--an in-depth analysis is made of an area in order to
identify all contents and behaviors that are included in that area.

Defining the adequate of an objective. Objectives may be considered
inappropriate for one or more of the following reasons: (a) One or more
of an objective's three parts are missing. An objective has three main
parts--the performance, what the objective requires people to know and
do; the condition, the situation under which people's performance will
be evaluated; and standard, the level of performance which indicates
satisfactory achievement of the objective. (b) The indicator is impro-
per. An improper indicator is when the action verb indicates a behavior
that you did not intend. Main intents are either covert or overt. An
overt main intent is one which is observable and measureable. They do
not require indicators. Covert main intents require indicators since
the performance they require is not directly observable. A good indica-
tor is simple, direct, and a task that students can be expected to
achieve. (c) An objective is not unitary. That is, it covers more
than one separate task. (d) The main intent is unclear. The performance statement should call clearly for the performance which demonstrates the objective. (e) Performance, condition, or standard are not specified in precise, operational terms. Each statement should be easily translatable into action.

**Developing a test plan.** Factors that should be considered in developing a test plan include: practical constraints, such as time, manpower, item format, which includes written items, performance items, etc.; and number of items, the number of items which adequately covers each objective. Gronlund (1976) states that in order for objectives to function most effectively in evaluations, an effort must be made to relate the evaluation procedures to the specific learning outcomes encompassed by each objective. This can be facilitated by: (a) A general evaluation plan. This consists of a list of all general instructional objectives and specific learning outcomes with an indication of the type of evaluation technique to be used for each intended outcome. (b) A table of specifications. This is a two-way chart that relates the objective to the subject-matter content. (c) A selection of evaluation techniques that measure each learning outcome closely--matching test behavior to intended outcomes.

**Constructing the item pool.** Following the test plan, instructional statements are transformed into items. Because of the vast number of test items that might be constructed for any given objective, this step becomes one of the most difficult in the total developmental process. There are item generating rules which provide the item writer with a set of requirements. Baker (1974) and Bormuth (1971) have both developed
such rules. The number of items to construct for each objective is influenced by factors such as the amount of testing time available and the cost of making an interpretation error—assuming a student has met the criteria of an objective when in reality he/she has not.

After the items have been prepared for the item pool, the adequacy of each item must be assessed. Factors to be considered in this assessment include: (a) item matches objective, (b) item relatively easy to administer, (c) item contains no ambiguities, and (d) item maintains a high fidelity level.

Selecting final test items. After the item pool has been developed, a selection process must be done to reduce the number of items for the final test form. There are three selection methods that are commonly used. They are: (a) Panel of experts—a group of measurement and curriculum "experts" decide which items should be used, based on their knowledge and experience of the field. (b) Systematic sampling—this is a variation of a classical test construction technique. A matrix of contents and behavior for each objective is developed. Items are then systematically sampled within this matrix. (c) Systematic item generation—this is the most sophisticated procedure. When this procedure is used the assumption has been made that all relevant contents, behaviors, stimulus, and response characteristics and related factors can be defined for a given domain of objectives. After relevant factors have been defined, basic item forms are constructed. Variations to these basic forms can be used to increase the size of the item pool.

In the selection process, a question arises as to how many items are necessary. A survey of current measures revealed that the usual
practice is to use about three to five items per objective. This practice appears to stem more from feasibility constraint than any sound foundation of psychometric theory or technology (Klein & Kosecoff, 1973, p. 6).

After a final selection is made it is axiomatic that measures are field tested prior to basing decisions upon them (Green, 1970). An item analysis will provide useful information. It provides data on the effectiveness of each item. According to Klein and Kosecoff (1973), there are four kinds of analysis methods. They are: (a) Comparison group. The test is given to two groups who are known to possess different degrees of skill with respect to the objective measured. Next, those items that discriminate best between the groups in the desired direction are identified. (b) Single group--post-test only. The test is given to one group after a fixed period of instruction. Since the students are somewhat heterogeneous in their ability, a point biserial correlation can be employed to identify faulty items. (c) Single group--pre- and post-test. The test is given to the same group twice--once before instruction and again after instruction. Items that discriminate between the two test sessions are identified. (d) Single group--repeated measure. Each student periodically takes the complete test until he/she is able to achieve mastery. A record is kept of the number of times the student passes and fails each item. An analysis is made to determine whether the item generally exhibits the desired pattern of failure then success.
Item difficulty is one of the measures in running an item analysis. The desired level of item difficulty for a criterion-referenced mastery test is not based on the ability of the items to discriminate between high and low achievers, as it is for norm-referenced tests. Instead, the difficulty of each test item is determined by the specific learning outcome it is designed to measure. The standard formula for determining item difficulty for norm-referenced testing can be applied to criterion-referenced test items, but the results are not typically used to manipulate item difficulty.

Item discriminating power is another measure in performing an item analysis for norm-referenced tests. However, the ability of test items to discriminate between high and low achievers is not a crucial factor in evaluating the effectiveness of CRT items. Some of the best items might have very low, or zero, indices of discrimination. Since the purpose of a CRT is to describe what students can do, rather than to discriminate among them, the traditional indices of discriminating power are of little value for judging the quality of the test items.

A crucial question in evaluating CRT is "To what extent did the test items measure the effects of instruction?" (Gronlund, 1976, p. 272). To answer this question the same test must be given before instruction (pretest) and after instruction (posttest) and the results compared. An item-by-item comparison can be made by means of an item-response chart. By listing the number of the test items across the top and the students' names down the side, then recording correct or incorrect responses for each pupil on the pretest and posttest, an analysis of the effectiveness of each item can be performed. Effective items yield indices between
0 and 1.00. The higher the positive value, the more sensitive the item is to instructional effects. Items with zero and negative values do not reflect the intended effects of instruction.

The effectiveness of distractors also is an important function of a CRT. Ideally, a student should choose one of the incorrect alternatives if he or she has not achieved the objective the item measures. A check is necessary to correlate the frequency with which each distractor is selected by those failing an item. If some items contain distractors that are not selected at all, or only rarely, a need for revision is indicated.

Administering and scoring the test. The same care which has gone into the preparation of the test should be carried out in the administration and scoring. These concerns include: (a) providing optimum conditions for obtaining the students' responses, and (b) selecting convenient and accurate procedures for scoring the results.

Establishing validity. Test validity is typically divided into four categories; namely, content validity, concurrent validity, predictive validity, and construct validity. Content validity compares content of test to objectives. Concurrent validity compares results on test to results on another measure of the objectives. Predictive validity compares results on test to results measured at a later period. Construct validity is the study of rival hypotheses to determine the degree to which an instrument measures hypothetical constructs (Born & Gall, 1971).

Test developers may provide evidence of the validity of their test. Davis (1974) stated that there are two validity questions. They were: (a) What can be inferred about what is being measured by the
test? The measuring instrument is an operational definition of a specified domain of skill or knowledge, or of a trait, or interest to the test developer or user. The answer to this question determines how faithfully the scores represent the domain. (b) What can be inferred about other behaviors? This is the usefulness of the measurement as an indicator of some other variable as a predictor of behavior (Davis, 1974). Gronlund (1976), however, indicates that the most important question in the construction of an evaluation instrument is: To what extent will the results serve the particular uses for which they are intended? The essence of the validity of a test, according to Gronlund, lies in this question.

Content validity can be determined by the curricular or expert opinion approach. With this approach subject-matter experts examine content for which it is designed. Another method of establishing content validity is through a systematic test development. A third method is to conduct an item analysis. By computing the internal consistency users are able to see whether an item on a given objective correlates more highly with other items for this objective than it does on other objectives. There are two types of content validity. Face validity is one type. This refers to the evaluators appraisal of how well the test measures the content. Another type of content validity is sampling validity. This is the degree to which the test serves as an adequate sample of the entire universe of content that one wishes to measure.

Construct validity is the extent to which a test can be shown to measure hypothetical constructs. Constructs refer to a psychological quality that is assumed to exist in order to explain some aspect of
behavior. Construct validation depends on logical inferences drawn from a variety of data. The following procedures are some methods that might be used in obtaining evidence for construct validity.

1. Analysis of the mental process required by the test items. Analyzing the mental process involves examining the test items to determine what factors they appear to measure and/or by administering the test to individuals and having them "think aloud" as they answer.

2. Comparison of the scores of known groups. A prediction of differences for a particular test can be checked against groups that are known to differ and the results used as partial support for construction validation. These may be age groups, boys and girls, trained and untrained, adjusted and maladjusted, etc.

3. Comparison of scores before and after some particular treatment. Test scores can be expected to change as certain types of experimental treatment are introduced.

4. Correlation with other tests. Scores of any particular test can be expected to correlate substantially with the scores of other tests that presumably measure the same thing (Remmers, Gage, & Rummel, 1965).

Both concurrent and predictive validity rely on the empirical approach, which uses an outside criterion for comparison. The distinction between concurrent and predictive validity is dependent upon whether the criterion measure is administered at the same time as the outside criterion measurement (concurrent) or later, usually after a period of several months or more (predictive).
When using validity in relation to testing there are three cautions to be kept in mind. They are: (a) Validity pertains to the test and not to the instrument itself. Specifically, it pertains to the interpretation of the results. (b) Validity is a matter of degree and not an all-or-none situation. (c) Validity is always specific to some particular use and not to generality (Gronlund, 1976).

There are a number of factors that tend to influence the validity of test results. Some influences can be found in the test instrument itself, some in the relation of teaching to testing, some in the administration and scoring of the tests, some in the atypical responses of students to the test situation, and still others in the nature of the groups tested. A major aim in the construction of evaluation instruments is to control those factors.

Establishing test reliability. Test reliability refers to the extent to which a test yields consistent scores. In classical test theory, the two primary views of reliability theory are: (a) the determination of test reliability through the analysis of scores of groups of individuals to identify the proportion of variation attributable to differences of a particular characteristic of an object or (b) individual to determine the magnitude of error associated with a test instrument. Gronlund (1976) indicates that next to validity, reliability is the most important characteristic of evaluation results. Reliability provides the consistency which makes validity possible and indicates how much confidence can be placed in the results.

Because of the differences between a CRT and the norm-referenced tests, however, the classical and generally accepted mathematical model
and assumptions that underlie the definitions of traditional measurement
error and norm-referenced test reliability are not applicable to CRT
reliability. It is not consistent with CRT when the reliability of a
test has to do with the consistency of decision-making—whenever this
question is answered dichotomously (mastery/nonmastery). According to
Marshall (1976), a CRT reliability coefficient should have the following
characteristics:

It should be associated with the notion of consistency
or accuracy of dichotomous classification; hence the
more the scores depart from the cutoff point, the higher
the CRT reliability index should be, since such depar­
ture most clearly represents a separation between the
mastery and nonmastery categories.

It should be, at least in some respects, variance-free,
so that it will not vanish when total score variance
approaches 0.

It should avoid any reliance on classical measurement
error concepts, since they are not necessarily rele­
vant to a test whose purpose is to make a dichotomous
decision.

It should be a function of the criterion level, since
the criterion level is an integral part of the CRT.

It should if possible have a familiar range of values,
most probably (0,1) for ease of interpretation. (pp. 23-24)

A single-administration coefficient that reflects this notion is
the mean of all possible split-half coefficients of agreement, where the
coefficient of agreement is the proportion of consistent categorizations,
or the index labeled coefficient beta. It was derived from Marshall
and Haertel (Marshall, 1976).

Even though an evaluation instrument may be highly reliable, there
are a number of factors which induce variation in test scores; such as
systematic or orderly changes and unsystematic changes. Systematic changes include learning, growth, which raise scores; or fatigue, aging which reduces scores. Unsystematic changes include attention, emotional factors, test environmental conditions which can have either positive or negative effects.

Cattell (1964) suggested that test consistency is a better term than reliability. There are distinct forms of consistency. They include reliability, homogeneity, and transferability. Cattell defines test consistency as:

The extent to which a test continues to measure the same psychological concept despite such changes that inevitably and normally occur in a test, its administration, and to the populations to which it is administered. (1964, p. 11)

The procedures used in developing an assessment instrument to measure environmental education competencies are important. However, equally important as the construction is the content of the test. According to Reilly et al. (1977) the most relevant aspect of measuring competencies are with respect to pupil outcomes. It is in terms of pupil behavior or outcomes that teaching becomes meaningful. Thus, the measurement and validation problem becomes one of defining the point at which competencies are to be measured and related to pupil outcomes.

The development of appropriate competencies is exceedingly difficult unless the tasks for which competencies are to be developed are known. Therefore, the community should determine the objectives for its schools in such a way that the tasks and competencies necessary to achieve the objectives can be developed. Having the community develop
objectives for environmental education, and basing the test to meet these objectives will allow for the instrument to be broad enough to cover the entire realm of environmental education and not just geared to meet one particular class of objectives.
CHAPTER III
PROCEDURES

There is not a single correct way to construct a CRT. The procedures used to reach the objectives of this study were based on the outline of test construction steps with a few minor revisions outlined by Swezey and Pearlstein (1975). They were as follows:

Determine Objectives and Content Area

The inputs to the CRT development process are called objectives. CRTs are developed from objectives that tell what must be done to successfully complete or perform certain tasks. The determination of the objectives should be established through a community effort based on their desires of pupil outcomes (Reilly, et al., 1977). The steps taken in this study to determine the objectives and content area of the test were: (a) Review literature concerning current environmental education movements. (b) Receive a tentative outline of objectives and course content developed by Dr. Donald Daugs, Professor of the science methods course in Level III at Utah State University. (c) Discuss with Ed Dalton, Energy and Man's Environment: A Course of Study, Coordinator, to get input on objectives and course content for environmental education. (d) Discuss with Dr. Richard Petersen, Utah State Board of Education Science Specialist, to get input on objectives and course content for environmental education.
Assess the Adequacy of each Objective

Objectives, to be suitable for use in developing test items, must contain explicit statement of performance, conditions, and standards. Objectives can, however, have all three parts and still be inadequate. There are six major checks that are necessary in assessing the objective’s adequacy. These six checks were used in this study. They were:

1. Check for three main parts of an objective—performance, condition, and standard.
2. Check to make sure objective is unitary—covers only one task.
3. Check for clarity of main intent. Level II students are given a copy of the objectives. They are to check the performance statement of the objective ensuring that the performance statement calls for that performance which demonstrates the objective. Any objective the students question will be taken back to the originators and revised or eliminated.
4. Determine if main intent is overt or covert.
5. If main intent is covert, check indicator. Indicator should be simple, direct, and part of student’s normal repertoire.
6. If main intent is overt, check three main parts—performance, condition, and standard. They should be stated in precise, operation terms. The student should be able to understand what is expected of them.

Develop a Test Plan

A test plan provides a systematic procedure in the actual test construction process. In this step factors are considered which will enable the construction of test items based upon objectives. This
documents the characteristics of the items necessary for the instrument. The steps used in developing a test plan were:

1. Examine objectives to see if they are actually administrable by examining practical constraints.

2. Determine if practical constraints are severe enough to prohibit testing all objectives as stated. If practical constraints prevent testing of all objectives, a selection or modification of objectives must be made.

3. Plan item format and level of fidelity. Item type should be the type that best approximates the behavior specified by the objective.

4. Determine if items should be sampled for objectives. Item sampling is necessary when there are large numbers of items that could be created for an objective.

5. Determine the number of items the test should include. The number of items used is dependent upon the complexity of the objective, variety of conditions under which the objective must be tested, and the objective's standard of acceptable performance.

Construct the Item Pool

This is the process of creating a group of items from which final test items are selected. The key characteristic of these items is that they are developed to measure the degree of attainment of an objective. Instructions are considered part of the item pool and should provide clear directions to students giving them the procedure that is expected of them. The procedures used in developing the item pool for this study were:
1. Write the test items. When writing test items, the objective's performance should be noted, following the test plan specifications. Performance in each written item should match the performance stated in the objective. Conditions and standards should be the same in both test item and the objective. Approximately seven items will be written for each objective since the final form of the test will have approximately three to four items per objective.

2. Develop instructions. Specific instructions are necessary if the item requires: (a) special equipment, facility, conditions, or standards which the test administrator must implement, or (b) special instructions must be presented to students before the task can be attempted. Special instructions are part of the items to which they are appended.

3. Assess the adequacy of items. Performance, standards, and conditions in both the item and the objective should match. The overt main intent or indicators should be the same in the objective and the item. Check to make sure the items are clear and unambiguous, reasonably easy to administer, and at the appropriate level of fidelity.

4. Develop general test instructions. General test instructions apply to the entire test. They should be clear, unambiguous, and brief as possible. General instructions include the following information: (a) purpose of test, (b) time limits, (c) description of test conditions, (d) description of test standards, (e) description of test items, and (f) general test regulations.
Select Final Test Items

The items selected for the final version of the instrument depend primarily upon how effectively each item measures each objective. Item-generating rules, content validity, and clearness should be considered. The selection of final items for this project followed this procedure:

Review of item pool. A team of environmental critical reviewers, Dr. Donald Daugs, Vernon Summers (local high school science teacher), and Dr. Richard Peterson (Utah State Board of Education Science Specialist); test developer, Dr. Izar Martinez; and students, Level II students of the Elementary Teacher Training Program at Utah State University, examine the items. Evaluations will be made according to their personal judgments in their particular field of expertise. The test developer will be able to identify problems which violate established testing principles. Students will provide input as to the clarity of each item. To ensure content validity, subject matter experts match the item to the list of objectives. An 80% agreement as to the effectiveness of the item will be set as the criterion items will have to meet to be considered for the final test form.

Pilot the Evaluation Instrument

The test form should be piloted on the same type of population as those for whom the test is intended. Through actual administrations of the test, new problems such as ambiguities on test items and test instructions may be resolved. The procedures used in this step were:

1. Have Level III students sign the "Informed Consent Agreement Form." No names or addresses will be identified with subjects in processing or analyzing the data.
2. Standardize environmental, personal, instruction, and tester variables.

3. Administer test to available Level III students (Spring Quarter).

4. Score test.

5. Record test results.

6. Run an item analysis on individual test items.

7. Eliminate defective test items or revise necessary items indicated by information collected from item analysis.

8. Compile revised test items and readminister test to Level III students (Summer Quarter) twice during the quarter.

Assess Test Reliability and Validity

Content validity is important primarily in achievement testing and various tests of skills and proficiency (Borg & Gall, 1971). It is also an important consideration when testing the effect of training methods on achievement. Reliability is an extremely important characteristic of tests. This is the level of consistency of the measuring device. The procedures used in this step to assess reliability and validity were:

1. Determine test reliability. Reliability coefficient determined according to the Marshall-Haertel reliability formula. A reliability coefficient of .80 will be set as the criteria to be an effective assessment instrument (Borg & Gall, 1971).

2. Content validity previously established. Established in review of item pool subheading.

3. Perform an item analysis on both administrations.

**Procedures Flow Charts**

The diagrams below and following are flow charts that show the basic outline of the procedures used in this study. The numbering on the charts correspond to the numbering of the description of the procedures in the succeeding pages.

```
Determine Objectives
1.0

Assess the Adequacy of Objectives
2.0

Developing Test Plan
3.0

Construct the Item Pool
4.0

Select the Final Test Items
5.0

Pilot the Test
6.0

Assess Reliability and Validity
7.0

Suitable Assessment Instrument
8.0
```
1.0 Determine Objectives and Content Area

- Review of Literature
- Dr. Donald Daugs
  Level III Professor
- Ed Dalton
  Energy and Man's Environment
- Dr. Richard Petersen
  State Board of Educ.
  Science Specialist

Specific Objectives and Content Area
2.0 Assess the Adequacy of an Objective

Does Objective Contain the Three Main Parts? Yes → Does Objective Cover One Task Only? Yes → Is Main Intent of Objective Clear? Yes → Is Main Intent Overt or Covert? No → Covert → Overt

No → Break Down Objective into Several Unitary Objectives.

Modify if Possible then Send Revision Through Channels for Approval or Document Difficulty and Send Objective Back Through Channels for Clarifications/Revisions.

In Either Case, Take Approval, Modified Material and Continue Adequacy Check.

Is Indicator Simple, Direct, and Part of Normal Repertoire of Behavior? No → Are Performance, Condition, and Standard Specified in Precise, Operational Terms? Yes → Yes → No

Objective Is Adequate
2.0 Assess the Adequacy of Objectives

- Do These Constraints Necessitate Sampling of Objectives?
  - Yes
    - Feasible to Select Among Objectives?
      - No
        - Modify Objectives in Light of Practical Constraints. Obtain Approval of Modified Objectives.
      - Yes
        - Practical Constraints Overcome by Selecting Among Objectives?
          - No
            - Plan Item Format and Level of Fidelity.
          - Yes
            - Develop Plan for Selecting Among Objectives.
  - No
    - Plan Item Format and Level of Fidelity.
    - No
      - Necessary to Sample Item for Objective?
        - Yes
          - Develop Item Sampling Plan
        - No
          - Decide How Many Items to Include on Test
            - Yes
              - Document Test Plan on Test Plan Worksheet
              - 4.0 Constructing the Item Pool
4.0 Construct the Item Pool

3.0 Develop the Test Plan

- Create Items Based on Test Plan Specifications
- Develop and Document Instructions for Item Use
- Assess Adequacy of Items
- Develop General Test Instructions

5.0 Select Final Test Items
5.0 Select the Final Test Items

4.0 Construct the Item Pool

Content Validity--Review of Test Items by Test Developers, Subject Matter Experts, and Students

Tabulate Results of Review

Reduce Item Pool by Eliminating or Revising Items that Were Inadequate According to Item Review

Are Enough Items Left for Final Version of the Test?

No

Write New Items

Yes

Are There Extra Items?

No

Create Alternate Test Form Using Extra Items as Desired.

Yes

6.0 Pilot Assessment Instrument
6.0 Pilot the Assessment Instrument

5.0
Select the Final Test Items

- Standardize Test Administration Procedures
- Administer the Test
- Score the Test

- Record Test Results
- Run an Item Analysis
- Revise the Test

- Readminister in Two Different Testings

7.0
Measure the Test Reliability and Check the Validity
7.0 Assess Reliability and Validity

6.0
Pilot the Assessment Instrument

Determine Reliability According to the Marshall-Haertel

Check Content Validity

Perform Item Analysis of Item Difficulty

Determine Test Stability--Test-Retest Check

Does Test Have Acceptable Reliability and Validity?

Yes

Suitable Assessment Instrument

No

Revise Test
CHAPTER IV

RESULTS

The purpose of this chapter is to present the findings from the step-by-step process of constructing and validating the Test of Environmental Education Competencies, an instrument designed to assess the impact of implementing an environmental education component to the Level III component of the Elementary Teacher Training Program at Utah State University.

**Determination of Objectives and Content Area**

A tentative outline of objectives and course content was developed by Dr. Donald R. Daugs, Professor of the science methods course in Level III of the Elementary Teacher Training Program at Utah State University. This outline was used as a basis for discussion with Dr. Richard Petersen, Utah State Board of Education Science Specialist. He reviewed the objectives and description of course content with the researcher verbally. He gave a general agreement with the objectives as stated. He indicated that because of the broadness objectives 4, 5, and 8 entailed (Appendix B), these objectives should be narrowed down by specifying curricular activities that the students would be engaged in. However, when this input was taken back to Dr. Daugs, it was indicated that the reason for not specifically stating particular activities is that it would leave the content area open enough to implement recent environmental education activities that may come onto the
market. Dr. Petersen felt the objectives covered all important aspects of environmental education and felt that any additional objectives would only overlap into one of the previously stated objectives.

Because of conflicting schedules, a written evaluation of the objectives was performed by Ed Dalton, Energy and Men's Environment coordinator. His written reply indicated an agreement with the outlined objectives and content area. His only concern dealt specifically with the addition of energy-related activities to the objectives. However, in discussing this input with Dr. Daugs, it was decided that energy-related activities would be included in objectives 4, 5, and 8.

Assessment of the Adequacy of each Objective

The objectives developed by Dr. Daugs were then taken and assessed for their adequacy by the researcher. In checking for the three main parts, most objectives were found to be lacking the condition and standard parts. Conditions were then added to the objective. Standards were not included because they would be set later when determining the criteria that masters or nonmasters must meet in the competencies in environmental education. Each objective was found to be unitary in task. The revised objectives are listed in Appendix B.

A list of the revised objectives was distributed to 10 Spring Quarter Level II students of the Elementary Teacher Training Program at Utah State University. They were given the instructions to read each objective and write down what they thought the objective was expecting the student to do. These students had just successfully completed a study on behavioral objectives, thus it could be assumed that
they understood the vocabulary of "objective's three main parts," "main intent," "indicator," "overt and covert." Additional instructions indicated that if the performance was covert, to check the indicator to make sure it was a reasonable task to ask students to do. The students were also told that the content of many objectives may be unclear to them, but the check was only on the performance words of the objectives. Each student was able to identify the behavior indicated by the main intent of the objective.

Development of a Test Plan

Examination of the objectives led to the researcher's conclusion that none were impractical to administer because of practical constraints. Multiple choice items were selected as the item format and fidelity level. This written format would make administration relatively easy and a broad amount of content would be covered in a limited amount of time.

Item sampling was found necessary because of the large number of items that could be generated from each objective. Because of the limited testing time, a test consisting of 40 items was considered as a desirable test length. This would allow approximately four to five items per objective, which according to Klein and Kosecoff (1973) is the number most commonly used in test construction.

Construction of the Item Pool

The pool of test items, consisting of 76 items (at least seven items for each of the nine objectives) was generated. Care was taken to match performance and conditions of objectives to the items corresponding to that objective.
Since the majority of the items were multiple choice, general test instructions were developed that covered the major portion of the items. Because of the intended use of the test is to administer the same test twice per quarter, an answer sheet was used to facilitate scoring.

Questions 75 and 76 of the item pool consisted of a matching exercise, so specific instructions were written to give direction to the student in how to complete the exercises.

Selection of the Final Test Items

The item pool was rated by the panel of critical reviewers as indicated in Table 1 of Appendix A. Only those items receiving an 80% agreement on being effective were considered for the final test form. Because there were enough items receiving a 100% agreement to construct the test, all but one of the items used on the preliminary test form and final test form received a 100% agreement score. Using at least an 80% agreement score will insure a high content validity for the test. Preliminary test item number 25 received an 80% agreement score. The reason for using item 25 is that it required the student to select observations, which is one of the steps in the science process, a skill which is stated in objective 3. The subject matter experts, however, all matched the item to the same objective, so content validity is not hurt by using this item.

Piloting of the Instrument

The preliminary form of the test was administered to the 1978 Spring Quarter Level III students of the Elementary Teacher Training Program at Utah State University. In accordance with university
requirements, Level III students were informed about the study. Before they participated in the study, they signed the "Informed Consent Agreement Form" giving their acknowledgment to participate in this study.

All students were given the test in the same class environment and time they had been scheduled for during the quarter. An item analysis of this preliminary form produced information regarding the level of difficulty for each item, as well as the ability of the distractors to distract. Appendix E gives the index of difficulty for each item and shows the effectiveness of each distractor. The entire test averaged a .67 level of difficulty.

In selecting items for the final form of the test, all items were reviewed once again by Dr. Izar Martinez, a critical reviewer with background in test development. This provided additional input to the results of the item analysis. Combining the information of the item analysis and Dr. Martinez, the following test item changes were made which reduced the 38 test items on the preliminary form to 36 items on the final test form.

Changes made in wording of either the distractors or the test item question included:

1. The preliminary test form, items 2 (Final Test Form item 4) and 21 (Final Test Form item 18) each had one distractor revised because the results of the item analysis indicated that no students were distracted by these alternatives.

2. Preliminary test form items 4 (Final Test Form item 15) and 17 (Final Test Form item 16) each had the wording in a distractor changed because Dr. Martinez felt the existing words were ambiguous.
Changes made in actual elimination or additions of test items included:

1. Preliminary test item 10 was eliminated since preliminary test form item 8 (Final Test Form item 2) question answered it.

2. Preliminary test form item 15 (Final Test Form item 6) was revised to include the information in preliminary test form item 20. So preliminary test form item 20 was eliminated from the final test version.

3. Because of the questions resulting from students who piloted the preliminary test form, preliminary test item 25 was eliminated.

4. Item 23 on the final form is an entirely new item that was not used on the preliminary test form. This item is item 76(3) on the item pool, which received a 100% agreement score by the panel of critical reviewers. The reason for selecting this item was that it measured objective 7. This objective on the preliminary test form had three items measuring it. With the addition of this item to the test, objective 7 is measured by four test items.

Thus the elimination of preliminary test form items 10, 20, and 25 and the addition of Final Test Form item 23, the 38 item preliminary form was reduced to include 36 multiple-choice and matching items in the final form.

The final form of the test was readministered to a second pilot group (1978 Summer Quarter Level III students) at the beginning of the quarter (first testing). The students then participated in environmental instruction and the test was readministered in a second testing.
Assessment of Test Reliability and Validity

Reliability. Analysis of the second pilot group's first administration using the Marshall-Haertel reliability formula, yielded a reliability coefficient of .81. An 80% criterion was set as a point dividing masters and nonmasters. Four students in the first administration met this criteria.

A second reliability analysis on the second administration using the Marshall-Haertel reliability formula resulted in a reliability coefficient of .78. The 80% criterion level was set as a dividing point of masters and nonmasters. Sixteen students in the second administration met this criterion level.

To establish a measure of stability another reliability test was performed using the test-retest formula. This resulted in a Pearson-product-moment correlation of .8191.

Validity. The content validity of the instrument was established by the review performed by the critical reviewers. All items used on the final test form received a 100% agreement of item effectiveness.

Item analysis. An item analysis was performed on both administrations of the final test form. The data from the first administration item analysis is in Appendix G. This provides a detailed breakdown of item difficulty level for individual test items and the ability for each distractor to distract. The first administration averaged a .69 difficulty level.

A second item analysis was performed on the second administration. Detailed information is provided in Appendix H. The administration averaged a .81 difficulty level.
CHAPTER V
SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this chapter is to summarize the procedures and findings of the study and to present conclusions and recommendations based on results of the study.

Summary of Procedures

The instrument was developed, using the following steps:

1. Tentative objectives of the environmental education component and content area were outlined. The outline was reviewed by two environmental education experts to get their input as to what should be included and expected from students of an environmental education component for elementary teachers.

2. The adequacy of each objective was assessed. This consisted of a check that objectives contained the three main parts--performance, condition, and standard; unitary in task; clarity of main intent; and simplicity and directness of indicators. Objectives not meeting this check were revised and reapproved by the originator.

3. A test plan was developed to determine item format, level of fidelity, and the number of items the test should include.

4. A pool of test items, comprised of at least seven items per objective, was constructed. A total of 76 items were written for the nine objectives. This pool was then submitted to a panel of critical reviewers. Based on their review, an 80% agreement of total
effectiveness, was set as the criteria for items to be considered for the final test form.

5. A preliminary test form was constructed from those items which met the above criteria stated in Step 4, and administered to a pilot group of Level III students.

6. An item analysis was performed on the preliminary test form items to determine the level of difficulty and the ability of the distractors to distract.

7. On the basis of the item analysis and a review with a critical reviewer who had background in test development, defective items were either eliminated or revised.

8. The final form of the test was constructed and administered to a second pilot group of Level III students at the beginning of the quarter. This same test was readministered again after instruction at the end of the quarter. An item analysis was again performed on the test items for both administrations to determine the level of difficulty and the ability of the distractors to distract.

9. The reliability of both administrations was determined by using the Marshall-Haertel reliability formula. By using the test-retest method, a reliability measure of stability was also established by correlating the scores of both administrations.

Summary of Findings

Reliability. The reliability coefficient of the first administration was .81 and .78 for the second administration. The Marshall-Haertel reliability formula was used in the calculations.
The first and second administrations of the final test form resulted in a Pearson-product-moment correlation of .8191. This coefficient provides an index of stability for the instrument.

The variance of the first testing was 10.96 with a standard deviation of 3.31. The variance of the second testing was 11.42 resulting in a standard deviation of 3.38.

**Validity.** Content validity was established through a review by critical reviewers. An 80% agreement on effectiveness on each item was set as the criteria. The final test form consisted of test items that received a 100% agreement score of item effectiveness by the critical reviewers.

**Item analysis.** An item analysis performed on the first administration showed item difficulty ranged from .25 to .95. The entire test averaged a .69 level of difficulty. The item analysis performed on the second administration of the test resulted in item difficulty coefficients ranging from .40 to 1.00. The test averaged a difficulty level of .81 for the second testing.

**Conclusions**

Based on the findings of this study, the following conclusions can be reached:

1. The Environmental Education Competency Test will give reliable and consistent results. A reliability coefficient of .81 and .78 for the two administrations average to a reliability coefficient of .80. This internal consistency coefficient of .80 meets the criteria set in Chapter III, Procedures. The reliability coefficient of .8191 also
meets the criterion set in Chapter III. This coefficient indicates a reliability in stability between administrations.

2. By comparing the level of difficulty for the two administrations, the test does show positive learning gains occurring between the two administrations. The difficulty level of the first administration was .69 and .81 for the second administration. The increase in the difficulty score in the second testing shows that during the two administrations, learning growth caused the test to become easier. Therefore, it can be concluded that the test is affected by instruction.

Recommendations

Based on the conclusions derived from this study, the following recommendations are made:

1. The Environmental Education Competency Test should be considered an acceptable, reliable instrument.

2. The test is effective when used as a pretest and posttest.

3. The content taught in the environmental education component should be examined for content validity with the stated objectives established for the environmental education component.

4. Testing for the data reported herein, was done during regular 50-minute class periods. Therefore if the Environmental Education Competency Test is used as an assessment instrument, it is recommended that a time limit of 50 minutes be imposed. If the test is to be used without time limits on testing or with a different time limit, new data should be collected.
5. Assessment instruments should be developed to measure the stated objectives of the five disciplines currently being taught in Level III. This additional instrument would provide data on the five traditional disciplines indicating whether the environmental education component had positive or negative effects in each individual content area. Such effort could be the focus of a future thesis.
REFERENCES

Alldredge, D. An evaluation of the effectiveness of the teacher education program at Utah State University for elementary teachers (MS thesis, Utah State University, 1977).


APPENDICES
Appendix A

Tables
### Table 1

Item Pool Review Performed by Critical Reviewers—Environmental Education Experts

Test Developer, and Students

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/ = effective item
X = defective item
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Mean Score: 25.95
Test possible: 38
Sample Size: 40
Standard Dev.: 3.17

Total: 1038

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Table 3
The Frequency Distribution of Items Passed on the Piloting of the Final Form of the Environmental Education Competency Test.
This test was given on June 22, 1978 to Summer Quarter Level III students

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Variance . . . . 10.05

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* Revisions or changes from preliminary test item form
Appendix B

List of Objectives and Course Description

as designed by Dr. Donald R. Daugs

Used to Discuss with Panel

of Experts
ENVIRONMENTAL EDUCATIONAL METHODS

Course content and methods are based on the belief that there is an urgent need for individuals to investigate relationships that exist between man, all other living things, and the physical environment. Environmental experiences should begin in or near the classroom and extend out as field experiences where appropriate. By being full participants in many activities, students may become more seriously aware of their surroundings, of how man influences the total environment. Such an approach is by necessity multi-disciplinary. Division of content with traditional subject areas is neither possible or desirable.

Upon completion of the course, the student should be able to:

1. define environmental education.
2. identify and define basic concepts of ecology.
3. identify and define science process skills.
4. participate in environmental education activities that emphasize science process skills and concepts of ecology.
5. participate in environmental education activities that illustrate the impact man has on the environment.
6. infer the need for an environmentally aware citizenry.
7. state a philosophy of environmental education that reflects the above objectives.
8. examine environmental education curricula for emphasis on process, content, teaching methods and philosophy.
9. plan an effective environmental education learning experience that reflects personal philosophy.
10. demonstrate the ability to integrate environmental education concepts and materials with the total elementary curriculum.

CURRICULUM GUIDELINES

Environmental education should be designed in accordance with children's developmental stages. The preoperational, concrete-operations, and formal-operations stages posited by Piaget might serve as reference points. Experiences should be designed to facilitate the child's perception of his world through all his senses.
The curriculum design should incorporate concepts and processes from the natural (physical) and social sciences. Teaching basic principles of ecology is not enough; we must help students to appreciate their environment and to develop values that will guide positive action.

The core of the curriculum should be recognition of man's interdependence with both the natural and man-made components of his environment. Helping students to see themselves as interdependent with, rather than plundering masters of, their environment is crucial.

Environmental education should be an integral component of the curriculum and not simply an appendage "tacked on" to the existing curriculum. Previous efforts in this direction have been limited primarily to "conservation education" or "outdoor education". Although such instruction has merit, it is limited in scope and is often treated as an appendage to the central curriculum. Environmental education can become integral to the curriculum by either completely altering the existing curricular framework or extending existing programs. It is possible, for instance, to revise traditional programs of science and social sciences to include appropriate environmental education.

Appropriate emphasis should be given to the study of natural, social, and man-made environments, especially their interrelations. The natural environment comprises the biotic world; the social environment, which is the network of relations among men; and the man-made environment, which consists of man's concrete modifications or structuring of the physical environment. Too often we have failed to help pupils understand the interrelations among these three and have taught instead only a limited conception of the natural environment.

The process of inquiry should be a prime vehicle for involving pupils in environmental studies. Too much schooling today consists of irrelevant paper-and-pencil exercises dictated by teachers. We must engage pupils in firsthand experiences that will have genuine meaning for them, and we must value students' questions as much as we value their answers. The school, school grounds, and overall community should serve as an "environmental laboratory" in which "children learn what they live".

Appropriate attention should be given to cognitive, affective, and psychomotor achievement. If one domain is to be emphasized, it should be the oft-neglected affective domain. Pupils need to develop systems of value analysis that will guide positive action related to the environment. All of us need a "science of humanity" through which man can interpret his world, find the best way to live in it, and contribute to betterment for all mankind.

The program should be planned on a continuum extending from kindergarten through the university. Environmental studies should have both continuity and sequence, with emphasis on related principles, concepts, and processes, rather than on apparently unrelated facts.

Provision should be made for in-service training of both professional and paraprofessional personnel. It is especially important to draw upon
local citizens and local, state, and regional experts in environmental problems. We must develop partnerships in designing experiences for pupils. With the possible exception of some formal university study of ecology and related sciences, training programs can best be conducted, with a variety of human and material resources, at the local level.

Provisions for continuous evaluative feedback should be built into the program. This feedback should include data from pupils, patrons, and school personnel on how to achieve ever-greater improvement. (Sale, 1970)
REVISED OBJECTIVES

1. When given a set of educational descriptors, the student will be able to select those characteristics that most appropriately describe environmental education.

2. A. When presented with a variety of concepts, the student will be able to identify those that pertain to ecology.
   B. When presented with the basic concepts of ecology, the student will be able to define them.

3. A. When given a list of skills, the student will be able to identify those skills that are part of the science process.
   B. When presented with the science process skills, the student will be able to define each skill.

4. A. Through participation in environmental education activities, the student will be able to apply science process skills in problem solving.
   B. Through participation in environmental education activities, the student will be able to recognize those activities that are emphasizing concepts of ecology.
   C. Through participation in environmental education activities, the student will be able to evaluate the impact man has on the environment as illustrated by those activities.

5. When given a set of alternatives, the student will be able to select those that infer the need for an environmentally aware citizenry.

6. When given a list of different philosophical approaches to environmental education, the student will select the approach that will best exemplify the philosophy of the Department of Elementary Education at Utah State University.

7. Given environmental curricula, the student will be able to identify its content emphasis, teaching methods, and philosophy.

8. Based on personal philosophy, the student will be able to develop an effective lesson plan dealing with environmental education.

9. When given a list of multi-disciplinary environmental education activities, the student will be able to identify the environmental education concept and the separate disciplines combined into each activity.
Appendix C

Pool of Test Items and Accompanying Evaluation Form
## ENVIRONMENTAL EDUCATION TEST ITEMS

**Review Sheet**

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ITEM POOL

1. The following are essential elements in environmental education, except for:
   (a) the use of an interdisciplinary approach
   (b) the understanding of factors and forces that operate in our environment
   * (c) the pursuit of affective goals as well as cognitive goals
   (d) basing curriculum on a science approach

2. The major goals of environmental education is to:
   * (a) teach man's relationships to his surroundings
   (b) emphasize outdoor resource management
   (c) provide an opportunity to use problem-solving skills
   (d) develop the use of local resources

3. The following are characteristics of an effective environmental education, except for:
   (a) it must facilitate a child's perception of the world
   (b) it must be activity-centered in the "real" world
   * (c) it must be a narrow involvement of disciplines
   (d) it must have a future orientation

4. In the past environmental education has been a small part of elementary curriculum because:
   (a) it wasn't designed in accordance with children's developmental stages
   * (b) it was narrowly defined; treated as an appendage to the curriculum
   (c) lack of government money to support environmental education
   (d) all of the above

5. Which statement is true about environmental education?
   (a) Environmental education is science oriented so activities from other curriculum areas should be avoided.
   * (b) Environmental education involves the making of enlightened decisions about the quality of life.
   (c) Environmental education is conservation, outdoor resource management, and nature study.
   (d) Environmental education is a self-contained course to be added to the present curriculum.

6. The process that promotes among citizens the awareness and understanding of their surroundings, their relationship to it, and the concern and responsibility necessary to insure their survival and to improve the quality of life.

   The above is the definition of:
   (a) ecology
   (b) outdoor resource management
   * (c) environmental education
   (d) man's impact on his environment

* Correct Answers
7. The primary goal of teaching environmental education should be to develop
   (a) environmental literacy
   (b) investigation skills and processes
   (c) decision-making skills
   * (d) awareness of man's interdependence of the earth

8. The above is an illustration of a/an
   * (a) organism
   (b) ecosystem
   (c) food chain
   (d) community

9. The above is an illustration of
   * (a) an ecosystem
   (b) abiotic components
   (c) biotic components
   (d) food chain

10. The above illustrates
    (a) a niche
    * (b) producers
    (c) a food chain
    (d) ecological succession

11. A complex network of biotic and abiotic factors in which each factor is affected by the other is called
    * (a) an ecosystem
    (b) an ecotone
    (c) a distribution
    (d) a niche
    
* Correct Answers
12. Temperature, moisture, light, wind, and soil characteristics are all examples of
   *(a) abiotic factors
   *(b) biotic factors
   *(c) primary sources
   *(d) dominants

13. Each species has a **niche** in an ecosystem. What best describes niche?
   *(a) function
   *(b) similarity
   *(c) demand
   *(d) transformation

14. Complete the following food chain:
   
   Grass → Cricket
   *(a) deer
   *(b) bird
   *(c) squirrel
   *(d) earthworm

15. Which community would have the greatest species diversity?
   *(a) desert
   *(b) tropical forest
   *(c) grassland
   *(d) alpine

16. The process where living organisms modify their environment, making it less favorable for themselves but more favorable for another community is called
   *(a) energy flow
   *(b) abiotic stratification
   *(c) autotrophic continuum
   *(d) ecological succession

17. An unfavorable alteration of our surroundings, wholly or largely as a by-product of man's actions is called
   *(a) expenditures
   *(b) pollution
   *(c) consumption
   *(d) aesthetic valuing

18. The following are all components of an ecosystem except for
   *(a) decomposers
   *(b) energy source
   *(c) ecotones
   *(d) consumers

19. The branch of life science that studies the relationships among living organisms and between organisms and their environment is called
   *(a) man's impact on his environment
   *(b) ecology
   *(c) conservation
   *(d) resource management

* Correct Answers
20. Community is to ecosystem as
   (a) soil is to ground
   (b) light is to dark
   (c) spokes is to wheel
   (d) fight is to argue

21. Which of the following statements is true of ecosystems?
   (a) Ecosystems are static.
   (b) Altering one factor in an ecosystem may destroy it.
   (c) An ecosystem’s demand on energy is sporadic.
   (d) Man is an independent organism in an ecosystem.

22. Specialized consumers which feed on dead organisms; returning basic substances such as minerals and water to the soil are called
   (a) biomes
   (b) decomposers
   (c) a niche
   (d) abiotic factors

---

23. Which statements are accurate observations?
   (a) B, D, C
   (b) C, G, I
   (c) B, C, D
   (d) B, C

* Correct Answers
24. Which statements are inferences?
   * (a) E, G, H, I
   (b) E, I
   (c) B, E, H
   (d) D, F, G, I

25. Which statement is the most reasonable inference based on the observations?
   (a) E
   (b) D
   (c) H
   * (d) I

26. The act of directly seeing, hearing, tasting, smelling, or feeling is called
   (a) abstracting
   * (b) observing
   (c) classifying
   (d) testing

27. An inference is
   (a) a complex relationship between two variables
   (b) an occurrence in the investigation
   * (c) a guess about an observation that may or may not be true
   (d) a determining factor in the analysis of experiments

28. Ask the children to identify objects in their classroom as living and non-living.
   What science process skills does the above activity emphasize?
   * (a) classifying
   (b) inferring
   (c) decision-making
   (d) hypothesizing

29. Have the children develop a list of similarities and differences between human beings and other living organisms.
   The above is an activity emphasizing which skill in the science process?
   (a) valuing
   (b) communicating results
   * (c) data-collecting
   (d) inferring

30. Observing, describing, categorizing, identifying, inferring, stating hypothesis, testing hypothesis, generalizing, and communicating results are all separate operations collectively called
   (a) convergent thinking process
   (b) environmental education investigation
   (c) rational technique
   * (d) science process skills

* Correct Answers
31. All of the following are operations in the science process except for
   (a) testing
   * (b) practicing
   (c) stating hypothesis
   (d) communicating results

32. To extend conclusions from hypothesis testing to other situations
   is to
   (a) abstract
   (b) classify
   * (d) generalize
   (e) infer

33. What is a logical science process operation to follow inferring?
   (a) communicating results
   (b) generalizing
   (c) identifying
   * (d) stating hypothesis

34. Look at this picture of a pot of plants that is being cared for
   by a child in an elementary school classroom. Write three
   inferences you might make on the basis of the picture alone.

The above is an activity emphasizing
   (a) convergent thinking
   * (b) science process skills
   (c) ecology concepts
   (d) inventory analysis

35. Environmental education activities that use the science process
   skills would
   (a) use an emphasis on vocabulary terms.
   * (b) involve experiences containing elements primarily from
       science.
   (c) use test results to insure correct placement of students
       in individualized programs.
   (d) be activity centered.
36. Starting with the generalisation that a person’s environment is “everything that surrounds him”, have the students devote a day to identifying and describing as many different examples of the components of their environment as they can.
   (a) ecosystems
   * (b) science process skills
   (c) ecological niches
   (d) biotic community

37. Have students attempt to explain why people continually discard trash on roadsides despite “No Dumping” signs.
   (a) consumption
   (b) man and the ecosphere
   (c) decomposers
   * (d) man’s impact on his environment

38. Have students select a type of environment and complete a food chain that is indicative of that environment. Have students draw and label the food chain.
   (a) science process skills
   (b) species uniformity
   * (c) ecological niches
   (d) ecotones

39. Have the students visit a local sewage treatment plant to determine:
   (a) the procedure used in treating sewage, (b) the nature and destiny of the solid product (sludge) of the treatment process, and (c) the quality and destiny of the water treated by the plant.
   (a) decomposition
   (b) biomass
   (c) eutrophication
   * (d) man’s impact on his environment

40. Have students survey homes in the neighborhood to determine ways people select their property or make it more aesthetically pleasing.
   (a) inferring
   * (b) man’s impact on his environment
   (c) ecosystems
   (d) adaptation

41. Have the students keep careful records for a week to determine the number of hours lights are on in the school when they are not needed. After collection of this data have them suggest ways to avoid wasting electricity.
   (a) science process skills
   * (b) energy flow
   (c) abiotic factors
   (d) consumers

* Correct Answers
42. Have students identify the different kinds of wastes produced during the normal operation of the school and discuss their findings. Then have the students from teams to investigate the amounts of waste produced in each of the categories they formed in their discussion. Have the teams establish a flow pattern of these wastes.
   (a) energy flow
   * (b) problem-solving using the science process skills
   (c) abiotic factors
   (d) consumers

43. Have teams of students identify the group or groups of people responsible for most of the littering in the community and determine: (1) if any particular age group seems more responsible for littering than any other, (2) if there are any apparent socioeconomic characteristics of litterers, and (3) any other characteristics common among litterers.
   (a) generalizing
   (b) mini-ecosystems
   (c) population growth
   * (d) man's impact on his environment

44. Have students respond to the following question: When people are in differing environments do they interact with other people in varying ways?
   (a) biotic communities
   (b) ecosystems
   * (c) man's interrelationships with his surroundings
   (d) science process skills

45. Find some litter in your schoolyard, collect it. Empty your collection and classify it into several piles, placing similar objects into the same pile. Count the objects in each pile. Make a bar graph of your data plotting numbers of pieces of litter versus type of litter collected. What inferences can be made from your graph? Can you predict what type of litter would be obtained if someone else went to visit your area? Make a prediction and then try it out.
   (a) conservation
   (b) data-collecting
   (c) ecological succession
   * (d) science process skills

46. The disturbance of normal cycling is called
   * (a) pollution
   (b) consumption
   (c) decomposing
   (d) erosion

* Correct Answers
47. All of the following are ways students can influence better environmental decision-making except for
(a) learning more about environmental interactions themselves
(b) helping inform their parents, other students, and members of the community
(c) supporting, through their parents, legislation designed to protect the environment
* (d) all of the above

48. An environmentally aware citizen will know that
(a) resources and energy are limited so new attitudes must be developed.
(b) there are no right and wrong answers in conservation—only intelligent choices.
(c) environmental decisions require skills and knowledge in a great many areas.
* (d) all of the above

49. The reason for the need of an "environmentally literate" citizenry is
(a) man can only live in harmony with his environment if he understands and uses it wisely.
(b) a reform is needed in the way society looks at problems and makes environmental decisions.
(c) to insure correct responses to the threat of environmental deterioration.
* (d) all of the above

50. Why should the affective dimension be emphasized in environmental education?
(a) It is often neglected in teaching.
(b) Cognitive concepts are irrelevant to environmental education.
* (c) It develops a system of value analysis that will guide positive action to the environment.
(d) All of the above

51. Which of the following would be the least important reason for an environmentally aware citizenry?
(a) A people that wants to govern itself must educate itself.
(b) There are no right or wrong answers in conservation—only intelligent choices.
* (c) Environmental education decisions can be made by everyone.
(d) Environmental choices you make do not affect others.

52. Which attitude is indicative of an environmentally aware citizenry?
(a) The more energy you use, the more energy companies will produce.
(b) Being able to get your "fair share" of available energy.
* (c) Realizing resources and energy are limited so careful decisions must be made.
(d) All of the above

* Correct Answers
53. To be effective in teaching the concepts of environmental education, the teacher should
   * (a) use a multi-disciplinary approach
   (b) use a science oriented curriculum
   (c) emphasize the ecological facts
   (d) all of the above

54. Which of the following philosophies to teaching would not be effective in teaching man's interdependence on his environment?
   * (a) focus on being an intelligent consumer
   (b) be interdisciplinary in nature
   (c) build toward a universal view of the environment
   (d) have a future-orientation--today's decisions determine future consequences

55. Which philosophy would be effective in teaching man's interrelationships with his surroundings?
   (a) emphasize the facts of ecology
   * (b) immerse students in the "real" world which they can see, touch, and smell
   (c) use a science oriented curriculum
   (d) emphasize that nature should be left in its natural state

56. All of the following are philosophies that would be effective in teaching students that they have an inseparable relationship with their environment except for
   * (a) having experiences which draw simultaneously from different subject areas.
   (b) be environmentalist oriented--leave nature as it is.
   (c) encourage student participation by allowing students to help.
   (d) promote the affective dimension of environmental education.

57. To develop attitudes which will foster positive action to the environment, which philosophical approach would be effective?
   (a) be science oriented
   * (b) be based on the basic concepts of ecology
   (c) emphasize interdisciplinary approaches to the curriculum
   (d) stress the exploitation of natural resources

58. Which philosophical approach would be effective in developing an understanding of man's environmental problems and the decision-making skills to solve them?
   (a) the emphasis on utilization of natural resources for profit
   (b) the importance of not disturbing nature
   * (c) the integration of all disciplines in the curriculum
   (d) emphasizing the science aspect of the problem

* Correct Answers
FOR EACH ACTIVITY BELOW, EXAMINE THEM CAREFULLY THEN ANSWER THE QUESTIONS FOLLOWING EACH ACTIVITY. (Items 59-68)

**Activity**

Have students become jurors and the teacher be the judge. Each student is to have prepared the defense of an animal threatened with extinction. (Example—First defendant called. "Will Francis L., the platypus, please come to the witness stand?" says the judge. The platypus presents his defense. Members of the jury cross examine him. Possible questions—"You're not important for food or fur, why should we save your life?"
The verdict either extinction or survival requires a judgment about what makes an animal valuable? Is it food or fur, or something more?

59. What content area is the above activity emphasizing?
   (a) species diversity
   (b) ecosystems
   (c) ecological succession
   (d) biogeochemistry

   * Correct Answer—(a)

60. What philosophical method is the activity using?
   (a) a multi-disciplinary approach
   (b) an emphasis on exploitation
   (c) a science orientation
   (d) none of the above

   * Correct Answer—(b)

**Activity**

Fiction dealing with our environment can strengthen and broaden the real-life experiences of a child. Use the books as an extension of a study on ecology. Each child is to read at least one book. Spend an hour or so for a book blab—a book discussion where many books are shared and compared. No time is spent on plot or story line—the children are specialists interested in environmental implications only.

61. What philosophical approach does the above activity illustrate?
   (a) an emphasis on exploitation
   (b) the importance of intelligent consumption
   (c) an integration of curriculum areas
   (d) a science oriented approach

   * Correct Answer—(c)

**Activity**

Have an outdoor activity called the "All Day Field Day". During this activity the student takes a compass hike, cooks his own lunch out-of-doors, and does a field study. Divide the class into small groups and have them choose a topic that they would like to pursue for their field study. Questions are prepared for each topic that the group has selected. This is their assignment and must be completed before they return to the school in the afternoon. (Example—topic is on rocks and minerals. Questions—(a) Can you find a sample of three kinds of rocks: igneous, metamorphic, and sedimentary? (b) How many different colors are there in the same rock? (c) What rock do you find the most of throughout the area? Activity—Make a collection for display.
62. The above activity is emphasizing which of the following content areas?
   (a) resource management
   * (b) the student's environment
   (c) ecological niches
   (d) conservation

63. Which philosophical approach does the activity employ?
   (a) science orientation
   * (b) a multi-disciplinary approach
   (c) emphasis on facts of ecology
   (d) all of the above

**Activity**

**September**—Have students find their own tree. Have them draw it and the environment around it as it looks today. Make a record-keeping folder for the year's study.

**October**—Draw the tree again with detailed illustrations of fruit and leaves.

**November**—Tree with colored leaves. Press between waxed paper with iron.

**December**—Tree bare...can be painted with soap suds on charcoal drawing

**January**—Bark rubbings

**February**—Tree in snow—can be painted with soap suds

**March**—Signs of spring—draw a section of the tree and show buds just beginning to form

**April**—Flowers or fruits or both. Detailed drawing of twig in full bloom, etc.

**May**—Tree with leaves—shape—draw a person next to it for scale

**June**—Mount a green leaf—identify trees now.

64. The major philosophy of this activity is
   (a) science oriented
   (b) emphasis on the facts of ecology
   * (c) investigation approach
   (d) integration of curriculum areas

65. The content emphasis of the above activity is
   * (a) change
   (b) energy
   (c) alternatives
   (d) equilibrium

**Activity**

Give children some seeds, soil, and a tray. Ask them to plant these seeds and place them anywhere in the room. Then compare the growth results. Record data on time of germination, percentage of germination, and rate of growth. Have the children devise ways of illustrating the data. Make comparisons between plants in different locations and try to determine why some plants grow larger and/or faster.

* Correct Answers
66. In examining the above activity, what does it emphasize?
(a) science process skills
(b) art
(c) communication skills
* (d) all of the above

Activity
Have the students create a puppet show in which plants and animals portray their activities, impressions, and emotions during a forest fire.

67. The above activity is emphasizing
(a) terrestrial ecology
(b) divergent thinking
(c) an integration of curriculum
* (d) all of the above

68. When selecting curriculum activities to be used in the classroom
(a) they should contradict personal philosophy thus forcing the reception of new ideas
* (b) they should agree with personal philosophy
(c) personal philosophy is an unnecessary criteria in selection
(d) none of the above

READ THE FOLLOWING FOUR PERSONAL PHILOSOPHIES OF ENVIRONMENTAL EDUCATION AND SELECT THE ONE WHICH BEST DESCRIBES YOUR OWN PERSONAL PHILOSOPHY. BASED ON THE PHILOSOPHY YOU SELECT, ANSWER QUESTIONS 69 THROUGH 74.

I. Environmental education should be interdisciplinary, involve an experience containing elements drawn from two or more disciplines. The activities should be activity-centered and process-oriented. It should require the learner to study various environments firsthand and promote the practice and application of the science process skills. It should promote the acquisition of knowledge of basic ecological concepts and provoke value judgments concerning man's interrelationships with his environment.

II. Environmental education should be science oriented. It should remain a separate discipline to be added to the existing curriculum. Basic facts of ecology should be emphasized. The learning experiences should be teacher oriented. The affective domain should be avoided because the school's responsibility is for the intellectual growth of students.

III. Environmental education activities should take place outdoors, because that's what environmental education is all about—the outdoors. The activities should be student-centered, the students should be allowed to select those concepts they want to learn. Assignments are unnecessary as the experience is the important part of learning. Emphasis needs to be placed on leaving nature as it is.

* Correct Answers
IV. Environmental education should emphasize that the world has ample mineral wealth and that we need only new technologies to exploit this wealth. The time and money being spent on conservation and the Environmental Protection Act are only wasting valuable resources that could be channeled to technology.

69. Which of the above philosophies best describes your own personal philosophy?
   (a) I
   (b) II
   (c) III
   (d) IV

70. To teach the concept of pollution, based on your personal philosophy, which approach would you use?
   (a) This topic is not as important to teach than it is to emphasize the importance of wise utilization of resources.
   (b) Take a walk and have the students note the easily observed harmful effects of technology that are in their local community.
   (c) Mark a piece of wax paper into centimeter squares. Smear the paper with petroleum jelly. Attach it to a board. Put outside for one week. Have students examine materials the collect on the petroleum jelly with magnifying glasses. Have them make several inferences based on their observations.
   (d) Define pollution and its effects on man and other species in scientific terms.

71. In teaching about trees in the environment, which approach would you use based on your personal philosophy?
   (a) Make sure students know the process of photosynthesis.
   (b) Emphasize the aesthetic beauty and value of forests through a sensitivity hike.
   (c) Construct either a forester’s tape, diameter tape, or merritt hypsometer. Take the various forestry tools and use it in finding appropriate trees that could be used in lumbering.
   (d) Emphasize that trees are a replenishable source of energy. It is, therefore, a cheap source of energy.

72. To help the students better understand the way energy and materials in his environment influence him and are influenced by him, which approach would you use.
   (a) Survey the total environment and determine those things affecting them which might be classified as energy. Examine the list and determine those which are essential for survival. Have students select an activity which is characteristic of their life style but not necessary for survival and try to omit it from their daily activity for a week. (Example--walk to school instead of riding a bus). Record how omission affected them.
   (b) The student will construct a simple generating device and measure the voltage output.
Let students go outside to observe the world's natural energies at work. Point out the wind, streams, solar energy, lightning, etc.

Emphasize the resources available to the world to supply energy. Even though resources may be limited, with the growing technology of the world, new energy discoveries will be found before present energy sources are depleted.

To introduce the students with the term "geosphere" which includes all nonliving components of the earth, which approach would you use?

(a) Emphasize that soil is a basic resource comprised of a variety of minerals. Teach the major groups of rocks--igneous, sedimentary, and metamorphic. All activities are centered around the definitions of geological terms.

(b) Have students sit outside and observe all the nonliving components of their environment. Have them react verbally as to if the component is in its natural state or if it has been altered by man. Stress the beauty of the simplicity of the natural geological setting.

(c) Stress all the minerals available to produce energy and promote the advancement of the technical growth of man.

(d) Take the students outdoors and have the children identify all nonliving objects in their environment. From this list have children identify similarities and develop characteristics unique to each group. Have the students group different sets of nonliving objects. Have them collect those objects that they are able to and make a collage.

To help students examine the nature of sound, which activity best fits your personal philosophy?

(a) Choose a simple game, such as dodgeball, for the class to play. Have them play silently (i.e. with students making no verbal sounds). After examining the students reactions to the silent game, determine the functions that sound normally has in the game.

(b) Take students near a busy freeway or another noisy place near your school. Read the class poetry. After you have returned back to the classroom, discuss the problems of noise pollution caused by excessive traffic or industry.

(c) Explain that sound is produced by vibrations; use a tuning fork to show that sound occurs from vibrations. Explain that sound is measured by the unit decibel.

(d) Although an extreme amount of noise is disturbing, emphasize to students that there are some consequences to the growth and productivity of a nation.
FOR EACH ENVIRONMENTAL EDUCATION ACTIVITY GIVEN, MATCH THE CORRECT ENVIRONMENTAL EDUCATION CONCEPT AND THE SEPARATE DISCIPLINES THAT HAVE BEEN INTEGRATED INTO IT. EACH ALTERNATIVE MAY BE USED ONLY ONCE.

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<th>Env, Ed. Con.</th>
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<td>1. Assign students to use the map to calculate the total land area within their community boundaries.</td>
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<td>2. Take students outdoors after a rain and have them carefully press a leaf, vein side down into firm mud. They should leave the leaf in place until the mud has partially dried. Remove the leaf and observe the remains. Have the students discuss what has happened. When back into the classroom, have the students record the process and the results.</td>
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<td>3. Use a flannelboard, cut shapes to introduce the basic triangle, square, and circle. Then take the students on a short walk in or near the schoolyard and ask them to identify the shapes of the various trees and bushes. Back in the classroom, students can sketch trees that match the shapes.</td>
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<td>4. Have students determine the year's cost and the percentage of the total family income of financing various energy-related activities.</td>
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**Environmental Education Concepts**
(a) Fossils
(b) Energy
(c) Vegetation Analysis
(d) Communities

**Integrated Disciplines**
(aa) Math and Social Studies
(bb) Math
(cc) Art and Communication Skills
(dd) Math and Art
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| 1. Help students to personify by demonstrating with large muscle activity the emotions felt by a tree when there is:  
  - a gentle breeze  
  - a violent rain storm  
  - a forest fire  
  - a squirrel running up the trunk  
  - a person planting a tree |               |                  |
| 2. Help students make a large color wheel including browns, tans, and grays. Take the class on a short hike and ask students to try to match objects they see with sections of the color wheel. Have them respond to their matches. |               |                  |
| 3. On a visit to a park during the fall give students these directions.  
  - take three steps forward, take 5 steps to the left  
  - pick up 6 leaves. Arrange them in different sets.  
  - arrange seven leaves in order of size, the big one first and the small one last  
  - find three leaves and arrange them so that the middle leaf is greater than the one on its right and less than the one on its left  
  - return the objects used to where they were found.  
  Discuss the importance of doing this. Have them look for partially decayed leaves. |               |                  |
<p>| 4. Compose a letter to an official of the community water department inviting him to visit the class and/or to answer questions concerning the origins of water entering their homes from the water distribution system. |               |                  |</p>
<table>
<thead>
<tr>
<th>Environmental Education Concept</th>
<th>Integrated Disciplines</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Environmental aesthetic</td>
<td>(aa) P.E. and Language</td>
</tr>
<tr>
<td>Awareness</td>
<td>Arts</td>
</tr>
<tr>
<td>(b) Water Quality</td>
<td>(bb) Math and P.E.</td>
</tr>
<tr>
<td>(c) Decomposition</td>
<td>(cc) Language Arts</td>
</tr>
<tr>
<td>(d) Effects of Environmental</td>
<td>(dd) Language Arts and Art</td>
</tr>
<tr>
<td>Factors</td>
<td></td>
</tr>
</tbody>
</table>
Appendix D

Preliminary Test Form Answer Keys,

Informed Consent Agreement
ELEMENTARY EDUCATION

Environmental Education Competency Test

Carefully read each of the following questions below and determine the correct answer. Mark the correct answer on the answer sheet with an "X".

**All answers are to be marked on the answer sheet. Please do not make any marks on the test.**

1. When selecting curriculum activities to be used in the classroom,
   (a) they should contradict personal philosophy thus forcing the reception of new ideas.
   (b) they should agree with personal philosophy.
   (c) personal philosophy is an unnecessary criteria in selection
   (d) none of the above.

2. The above is an illustration of a/an
   (a) organism
   (b) ecosystem
   (c) food chain
   (d) community

3. All of the following are ways students can influence better environmental decision-making, except for
   (a) learning more about environmental interactions themselves.
   (b) helping inform their parents, other students, and members of the community.
   (c) supporting, through their parents, legislation designed to protect the environment.
   (d) modifying their behavior to lead to a comfortable lifestyle.
4. Environmental education activities that use the science process skills would
(a) use an emphasis on vocabulary terms to aid communication skills.
(b) involve experiences containing elements primarily from science.
(c) use test results to insure correct placement of students in individualized programs.
(d) be activity centered.

5. Why should the affective domain be emphasized in environmental education?
(a) It is often neglected in teaching.
(b) Cognitive concepts are irrelevant to environmental education.
(c) It develops a system of value analysis that will guide positive action to the environment.
(d) All of the above

6. To develop attitudes which will foster positive action to the environment, which philosophical approach would be effective?
(a) be science oriented
(b) be based on the basic concepts of ecology
(c) emphasize the interdisciplinary approach to the curriculum
(d) stress the exploitation of natural resources

7. The process that promotes among citizens the awareness and understanding of their surroundings, their relationship to it, and the concern and responsibility necessary to insure their survival and to improve the quality of life.

The above is a definition of
(a) ecology.
(b) outdoor resource management.
(c) environmental education.
(d) man's impact on his environment.

8. What is a logical science process operation to follow inferring?
(a) communicating results
(b) generalizing
(c) identifying
(d) stating hypothesis

9. An unfavorable alteration of our surroundings, wholly or largely as a by-product of man's actions is called
(a) expenditures.
(b) pollution.
(c) consumption.
(d) aesthetic valuing.
10. Observing, describing, categorizing, identifying, inferring, stating hypothesis, testing hypothesis, generalizing, and communicating results are all separate operations collectively called the
(a) convergent thinking process.
(b) environmental education investigation.
(c) rational technique.
(d) science process skills.

11. Which philosophical approach would be effective in developing an understanding of man's environmental problems and the decision-making skills to solve them?
(a) the emphasis on utilization of natural resources for profit
(b) the importance of not disturbing nature
(c) the integration of all disciplines in the curriculum
(d) emphasizing the science aspect of the problem

12. The act of directly seeing, hearing, tasting, smelling, or feeling is called
(a) abstracting.
(b) observing.
(c) classifying.
(d) testing.

13. The following are all components of an ecosystem, except for
(a) decomposers.
(b) energy source.
(c) ecotones.
(d) consumers.

14. The process where living organisms modify their environment, making it less favorable for themselves but more favorable for another community is called
(a) energy flow.
(b) abiotic stratification.
(c) autotrophic continuum.
(d) ecological succession.

15. Complete the following food chain.
GRASS → CRICKET →
(a) deer
(b) bird
(c) squirrel
(d) earthworm
16. An environmentally aware citizen will know that
(a) resources and energy are limited so new attitudes must be developed.
(b) there are no right or wrong answers in conservation—only intelligent choices.
(c) environmental decisions require skills and knowledge in a great many areas.
(d) all of the above.

17. An inference is
(a) a complex relationship between two variables.
(b) an occurrence in the investigation.
(c) a guess about an observation that may or may not be true.
(d) a determining factor in the analysis of experiments.

18. The branch of life science that studies the relationships among living organisms and between organisms and their environment is called
(a) man's impact on his environment.
(b) ecology.
(c) conservation.
(d) resource management.

Questions 19 through 26 are based on various activities that can be done in the elementary school. Carefully examine each activity before answering the questions following it.

Activity

Have the students visit a local sewage treatment plant to determine:
- the procedure used in treating sewage
- the nature and destiny of the solid product (sludge) of the treatment process
- the quality and destiny of the water treated by the plant

19. The above activity is emphasizing what content area?
(a) decomposition
(b) biomass
(c) eutrophication
(d) man's impact on his environment
Activity

Have each student select a type of environment and complete a food chain that is indicative of that environment. Have students draw and label the food chain.

20. What content area is the above activity emphasizing?
   (a) science process skills
   (b) ecotones
   (c) ecological niches
   (d) ecological succession

Activity

Try to find some litter in the schoolyard, collect it. Empty the collection and classify it into several piles, placing similar objects in the same pile. Count the objects in each pile. Make a bar graph of the data, plotting the number of pieces of litter versus the type of litter collected. What inferences can be made from the graph? What can be predicted about the type of litter that would be obtained if someone else went to visit the area? Make a prediction and then try it.

21. What content area is the above activity emphasizing?
   (a) conservation
   (b) data-collecting
   (c) species diversity
   (d) science process skills

Activity

Have the students become jurors and the teacher be the judge. Each student is to have prepared the defense of an animal threatened with extinction. (Example--First defendant called. "Will Francis L., the platypus please come to the witness stand?" says the judge. The platypus presents his defense. Members of the jury cross examine him. Possible questions--"You're not important for food or fur, why should we save your life?" The verdict--either extinction or survival--requires a judgment about what makes an animal valuable. Is it food, fur, or something more?

22. What philosophical method is the above activity using?
   (a) a multi-disciplinary approach
   (b) an emphasis on exploitation
   (c) a science orientation
   (d) none of the above
Activity

Fiction dealing with our environment can strengthen and broaden the real-life experiences of a child. Use the books as an extension of a study on ecology. Each child is to read at least one book. Spend an hour or so for a "Book Blab"—a book discussion where many books are shared and compared. No time is spent on plot or story line—the children are specialists interested in environmental implications only.

23. What philosophical approach does the above activity illustrate?
   (a) an emphasis on exploitation
   (b) the importance of intelligent consumption
   (c) an integration of curriculum areas
   (d) a science oriented approach

Activity

Have an outdoor activity called the "All Day Field Day". During this activity, the student takes a compass hike, cooks his own lunch out-of-doors, and does a field study. Divide the class into small groups prior to the field day and have them choose a topic that they would like to pursue for their field study. For each topic that they would like to study, prepare questions that the group must answer. This is their assignment and must be completed before they return to the school in the afternoon. (Example—topic is on rocks and minerals. Questions: (1) Can you find a sample of three different kinds of rocks: igneous, sedimentary, and metamorphic? (2) How many different colors are there in the same rock? (3) What rocks do you find most of throughout the area? Activity—Make a collection for display.

24. Which philosophy does the above activity employ?
   (a) science orientation
   (b) a student-centered activity
   (c) emphasis on facts of ecology
   (d) none of the above
Activity

A pupil sets up four identical pieces of apparatus as follows:

![Diagram of apparatus]

Equal volumes of three different soils are placed in each of the cups, A, B, and C. Cup D is left empty. One half cup of water is poured into each and percolates through into the dish. The following statements are recorded.

(A) Most water comes through A.
(B) Least water comes through C.
(C) Water comes through B first.
(D) C continues to drip for the longest period.
(E) Soil A absorbs and holds the most water.
(F) There is more soil in C than in A.
(G) Soil of type B has the greatest absorbent quality.
(H) Dark soils have the greatest absorbency.
(I) Soils vary in their water holding capacity.

25. Which statements are accurate observations?

(a) B, D, G
(b) C, G, I
(c) B, C, D
(d) B, E

26. Which statement is the most reasonable inference based on the observations?

(a) E
(b) D
(c) H
(d) I
Read carefully the four philosophies of environmental education below, and determine which best exemplifies your own personal philosophy. Questions 27 through 30 will be based upon the philosophy you have chosen.

PHILOSOPHIES

I. Environmental education should be interdisciplinary, involving an experience containing elements drawn from two or more disciplines. The activities should be activity-centered and process-oriented. It should require the learner to study various environments first-hand and promote the practice and application of the science process skills. It should promote the acquisition of knowledge of basic ecological concepts and provoke value judgments concerning man's interrelationships with his environment.

II. Environmental education should be science oriented. It should remain a separate discipline to be added to the already existing curriculum. Basic facts of ecology should be emphasized. The learning experiences should be teacher centered. The affective domain of environmental education should be avoided because the school's responsibility is for the intellectual growth of students.

III. Environmental education activities should take place outdoors, because that's what environmental education is all about—the outdoors. The activities should be student-centered, the students should be allowed to select those concepts they want to learn. Assignments are unnecessary as the experiences is the important part of learning. Emphasis needs to be on leaving nature as it is.

IV. Environmental education should emphasize that the world has ample mineral wealth and that we need only new technologies to exploit this wealth. The time and money spent on conservation and the Environmental Protection Act are only wasting valuable resources that could be channeled to technology.

27. Which of the above philosophies best describes your own personal philosophy?
   (a) I
   (b) II
   (c) III
   (d) IV

Now based on the personal philosophy you have selected in question 27, answer the following questions.
28. In teaching about trees in the environment, which approach would you use?
   (a) Make sure students know about the process of photosynthesis.
   (b) Emphasize the aesthetic beauty and value of forests through a sensitivity hike.
   (c) Construct either a forester's tape, diameter tape, or merrit hypsometer. Take the various forestry tools and use it in finding appropriate trees that could be used for lumbering.
   (d) Emphasize that trees are replenishable as a source of energy. It is, therefore, a cheap source of energy.

29. To help students better understand the way energy and materials in his environment influence him and are influenced by him, which approach would you use?
   (a) Students survey their total environment to determine those things affecting them which might be classified as energy. Examine the list and determine those which are essential for survival. Have students select an activity which is characteristic of their life style, but not necessary for survival and try to omit it from their daily activities for a week. (i.e. walk to school instead of riding a bus). Record how omission affected them.
   (b) The student will construct a simple generating device and measure the voltage output.
   (c) Let students go outside to observe the world's natural energies at work. Point out the wind, streams, solar energy, lightning, etc.
   (d) Emphasize the resources available to the world to supply energy. Even though resources may be limited, with the growing technology of the world, new energies will be found before present energy sources are depleted.

30. To introduce the students with the term "geosphere" (which includes all nonliving components of the earth), which approach would you use?
   (a) Emphasize that soil is a basic resource comprised of a variety of minerals. Teach the major groups or rocks--igneous, sedimentary, and metamorphic. All activities are centered around the definitions of geological terms.
   (b) Have students sit outside and observe all the nonliving components of their environment. Have them react verbally as to if the component is in its natural state or if it has been altered by man. Stress the beauty of the simplicity of the natural geological setting.
   (c) Stress all the minerals available to produce energy and promote the advancement of the technical growth of man.
   (d) Take the students outdoors and have the children identify all nonliving objects in their environment. From this list have children identify similarities and develop characteristics unique to each group. Have students group different sets of nonliving objects. Then have them collect those objects that they are able to and make a collage.
For each of the four environmental education activities below, match the correct environmental education concept and the separate disciplines that have been integrated into it. Each alternative may be used only once.

<table>
<thead>
<tr>
<th>Environmental Education Concept</th>
<th>Integrated Disciplines</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) vegetation analysis</td>
<td>(aa) Art and Language Arts</td>
</tr>
<tr>
<td>(b) energy</td>
<td>(bb) Math and Art</td>
</tr>
<tr>
<td>(c) effects of environmental factors</td>
<td>(cc) Math</td>
</tr>
<tr>
<td>(d) environmental aesthetic awareness</td>
<td>(dd) Language Arts and P.E.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Env. Ed. Concept</th>
<th>Integrated Disciplines</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Use a flannel board and cut shapes to introduce the basic triangle, square, and circle. Then take the students on a short walk in or near the schoolyard and ask them to identify the shapes of the various trees and bushes. Back in the classroom, students sketch trees that match the shapes.</td>
<td>31.</td>
<td>35.</td>
</tr>
<tr>
<td>II. Have students personify by demonstrating with large muscle activity the emotions felt by a tree when there is: a gentle breeze, a violent rain storm, a forest fire, a squirrel running up the trunk, a person planting a tree</td>
<td>32.</td>
<td>36.</td>
</tr>
<tr>
<td>III. Have students make a large color wheel including browns, tans, and grays. Take the class on a short hike and ask students to try to match objects they see with sections of the color wheel. Have them record their matches.</td>
<td>33.</td>
<td>37.</td>
</tr>
<tr>
<td>IV. Have students determine the year's cost and the percentage of the total family income of financing various energy-related activities.</td>
<td>34.</td>
<td>38.</td>
</tr>
</tbody>
</table>
The following are four answer keys for the preliminary test form. Based on the answer given on item 27, different keys are needed. There is no right or wrong answer on item 27, but based on the answer given to this question, the answers to items 28, 29, and 30 are determined.

The answers given in items 28, 29, and 30 must be consistent with the philosophy chosen in item 27.

Key I -- Use when item 27 is answered A.
Key II -- Use when item 27 is answered B.
Key III -- Used when item 27 is answered C.
Key IV -- Used when item 27 is answered D.
KEY I

ELEMENTARY EDUCATION

Environmental Education Competency Test

Answer Sheet

1. (a) (x) (c) (d) 20. (a) (b) (x) (d)
2. (a) (x) (c) (d) 21. (a) (b) (c) (x)
3. (a) (b) (c) (x) 22. (x) (b) (c) (d)
4. (a) (b) (c) (x) 23. (a) (b) (x) (d)
5. (a) (b) (x) (d) 24. (a) (x) (c) (d)
6. (a) (b) (x) (d) 25. (a) (b) (x) (d)
7. (a) (b) (x) (d) 26. (a) (b) (c) (x)
8. (a) (b) (c) (x) 27. (a) (b) (c) (d)
9. (a) (x) (c) (d) 28. (a) (b) (x) (d)
10. (a) (b) (c) (x) 29. (x) (b) (c) (d)
11. (a) (b) (x) (d) 30. (a) (b) (c) (x)
12. (a) (x) (c) (d) 31. (x) (b) (c) (d)
13. (a) (b) (x) (d) 32. (a) (b) (x) (d)
14. (a) (b) (c) (x) 33. (a) (b) (c) (x)
15. (a) (x) (c) (d) 34. (a) (x) (c) (d)
16. (a) (b) (c) (x) 35. (aa) (xx) (cc) (dd)
17. (a) (b) (x) (d) 36. (aa) (bb) (cc) (xx)
18. (a) (x) (c) (d) 37. (xx) (bb) (cc) (dd)
19. (a) (b) (c) (x) 38. (aa) (bb) (xx) (dd)

* Item determining which key should be used.

X Correct Answers
**KEY II**

**ELEMENTARY EDUCATION**

Environmental Education Competency Test

Answer Sheet

<table>
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<tr>
<th>Question</th>
<th>Answer Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
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<td>2.</td>
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<tr>
<td>3.</td>
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<td>4.</td>
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<tr>
<td>5.</td>
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<td>6.</td>
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<td>7.</td>
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<tr>
<td>8.</td>
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<tr>
<td>9.</td>
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<tr>
<td>10.</td>
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<tr>
<td>11.</td>
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<tr>
<td>12.</td>
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<tr>
<td>13.</td>
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<tr>
<td>14.</td>
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<td>15.</td>
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<td>16.</td>
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<tr>
<td>19.</td>
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<tr>
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<tr>
<td>21.</td>
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<td>27.</td>
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<tr>
<td>38.</td>
<td>(a) (b) (x) (d)</td>
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</tbody>
</table>

* Item determining which key should be used.

X Correct Answers
### KEY III

**ELEMENTARY EDUCATION**

**Environmental Education Competency Test**

**Answer Sheet**

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1 | (a) | (x) | (c) | (d) |   | 20 | (a) | (b) | (x) | (d) |   |   |   |   |   |   |   |   |   |
| 2 | (a) | (x) | (c) | (d) |   | 21 | (a) | (b) | (c) | (x) |   |   |   |   |   |   |   |   |   |
| 3 | (a) | (b) | (c) | (d) |   | 22 | (a) | (b) | (c) | (d) |   |   |   |   |   |   |   |   |   |
| 4 | (a) | (b) | (c) | (d) |   | 23 | (a) | (b) | (c) | (d) |   |   |   |   |   |   |   |   |   |
| 5 | (a) | (b) | (x) | (d) |   | 24 | (a) | (b) | (x) | (d) |   |   |   |   |   |   |   |   |   |
| 6 | (a) | (b) | (x) | (d) |   | 25 | (a) | (b) | (x) | (d) |   |   |   |   |   |   |   |   |   |
| 7 | (a) | (b) | (x) | (d) |   | 26 | (a) | (b) | (x) | (d) |   |   |   |   |   |   |   |   |   |
| 8 | (a) | (b) | (c) | (d) |   | 27 | (a) | (b) | (x) | (d) |   |   |   |   |   |   |   |   |   |
| 9 | (a) | (x) | (c) | (d) |   | 28 | (a) | (x) | (c) | (d) |   |   |   |   |   |   |   |   |   |
| 10 | (a) | (b) | (c) | (x) |   | 29 | (a) | (b) | (x) | (d) |   |   |   |   |   |   |   |   |   |
| 11 | (a) | (b) | (x) | (d) |   | 30 | (a) | (x) | (c) | (d) |   |   |   |   |   |   |   |   |   |
| 12 | (a) | (x) | (c) | (d) |   | 31 | (x) | (b) | (c) | (d) |   |   |   |   |   |   |   |   |   |
| 13 | (a) | (b) | (x) | (d) |   | 32 | (a) | (b) | (x) | (d) |   |   |   |   |   |   |   |   |   |
| 14 | (a) | (b) | (c) | (x) |   | 33 | (a) | (b) | (c) | (x) |   |   |   |   |   |   |   |   |   |
| 15 | (a) | (x) | (c) | (d) |   | 34 | (a) | (x) | (c) | (d) |   |   |   |   |   |   |   |   |   |
| 16 | (a) | (b) | (c) | (x) |   | 35 | (aa) | (bb) | (cc) | (dd) |   |   |   |   |   |   |   |   |   |
| 17 | (a) | (b) | (x) | (d) |   | 36 | (aa) | (bb) | (cc) | (dd) |   |   |   |   |   |   |   |   |   |
| 18 | (a) | (x) | (c) | (d) |   | 37 | (aa) | (bb) | (cc) | (dd) |   |   |   |   |   |   |   |   |   |
| 19 | (a) | (b) | (c) | (x) |   | 38 | (aa) | (bb) | (cc) | (dd) |   |   |   |   |   |   |   |   |   |

* Item determining which key should be used.

* Correct Answers
KEY IV

ELEMENTARY EDUCATION

Environmental Education Competency Test

Answer Sheet

1. (a) (x) (c) (d) 20. (a) (b) (x) (d)
2. (a) (x) (c) (d) 21. (a) (b) (c) (x)
3. (a) (b) (c) (x) 22. (x) (b) (c) (d)
4. (a) (b) (c) (x) 23. (a) (b) (x) (d)
5. (a) (b) (x) (d) 24. (a) (x) (c) (d)
6. (a) (b) (x) (d) 25. (a) (b) (x) (d)
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16. (a) (b) (c) (x) 35. (aa) (xx) (cc) (dd)
17. (a) (b) (x) (d) 36. (aa) (bb) (cc) (xx)
18. (a) (x) (c) (d) 37. (XX) (bb) (cc) (dd)
19. (a) (b) (c) (x) 38. (aa) (bb) (XX) (dd)

* Item determining which key should be used.

X Correct Answer
INFORMED CONSENT AGREEMENT

UTAH STATE UNIVERSITY
The Development of an Assessment Instrument to Measure
Environmental Education Competencies
For Level III of the Elementary Teacher Training Program at Utah State University

I hereby give my consent to participate in the project involving human subjects, The Development of an Assessment Instrument to Measure Environmental Education Competencies for Level III of the Elementary Teacher Training Program at Utah State University. I understand the procedures to be followed in the study and am aware that the data collected will be kept confidential. I will receive answers to any inquiries regarding the project and am free to withdraw my consent and discontinue participation in the project at any time.

Signed ___________________________  Date ___________________________
Appendix E

Preliminary Test Form Item Analysis Data
PRELIMINARY TEST FORM

ITEM ANALYSIS

1. When selecting curriculum activities to be used in the classroom
   (a) they should contradict personal philosophy
   (b) they should agree with personal philosophy
   (c) personal philosophy is an unnecessary criteria in selection
   (d) none of the above

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   Difficulty = .48

2. The above is an illustration of a/an
   (a) organism
   (b) food chain
   (c) ecosystem
   (d) community

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   Difficulty = .79

3. All of the following are ways students can influence better environmental decision-making except for
   (a) learning more about environmental interactions themselves.
   (b) helping inform their parents, other students, and members of the community.
   (c) supporting through their parents, legislation designed to protect the environment.
   (d) modifying their behavior to lead to a comfortable life style.

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   Difficulty = .88

* Correct Answers
4. Environmental education activities that use the science process skills would
   (a) use an emphasis on vocabulary terms to aid communication
   (b) involve experiences containing elements primarily from science
   (c) use test results to insure correct placement of students in individualized programs
   (d) be activity-centered

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   Difficulty = .50

5. Why should the affective dimension be emphasized in environmental education?
   (a) It is often neglected in teaching.
   (b) Cognitive concepts are irrelevant to environmental education.
   (c) It develops a system of value analysis that will guide positive action to the environment.
   (d) All of the above

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   Difficulty = .67

6. To develop attitudes which will foster positive action to the environment, which philosophical approach would be effective?
   (a) be science oriented
   (b) be based on the basic concepts of ecology
   (c) emphasize the interdisciplinary approach to the curriculum
   (d) stress the exploitation of natural resources

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   Difficulty = .54

7. The process that promotes among citizens the awareness and understanding of their surroundings, their relationship to it, and the concern and responsibility necessary to insure their survival and to improve the quality of life.

   The above is a definition of
   (a) ecology
   (b) outdoor resource management
   (c) environmental education
   (d) man's impact on his environment

   * Correct Answers
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**Difficulty = .75**

8. What is a logical science process operation to follow inferring?
   (a) communicating results
   (b) generalizing
   (c) identifying
   (d) stating hypothesis

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**Difficulty = .75**

9. An unfavorable alteration of our surrounding, wholly or largely as a by-product of man's actions is called
   (a) expenditures.
   (b) pollution.
   (c) consumption.
   (d) aesthetic valuing.

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**Difficulty = .92**

10. Observing, describing, categorizing, identifying, inferring, stating hypothesis, testing hypothesis, generalizing, and communicating results are all separate operations collectively called the
   (a) convergent thinking process.
   (b) environmental education investigation.
   (c) rational technique.
   (d) science process skills.

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**Difficulty = .96**

* Correct Answers
11. Which philosophical approach would be effective in developing an understanding of man's environmental problems and the decision-making skills to solve them?
(a) The emphasis on utilization of natural resources for profit
(b) The importance of not disturbing nature
(c) The integration of all disciplines in the curriculum
(d) Emphasizing the science aspect of the problem

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Difficulty = .58

12. The act of directly seeing, hearing, tasting, smelling, or feeling is called
(a) abstracting.
(b) observing.
(c) classifying.
(d) testing.

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Difficulty = .38

13. The following are all components of an ecosystem, except for
(a) decomposers.
(b) energy source.
(c) ecotones.
(d) consumers.

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Difficulty = .67

14. The process where living organisms modify their environment making it less favorable for themselves but more favorable for another community is called
(a) energy flow.
(b) abiotic stratification.
(c) autrophic continuum
(d) ecological succession.

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Difficulty = .67

* Correct Answers
15. Complete the following food chain

\[ \text{GRASS} \rightarrow \text{CRICKET} \rightarrow \text{?} \]

(a) deer  
(b) bird  
(c) squirrel  
(d) earthworm

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Difficulty = .92

16. An environmentally aware citizen will know that
(a) resources are limited so new attitudes must be developed.
(b) there are no right or wrong answers in conservation—only intelligent choices.
(c) environmental decisions require skills and knowledge in a great many areas.
(d) all of the above

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Difficulty = .92

17. An inference is
(a) a complex relationship between two variables.
(b) an occurrence in the investigation.
(c) a guess about an observation that may or may not be true.
(d) a determining factor in the analysis of experiments.

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Difficulty = 1.00

18. The branch of life science that studies the relationship among living organisms and between organisms and their environment is called
(a) man's impact on his environment
(b) ecology
(c) conservation
(d) resource management

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Difficulty = .79

* Correct Answers
19. **Activity**  
Sewage Treatment Plant  
(a) decomposition  
(b) biomass  
(c) eutrophication  
(d) man's impact on his environment  

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Difficulty = .38

20. **Activity**  
Food Chain  
(a) science process skills  
(b) ecotones  
(c) ecological niches  
(d) ecological succession  

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Difficulty = .26

21. **Activity**  
Litter In Schoolyard  
(a) conservation  
(b) data-collcting  
(c) species diversity  
(d) science process skills  

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Difficulty = .50

22. **Activity**  
Jurors & Judge  
(a) a multi-disciplinary approach  
(b) an emphasis on exploitation  
(c) a science orientation  
(d) none of the above  

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Difficulty = .67

* Correct Answers
23. Activity
Fiction Reading
(a) an emphasis on exploitation
(b) the importance of intelligent consumption
(c) an integration of curriculum areas
(d) a science oriented approach

Alternatives
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Difficulty = .67

24. Activity
All Day Field Day
(a) science orientation
(b) a student-centered activity
(c) emphasis on facts of ecology
(d) none of the above

Alternatives
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Difficulty = .71

25. Activity
Water Experiment (Observations)
(a) B, D, G
(b) C, G, I
(c) B, C, D
(d) B, E

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Difficulty = .50

26. Activity
Water Experiment (Inferences)
(a) E
(b) D
(c) H
(d) I

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Difficulty = .75

* Correct Answers
27. Philosophy

(a) I
(b) II
(c) III
(d) IV

NO ITEM ANALYSIS

28. (Which philosophical approach)

Wrong

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29. (Which philosophical approach)

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30. (Which philosophical approach)

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31. Selecting content area (Shapes of trees, bushes, etc.)

(a) vegetation analysis
(b) energy
(c) effects of environmental factors
(d) environmental aesthetic awareness

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| Difficulty | 0.13 |

32. Selecting content area (Acting out effects of wind, forest fire, etc.)

(a) vegetation analysis
(b) energy
(c) effects of environmental factors
(d) environmental aesthetic awareness

* Correct Answers
### Alternatives

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**Difficulty = .79**

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### 33. Selecting content area (Color wheel and nature hike)

(a) vegetation analysis  
(b) energy  
(c) effects of environmental factors  
(d) environmental aesthetic awareness

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**Difficulty = .21**

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### 34. Selecting content area (Calculating percentage of income energy expense uses)

(a) vegetation analysis  
(b) energy  
(c) effects of environmental factors  
(d) environmental aesthetic awareness

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**Difficulty = .88**

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### 35. Selecting integrated disciplines (Shapes of trees, bushes, etc.)

(aa) Art and Language Arts  
(bb) Math and Art  
(cc) Math  
(dd) Language Arts and P. E.

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**Difficulty = .63**

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### 36. Selecting integrated disciplines (Acting out effects of wind, forest fire, etc.)

(aa) Art and Language Arts  
(bb) Math and Art  
(cc) Math  
(dd) Language Arts and P. E.

* Correct Answers
### Alternatives

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Difficulty = 1.00

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37. Selecting integrated disciplines (Color wheel and nature hike)

(a) Art and Language Arts
(b) Math and Art
(c) Math
(d) Language Arts and P. E.

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Difficulty = 0.58

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38. Selecting integrated disciplines (Calculating percentage of income energy expense uses)

(a) Art and Language Arts
(b) Math and Art
(c) Math
(d) Language Arts and P. E.

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Difficulty = 1.00

* Correct Answers
Appendix F

Final Form of the Environmental Education Competency Test and Answer Keys
Read each of the following questions carefully and determine the correct answer. Mark the correct answer on the answer sheet with an "X". Please do not make any marks on the test.

1. Why should the affective dimension be emphasized in environmental education?
   (a) It is often neglected in teaching.
   (b) Cognitive concepts are irrelevant to environmental education.
   (c) It develops a system of value analysis that will guide positive action to the environment.
   (d) All of the above

2. What is a logical science process operation that follows the "inference" step?
   (a) communicating results
   (b) generalizing
   (c) identifying
   (d) stating hypothesis

3. The branch of life science that studies the relationships among and between living organisms and their environment is called
   (a) man's impact on his environment.
   (b) ecology.
   (c) conservation.
   (d) resource management.

4. The above is an illustration of a/an
   (a) life cycle.
   (b) ecosystem.
   (c) food chain.
   (d) community.
5. To develop attitudes which will foster positive action to the environment, which philosophical approach would be effective?
   (a) be science oriented
   (b) be based on the basic concepts of ecology
   (c) emphasize the interdisciplinary approach to the curriculum
   (d) stress the exploitation of natural resources

6. Complete the following food chain so that it would be typical of a desert environment.

   PLANT ROOT  →  MOUSE  →  

   (a) cat
   (b) snake
   (c) bear
   (d) horned toad

7. When selecting environmental education curriculum activities to be used in the classroom,
   (a) they should contradict personal philosophy thus forcing the reception of new ideas.
   (b) they should agree with personal philosophy.
   (c) personal philosophy is an unnecessary criteria in selection.
   (d) none of the above

8. The process that promotes among citizens the awareness and understanding of their surroundings, their relationship to it, and the concern and responsibility necessary to insure their survival and to improve the quality of life defines
   (a) ecology.
   (b) outdoor education.
   (c) environmental education.
   (d) man's impact on his environment.

9. An environmentally aware citizen will know that
   (a) resources and energy are limited so new attitudes must be developed.
   (b) there are no right or wrong answers in conservation—only intelligent choices.
   (c) environmental decisions require skills and knowledge in a great many areas.
   (d) all of the above

10. The following are all components of an ecosystem, except for
    (a) decomposers.
    (b) energy source.
    (c) ecotones.
    (d) consumers.
11. All of the following are ways students can influence better environmental decision-making except for
   (a) learning more about environmental interactions themselves.
   (b) helping inform their parents, other students, and members of
        the community.
   (c) supporting, through their parents, legislations designed to
        protect the environment.
   (d) modifying their behavior to lead to a comfortable life style.

12. The act of directly seeing, hearing, tasting, smelling, or feeling
    is called
    (a) abstracting.
    (b) observing.
    (c) classifying.
    (d) testing.

13. Which curricular approach would be effective in developing an understanding of man's environmental problems and the decision-making
    skills to solve them?
    (a) the emphasis on utilization of natural resources for profit
    (b) the importance of not disturbing nature
    (c) the integration of all disciplines
    (d) emphasizing the science aspect of the problem

14. The process where living organisms modify their environment, making
    it less favorable for themselves but more favorable for another
    community is called
    (a) energy flow.
    (b) abiotic stratification.
    (c) autotrophic continuum.
    (d) ecological succession.

15. Environmental education activities that use the science process skills
    would
    (a) use an emphasis on vocabulary terms to aid communication skills.
    (b) involve experiences containing elements primarily from science.
    (c) use test results to insure correct placement of students in
        individualized programs.
    (d) be a hands-on experience.

16. An inference is
    (a) a critical trial or evaluation.
    (b) an occurrence in the investigation.
    (c) a conclusion about an observation that may or may not be true.
    (d) a formulation of objects into classes.
17. An unfavorable alteration of our surroundings, wholly or largely as a by-product of man's actions is called

(a) expenditures.
(b) pollution.
(c) erosion.
(d) aesthetic valuing.

Questions 18 through 24 are based on various activities that may be done in the elementary school. Carefully examine each activity before answering the questions following it.

Activity
Find some litter in the schoolyard, collect it. Empty the collection and classify it into several piles, placing similar objects in the same pile. Count the objects in each pile. Make a bar graph of the data, plotting the number of pieces of litter versus the type of litter collected. What inferences can be made from the graph? What can be predicted about the area? Make a prediction and then try it out.

18. What content area is the above activity emphasizing?

(a) conservation  
(b) data-collecting  
(c) convergent thinking process  
(d) science process skills

Activity
Have an outdoor activity called the "All Day Field Day". During this activity, the student takes a compass hike, cooks his own meal out-of-doors, and conducts a field study. Divide the class into small groups prior to the field day and have them choose a topic that they would like to pursue for their field study. For each topic have questions prepared that the group must answer. This is their assignment and must be completed before they return to the school in the afternoon. (Example--topic is on rocks and minerals. Questions: (1) Can you find a sample of three different kinds of rocks--igneous, metamorphic, and sedimentary? (2) How many different colors are there in the same rock? (3) What rock do you find most of throughout the area? Activity--Make a collection for display.

19. Which philosophy does the above activity employ?

(a) science orientation  
(b) a student-centered activity  
(c) emphasis on facts of ecology  
(d) none of the above
Activity
A pupil sets up four identical pieces of apparatus as follows:

Equal volumes of three different types of soils are placed in each of the cups, A, B, and C. Cup D is left empty. One half cup of water is poured into each and percolates through in the dish. The following statements are recorded.

(A) Most water comes through A.
(B) Least water comes through C.
(C) Water comes through B first.
(D) C continues to drip for the longest period.
(E) Soil A absorbs and holds the most water.
(F) There is more soil in C than in A.
(G) Soil of type B has the greatest absorbency.
(H) Dark soils have the greatest absorbency.
(I) Soils vary in their water holding capacity.

20. Which statement is the most reasonable inference based on the observations?
(a) E
(b) D
(c) H
(d) I

Activity
With the students assuming the roles of jurors and the teacher that of the judge, selected students will prepare the defense of an animal threatened with extinction. Students may prepare any aides they desire to strengthen their defense. (Example--First defendant called. "Will Francis L., the platypus, please come to the witness stand?" says the judge. The platypus presents his defense. Members of the jury cross examine him. Possible questions--"You're not important for food or fur, why should we save your life?" The verdict either extinction or survival requires a judgment about what makes an animal valuable. Is it food, fur, or something more?)

21. What philosophical method is the above activity using?
(a) a multi-disciplinary approach
(b) an emphasis on abiotic factors
(c) a science orientation
(d) none of the above
Activity
Fiction dealing with our environment can strengthen and broaden the real-life experiences of a child. Use the books as an extension of a study on ecology. Each child is to read at least one book. Spend an hour or so for a "Book Blah"—a book discussion where many books are shared and compared. No time is spent on plot or story line—the children are specialists interested in environmental implications only.

22. What philosophical approach does the above activity illustrate?
   (a) an emphasis on exploitation
   (b) the importance of intelligent consumption
   (c) an integration of curriculum areas
   (d) a science oriented approach

Activity
On a visit to a park during fall give students these directions.
   . Take three steps forward, take five steps to the left.
   . Pick up six leaves. Arrange them in different sets.
   . Arrange the leaves in order of size, with the largest one first and the smallest one last.
   . Find three leaves and arrange them so that the middle leaf is greater than the one on its right and less than the one on its left.
   . Return the objects used to where they were found.
Discuss with the class the importance of doing this. Have them look for partially decayed leaves.

23. Which philosophy does the above activity employ?
   (a) emphasis on exploitation
   (b) multi-disciplinary approach
   (c) science orientation
   (d) none of the above

Activity
Students visit a local sewage treatment plant to determine:
   . the procedure used in treating sewage.
   . the nature and destiny of the solid product (sludge) of the treatment process.
   . the quality and destiny of the water needed by the plant.

24. The above activity is emphasizing what content area?
   (a) biomass
   (b) eutrophication
   (c) decomposition
   (d) man's impact on his environment
Read carefully the four philosophies of environmental education below, and determine which best exemplifies your own personal philosophy. Questions 25 through 28 will be based upon the philosophy you have chosen.

PHILOSOPHIES

I. Environmental education should be interdisciplinary, involving an experience containing elements drawn from two or more disciplines. The activities should be activity-centered and process-oriented. It should require the learner to study various environments first-hand and promote the practice and application of the science process skills. It should promote the acquisition of knowledge of basic ecological concepts to provoke value judgments concerning man's interrelationships with this environment.

II. Environmental education should be science oriented. It should remain a separate discipline to be added to the already existing curriculum. Basic facts of ecology should be emphasized. The learning experiences should be teacher-centered. The affective domain should be avoided because the school's responsibility is for the intellectual growth of students.

III. Environmental education activities should take place outdoors, because that's what environmental education is all about--the outdoors. The activities should be student-centered--the students should be allowed to select those concepts they want to learn. Assignments are unnecessary as the experience is the important part of learning. Emphasis needs to be on leaving nature as it is.

IV. Environmental education should emphasize that the world has ample mineral wealth and that we need only new technologies to exploit this wealth. The time and money spent on conservation and the Environmental Protection Act are only wasting valuable resources that could be channeled to technology.

25. Which of the above philosophies best describes your own personal philosophy?
   (a) I
   (b) II
   (c) III
   (d) IV

Now based on the personal philosophy you have selected in 25, answer questions 26 through 23.
26. To introduce the students with the term "geosphere" (which includes all nonliving components of the earth), which approach would you use?

(a) Emphasize that soil is a basic resource comprised of a variety of minerals. Teach the major groups of rocks--igneous, sedimentary, and metamorphic. All activities are centered around the definitions of geological terms.

(b) Have students sit outside and observe all the nonliving components of their environment. Have them react verbally as to if the component is in its natural state or if it has been altered by man. Stress the beauty of the simplicity of the natural geological setting.

(c) Stress all the minerals available to produce energy and promote the advancement of the technical growth of man.

(d) Take the students outdoors and have the children identify all nonliving objects in their environment. From this list have children identify similarities and develop characteristics unique to each group. Have the students group different sets of nonliving objects. Then have them collect those objects that they are able to and make a collage.

27. In teaching about trees in the environment, which approach would you use?

(a) Make sure students know about the process of photosynthesis.

(b) Emphasize the aesthetic beauty and value of forests through a sensitivity hike.

(c) Construct either a forester's tape, diameter tape, or merit hypsometer. Take the various forestry tools and use it in finding appropriate trees that could be used for lumbering.

(d) Emphasize that trees are replenishable as a source of energy. It is, therefore, a cheap source of energy.

28. To help students better understand the way energy and materials in his environment influence him, and are influenced by him, which approach would you use?

(a) Students survey their total environment to determine those things affecting them which might be classified as energy. Examine the list and determine those which are essential for survival. Have students select an activity which is characteristic of their life style, but not necessary for survival and try to omit it from their daily activity for a week. (i.e. walk to school instead of riding a bus). Record how omission affected them.

(b) The student will construct a simple generating device and measure the voltage output.

(c) Let students go outside to observe the world's natural energies at work. Point out the wind, streams, solar energy, lightning, etc.

(d) Emphasize the resources available to the world to supply energy. Even though resources may be limited, with the growing technology of the world, new energies will be found before present energies are depleted.
For each of the four environmental education activities below, match the correct environmental education concept and the separate disciplines that have been integrated into it. Each alternative may be used only once.

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<th>Integrated Disciplines</th>
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<td>(aa) art and language arts</td>
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<tr>
<td>(b) energy</td>
<td>(bb) math and art</td>
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<td>(c) effect of environmental factors</td>
<td>(cc) math</td>
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<td>(d) spectrum analysis</td>
<td>(dd) language arts and P.E.</td>
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<td>I. Have students personify by demonstrating with large muscle activity the emotions felt by a tree when there is: . a gentle breeze . a violent rain storm . a forest fire . a squirrel running up the trunk . a person planting a tree</td>
<td>29.</td>
<td>33.</td>
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<td>II. Have students determine the year’s cost and the percentage of the total family income of financing various energy-related activities.</td>
<td>30.</td>
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<td>III. Use a flannelboard and cut shapes to introduce the basic triangle, square, and circle. Then take the students on a short walk in or near the schoolyard and ask them to identify the shapes of the various trees and bushes. Back in the classroom, students can sketch trees that match the shapes.</td>
<td>31.</td>
<td>35.</td>
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<tr>
<td>IV. Have students make a large color wheel including browns, tans, and grays. Take the class on a short hike and ask students to try to match objects they see with sections of the color wheel. Have them record their matches.</td>
<td>32.</td>
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The following are four answer keys for the final test form. Based on the answer given on item 25, different keys are needed. There is no right or wrong answer on item 25, but the answers to items 28, 29, and 30 must be consistent with the philosophy selected in item 25.

Key I - Used when item 25 is answered A.

Key II - Used when item 25 is answered B.

Key III - Used when item 25 is answered C.

Key IV - Used when item 25 is answered D.
KEY I

ELEMENTARY EDUCATION

Environmental Education Competency Test

Answer Sheet

1. (a) (b) (c) (d)
2. (a) (b) (c) (d)
3. (a) (b) (c) (d)
4. (a) (b) (c) (d)
5. (a) (b) (c) (d)
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8. (a) (b) (c) (d)
9. (a) (b) (c) (d)
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21. (a) (b) (c) (d)
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24. (a) (b) (c) (d)
25. (a) (b) (c) (d)
26. (a) (b) (c) (d)
27. (a) (b) (c) (d)
28. (a) (b) (c) (d)
29. (a) (b) (c) (d)
30. (a) (b) (c) (d)
31. (a) (b) (c) (d)
32. (a) (b) (c) (d)
33. (a) (b) (c) (d)
34. (a) (b) (c) (d)
35. (a) (b) (c) (d)
36. (a) (b) (c) (d)

* Item determining which key should be used.

X Correct Answers
KEY II

ELEMENTARY EDUCATION

Environmental Education Competency Test

Answer Sheet

1. (a) (b) (c) (d) 19. (a) (X) (c) (d)
2. (a) (b) (c) (X) 20. (a) (b) (c) (X)
3. (a) (X) (c) (d) 21. (X) (b) (c) (d)
4. (a) (X) (c) (d) 22. (a) (b) (X) (d)
5. (a) (b) (X) (d) 23. (a) (X) (c) (d)
6. (a) (X) (c) (d) 24. (a) (b) (c) (X)
7. (a) (X) (c) (d) 25. (a) (X) (c) (d)
8. (a) (b) (X) (d) 26. (X) (b) (c) (d)
9. (a) (b) (c) (X) 27. (X) (b) (c) (d)
10. (a) (b) (X) (d) 28. (a) (X) (c) (d)
11. (a) (b) (c) (X) 29. (a) (b) (X) (d)
12. (a) (X) (c) (d) 30. (a) (X) (c) (d)
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18. (a) (b) (c) (X) 36. (XX) (bb) (cc) (dd)

* Item determining which key should be used.

X Correct Answers
KEY III

ELEMENTARY EDUCATION

Environmental Education Competency Test

Answer Sheet

1. (a) (b) (X) (d)  19. (a) (X) (c) (d)
2. (a) (b) (c) (X)  20. (a) (b) (c) (X)
3. (a) (X) (c) (d)  21. (X) (b) (c) (d)
4. (a) (X) (c) (d)  22. (a) (b) (X) (d)
5. (a) (b) (X) (d)  23. (a) (X) (c) (d)
6. (a) (X) (c) (d)  24. (a) (b) (c) (X)
7. (a) (X) (c) (d)  25. (a) (b) (X) (d)
8. (a) (b) (X) (d)  26. (a) (X) (c) (d)
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10. (a) (b) (X) (d)  28. (a) (b) (X) (d)
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18. (a) (b) (c) (X)  36. (X) (bb) (cc) (dd)

* Item determining which key should be used.

X Correct Answer
KEY IV

ELEMENTARY EDUCATION

Environmental Education Competency Test

Answer Sheet

1. (a) (b) (c) (d) 19. (a) (b) (c) (d)
2. (a) (b) (c) (d) 20. (a) (b) (c) (d)
3. (a) (b) (c) (d) 21. (a) (b) (c) (d)
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18. (a) (b) (c) (d) 36. (aa) (bb) (cc) (dd)

* Item determining which key should be used.

X Correct Answers
Appendix G

Final Test Form Item Analysis Data
First Administration
1. Why should the affective dimension be emphasized in environmental education?
   (a) It is often neglected in teaching.
   (b) Cognitive concepts are irrelevant to environmental education.
   (c) It develops a system of value analysis that will guide positive action to the environment.
   (d) All of the above

   Alternatives  | A  | B  | C* | D  | OMITS |
   0  0  8  2  0  0
   0  1  7  2  0  0

   Difficulty = .85

2. What is a logical science process operation that follows the "inference" step?
   (a) communicating results
   (b) generalizing
   (c) identifying
   (d) stating hypothesis

   Alternatives  | A  | B  | C  | D* | OMITS |
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   Difficulty = .50

3. The branch of life science that studies the relationships among and between living organisms and their environment is called
   (a) man's impact on his environment.
   (b) ecology.
   (c) conservation.
   (d) resource management.

   Alternatives  | A  | B* | C  | D  | OMITS |
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   2  8  0  0  0

   Difficulty = .90

* Correct Answers
The above is an illustration of a/an
(a) life cycle.
(b) ecosystem.
(c) food chain.
(d) community.

Alternatives

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Difficulty = .70

5. To develop attitudes which will foster positive action to the environment, which philosophical approach would be effective?
(a) be science oriented
(b) be based on the basic concepts of ecology
(c) emphasize the interdisciplinary approach to the curriculum
(d) stress the exploitation of natural resources

Alternatives

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Difficulty = .65

6. Complete the following food chain so that it would be typical of a desert environment.

( ) → MOUSE → ( )

(a) cat
(b) snake
(c) bear
(d) horned toad

Alternatives

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Difficulty = .95

* Correct Answers
7. When selecting environmental education curriculum activities to be used in the classroom,
   (a) they should contradict personal philosophy thus forcing the reception of new ideas.
   (b) they should agree with personal philosophy.
   (c) personal philosophy is an unnecessary criteria in selection.
   (d) none of the above.

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   Difficulty = .30

8. The process that promotes among citizens the awareness and understanding of their surroundings, their relationship to it, and the concern and responsibility necessary to insure their survival and to improve the quality of life defines
   (a) ecology
   (b) outdoor education
   (c) environmental education
   (d) man's impact on his environment

   Alternatives
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   Difficulty = .80

9. An environmentally aware citizen will know that
   (a) resources and energy are limited so new attitudes must be developed.
   (b) there are no right or wrong answers in conservation—only intelligent choices.
   (c) environmental education decisions require skills and knowledge in a great many areas.
   (d) all of the above

   Alternatives
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   Difficulty = .70

* Correct Answers
10. The following are all components of an ecosystem, except for
(a) decomposers
(b) energy source
(c) ecotones
(d) consumers

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Difficulty = .80

11. All of the following are ways students can influence better environmental decision-making, except for
(a) learning more about environmental interactions themselves.
(b) helping inform their parents, other students, and members of the community.
(c) supporting, through their parents, legislations designed to protect the environment.
(d) modifying their behavior to lead to a comfortable lifestyle.

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Difficulty = .90

12. The act of directly seeing, hearing, tasting, smelling, or feeling is called
(a) abstracting.
(b) observing.
(c) classifying.
(d) testing.

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Difficulty = .50

13. Which curricular approach would be effective in developing an understanding of man's environmental problems and the decision-making skills to solve them?

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Difficulty = .80

* Correct Answers
14. The process where living organisms modify their environment, making it less favorable for themselves but more favorable for another community is called

- (a) energy flow.
- (b) abiotic stratification.
- (c) autotrophic continuum
- (d) ecological succession

Alternatives

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Difficulty = .60

15. Environmental education activities that use the science process skills would

- (a) use an emphasis on vocabulary terms to aid communication skills.
- (b) involve experiences containing elements primarily from science.
- (c) use test results to insure correct placement of students in individualized programs.
- (d) be a hands-on experience.

Alternatives

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Difficulty = .50

16. An inference is

- (a) a critical trial or evaluation.
- (b) an occurrence in the investigation.
- (c) a conclusion about an observation that may or may not be true.
- (d) a formulation of objects into classes.

Alternatives

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Difficulty = .75

17. An unfavorable alteration of our surroundings, wholly or largely as a by-product of man's actions is called

- (a) expenditures.
- (b) pollution.
- (c) erosion.
- (d) aesthetic valuing.

* Correct Answers
18. Activity
Litter in Schoolyard
(a) conservation
(b) data-collecting
(c) convergent thinking process
(d) science process skills

Difficulty = .25

19. Activity
All Day Field Day
(a) science orientation
(b) a student-centered activity
(c) emphasis on facts of ecology
(d) none of the above

Difficulty = .45

20. Activity
Water experiment (Inference)
(a) E
(b) D
(c) H
(d) I

Difficulty = .90

* Correct Answers
21. Activity
Jurors and Judge
(a) a multi-disciplinary approach
(b) an emphasis on abiotic factors
(c) a science orientation
(d) none of the above

Alternatives

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Difficulty = .45

22. Activity
Fiction Reading
(a) an emphasis on exploitation
(b) the importance of intelligent consumption
(c) an integration of curriculum areas
(d) a science oriented approach

Alternatives

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Difficulty = .80

23. Activity
Park Activity
(a) an emphasis on exploitation
(b) multi-disciplinary approach
(c) science orientation
(d) none of the above

Alternatives

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Difficulty = .45

24. Activity
Sewage Treatment Plant
(a) biomass
(b) eutrophication
(c) decomposition
(d) man's impact on his environment

Alternatives

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Difficulty = .55

*Correct Answers
25. Philosophy
   (a) I
   (b) II
   (c) III
   (d) IV

NO ITEM ANALYSIS

26. (Which philosophical approach)

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Difficulty = .90

27. (Which philosophical approach)

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Difficulty = .50

28. (Which philosophical approach)

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Difficulty = .80

29. Selecting Content Area (Acting out effects of wind, forest fire, etc.)

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Difficulty = .65

* Correct Answers
30. **Selecting Content Area (Calculating percentage of energy expense uses)**

(a) foliage observation  
(b) energy  
(c) effects of environmental factors  
(d) spectrum analysis

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Difficulty = .85

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31. **Selecting Content Area (Shapes of trees, bushes)**

(a) foliage observation  
(b) energy  
(c) effects of environmental factors  
(d) spectrum analysis

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Difficulty = .80

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32. **Selecting Content Area (Color wheel and nature hike)**

(a) foliage observation  
(b) energy  
(c) effects of environmental factors  
(d) spectrum analysis

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Difficulty = .85

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33. **Selecting integrated content areas (Acting our effects of wind, forest fire, etc.)**

(aa) art and language arts  
(bb) math and art  
(cc) math  
(dd) language arts and P. E.

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Difficulty = .85

* Correct Answers
34. Selecting integrated content area (Calculating percentage of income energy expense uses)

(aa) art and language arts
(bb) math and art
(cc) math
(dd) language arts and P.E.

Alternatives

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Difficulty = 1.00

35. Selecting integrated content area (Shapes of trees, bushes)

(aa) art and language arts
(bb) math and art
(cc) math
(dd) language arts and P.E.

Alternatives

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Difficulty = .60

36. Selecting integrated content area (Color wheel and nature hike)

(aa) art and language arts
(bb) math and art
(cc) math
(dd) language arts and P.E.

Alternatives

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Difficulty = .50

* Correct Answers
Appendix H

Final Test Form Test Analysis Data
Second Administration
FINAL FORM - SECOND ADMINISTRATION

ITEM ANALYSIS

1. Why should the affective dimension be emphasized in environmental education?
   (a) It is often neglected in teaching.
   (b) Cognitive concepts are irrelevant to environmental education.
   (c) It develops a system of value analysis that will guide positive action to the environment.
   (d) All of the above

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   Difficulty = .80

2. What is a logical science process operation that follows the "inference" step?
   (a) communicating results
   (b) generalizing
   (c) identifying
   (d) stating hypothesis

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   Difficulty = .50

3. The branch of life science that studies the relationships among and between living organisms and their environment is called
   (a) man's impact on his environment
   (b) ecology
   (c) conservation
   (d) resource management

   Alternatives
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   Difficulty = 1.00

* Correct Answers
4. The above is an illustration of a/an
(a) life cycle.
(b) ecosystem.
(c) food chain.
(d) community.

Alternatives

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Difficulty = .63

5. To develop attitudes which will foster positive action to the environment, which philosophical approach would be effective?
(a) be science oriented
(b) be based on the basic concepts of ecology
(c) emphasize the interdisciplinary approach to the curriculum
(d) stress the exploitation of natural resources

Alternatives

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Difficulty = .60

6. Complete the following food chain so that it would be typical of a desert environment.

       PLANT ROOT ----------> MOUSE ---------->
(a) cat
(b) snake
(c) bear
(d) horned toad

Alternatives

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Difficulty = 1.00

* Correct Answers
7. When selecting environmental education activities to be used in the classroom,
   (a) they should contradict personal philosophy thus forcing the reception of new ideas.
   (b) they should agree with personal philosophy.
   (c) personal philosophy is an unnecessary criteria in selection.
   (d) none of the above

Alternatives

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Difficulty = .40

8. The process that promotes among citizens the awareness and understanding of their surroundings, their relationship to it, and the concern and responsibility necessary to insure their survival and to improve the quality of life defines
   (a) ecology.
   (b) outdoor education.
   (c) environmental education.
   (d) man's impact on his environment.

Alternatives

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Difficulty = .85

9. An environmentally aware citizen will know that
   (a) resources and energy are limited so new attitudes must be developed.
   (b) there are no right or wrong answers in conservation—only intelligent choices.
   (c) environmental decisions require skills and knowledge in a great many areas.
   (d) all of the above

Alternatives

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Difficulty = .95

10. The following are all components of an ecosystem, except for
    (a) decomposers.
    (b) energy source.
    (c) ecotones.
    (d) consumers.

* Correct Answers
11. All of the following are ways students can influence better environmental decision-making, except for
(a) learning more about environmental interactions themselves.
(b) helping inform their parents, other students, and members of the community.
(c) supporting, through their parents, legislation designed to protect the environment.
(d) modifying their behavior to lead to a comfortable lifestyle.

12. The act of directly seeing, hearing, tasting, smelling, or feeling is called
(a) abstracting
(b) observing
(c) classifying
(d) testing

13. Which curricular approach would be effective in developing an understanding of man's environmental problems and the decision-making skills to solve them?
(a) the emphasis on utilization of natural resources for profit
(b) the importance of not disturbing nature
(c) the integration of all disciplines
(d) emphasizing the science aspect of the problem
14. The process where living organisms modify their environment, making it less favorable for themselves but more favorable for another community is called
(a) energy flow.
(b) abiotic stratification.
(c) autotrophic continuum.
(d) ecological succession.

Alternatives  A   B   C   D*   OMITS
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Lower 10      0   1   3   6   0
Difficulty = .80

15. Environmental education activities that use the science process skills would
(a) use an emphasis on vocabulary terms to aid communication skills.
(b) involve experiences containing elements primarily from science.
(c) use test results to insure correct placement of students in individualized programs.
(d) be a hands-on experience.

Alternatives  A   B   C   D*   OMITS
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Lower 10      0   3   0   7   0
Difficulty = .85

16. An inference is
(a) a critical trial or evaluation.
(b) an occurrence in the investigation.
(c) a conclusion about an observation that may or may not be true.
(d) a formulation of objects into classes.

Alternatives  A   B   C*   D  OMITS
Upper 10      0   0   10  0   0
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Difficulty = 1.00

17. An unfavorable alteration of our surroundings, wholly or largely as a by-product of man's actions is called
(a) expenditures.
(b) pollution.
(c) erosion.
(d) aesthetic valuing.

* Correct Answers
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Difficulty = .85

18. **Activity**
Litter in Schoolyard
(a) conservation
(b) data-collecting
(c) convergent thinking process
(d) science process skills

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Difficulty = .55

19. **Activity**
All Day Field Day
(a) science orientation
(b) a student-centered activity
(c) emphasis on facts of ecology
(d) none of the above

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Difficulty = .75

20. **Activity**
Water Experiment (Inference)
(a) E
(b) D
(c) H
(d) I

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Difficulty = 1.00

* Correct Answers
21. **Activity**  
Jurors and Judge

(a) a multi-disciplinary approach  
(b) an emphasis on abiotic factors  
(c) a science orientation  
(d) none of the above

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Difficulty = .85

22. **Activity**  
Fiction Reading

(a) an emphasis on exploitation  
(b) the importance of intelligent consumption  
(c) an integration of curriculum areas  
(d) a science oriented approach

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Difficulty = .65

23. **Activity**  
Park Activity

(a) emphasis on exploitation  
(b) multi-disciplinary approach  
(c) science orientation  
(d) none of the above

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Difficulty = .55

24. **Activity**  
Sewage Treatment Plant

(a) biomass  
(b) eutrophication  
(c) decomposition  
(d) man's impact on his environment

* Correct Answers
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Difficulty = .60

25. Philosophy
(a) I
(b) II
(c) III
(d) IV

NO ITEM ANALYSIS

26. (Which philosophical approach)

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Difficulty = .90

27. (Which philosophical approach)

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Difficulty = .45

28. (Which philosophical approach)

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Difficulty = 1.00

29. Selecting Content Area (Acting out effects of wind, forest fire, etc.)
(a) foliage observations
(b) energy
(c) effects of environmental factors
(d) spectrum analysis

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Difficulty = .90

* Correct Answers
30. Selecting Content Area (Calculating percentage of income energy expense uses)
   (a) foliage observations
   (b) energy
   (c) effects of environmental factors
   (d) spectrum analysis

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Difficulty = .90

31. Selecting Content Area (Shapes of trees, bushes)
   (a) foliage observations
   (b) energy
   (c) effects of environmental factors
   (d) spectrum analysis

<table>
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<th>A*</th>
<th>B</th>
<th>C</th>
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Difficulty = .95

32. Selecting Content Area (Color wheel and nature hike)
   (a) foliage observations
   (b) energy
   (c) effects of environmental factors
   (d) spectrum analysis

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<tr>
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<th>A</th>
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<th>C</th>
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Difficulty = .95

33. Selecting integrated content area (Acting out effects of wind, forest fire, etc.)
   (aa) art and language arts
   (bb) math and art
   (cc) math
   (dd) language arts and P.E.

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<tr>
<th>Alternatives</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D*</th>
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</tbody>
</table>

Difficulty = 1.00

* Correct Answers
34. Selecting integrated content area (Calculating percentage of income energy expense uses)

(a) art and language arts
(b) math and art
(c) math
(d) language arts and P.E.

Alternatives

<table>
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<tr>
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<th>B</th>
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</table>

Difficulty = 1.00

35. Selecting integrated content area (Shapes of trees, bushes)

(a) art and language arts
(b) math and art
(c) math
(d) language arts and P.E.

Alternatives

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<th>C</th>
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</table>

Difficulty = 0.75

36. Selecting integrated content area (Color wheel and nature hike)

(a) art and language arts
(b) math and art
(c) math
(d) language arts and P.E.

Alternatives

<table>
<thead>
<tr>
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<th>A*</th>
<th>B</th>
<th>C</th>
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Difficulty = 0.70

* Correct Answers