DOCUMENT RESUME

ED 335 232 SE 052 224

AUTHOR	Howe, Robert W.; Disinger, John F.
TITLE	Environmental Activities for Teaching Critical Thinking. Environmental Education Information Report.
INSTITUTION	ERIC Clearinghouse for Science, Mathematics, and Environmental Education, Columbus, Ohio.
SPONS AGENCY	Office of Educational Research and Improvement (ED), Washington, DC.
PUB DATE	Jun 90
CONTRACT	RI88062006
NOTE	129p.
AVAILABLE FROM	ERIC Clearinghouse for Science, Mathematics and Environmental Education, The Ohio State University, 1200 Chambers Rd., Room 310, Columbus, OH 43212 ($12.50).
PUB TYPE	Guides - Classroom Use - Teaching Guides (For Teacher) (052) -- Information Analyses - ERIC Clearinghouse Products (071)
EDRS PRICE	MF01/PC06 Plus Postage.
DESCRIPTORS	Case Studies; Conservation (Environment); Cooperative Learning; *Critical Thinking; Data Analysis; Ecology; *Elementary School Science; Elementary Secondary Education; Energy; *Environmental Education; Magnets; Plastics; Pollution; Problem Solving; Public Opinion; Recycling; Role Playing; *Science Activities; Science Education; *Secondary School Science; Simulation; Teaching Methods; Waste Disposal; Water

ABSTRACT

The ability to think critically is essential if individuals are to live, work, and function effectively in our current and changing society. The activities included in this publication were selected to identify a variety of effective strategies for teaching critical thinking skills through environmental education. Activities include library research and analysis of information; interviewing and analysis of information obtained through interviews, debates, simulations, and role playing; analyzing speeches and presentations; case studies; critical writing for community action; planning alternative actions; and evaluating alternative actions. The activities also emphasize analyses of materials and ideas by individual students, analyses and comparisons of analyses within small groups of students, class analyses and discussions of materials and ideas, comparing student developed materials and statements to published and community statements, and rethinking ideas at all levels of analyses based on new or different information. Topics include recycling, magnetism, packaging, plastics, water use, energy conservation, waste disposal, ecology, plant growth, soil compaction, wildlife, endangered species, carrying capacity, pollution, and zoning. Each activity includes the title, level, subject, reference, objectives, procedures, extensions and variations, and evaluation. Twenty-five references are included. (KR)

Robert W. Howe

and

John F. Disinger

ENVIRONMENTAL ACTIVITIES FOR TEACHING CRITICAL THINKING

ERIC Clearinghouse for Science, Mathematics and Environmental Education
The Ohio State University
1200 Chambers Road, Third Floor
Columbus, OH 43212
Telephone: (614) 292-6717

June 1990

ENVI
EDU
INFO
REPO

ENVIRONMENTAL EDUCATION INFORMATION REPORT

THE ERIC SCIENCE, MATHEMATICS AND
ENVIRONMENTAL EDUCATION CLEARINGHOUSE
in cooperation with
Center for Science and Mathematics Education
The Ohio State University

ENVIRONMENTAL EDUCATION INFORMATION REPORTS

Environmental Education Information Reports are issued to analyze and summarize information related to the teaching and learning of environmental education and provide examples of instructional materials and curriculum. It is hoped that these publications will provide information for personnel involved in development, ideas for teachers, and indications of trends in environmental education.

Your comments and suggestions for these publications are invited.

Robert W. Howe
Director
ERIC/SMEAC

Permission to include revised versions of copyrighted materials has kindly been granted by several organizations:

The CLASS Project	pp. 87, 100, 113
Project Learning Tree	pp. 15,19, 23, 25, 37 ,38, 121
Project WILD	pp. 27, 31, 44, 48, 52, 59, 66, 73, 81, 92, 97

For additional information concerning these projects and their materials, contact:

The CLASS Project, National Wildlife Federation, 1400 Sixteenth Street, NW, Washington, DC 20036-2266

Project Learning Tree, The American Forest Institute, Inc., 1619 Massachusetts Ave., NW, Washington, DC 20036

Project WILD, P. O. Box 18060, Boulder, Colorado 80308-8060

OERI

This document was funded by the Office of Educational.Research and Improvement, U.S. Department of Education under contract no. RI-88062006. Opinions expressed in this document do not necessarily reflect the positions or policies of OERI or the Department of Education.

TABLE OF CONTENTS

PREFACE

This is the 21st volume in ERIC/SMEAC's Teaching Activities in Environmental Education series, which was initiated in 1973. The first three titles in the series were of a general nature, dealing with multiple aspects of environmental education. Starting with the fourth, topical areas have been identified as themes, with the expectation that such an organizational pattern might prove more useful to practitioners in both formal and non-formal settings.

As a general rule, most of the activities selected for inclusion in the various volumes have been adapted from materials developed by others; many of the source publications have been reported through the ERIC data base, and are available in ERIC documents. Some have been "original," in the sense that ERIC staff or other authors have developed them more or less from scratch. Common formats have been employed for all activities in each volume.

The current volume was developed by Robert Howe and John Disinger. Most of the activities are based on reports, instructional materials, and other information located through the ERIC system, as referenced. Activities include a mix of original and adapted materials.

Other titles in the Teaching Activities in Environmental Education series include:

John H. Wheatley and Herbert L. Coon, *One Hundred Teaching Activities in Environmental Education*. 1973; ED 091 172; 204 pages.

John H. Wheatley and Herbert L. Coon, *Teaching Activities in Environmental Education, Volume II*. 1974; ED 102 031; 200 pages.

John H. Wheatley and Herbert L. Coon, *Teaching Activities in Environmental Education, Volume III*. 1975; ED 125 268; 195 pages.

Herbert L. Coon and Michele Y. Alexander, *Energy Activities for the Classroom*. 1976; ED 130 833; 148 pages.

Herbert L. Coon and Mary Lynne Bowman, *Environmental Education in the Urban Setting: Rationale and Teaching Activities*. 1977; ED 137 140; 199 pages.

Judith M. Schultz and Herbert L. Coon, *Population Education Activities for the Classroom*. 1977; ED 141 178; 195 pages.

Robert H. McCabe, J. Terence Kelly, and Doris Lyons, *Man and Environment Teaching Activities*. 1977; ED 144 626; 336 pages.

Herbert L. Coon and Charles L. Price, *Water-Related Teaching Activities*. 1977; ED 152 541; 265 pages.

Mary Lynne Bowman and John F. Disinger, *Land Use Management Activities for the Classroom*. 1977; ED 152 541; 265 pages.

Mary Lynne Bowman and Herbert L. Coon, *Recycling: Activities for the Classroom*. 1978; ED 159 075; 145 pages.

William R. Hernbrode, *Multidisciplinary Wildlife Teaching Activities.* 1978; ED 162 897; 95 pages.

Herbert L. Coon and Mary Lynne Bowman, *Energy Activities for the Classroom, Volume II.* 1978; ED 173 072; 165 pages.

Mary Lynne Bowman, *Values Activities in Environmental Education.* 1979; ED 182 118; 134 pages.

Charles E. Roth and Linda G. Lockwood, *Strategies and Activities for Using Local Communities as Environmental Education Sites.* 1979; ED 194 349; 207 pages.

Mary Lynne Bowman, *Teaching Basic Skills through Environmental Education Activities.* 1979; ED 196 704; 132 pages.

Mary Lynne Bowman, *Teaching Natural Resources Management through Environmental Education Activities.* 1981; ED 214 752; 206 pages.

Lori D. Mann and William B. Stapp, *Thinking Globally and Acting Locally: Environmental Education Teaching Activities.* 1982; ED 229 214; 327 pages.

John F. Disinger and Marylin Lisowski, *Teaching About Hazardous and Toxic Materials.* 1985; ED 273 432; 268 pages.

John F. Disinger and Marylin Lisowski, *Teaching Activities in Science/Society/Technology/Environment.* 1986; ED 282 711; 164 pages.

Robert W. Howe, John F. Disinger and Terry L. Wilson, *Activities for Teaching About Hazardous Wastes in the Home.* 1989; 160 pages.

SECTION I - Introduction: What is Critical Thinking and What Are Some Conditions and Approaches to Teach Critical Thinking?

The ability to think critically is essential if individuals are to live, work, and function effectively in our current and changing society.

Students must make choices, evaluations, and judgments everyday regarding (1) information to obtain, use and believe, (2) plans to make, and (3) actions to take. As adults they will be living in a complex world and in a democracy where both individual and collective actions will also require effective selection, processing, and use of information. State and local curriculum guides contain goal and objective statements regarding the importance of critical thinking skills. National, state association, business and industry reports on education produced since 1983 have called for increased emphasis on higher order learning skills, including critical thinking skills.

At the same time national and state evaluations have indicated a high percentage of students in American schools are not able to use critical thinking skills effectively. Business and industry continue to report that many employees are not able to think critically in job situations requiring these abilities.

There is a profound difference between goals, objectives, and expectations and demonstrated achievement. Schools need to review what they are doing, what they are achieving, and ways to improve students' thinking abilities.

What is critical thinking?

Many definitions of critical thinking have been published. Ennis (1987) stated that it is the process and skills involved in rationally deciding what to do or what to believe.

Educational researchers and program developers (Costa, 1985; Keating, 1988) have tended to include four elements in reports and writings on critical thinking. These include (1) content knowledge [knowledge of the discipline(s)], (2) procedural knowledge (knowledge of thinking skills), (3) ability to monitor, use and control thinking skills (metacognition), and (4) an attitude to use thinking skills and knowledge.

Critical thinking skills identified as important for various disciplines differ somewhat, but skills common to most such lists are included in publications developed by Winocut (Costa, 1985) and by the California State Department of Education.

Winocut's listing of skills (See Figure 1) includes three categories: (1) enabling skills, (2) processes, and (3) operations. Enabling skills include observing, comparing/contrasting, grouping/labeling, categorizing/classifying, ordering, patterning, and prioritizing. Processes include skills related to analyzing questions, facts/opinion, relevancy of information, and reliability of information . Processes also include skills necessary for inferring, understanding meanings, cause/effect, making predictions, analyzing assumptions, and identifying points of view. Operations include logical reasoning, creative thinking, and problem solving skills.

Critical Thinking Skills*

1.0 ENABLING SKILLS

1.1 PERCEIVING
- 1.11 Observing
- 1.12 Comparing/ Contrasting

1.2 CONCEIVING
- 1.21 Grouping/Labeling
- 1.22 Classifying/ Categorizing

1.3 SERIATING
- 1.31 Ordering
- 1.32 Sequencing
- 1.33 Patterning
- 1.34 Prioritizing

2.0 PROCESSES

2.1 ANALYZING
- 2.11 Relevant/ Irrelevant
- 2.12 Fact/Opinion
- 2.13 Reliable/ Unreliable

2.2 QUESTIONING

2.3 INFERRING
- 2.31 Meaning of Statements
- 2.32 Assumptions
- 2.33 Cause/Effect
- 2.34 Generalizations
- 2.35 Predictions
- 2.36 Point-of-View

3.0 OPERATIONS

3.1 LOGICAL REASONING
- 3.11 Deductive
- 3.12 Inductive

3.2 EVALUATING
- 3.21 Judgment
- 3.22 Decision-making

Figure 1

*Adapted from Winocut (Costa, 1985).

Figure 2 presents the California State Department of Education model (Costa, 1985). It includes most of the same skills organized into three categories: (1) Defining and Clarifying the Problem, (2) Judging Information Related to the Problem, and (3) Solving Problems/Drawing Conclusions.

TWELVE ESSENTIAL CRITICAL THINKING SKILLS*

DEFINING AND CLARIFYING THE PROBLEM

1. Identify central issues or problems
   The ability to identify the main idea or point of a passage, an argument, or a political cartoon, for example. At the higher levels, students are expected to identify central issues in complex political arguments. Implies the ability to identify major components of an argument, such as reasons and conclusions.

2. Compare similarities and differences
   The ability to compare similarities and differences among two or more objects, living things, ideas, events, or situations at the same or different points in time. Implies the ability to identify distinctive attributes and to organize information into categories for different purposes.

3. Determine which information is relevant
   The ability to make distinctions between verifiable and unverifiable, relevant and nonrelevant, and essential and incidental information.

4. Formulate appropriate questions
   The ability to formulate questions that will lead to a deeper and clearer understanding of an issue or situation, and of different viewpoints from which an issue or situation can be approached.

JUDGING INFORMATION RELATED TO THE PROBLEM

5. Distinguish among fact, opinion and reasoned judgment
   The ability to apply criteria for judging the quality of observation and inference.

6. Check consistency
   The ability to determine whether given statements or symbols are consistent with each other and their context. For example, the ability to determine whether the different points or issues in a political argument are logically connected and agree with the central issue.

7. Identify unstated assumptions
   The ability to identify what is taken for granted, though not explicitly stated, in an argument.

8. Recognize stereotypes and cliches
   The ability to identify fixed or conventional notions about a person, group, or idea.

9. Recognize bias, emotional factors, propaganda, and semantic slanting
   The ability to identify partialities and prejudices in written and graphic materials. Includes the ability to determine the credibility of sources (gauge reliability, expertise, and objectivity).

10. Recognize different value orientations and ideologies
    The ability to recognize the similarities and differences among different value orientations and ideologies.

SOLVING PROBLEMS/DRAWING CONCLUSIONS

11. Recognize the adequacy of data
    The ability to decide whether the information provided is sufficient in quality and quantity to justify a conclusion, decision, generalization, or plausible hypothesis.

12. Predict probable consequences
    The ability to predict probable consequences of an event or series of events.

Figure 2

*Adapted from the California State Department of Education model (Costa, 1985).

What does research indicate regarding teaching critical thinking?

In general, data indicate that critical thinking skills are not learned well unless schools emphasize critical thinking and the use of critical thinking skills on a continuing basis.

Whether critical thinking is a generalized and a transferable skill, or whether it is bound up in the particulars of a specific content domain is still an issue to be resolved (Keating,1988). Glaser (1984) contends the latter is true and, further that the former perspective is based on an early and ultimately less useful model of human cognitive activity. Kuhn et. al. (1988), while recognizing strong evidence for domain-specificity, argue that mastery in some topic areas may lead to a subsequent ability to think critically in related areas. The necessity of integrating different sources of knowledge (Keating, 1988) is being recognized in most current research paradigms.

Based on research results in the science fields related to reasoning (Glaser, 1984; Carey, 1986; Kuhn, 1985), developing an understanding of knowledge and the ability to retrieve useful knowledge is important for effective thinking. Analyses of items from tests using Bloom's Taxonomy has produced similar conclusions; students are generally not able to effectively use thinking skills without appropriate knowledge.

Focusing directly on thinking skills and the development and use of thinking skills over time tends to produce more effective thinking than unplanned emphasis on skill development or short term emphasis. State education programs such as those in California emphasize the development of thinking skills throughout the curriculum and over time. Emphasis should be given to critical questioning, reading, writing, listening, and planning and carrying out activities in all curriculum areas.

There are many reasons to believe that the development of higher order reasoning rests squarely on the availability of ample amounts of relevant discourse (Glaser, 1984, Keating, 1988). This has not occurred on any regular basis in most middle, junior high, and senior high schools due to lack of teacher knowledge, lack of materials, class size and competing demands such as emphasis of tests, coverage of textbook content, and required academic content. Organizational rearrangements which would dramatically reduce class size, at least for some proportion of the school day, would likely enhance the development of higher order thinking skills (Bennett, 1987).

The quality of discourse and the amount of student interaction are also important. There needs to be a shift in many classes, from a teacher centered classroom to a student-centered classroom in which students can be involved in collecting and analyzing information, paired problem solving, cooperative learning settings, simulations, debates, and critical reporting sessions.

Providing experiences in real-life situations or situations that simulate real-life situations increases the probability that skills will be used. Providing modeling of the skills, ample opportunities for practice, and feedback on the effectiveness of the student's thinking are also important considerations. Selection of experiences should be based on the developmental levels of the students.

Why is environmental education an important focus for critical thinking and an effective mechanism to enhance critical thinking?

Current and anticipated environmental problems are receiving increased attention in the media, by all levels of government, by citizen groups, and by individuals concerned with the potential implications for humans and other life on Earth. These problems are local, regional, national, and international in scope. Developing workable solutions to environmental problems will require choices and decisions based on a critical examination of information and opinions.

Environmental education provides a good mechanism for developing critical thinking skills by (1) providing topics and problems that cut across the school curriculum and can enhance the integration of knowledge, (2) providing real problems that can be studied or simulated, and (3) by providing topics and problems that can be adjusted to the developmental levels of students..

What materials are available for environmental education that emphasize critical thinking skills?

While there are many environmental education materials available that include critical thinking skill development, there are several that provide for both a structure and a variety of activities and experiences. Examples of materials that contain a variety of critical thinking activities include *Aquatic Project Wild, Project Wild, Project Learning Tree, Class, Science-Technology-Society: Preparing for Tomorrow's World,* and *SuperSaver Investigators.*

This activity manual includes examples of these and other materials. Included are examples of activities that you can use and that can be adapted for other environmental topics and problems. They provide a variety of effective instructional procedures and focus on specific or combinations of critical thinking skills.

What are some effective approaches and conditions for teaching critical thinking?

The activities that are included in this publication were selected to identify a variety of effective strategies for teaching critical thinking skills through environmental education. Activities include library research and analysis of information, interviewing and analysis of information obtained through interviews, debates, simulations and role playing, analyzing speeches and presentations, case studies, critical writing for community action, planning alternative actions, and evaluating alternative actions.

The activities also emphasize analyses of materials and ideas by individual students, analyses and comparisons of analyses within small groups of students, class analyses and discussions of materials and ideas, comparing student developed materials and statements to published and community statements and rethinking ideas at all levels of analyses based on new or different information.

Discussions with teachers who have used these approaches emphasize the need for evaluation conditions that support the critical thinking improvement effort. Tests and evaluations of materials and presentations should include items that clearly require critical thinking. Grades also should reflect attainment of critical thinking skills.

SECTION II - ELEMENTARY SCHOOL ACTIVITIES (K-8)

TITLE: **CATCH 'EM IF YOU CAN**
LEVEL: Grades 2-4
SUBJECT: Science
REFERENCES: SuperSaver Investigators

OBJECTIVES: Students will be able to: (1) sort aluminum cans for recycling by using a magnet; (2) classify materials based on the property of magnetism. Students will improve observation skills.

ACTIVITY:

PREPARATION

Make a fishing pole out of a dowel rod, string and magnet. Label a box with the words "Save and Recycle Aluminum" and another box with the words "Save and Recycle Steel." Collect three empty tin cans (usually made of steel with a tin coating), three empty aluminum cans, two wooden blocks, several steel bottle caps, steel nails, a steel can opener and blue poster board. (Avoid bi-metal cans made of tinned steel and aluminum.)

PROCEDURES

1. Discuss the concept of magnetic attraction using a magnet and steel or iron object not pictured in the handout.

2. Distribute the handout, *What Will A Magnet Attract?* and have students complete it after explaining directions. Collect the handout when completed.

3. Display the objects (tinned-steel cans, aluminum cans, wooden blocks, steel bottle caps, steel nails and steel can opener) in random order in front of the blue poster board. Have students take turns trying to "catch" the objects with the teacher-made fishing pole. Observe and discuss magnetic and non-magnetic attraction as each attempt to fish for an object is made. As steel or iron objects are picked up by the fishing pole magnet, have student holding the pole drop the object into the box marked "Save and Recycle Steel."

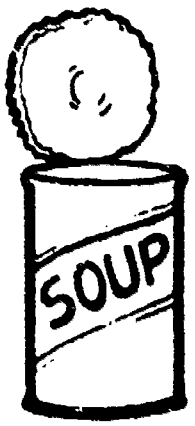
4. Explain that aluminum cans can be identified because they are not attracted to a magnet. Put the three aluminum cans in the box marked "Save and Recycle Aluminum." Explain why we should save and recycle aluminum cans.

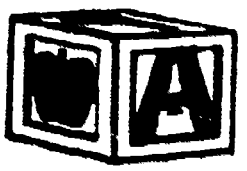
5. Ask students to save their aluminum cans at home and bring them to school so that they can be redeemed at a recycling center, if this can be arranged.

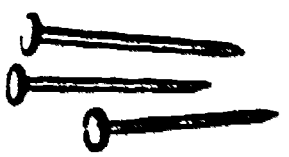
EVALUATION

Distribute the handout, *What Will A Magnet Attract?* as a post-test for each student to complete.

Directions: Circle the objects that a magnet will attract.







TITLE: **TO BUY OR NOT TO BUY**
LEVEL: Grades 1-6
SUBJECT: Social Studies, Language Arts, Science
REFERENCES: SuperSaver Investigators

OBJECTIVES: Students will be able to: (1) *classify* different types of packaging based on recyclability; (2) *describe* different reasons why products are packaged; (3) *identify* excess packaging that is unnecessary; (4) *make choices* based on a consideration of the environmental impact of actions. Students will improve their ability to *make consumer decisions*.

ACTIVITY: METHOD

Students observe and classify a variety of packaging brought from home. They identify alternatives to consuming and producing unnecessary or wasteful packaging. They discuss and write creative ideas for commercials that may be produced in class.

PREPARATION

For Step 2: nut shell, orange peel, banana peel; clay pot, paper grocery sack, glass bottle; plastic bubble packaging from a toy, plastic milk container and styrofoam packaging.

For Step 5: a toy without packaging, identical toy with packaging.

For Evaluation Exercise: sock in a plastic bag, glass bottle, cereal in a box with "made from recycled paper" symbol on it, large can of pork and beans.

VOCABULARY

Biodegradable, necessary, packaging, recyclable, unnecessary.

HANDOUT

Making Wise Decisions

PROCEDURES

1. Give students pre-test handout, *Making Wise Decisions*. Collect after they have completed it to the best of their knowledge.

2. Tell the students that there are three types of packaging. Present them with examples of three types of packaging:

   a. a nut shell, an orange peel and a banana peel as packaging in nature;

   b. a clay pot, a paper grocery sack, and a glass bottle as examples of reusable and recyclable packaging (discuss the meaning of reuse and recycling);

c. a plastic bubble used in packaging a toy, plastic milk containe: and styrofoam packing pieces as examples of packaging that are hard to recycle.

3. Announce that for the next week the students will be saving types of packaging to bring to school for further activities. Tell each student to place an empty grocery bag in the kitchen. As soon as Mom or Dad returns from the grocery store or department store, the student should help them unpack the goods and save the clean packaging to bring to school.

4. Divide the students into small groups of five or six and have them classify the packaging they brought to school into the three groups discussed in class. (i.e. packaging from nature; reuseable or recyclable, hard to recycle.) Note and discuss which group had the most packaging. You may want to weigh each group's collection and compare.

5. Use the above activity as a springboard to discuss the following:

   a. Much of the waste materials each household throws away is packaging. (Refer to the packaging brought in by the students).

   b. This packaging represents energy and natural resources because energy and natural resources are used to make the packaging. Have students identify the type of natural resources used to make the packaging (i.e. paper from trees, plastic from petroleum, glass from sand).

   c. Some packaging is necessary for the purpose of keeping things clean to protect our health (e.g. sterile bandages), to preserve what is inside the package (e.g. food in sealed glass jars), to tell you what the product is or how to use it. (You could use examples from packaging the students brought in).

   d. Point out that other types of packaging can be unnecessary. Present a toy without the packaging and an identical toy attractively packaged inside a bubble of plastic on cardboard. Have them vote for the one they think most people or children would choose to buy. Ask students why toys are packaged as they are, even though the packaging may be unnecessary.

6. In order to be wise consumers of goods and in order to save energy and natural resources, people need to think about the packaging of goods before they buy them. Have students make a list of recommendations. Compare with the following suggestions after they have already brainstormed their own recommendations.

   a. Don't buy things with unnecessary packaging. Buy unpackaged items whenever possible. (Don't buy toys in plastic bubbles with cardboard around them. Buy shirts on hangers instead of in plastic bags. Don't buy fruit wrapped in plastic).

b. Buy containers that can be refilled or recycled. (Returnable glass pop bottles and cans and only plastic items which can be recycled).

c. If products must be packaged, look for packages made from recycled materials. Look for a recycling symbol on the product. (NOTE: Many packaging materials and products are made from recycled materials but do not include a recycling symbol).

d. Buy a large package of a product instead of many small packages. Then there will only be one package to waste or recycle instead of many small packages. Big packages of items usually cost less, too.

e. If products are packaged, buy ones that have a package that could be reused.

7. Have students develop TV or radio commercials about unnecessary packaging and use of recyclable packaging. These could be put on videotape if equipment is available. Have students emphasize conservation values associated with saving resources and scarce landfill space. They could bring in magazines and newspaper advertisements. Discuss the fact and opinion approach to packaging and advertising: packaging that is necessary based on factual claims (i.e. freshness) and packaging that is unnecessary based on opinion (i.e. "exciting" tag). Find a good example of each. Write and share some original advertising techniques which could be used to sell products based on their recyclability.

EVALUATION

1. Present the following goods to the students and have them decide whether it would or would not be a wise choice to buy the good. Have them tell why or why not: sock in a plastic bag-no, unnecessary packaging, packaging difficult to recycle and is not usually degradable; glass bottle-yes, refillable or can be recycled; cereal in a box with the recycling symbol on it-yes, it was made from recycled paper, it can be recycled again, it is biodegradable; very large can of pork and beans-yes, the large can is better than many small cans, could be recycled or reused. Remember, reasoning is more important than "correct" answers, as there are often exceptions to be considered. For example, several small cans of beans may be more appropriate to buy than one large can if few people are being served at any one time. This is because leftover beans from a larger can may spoil before they could be eaten.

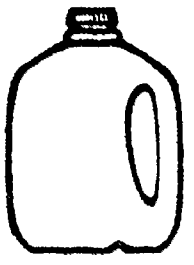
2. Have students again complete the test handout, *Making Wise Decisions.*

MAKING WISE DECISIONS

1. DRAW A LINE FROM THE DESCRIPTION TO THE PACKAGING IT DESCRIBES

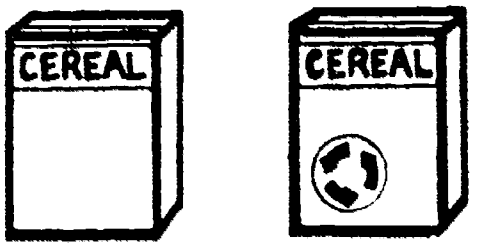
A. Packaging of nature

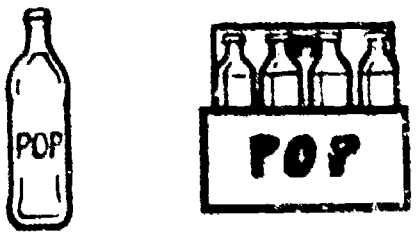
B. Can be reused or recycled

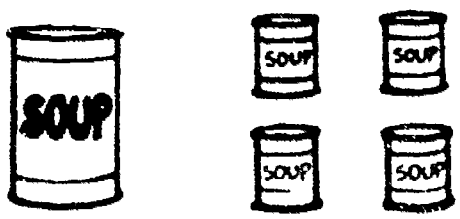


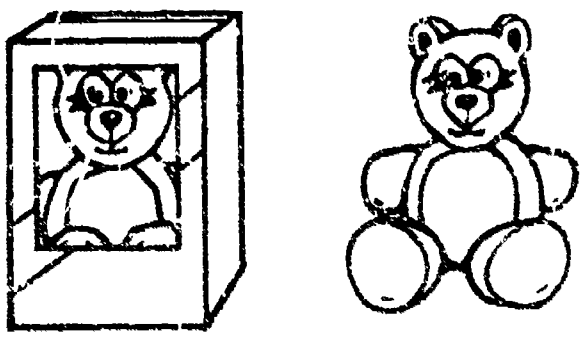
C. Hard to recycle

2. CIRCLE THE ITEM IN EACH OF THE TWO CHOICES THAT WOULD BE THE BEST CHOICE FOR SAVING NATURAL RESOURCES AND ENERGY









TITLE: **WHY WOODEN PENCILS?**
LEVEL: Grades 2-6
SUBJECT: Social Studies, Science, Language Arts, Humanities
REFERENCE: Project Learning Tree

OBJECTIVES: Students will be able to describe the suitability of certain materials for the manufacture of a particular consumer product. Students will demonstrate increased skill in categorizing, grouping, and evaluating.

ACTIVITY: Distribute papers with these headings to your students: wood, plastic, steel, aluminum, copper, iron.

Divide your class into six groups. Ask each group to compile a list of products used in the school which are made from each of the materials named. Once completed, ask all the groups to share their lists. Through discussion - and possibly after out-of-class investigation to verify the derivation of some materials - create a master list.

When the master list is complete, ask each student to pick any three products, each made of a different material (for instance, a pencil, a metal locker, and a plastic table) and write a brief explanation of the possible reasons each product was made from one material rather than another. In other words, why are most pencils made of wood rather than steel or plastic? What properties do these materials have which lend themselves to particular uses and not to others? Which materials are derived from renewable resources? Identify the others as being derived from nonrenewable resources. Note that some products are made using both renewable and nonrenewable resources. Which products are reusable? Which are recyclable? Ask the students to offer their opinions, based on the study they have done, of the appropriateness and suitability of the materials used to make each of the products.

TITLE: **HOW CAN WE REDUCE ENERGY WASTE?**
LEVEL: Grades 2-6
SUBJECT: Science
REFERENCES: Adapted from several previous ERIC/SMEAC activities.

OBJECTIVES: Students will be able to: (1) identify wasteful habits that could save energy and (2) actions that could be taken to reduce the waste.

ACTIVITY: Discuss with your class how energy may be saved by not wasting things. Anytime something is wasted, the energy used to produce that thing is also wasted. Throwing away uneaten foods and recyclable materials is a waste of much-needed energy.

1. Have students develop a list of things often wasted in their homes. Their lists should include such common products and items as food, water, paper, electricity, gas soap and other cleaning products, hot water and paper towels. From this list make a daily chart for students to complete.

2. Have students record on the daily chart for three days their personal scores on saving or wasting. Each time they do something which saves energy, they are to give themselves a plus (+) next to the item. Each time they waste energy, they are to give themselves a minus (-).

3. At the end of the three days discuss their score-keeping experiences. Where did they save the most energy? When was it most difficult to save energy? Were they successful in changing wasteful habits? Did they discover themselves to be more or less wasteful than they had previously thought? Do they feel as though they were making a personal sacrifice during the week? How many felt a sense of satisfaction for their efforts? How many intend to keep trying to conserve energy? Were family members influenced by their "waste consciousness?"

As a follow-up activity, have your class list household items which can be used again (paper bags, aluminum foil, plastic containers). Then have each student check ( ) the items that his/her family recycles. Finally, items may be ranked in order of recycling frequency. This activity might be made more meaningful by having each student select a single product (i.e., brown paper lunch sack) and recording the number of times it is used in the space of two weeks.

TITLE: **HOW MUCH WATER DO WE WASTE?**
LEVEL: Grades 2-8
SUBJECT: Science, Mathematics
REFERENCES: Adapted from previous ERIC/SMEAC activities.

OBJECTIVES: Students will be able to: (1) determine relevant data needed to solve a problem; (2) develop a procedure for collecting relevant data; and (3) analyze data collected to identify patterns.

ACTIVITY: Set up a system for monitoring water use in the classroom. This can be done by measuring water used (use a jar to measure) and by putting a dishpan in the sink to catch other water used (washing, etc.). Measure the water in the dishpan as it fills by using a second jar of the same size. Chart the water used for each day for two weeks.

1. Discuss how water is used in the classroom (list on board). How much water do you think goes down the drain each day? One jar full? Ten jars full? How could we find out?

2. Brainstorm some ways for reducing water waste and using collected waste water.

3. Discuss how students could determine water use at home.

4. Discuss what water conservation devices are currently available and how they would reduce water use.

TITLE: **PILED HIGHER AND DEEPER**
LEVEL: Grades 3-8
SUBJECT: Science, Mathematics
REFERENCES: Adapted from previous ERIC/SMEAC activities.

OBJECTIVES: Students will learn how to: (1) collect data regarding a problem or issue; (2) categorize data collected regarding a problem or issue; and (3) analyze data regarding a problem or issue.

ACTIVITY: Pre-Meeting Activity:

1. Ask students to see how much trash they collect in one day from their homes.

   a. Use standard size grocery bags.

   b. Separate bottles, cans, plastics and paper trash.

   c. Make a simple list which show the amount of each item as follows: Bottles - 3 Cans - 2 Plastics - 4 Paper trash - 1/2 bag.

   d. Bring list to next meeting.

2. Follow-Up Activity:

   a. Add totals from all lists to get total number of bottles, cans, plastics, and paper trash collected by the group for one day. Make a sample chart to show group results.

   b. Find the average for your group by dividing each total by the number of families in your group to learn the average amount of trash per day per family.

   c. Multiply each by 7 to get the average amounts of trash generated per week.

   d. Multiply these totals by 52 to get yearly totals.

Most of the group will be surprised by the amount of trash generated in a year by a small group.

3. Hold discussions on:

   a. How can we reduce the amount of solid waste?

   b. What items of trash could be recycled?

   c. Which natural resources are represented by items found in the trash? Which natural resources are being the most quickly depleted according to your trash counts? Are these resources renewable or nonrenewable?

TITLE: **MEMORY CIRCLE**
LEVEL: Grades 4-6
SUBJECT: Language Arts, Social Studies, Science
REFERENCE: Project Learning Tree

OBJECTIVES: Students will increase their listening and memory skills and be able to relate experiences they have had in the forest. Students will categorize the forest by their statements regarding how the activity impacted on the forest.

ACTIVITY: This is a memory game. Ask your students to arrange themselves in a circle. The first player tells something he or she has observed in a forest. ("I saw a trout hiding in a pool under some rocks.") The next player repeats the first statement and adds one of his or her own. The game continues around the circle until the list is too long to remember.

Students might also state what they *did to* or *in* the forest ("I caught a trout." "I burned wood in my campfire."), or what the forest did to or does for them ("I was warmed by the wood burning in my campfire." "I was refreshed by the long hike through the trees.").

After the game, list the students' statements on the chalkboard and ask the class to decide whether each is beneficial, detrimental, or has little effect on the forest environment. Lead a discussion including:

1. What makes an action or event beneficial to a forest?
2. How we can distinguish between a detrimental and a beneficial effect?
3. Were any of the actions detrimental to the forest but beneficial to people? If so, which ones? Whether, when, and how we can justify such actions?
4. Were any actions detrimental to people, but beneficial to the forest? If so, which ones? Whether, when, and how we can justify such actions?

TITLE: **PLANT GROWTH RACE**
LEVEL: Grades 3-8
SUBJECT: Science
REFERENCES: Expanding Children's Thinking

OBJECTIVES: Students will be able to: (1) infer some cause-effect relationships for the germination of seeds and the growth of plants; (2) design an experiment using plants; (3) determine relevant data and maintain records; and (4) analyze the results of the experiment.

ACTIVITY:

Focus: Growing plants from seeds is an activity which can become exciting when each student competes in a contest to grow the tallest plant. The time frame is over several weeks, not a few hours. Students are required to record data and to hypothesize the best conditions for growth.

Background: There are many important variables influencing the growth rate of plants: temperature, amount of light and water, type of soil, parasites, and many others. Younger children may be given a simplified problem by providing only one type of soil and/or relatively uniform light and temperature. Older youngsters may be challenged to consider a wide range of variables, especially soil types and fertilizers.

Challenge: Who can grow the tallest plant from a seed in four weeks?

Materials and Equipment:

Six seeds per student (Bean seeds, even dried beans from the grocery store are recommended. Pea seeds also work well.)

Cups for measuring water

Rulers

String for supporting tall plants

If done outdoors, stakes to identify plants

If done indoors, lamps with electrical outlets

Flower pots or styrofoam egg cartons

(Egg cartons are prepared by cutting off the top cover and using it inverted as a tray below the section with the egg cups. Use a knife or scissors to punch a small hole in the bottom of each egg cup. Through this hole, push a small strip of cloth to serve as a wick. When the "tray" contains water, the wick allows the soil in the egg cup to remain wet.)

How-To-Do-It: Begin by describing the long race which will not have a winner until several weeks later. (Set a time limit of approximately four weeks). Encourage the students to plan carefully the best strategies for getting their seeds to germinate quickly and to grow rapidly in height. Help them to organize a system for recording their activities.

Many youngsters enjoy working in pairs. Partners tend to discuss and even to argue over the best ways to treat their seeds. By pairing students, the class will require less materials and equipment. If one student of a pair is absent, the other can continue to apply water, measure the growth of the plant, and record the data.

Each pair of students should work with several seeds because some seeds may never germinate, and because some of the plants may die from adverse conditions. One seed in each of the twelve egg cups of an egg carton is a good system for each group of youngsters.

An expected outcome is that only a few plants will be tall and strong at the end of the four-week period. Some students may have no surviving plants at the end of the contest. Some of the problems are the development of mold on seeds because of too much watering, and cooking the plant because of too much heat from a lamp. Usually the winning plant is easily identified although its height should be carefully measured with a ruler.

The winners should be required to give the class their successful formula, i.e., procedures for encouraging rapid growth. Some reward, e.g., a florist's plant, may be given to the winners. If the winners have not kept adequate records, the first prize should go to those with the next tallest plant. Older youngsters may be required to graph their plants' growth rates.

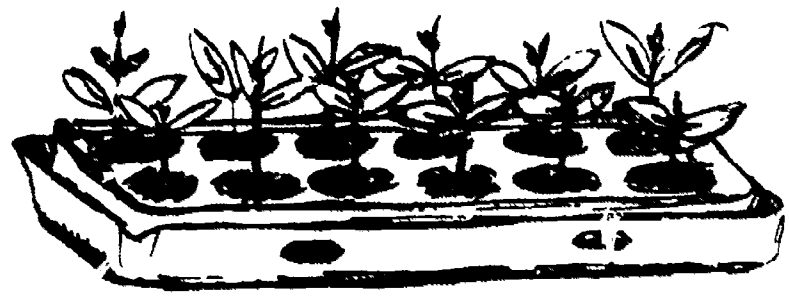
Further Challenges:

1) Another variable is to allow the selection of the type of seeds, e.g., beans, peas, corn, tomatoes, etc. Since the major goal is to identify optimum conditions for growth, one species of seed is sufficient. On the other hand, the genetic variable can be very interesting.

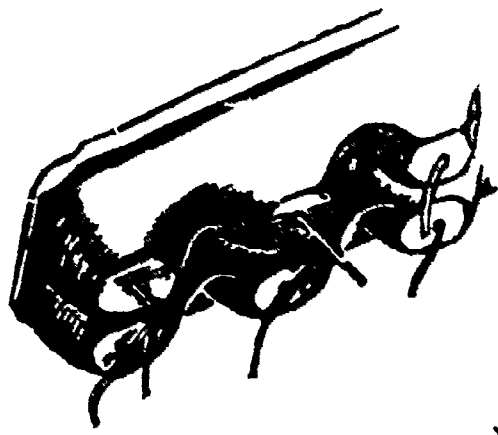
2) Various types of soil can be tested with "soil testing kits" for the presence of specific minerals. Hydrion paper allows the measurement of the pH (acidity) of the soil. The soil may also be analyzed for water-holding capacity and for pore space by measuring the amount of water which tends to run through the soil in a specific amount of time and by measuring the amount of water which may be added to the soil in a container. Various fertilizers may be added to the soil.

3) If the activity is done outdoors, a light meter may be very helpful in recording various intensities. If a light meter is not available, the students can make general observations, e.g., sunny, cloudy, raining, etc.

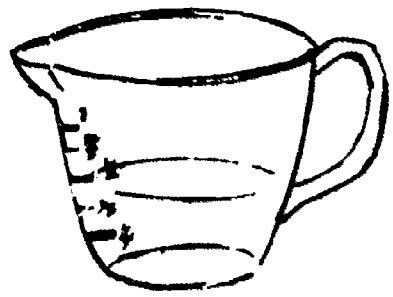
4) In the outdoors, the study could become focused upon animals and insects that may destroy or greatly weaken the plants. Caterpillars, snails, slugs, or nematodes may be identified as the problem. After identifying the cause of the problem, the youngsters can seek means to control them and evaluate the effectiveness of each technique.



① Egg carton planter



② Bottom of egg carton with wicks through holes



③ Record exact amount of water given to plants

ATS

TITLE: **VACATION HOMES**
LEVEL: Grades 4-6
SUBJECT: Sciences, Social Studies
REFERENCE: Project Learning Tree

OBJECTIVES: Students will learn how group decisions affecting private citizens and the public are made through participation in a simulation. They will also learn how to evaluate information presented.

ACTIVITY: Prepare a scenario describing a hypothetical situation for distribution to students:

There are 50 summer cabins on Lincoln National Forest land along Bear Creek. The sites for these cabins were leased to private citizens 30 years ago. At that time there was very little forest recreation in this area.

Since then, the nearest city has grown tenfold. Recreation in the Bear Creek area is almost 20 times what it was 30 years ago.

Some people feel that those 50 cabins should no longer be permitted to dominate that area of Bear Creek and that the land belongs to all of the people.

Should 50 families have Bear Creek to themselves or should their leases be terminated and the cabins removed? Should the cabin owners be allowed to remove the cabins? Should they be reimbursed for their value?

Divide the class into these three groups:

1. Three or four members to represent the Forest Service Advisory Board. They will conduct a hearing and arrive at a decision.

2. Half of the remainder of the class will role-play the cabin owners.

3. The other half of the remaining students will represent the general public.

Allow the "cabin owners" and "general public" time to prepare testimony stating their reasons for either renewing the leases or abolishing them. During this period the U.S. Forest Service Advisory Board should plan the hearing procedures, specifying who testifies, for how long, and in what order.

When all groups feel they are ready, the hearing should be convened. After the testimony has been presented and opportunity for rebuttal provided, the Advisory Board should meet briefly to reach a decision. They should then return and report their decision to the entire class, explaining the reasons for their decision.

Following this simulation, discuss with the students the means by which such land-use decisions are made in your local region. Note: It is useful to have the classroom arranged as a hearing room for the meeting or to find an available auditorium.

TITLE: **SUCCESSION AND SOIL COMPACTION**
LEVEL: Grades 5-6
SUBJECT: Science, Social Studies
REFERENCE: Project Learning Tree

OBJECTIVES: Students will be able to state the influence of soil compaction on plant and animal habitat and on water infiltration (cause/effect).

ACTIVITY: Select two sites where students congregate and two other sites where student traffic is light or nonexistent. Mark off study plots, each 6 feet by 6 feet (2 meters by 2 meters) on each site.

Suggest that students work in small groups to count and classify the natural cover and litter (living and dead plants, dead leaves, insects) on each study area.

Then ask the students to measure the soil's compaction by recording the average depth to which an ice pick penetrates the soil when dropped several times from a height of 3 to 4 feet (1 to 1.5 meters). For safety, the instructor should drop the pick.

Next ask the students to measure the water infiltration rate. This may be done by placing a No. 10 tin can, with both ends cut out, into the soil; filling it with a known quantity of water, and recording the length of time necessary for all of the water to penetrate into the soil.

Compaction and infiltration measurements should be taken at several locations within each of the study plots.

Fence off one of each type of plot to serve as experimental areas. Students should record with photographs or sketches the appearance of each of the four study sites on the date it is marked off and at various intervals as the fenced sites recover and grow back. As the sites recover, each group should remeasure infiltration, soil compaction, and the amount and nature of the litter on each of the four study areas.

Compare the data obtained from the two experimental and two control plots and discuss:

What effect does the degree of soil compaction appear to have on water infiltration into the soil?

How does soil compaction influence water runoff?

What apparent effect did soil compaction have on the type and amount of vegetation and animal life found originally on the study area? What would you expect the relationship to be? Are your results consistent or not consistent with your hypothesis?

What influence did compaction have on the rate at which the fenced plots recovered?

What influence did the fencing have on soil compaction? On the water infiltration rate?

Does it seem we should minimize the compaction of the soil on the school site? Why? If so, how?

TITLE: **KEEPING SCORE**
LEVEL: Grades 4-8
SUBJECT: Science, Social Studies, Language Arts, Mathematics
REFERENCE: Project WILD

OBJECTIVES: Students will be able to (1) describe cause and effect relationships that help and hinder wildlife in their community; and (2) recommend changes in their community that could benefit wildlife.

ACTIVITY: BACKGROUND

There are pleasant surprises to be found in discovering and exploring some of nature's secrets - and these are available in our own schoolyards, backyards, neighborhoods, and communities. We sometimes forget that nature is all around us - in cities, suburbs, and agricultural areas - and not just in woods and lakes, high mountain meadows, deserts, rivers, skies, and oceans.

This activity is designed to assist students in searching out these surprises, as well as to make them aware of any problems that may exist for wildlife in their near surroundings, particularly as a result of human actions.

Some of us live in areas where limited wildlife is in evidence. However, many of us forget to see wildlife around us, even when it is there. Sometimes it is easy to take birds, butterflies, squirrels, and earthworms for granted! Frequently, we don't take into consideration the impact of our actions on the other living things around us. It is particularly easy to acquire a sort of "selective" vision that has us see aphids in our vegetable patch, for example, and not think about the impact on other life forms in the environment if we use a toxic spray to get rid of the aphids. The major purpose of this activity is for students to increase their perceptions of cause and effect relationships affecting wildlife in their immediate communities, and to recommend some personal and community actions that could benefit wildlife.

MATERIALS

Dittoed or mimeographed scorecards; poster material; chalkboard or bulletin board for classroom display.

PROCEDURE

1. Ask the students to go home after school and look for "cause and effect" relationships in their neighborhood or community that seem to help or hurt wildlife - and some that seem not to affect wildlife at all. Ask every student to come back to school the next day prepared to share at least one example.

2. Get a sampling of information from the students in a brief discussion of what they found. Encourage them to explain their bases for identifying "cause and effect." Consider the following:

- What were some of the most surprising observations you made?

- What kinds of actions are people taking that directly affect wildlife? Which, if any, of these actions seem helpful to wildlife? Which, if any, seem to have no effect?

- What, if any, problems affecting wildlife were identified? How do you know there are problems? If there are problems, are they apt to get better or worse in the future? Are there any actions that can be taken - by individuals and by the community - to reduce or get rid of these problems?

3. Next ask the students to work in small groups of four to six students. They should share what they identified as cause and effect relationships and whether the effect hurts or helps wildlife in their community. They can add examples of cause and effect relationships that could help or harm wildlife, even if they did not actually see them happening in their community. They should pool their ideas, eliminating duplicates, and putting their cause and effect relationships on one list representing their group's ideas. Ask one person to report for each group and turn in the group's list.

4. Either the teacher or a small group of students can pool the ideas from all the groups, putting together one master "Community Wildlife Scorecard."

5. Provide each student or team of students with a copy of the "Community Wildlife Scorecard." For example:

Community Score Card

Name _____

Cause	Effect	Hurts	Helps	Neither	Day

Read through the scorecard together, making sure the students are clear about what they are looking for in each situation.

6. Decide where the students will be doing their observing and "scorekeeping." It might be on the school grounds. The activity works very well if the students each take their scorecards home with them, making their observations to and from school, and after school in their own neighborhoods.

7. Ask students to keep a score (tally) of each item they see - overnight, for a period of one week, or longer. (If a class cumulative scorecard is to be kept, prepare and post it in a conspicuous place - on a chalkboard, poster board, or bulletin board, for example.)

8. At the end of the week - or whatever recordkeeping period is established - ask the students to tally and score their personal sightings. Subtract one point for every sighting of a cause and effect relationship that hurts wildlife; add one point for every sighting that helps wildlife; zero points for sightings with no impact.

9. Combine the personal scores and come up with a whole class score representing the "Community Wildlife Score."

10. Based on what they observed and recorded, ask the students what actions they think they could take to improve their "Community Wildlife Score." If the score is excellent already, what actions, if any, need to be taken to maintain the quality of their environment?

EVALUATION

Identify and describe three kinds of wildlife habitat in your community, and list three kinds of wildlife which could live in each habitat.

Describe three actions taken by members of your community that are helpful to wildlife.

Describe three actions that might be taken in your community which could benefit wildlife, explaining what would happen, and why it would be helpful.

Identify what seems to be the greatest short-term problem for wildlife in your community, and the greatest long-term problem. Identify what might be done, if anything, to reduce or eliminate these problems.

COMMUNITY WILDLIFE SCORECARD			
Cause/Effect Relationship	**A** **Subtract 1**	**B** **Add 1**	**C** **No Impact**
Subtotals			
(Subtract Column A from Column B for Total Wildlife Score)		**Total Wildlife Score**	

TITLE: **ETHI-THINKING**
LEVEL: Grades K-8
SUBJECT: Social Studies, Science, Language Arts
REFERENCE: Project WILD

OBJECTIVES: Students will be able to: (1) generate a list of activities done outside that are harmful to wildlife and the environment; (2) discuss reasons these activities are inappropriate; and (3) recommend alternative activities that are not harmful.

ACTIVITY:

BACKGROUND

The major purpose of this activity is for students to discriminate between outdoor activities that are harmful to wildlife and the environment, and those which are not.

MATERIALS

Art materials (crayons, construction paper, magazines for photos) to make discussion cards.

PROCEDURE

1. Ask students to help you make a list of activities people do that seem harmful to wild plants and animals. Ask them to think about things they've seen or know about that might be harmful. Some of these things could be:

   - picking up baby wild animals in the environment (birds, fawns, etc.)
   - carving initials in trees
   - driving vehicles (cars, motorcycles) over fragile environments
   - removing plants from environment, like digging up cactus

2. Have students use cut-out photos or drawings to make these activities into cards showing pictures and describing what is happening. (Or, teacher can prepare cards in advance; laminate; and use again.) Or, older students can dramatize the situation in skits, "commercials," songs, poems, etc.

3. Collect the cards. Count students off to make groups of four each. Hand out one card to each group and ask them to discuss (or present the skits, poems, etc.):

   - What is happening?
   - Does it harm wildlife? How?
   - Does it seem to be appropriate or inappropriate behavior? Why?

- Is the person doing it having fun?
- What else could he or she do that would satisfy his or her needs and interests without harming wildlife or the environment?

4. Ask each group to report to everyone else about: a) their feelings concerning what is happening in the outdoor activity shown in the picture; and b) their recommendation for an alternative activity the people could do that would not be harmful.

EXTENSION

For Grades K-2:

Ask the students to draw pictures of things they know about or have seen happen that would hurt wild plants and animals. Ask them to describe what is happening in their drawing, and what could happen instead that would not be harmful.

For Older Students:

Choose something you or your family owns, like a car, television, refrigerator, etc. Imagine you are that object - and explore how you . . . from invention to garbage dump . . . affect wildlife!

EVALUATION

Make a list of five things which people do that harm wildlife habitat.

For each thing listed, describe what you can do about it.

TITLE: **SEPARATION MANIA**
LEVELS: Grades 4-8
SUBJECT: Science
REFERENCES: SuperSaver Investigators

OBJECTIVES: Students will be able to: (1) describe the function of various separation techniques in recycling processes; (2) make deductions from data to describe how physical properties of matter enable various separation techniques to be used; and (3) demonstrate problem solving skills related to sorting activities.

ACTIVITY:

PREPARATION

Rulers, metric scales, a magnetic device (preferably a bar magnet that could be attached to a flat piece of wood), a small fan with two speeds or a hair dryer with two speeds, an aquarium tank or other large vessel for water, s size sorter (a cardboard box at least 1' by 1' with 2" square holes cut in the bottom), another cardboard box with flaps taken away but no holes in it; for each pair of students or for each small group, have the following items: aluminum can, tin can, several used or unused staples, pieces of paper or pieces of cardboard, piece of wood, styrofoam container, plastic two-liter bottle and the cup part from the bottle, an orange peel, some steel bottle caps. Have extra pieces of paper or cardboard on hand.

VOCABULARY

Properties of matter, recycling, sorting techniques

HANDOUT

Properties of Waste Objects

PROCEDURES

1. Discuss the concept of properties of matter, ie. size, shape, weight, susceptibility to magnetism. Discuss the importance of sorting materials according to type before they can be recycled. Show students the pieces of paper and staples. Explain how these often end up together at paper recycling plants and can be separated based on the physical property of magnetism in staples.

2. Explain how all of the items in this activity often end up at refuse facilities such as landfills and incinerators. Sometimes materials which are combustible and organic are separated from those which can be recycled or cannot burn.

3. Divide the class into pairs or small groups. Give each pair or group a set of items mentioned in the **Preparation**. Discuss some physical properties of the items.

4. Pass out a copy of the handout, *Properties of Waste Objects,* to each pair or group of students and have them complete it. To do so, they will need to test the items in various ways in order to make choices on the handout. For this, have rulers, a tank of water, a magnet, a box with holes, and scissors at their disposal in various places throughout the room.

5. After the charts have been completed, discuss answers.

6. Display on a large table space the magnet, the small fan or hair dryer, the vessel of water, the size sorting device box with holes), scissors and cardboard box.

7. Based on information completed on the handout assign the following tasks to each pair or group of students.

GOAL: Use the equipment to construct a process for separating all ten items individually. Do this by designing separation techniques in a series of stages. You must begin with all ten items in one pile bunched up close together on the table. You can pick up items to place them where you want them to go each time you make a separation, but you cannot separate them with your hands while using a separation technique. The group that separates the items most efficiently, i.e. in the fewest stages or with the most success, wins.

EXAMPLE: You could do the following demonstrations for students to give them ideas. Ask students, based on their information sheet, which items should float and which will not. Put all ten items, as our first stage in the process, in the water. Put those that floated on the table in a separate bunch from those which did not float. This represents the first stage or step to be counted in the process. The next step(s) must involve sorting items from each of the two piles. Eventually you want to separate each item individually. The individual separation of one item from the rest could happen in a first step depending on design. Do another demonstration. Use scissors to make a pile of shredded plastic (from the bottle) and of shredded paper. The shredding process represents only one stage although two types of material have been shredded. Set the fan on the table in front of the pieces of paper and plastic. Put the cardboard box at end of table. Turn the fan on at a distance from the pieces and at a speed which will blow only paper into the box (or perhaps only the plastic if the paper is wet from having been in the water). Now you have separated these two items in two steps including the shredding process. You have eight more items to separate. Explain that you have deduced this step based on information about the weight of the materials listed on the handout. One important technique would be one that separates the items into three instead of two piles. You may also want to judge designs based on energy efficiency by creating a scale of energy required to use the various pieces of equipment. The team using the least energy could be given a prize.

8. Now direct pairs or groups of students to look carefully at their information sheets, and design stages in a process to separate all of the materials. (You could allow them to test parts of their designs as they create them, but this will require more time and perhaps more waste materials to do so, as material like paper could be destroyed in testing.)

9. Have each pair or group of students present their process to the class and judge which is the most efficient and/or energy saving.

EVALUATION

Have students explain what the following terms mean and why they are important for recycling processes.

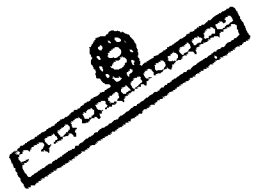
Air Classification System

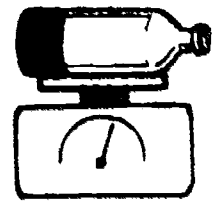
Magnetic Separation Device

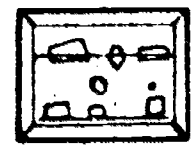
Water Separation System

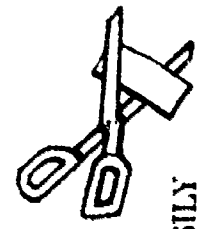
Size Sorting Device

PROPERTIES OF WASTE OBJECTS









NAME OF WASTE OBJECT	SIZE length × width	WEIGHT ounces	MAGNETIC	NONMAGNETIC	FLOATS	SINKS	SHREDS	DOES NOT SHRED EASILY

TITLE: **WHAT ARE THE CONSEQUENCES OF OUR ACTIONS?**
LEVEL: Grades 2-8
SUBJECT: Science, Social Studies
REFERENCE: Project . earning Tree.

OBJECTIVES; Students will learn to assess the short-term and long-term consequences of actions. They will also learn how values affect judgments.

ACTIVITY: Pose the following situation to your students:

We have six fully grown trees on our land. We have no other trees around our house or anywhere else on our land. We need firewood and are trying to decide whether to cut all the trees down during the next winter to use them for firewood.

Given the information, try to decide what seems to be the best action to take.

Consider:

What will happen next summer when it gets hot. (No shade.) What might happen the following winter when more firewood is needed to keep warm? (No fuel for cooking and heating.)

What problems might there be for animals? (Fewer places for some birds and squirrels to live.)

What might a person do to be sure that there are trees left for the future? (For example, each time a tree is cut, two could be planted.)

Through discussion, emphasize to the students the differences between short-term and long-term results of actions they recommend. Ask the students to describe the long-range effects of any action they recommend.

TITLE: **DID YOU NOTICE?**
LEVEL: Grades K-6
SUBJECT: Science, Social Studies, Fine Arts
REFERENCE: Project Learning Tree

OBJECTIVES: Students will be able to observe and describe changes in an environment. Students will also learn some criteria to use for deciding whether changes are desirable or undesirable.

ACTIVITY: Ask students to collect and display photographs of their community from various times in the past. Assist the students in identifying the locations represented in these photographs. Then visit one or more of the sites with your class or visit other areas of interest in the community for which photos are not readily available. If possible bring along cameras to take present-day photographs for comparison back in the classroom.

Ask the students to walk and observe for at least 30 minutes. Stress with them that all their observations are relevant and should be recorded in writing or on tape.

Invite the students to consider:

Impressions of the area, including feelings they have while there.

What the area might have been like at different periods in the past, including its vegetation and wildlife.

Changes they think might have taken place and possible reasons or these changes.

Whether any changes seem to have been beneficial or detrimental.

Once back in the classroom, ask the students to use the data they have collected and their own observations and feelings to discuss the role of people in changing the environments the students visited. For example, ask the students to:

Decide whether most changes appear to have been or be for the better or for the worse.

What determines which are beneficial and which detrimental?

Imagine themselves as decision-makers at the initiation of any of the human-made changes, stating their opinion of the value of the changes.

Show how time and circumstances might influence opinion as to whether a change is good or bad.

Imagine changes which might occur in the area in the future, attempting to decide whether they would be beneficial or detrimental.

VARIATION

Divide your class into small groups for the purpose of making a mural to show how local vegetation has changed since humans first settled in the area. Assign a specific historical time period to each group, beginning with the first recorded human habitation of the area, up to and including the present.

If you have younger students, you may wish to shorten the time span to cover only the period since their grandparents were born.

One way students can gather the necessary information about the more recent changes in the environment could be by interviewing long-time residents of the community. Longer-lived people from the various cultural backgrounds represented in the community over time could be asked to share information about changes in their lifestyles and those of their forebears as related to changes in the environment. Find out how, when, and why they think the changes happened, and their opinions about the changes.

If the students' interviews with residents are recorded, they could become valuable historical records, especially if they could be cataloged by the school librarian.

Students could then use the information to produce their section of the mural, showing the vegetation as it was during their assigned time period. You can attach the murals in sequence and view the environmental changes from past to present. You might wish to invite to class the resource people who assisted with the project in order for them to view the complete project. Looking over the entire mural, you and the students might discuss:

Changes in vegetation, wildlife, and human lifestyle.

Causes of some of these changes.

Whether you think these changes have made your community a better or less pleasant place in which to live, or have made no difference at all.
Whether most of the changes seem good, bad, or in-between.

Whether any changes were considered good at the time they occurred and bad later on.

Whether any trends can be identified, and what implications these may have for the future.

EXTENSION

Create one or more additional sections of the mural, or pictures of one or more of the areas for which you have photographs, showing:

Your idea of what the environment of the area (including plant, animal, and human life) might be like at some point in the future (specify, for example, 10 years, 50 years, 200 years.)

The area as you imagine it might have been 4,000 years ago 10,000 years ago, and so on.

SECTION III - ELEMENTARY-SECONDARY SCHOOL ACTIVITIES (K-12)

TITLE: **HOW MUCH ENERGY DO I USE?**
LEVEL: Grades 3-9
SUBJECT: Science, Mathematics
REFERENCES: Adapted from materials in other ERIC/SMEAC activities.

OBJECTIVES: Students will learn how to: (1) collect data to answer questions; and (2) analyze data to determine patterns of use.

ACTIVITY: For three or more days keep an exact account of the energy you use. Record in your notebook every time you 1) turn on a light, 2) start an electrical appliance, 3) get into a car or bus, 4) watch TV, and so on. Be sure you write down the amount of time you use the energy.

Also note energy that is being used for you, even if you are not turning it on, such as lights at school, school bells, etc.

After you have logged all your energy uses, go back over and see where you could have saved or not used energy at all. Answer questions such as: 1) Did I turn the light off when I left the room? 2) Could I have watched TV with someone else and did I leave it on when no one was watching? 3) Was the trip in the car necessary or could it have waited? 4) How could members of my family, school or club save energy?

Help think about ways to educate and encourage others to form energy-saving habits.

ADDITIONAL NOTES

This can become an interesting project for students to take home to have other family members check their energy use. Results of family analyses can be very useful for further class discussion. How does our family waste energy (and money!) that could be reduced to save energy and money? How does our school waste energy (and money!) that could be reduced to save energy and money?

TITLE: **HOW MANY BEARS CAN LIVE IN THIS FOREST?**
LEVEL: Grades 3-9
SUBJECT: Science, Social Studies, Mathematics
REFERENCES: Project WILD

OBJECTIVES: Students will be able to: (1) define carrying capacity; (2) describe the importance of carrying capacity for wildlife and people; and (3) be able to apply the concept of carrying capacity in making decisions about animals and people, and where animals and people live.

ACTIVITY:

BACKGROUND

Carrying capacity may be defined as the ability of a given unit of habitat to supply food, water, shelter, and necessary space to a wildlife species. It is the largest population the unit can support on a year-round basis, or during the most critical season., Carrying capacity varies throughout the year-and varies from year to year-dependent on conditions within the habitat such as rainfall, competition from domestic animals, etc.

An area of bear habitat can support only a specific number of bears, just as a one gallon bucket can hold only one gallon of water. All habitats, for whatever species, vary seasonally and/or yearly in their carrying capacity. Habitats can therefore only support the numbers which can be carried at the lowest ebb of the season or year. Those surplus animals, born during richer seasons, must be lost to some "limiting factor" prior to or during the harsher season. In this activity, we will be talking about black bears. The major purpose of this activity is for students to gain an understanding of "carrying capacity."

MATERIALS

Five colors of construction paper (two to three sheets of each color) or an equal amount of light poster board; one black felt pen; envelopes (one per student); pencils; one blindfold.

PROCEDURE

1. Cut the paper or poster board into 2" x 2" or 2" x 3" pieces. For a classroom of 30 students, make 30 cards of each color as follows:

   orange - nuts (acorns, pecans, walnuts, hickory nuts); mark five pieces N-20; make 25 pieces N-10.

   blue - berries (blackberries, elderberries, raspberries); mark five pieces B-20; mark 25 pieces B-10.

   yellow - insects (grub worms, larvae, ants, termites); make five pieces 1-12; mark 25 pieces 1-6.

red - meat (mice, rodents, peccaries, beaver, muskrats, young deer); mark five pieces M-8; mark 25 pieces M-4.

green - plants (leaves, grasses, herbs); mark five pieces P-20; mark 25 pieces P-1 .

The following estimates of total pounds of food for one bear in 10 days are used for this activity:

nuts	- 20 pounds	= 25%
berries	- 20 pounds	= 25%
insects	- 12 pounds	= 15%
meat	- 8 pounds	= 10%
plants	- 20 pounds	= 25%
	80 pounds	= 100% in ten days

NOTE: These figures are based on actual research data from a study in Arizona, indicating a mature black bear could typically eat about eight pounds of food per day in a ten-day period.

Keeping these figures in mind, make and distribute the appropriate number of food cards for your size group of students. There should be less than 80 pounds of food per student so that there is not actually enough food in the area for all the "bears" to survive.

2. In a fairly large open area (e.g., 50' x 50'), scatter the colored pieces of paper.

3. Have each student write his or her name on an envelope. This will represent the student's "den site" and should be left on the ground (perhaps anchored with a rock) at the starting line on the perimeter of the field area.

4. Have the students line up on the starting line leaving their envelopes between their feet on the ground. Give them the following instruction: "You are now all black bears. All bears are not alike, just as you and I are not exactly alike. Among you is a young male bear who has not yet found his own territory. Last week he met up with a larger male bear in the big bear's territory, and before he could get away, he was hurt. He has a broken leg. (Assign one student as the crippled bear. He must hunt by hopping on one leg.) Another bear is a young female who investigated a porcupine too closely and was blinded by the quills. (Assign one student as the blind bear. She must hunt blindfolded.) The third special bear is a mother bear with two fairly small cubs. She must gather twice as much food as the other bears. (Assign one student as the mother bear.)"

5. Do not tell the students what the colors, initials, and numbers on the pieces of paper represent. Tell them only that the pieces of paper represent various kinds of bear food: since bears are omnivores, they like a wide assortment of foods, so they should gather different colored squares to represent a variety of food.

6. Students must walk into the "forest." Bears do not run down their food; they gather it. When students find a colored square, they should pick it up (one at a time) and return it to their "den" before picking up another colored square. (Bears would not actually return to their den to eat; they would eat food as they find it.) Pushing and shoving-any competitive activity-is acceptable as long as it is under control. Snatching food right out from under the blind bear or the crippled bear is natural-but stealing from each other's dens is not. Remember that if bears fight (which they seldom do) they can become injured and unable to gather sufficient food; they they starve.

7. When all the colored squares have been gathered, the food gathering and hunting is over. Have students pick up their den envelopes containing the food they gathered and return to class.

8. Explain what the colors and numbers represent. Ask each student to add up the total number of pounds of food he or she gathered-whether it is nuts, meat, insects, berries, or plant materials. Each should write the total weight on the outside of his or her envelope.

9. Using a chalkboard, list "blind," and "mother." Ask the blind bear how much food she got. Write the amount after the word "blind." Ask the crippled bear and the mother bear how much they got and record the information. Ask each of the other students to tell how much food they found; record each response on the chalkboard. Add the poundage gathered by the entire class. This is the total amount of food available in this particular bear habitat. How many bears are there? Divide this number of bears into the total pounds available to find out how much is available for each bear. Tell the students each ear needs 80 pounds to survive. Which bears survived? Is there enough to feed all the bears? If not, how many bears can live in this area? What would happen to the extra bears? Would they all starve? ;How many pounds did the blind bear collect? Will she survive? What about the mother bear? Did she get twice the amount needed to survive? What will happen to her cubs? Will she feed cubs first, or herself? Why? What would happen to her if she fed the cubs? What if she ate first? If the cubs die, can she have more cubs in the future, and perhaps richer, years? (The mother bear will eat first and the cubs will get whatever, if any, is left. The mother must survive; she is the hope for a continued bear population. She can have more cubs in her life; only one needs to survive in order for the population to remain static.)

10. Discuss with the class that this area of black bear habitat can only support a certain number of bears. We call that number the "carrying capacity." Discuss the idea of a one gallon bucket only being able to contain one gallon of water. Carrying capacity also holds true for humans-the earth can only support so many.

11. Wrap up with a discussion of the idea that any piece of land can support only so many plants and/or animals. That is the land's "carrying capacity."

EVALUATION

Define carrying capacity.

Describe some of the factors which determine carrying capacity for a species of animal.

Explain why carrying capacity is important for wildlife.
Explain why carrying capacity is important for people.

TITLE: **URBAN NATURE SEARCH**
LEVEL: Grades 4-9 (and older)
SUBJECT: Science, Language Arts, Social Studies
REFERENCE: Project WILD

OBJECTIVE: Students will be able to generalize that each environment has characteristic life forms. Skills involved include observing, identifying patterns, and categorizing observations.

ACTIVITY: Every environment has its characteristic life forms - including animals - and the urban setting is no exception. Many of these life forms have adjusted as their habitat has changed from undeveloped to urban. Not only have people altered the environment, the human environment has been shaped by the characteristics of the ecologies within which people live.

The major purpose of this activity is for students to recognize that all environments have characteristic life forms.

MATERIALS

Questionnaires (designed by the teacher), pencils, notebooks or journals , an outdoor setting to conduct this investigation.

PROCEDURE

1. Preview and select the route of the nature search. Note stopping places where students can observe and record information.

2. Design a questionnaire to be distributed to the students for use on the "search." The questions and tasks should encourage increased student observation. For example, many of the following phenomena can be designed into this activity:

   Tally, describe, and sketch different kinds of plants growing on the north and south sides of buildings. (The differences may be due to temperature variations, sun and shade-loving species of plants, and less evaporation on the north side of building.)

   Look for birds. Tally the numbers of different kinds of birds. If they are migratory, sketch the pattern of their flying formation!

   Look for animals establishing "territory." Try to map the animals' territory. (During the mating season, birds can sometimes be seen choosing mates; males fighting, strutting, and dancing around the female species; and nest building.)

   Look for evidence of predator/prey relationships. If any mammal, bird, or insect is seen - attempt to determine what animal is its predator or prey.

Record evidence of plant disease and insect damage. It is always interesting to see insect galls or bag worms in their natural setting.

Look for evidence of food chains. For example, if insects are observed, look for partially eaten, damaged or mutilated leaves. Then look for who eats the insects. Draw a food chain and identify the parts.

Try to observe a bee cross-pollinating flowers while gathering nectar for the production of honey. If you're fast, you can observe the specialized organs of the bee, and study them further (from diagrams and photos) back in the classroom.

Sketch trees and list their contributions to the community. (For example, trees can be observed breaking the velocity or speed of the wind. This can reduce wind erosion and might save energy by reducing the winter heat loss from homes in the surrounding area. Trees also serve as part of the wildlife habitat, increase the oxygen content of the air, and have aesthetic value.)

Who likes lichen? Predict what plants and animals have a direct or indirect relationship with lichens. (Lichens will be found growing on rocks, tree trunks, and even on soil. Lichens are really algae and fungi functioning as a partnership in a symbiotic association.)

Trace water's path in an area - like on one street, around one tree, down a hillside. (For example, draw the route of any visible erosion.) Look for results of freezing and thawing on sidewalks and buildings.

Find mulches around trees and shrubs. Record any evidence or observation of life forms. (These mulches allow the soil to absorb and retain large amounts of moisture and reduce evaporation. Mulches also reduce temperature extremes and contain earthworms, as well as microscopic and other life forms.)

Look for evidence of components of habitat. Students can observe first-hand the basic wildlife needs. Match animals with their habitat needs (food, water, shelter, and space in appropriate arrangement). It can be a real challenge for students to determine if all basic needs can be met in the available habitat. Predict what animals should be able to live in the habitats identified.

3. On the field trip, each student should bring a copy of the questionnaire and a pencil and notebook or journal. Remind students not to disturb or destroy any plants or animals they may see.

4. What "characteristic life forms" did the students find that were most surprising? Involve the students in a discussion of their observations, their techniques, and their conclusions.

Encourage the generalization, warranted by the results of their investigation, that each environment has characteristic life forms.

EXTENSION

Chart the characteristic life forms found on the search, according to the environments in which they were found. For each animal listed, identify how its basic needs are met. Describe any animal adaptations that seem well-suited to survival in the urban environment. Note any interdependencies between plants and animals. Discuss ways in which people have altered the natural environment and ways in which natural forces have shaped the human environment.

EVALUATION

List ten types of plants you might see around the school.

List ten types of animals you might see around the school.

Select any four animals you might see around the school - and describe how these animals find food, shelter, and water in order to survive in the school community. If these animals were not living around people, how might the ways they meet their needs be changed?

URBAN NATURE SEARCH

Tally, describe, and sketch three plants you find on or near a building:

Indicate whether the plants are on the north, south, east, or west side of the building. Sketch and describe any differences in the kind of vegetation you find on each side of any building.

TITLE: **DEADLY WATERS**
LEVEL: Grades 3-12
SUBJECT: Science, Social Studies, Health, Home Economics, and Industrial Arts
REFERENCE: Aquatic WILD

OBJECTIVES: **For Younger Students**

Students will be able to name and describe different kinds of pollution that can affect water as well as animals and plants that live in water.

For Older Students

Students will be able to: 1) identify major sources of aquatic pollution; and 2) make inferences about the potential effects of a variety of aquatic pollutants on wildlife and wildlife habitats.

ACTIVITY: BACKGROUND

All the water that has ever been available to our planet is on or in the earth right now. On the entire planet there are 326 million cubic miles of water. If the earth were a globe 28 inches in diameter, all of the water on the planet would fill less than one cup. Of that amount, only .03% is in river systems and freshwater lakes. This means that only slightly more than one drop would fill all the rivers and lakes.

Waterways like rivers, lakes, and streams are a vital expression of the water cycle. All the rain and snow that falls on the land either seeps into the water table or is carried to the sea. In addition, all along the way, water evaporates or finds its way through plants and transpires back into the atmosphere to form clouds and precipitate again.

With this picture of the scale and interconnectedness of our planet's freshwater resources in mind, it is apparent how fragile this vital substance is. Yet each day water is being damaged by pollution - pollution that stresses ecosystems beyond their capacities to support life.

Pollution is a complex topic. Most current resource books include four definitions. . .

Chemical Pollution: the introduction of toxic substances into an ecosystem, e.g., acid rain, contamination of water supplies by pesticides.

Thermal Pollution: varying temperatures above or below the normal condition, e.g., power plant turbine heated water.

Organic Pollution: oversupplying an ecosystem with nutrients, e.g., fertilizer inflow.

Ecological Pollution: stresses ordinarily created by natural processes; i.e.,

1) adding a substance that is not a naturally occurring substance in the ecosystem (adding something that is not usually there), e.g., extreme tides pour saltwater into habitats ordinarily protected from sea water;

2) increasing the amount or intensity of a naturally occurring substance, e.g., abnormal increase in sediments in runoff water to produce silt;

3) altering the level or concentration of biological or physical components of an ecosystem (changing the amount of something that is already there), e.g., introduction of aquatic plants via bird droppings, etc.

Most of us view pollution dominantly as human caused. In the definitions above, chemical pollution through the introduction of toxic substances is clearly human caused. Organic pollution in lakes and rivers typically results when organisms living there are enhanced by chemical fertilizers used in agriculture. Thermal pollution is dominantly human caused through nuclear power plants, fuel-based electrical power production, and many industries. Some dams also produce unnaturally cooled water with bottom discharge of water.

Surprisingly, these three forms of pollution - chemical, thermal, and organic - can take place **without** human intervention. When pollution takes place without human intervention, it is most often ecological pollution. (At times, human activity can also increase pollution via naturally occurring substances. For example, roadbuilding and some forest practices can increase siltation.) Natural ecological pollution, in the larger view of things, may be beneficial rather than harmful. Whether beneficial or harmful or neither, ecological pollution - which is dominantly derived from natural processes - does affect wildlife and wildlife habitat. Some acid rain results from volcanic eruptions. Land-slides and avalanches alter runoff patterns as well as sometimes killing plant and animal life. Shifts in oceanic currents affect water temperature as well as weather patterns. Sometimes hot springs and geysers can heat water above normal temperatures in lakes and streams. Obviously, many substances naturally occurring in water are also beneficial as well as harmful to acquatic life and habitats.

Yet all that is known points to human as the greatest source of damage to habitat. To understand pollution's effects and causes prepares us to be able to take constructive action now and in the future to protect and maintain a healthy environment.

Documentation of human illness and death due to pollutants is overwhelming. Research shows that pollution also causes illness and death in wildlife.

The way we feel about pollution has to do with the attitudes and values we hold regarding the quality of life. Issues of

economic importance often affect human reaction to pollution. One researcher called pollution the "chosen disease." Only in catastrophic circumstances like the disaster in Bhopal, India are we able to see short-term effects of pollution. In the case of DDT, it took years before we could see the effects. For the most part, pollution is invisible; it often takes years to display its toxic destructiveness. Since the effects of most pollution are long term, we must develop long term views about its effects on wildlife and its habitat.

Groundwater is continually being affected by toxins we cannot see. Some pollutants enter water from a localized source, like a chemical discharge from a factory. This is called a point source pollution. Other pollutants enter from a variety of less easily identified sources; for example, when rain washes motor oil left from dripping cars in store parking lots into city drains to re-enter the water supply. This is called a non-point source pollution.

In its many journeys, water may be contaminated by thousands of different substances and conditions. For the most part these substances and conditions alter water in such ways that it becomes a hazard to wildlife, wildlife habitat, and humans as well. Some effects are direct. Others are indirect.

The major purpose of this activity is for students to increase their understanding of water pollution and its potential effects on human and wildlife habitats.

MATERIALS

Ten different colors of construction paper (2 sheets each); writing or graph paper; scotch tape or glue; paper punch; Pollutant Information Sheets (one for each student); 1/4 teaspoon measure (for paper punch tokens); 1 tablespoon (for 1/2" square tokens)

PROCEDURE

1. Before the activity begins, make 100 tokens of each of the ten colors of construction paper. The construction paper may be folded in quarters to speed up the process of cutting or punching. For younger students, cut the construction paper into 1/2" squares using a paper cutter. For older students, punch out construction paper tokens with a paper punch. Put all the tokens, either 1/2" squares or punched tokens, in a container. Stir them so the colors are thoroughly mixed.

   Make one copy of the Pollutant Information Sheet for each student.

2. List the four major categories of pollution on the chalkboard and discuss each. They are: chemical, thermal, organic, and ecological. Refer to the background for a description of each. NOTE: The first three are dominantly caused by humans, although there are rare cases where natural processes can cause them. Ecological pollution is typically natural, although there are cases where it is caused by humans.

3. Pass out the Pollutant Information Sheets. Review each kind of pollution with the students. Talk about how some of these can fit into more than one of the four kinds of pollution. Color code each with a different color or the construction paper. Write a short description of the pollution on a piece of paper of the color to which it is coded. (Some teachers have simply copied the Pollutant Information Sheets, cut the descriptions apart, and pasted the appropriate paragraphs on each of the colored sheets of paper.) Post each sheet of colored paper with its corresponding description of the kind of pollution it represents in a row in a convenient place.

4. Once all the kinds of pollution have been discussed, and the students understand that each kind of pollution will be represented in this activity by one color of paper, tell the students that they are to divide into teams of three. These will be research teams; each team will analyze the pollution content of a hypothetical river. Distribute the colored paper tokens that have been cut or punched from the construction paper. Provide 1/4 teaspoon of the paper-punched tokens, or one tablespoon of the cut 1/2" square tokens, to each research team. Also provide each team with a piece of graph paper.

5. The teams must separate the colored tokens into piles; using the color key, they should identify each type of pollutant. Once this is done, they should count the number of each kind of pollutant they have identified and then use graph paper to construct a simple bar graph showing the whole array of pollutants. Arrange the pollutants in the same order as they are displayed in the color key that is posted in the classroom. This makes it easy to compare each team's findings. Remind them that each has a different river. Their results are not likely to be the same!

6. When they have the bar graphs completed and have compared the teams' results, tell them that any quantity above two units of each kind of pollutant is considered damaging to wildlife habitat. In their hypothetical rivers, what pollutants would be likely to cause the most damage to wildlife and wildlife habitat? Give examples and discuss the kinds of damage that could be caused.

7. OPTIONAL: Invite the students to match the pollutants with the four categories of pollution listed at the beginning of the activity. Some seem to fit rather easily; other could fit in more than one category, depending on the source of the pollution. For example, is the thermal pollution human or naturally caused (power plant water effluent or thermal hot springs)?

EXTENSIONS

1. List five things you can do - starting today - in your own life to reduce the number of pollutants you add to the environment.
2. Conduct a field trip to a local waterway and attempt to identify what, if any, kinds of pollution are affecting it.

3. Get information about current national and state laws protecting water quality in the United States. Write a short history of the U.S. Clean Water Act.

4. Why is DDT still being used, and where? Find out the current status of this pesticide use in the U.S. and other parts of the world.

EVALUATION

Describe the effects that large quantities of the following things might have on an aquatic environment. Consider short term and long term effects: hot water, fertilizer, soil (silt), heavy metals, etc.

Water is taken from a river, treated, used by people of a community, sent to a city sewage treatment plant, and put back into the river. Is this aquatic pollution? Defend your response.

POLLUTANT INFORMATION SHEET

SEDIMENTS
Particles of soils, sand, silt, clay, and minerals wash from land and paved areas into creeks and tributaries. In large unnatural quantities, these natural materials can be considered a pollutant. Construction projects often contribute large amounts of sediment. Certain lumbering practices affect sediments in runoff. Sediments may fill stream channels and harbors that later require dredging. Sediments suffocate fish and shellfish populations by covering fish nests and clogging the gills of bottom fish and shellfish.

PETROLEUM PRODUCTS
Oil and other petroleum products like gasoline and kerosene can find their way into water from ships, oil drilling rigs, oil refineries, automobile service stations, and streets. Oil spills kill aquatic life (fish, birds, shellfish, and vegetation). Birds are unable to fly when oil loads the feathers. Shellfish and small fish are poisoned. If it is washed on the beach, the oil requires much labor to clean up. Fuel oil, gasoline, and kerosene may leak into ground water through damaged underground storage tanks.

ANIMAL WASTE
Human wastes that are not properly treated at a waste treatment plant and then released to water may contain harmful bacteria and viruses. Typhoid fever, polio, cholera, dysentery (diarrhea), hepatitis, flu and common cold germs are examples of diseases caused by bacteria and viruses in contaminated water. The main source of this problem is sewage getting into the water. People can come into contact with these microorganisms by drinking the polluted water or through swimming, fishing, or eating shellfish in polluted waters. Often unexpected flooding of barnyards or stock pens can suddenly increase the toxic effects of animal waste in water. Animal waste can also act as a fertilizer and create damage by increasing nutrients. (see Fertilizers)

ORGANIC WASTES
Domestic sewage treatment plants, food processing plants, paper mill plants, and leather tanning factories release organic wastes that bacteria consume. If too much waste is released, the bacterial populations increase and use up the oxygen in the water. Fish die if too much oxygen is consumed by decomposing organic matter.

INORGANIC COMPOUNDS
Detergents, pesticides, and many synthetic industrial chemicals are released to waterways. Many of these substances are toxic to fish and harmful to humans. They cause taste and odor problems and often can not be treated effectively. Some are very poisonous at low concentrations.

INORGANIC CHEMICALS
Inorganic chemicals and mineral substances, solid matter, and metal salts commonly dissolve into water. They often come from mining and manufacturing industries, oil field operations, agriculture and natural sources. These chemicals interfere with natural stream purification; they destroy fish and other aquatic life. They also corrode expensive water treatment equipment; and increase the cost of boat maintenance.

FERTILIZERS
The major source of pollution from agriculture comes from surplus fertilizers in the runoff. Fertilizers contain nitrogen and phosphorous that can cause large amounts of algae to grow. The large algae blooms cover the water's surface. The algae die after they have used all of the nutrients. Once dead, they sink to the bottom where bacteria feed on them. The bacterial populations increase and use up most of the oxygen in the water. Once the free oxygen is gone, many aquatic animals die. This process is called eutrophication.

HEATED OR COOLED WATER
Heat reduces the ability of water to dissolve oxygen. Eiectric power plants use large quantities of water in their stream turbines. The heated water is often returned to streams, lagoons, or reservoirs. With less oxygen in the water, fish and other aquatic life can be harmed. Water temperatures that are much lower than normal can also cause habitat damage. Deep dams often let extra water flow downstream. When the water comes from the bottom of the dam, it is much colder than normal.

ACID PRECIPITATION
Aquatic animals and plants are adjusted to a rather narrow range of pH levels. pH is a measure of the acidity of a solution. When water becomes too acid, due to inorganic chemical pollution or from acid rain, fish and other organisms die.

PESTICIDES, HERBICIDES, FUNGICIDES
Agricultural chemicals designed to kill or limit the growth of life forms are a common form of pollution. This pollution results from attempts to limit the negative effects of undesirable species on agricultural crop production. Irrigation, groundwater flow, and natural runoff brings these toxic substances to rivers, streams, lakes, and oceans.

TITLE: **TO DAM OR NOT TO DAM**
LEVEL: Grades 4-12
SUBJECT: Social Studies, Science
REFERENCES: Aquatic WILD

OBJECTIVES: Students will be able to evaluate potential positive and negative effects related to an issue.

ACTIVITY: BACKGROUND

Hypothetical situation: The town of Rocksburg, population 900, is located along the scenic Jones River approximately 60 miles from the closest big city. The mayor and city council of the big city have proposed that a dam be constructed two miles upriver of Rocksburg. In the Environmental Impact Statement written by the city engineers, the following information was identified.

The dam would meet the area's electrical power demand for ten or more years in the future. It would provide some water for irrigation and would help with flood control problems downriver.

Construction would be of rock-earth fill, 75 feet high and 300 feet across. Seven miles of river would be turned into a lake.

The dam construction would take five years to complete and would employ over 2,000 workers. After the dam was finished, approximately 150 workers would be required to keep the plant running.

Wildlife would be affected in the following ways:

- 20% loss to the deer herd that browses the lands alongside the river due to lost forage
- 20% loss to small mammals living in the river valley due to loss of habitat
- 20% loss to the area's songbird population due to lost riverbank nesting sites
- blockage of the upstream and downstream movement of fish that live in the river due to the creation of the lake and dam
- reduction of the area's wintering population of bald eagles due to the loss of riverbank trees where the eagles commonly roost while feeding on the fish; the eagles winter in the area and disperse to other areas in and out of the state to nest

- development of suitable habitat for bass, carp and other spiny-ray warm water fish due to the creation of the lake; the lake water tends to be warmer than the flowing river water

- loss of 10,000 acres of prime timber growing land and wildlife habitat.

The people in Rocksburg are concerned about the problems and benefits from the number of people that would come to their town during and after the construction of the dam. For example, they project the arrival of 2,000 workers plus their families during construction for five years and that 150 permanent workers plus their families would stay after the dam was finished. They are concerned about effects on schools, sewage disposal, roads, homesites, property values, and the rural atmosphere, as well as police, fire, and hospital emergency capacities. They see some potential benefits from the development, such as new recreation opportunities for the people of Rocksburg and the city which is only about an hour away (water skiing, sailboarding, motorboating, swimming, fishing, camping, picnicking, and other lake-related sports).

Other impacts include:

- loss of drinking water quality locally and in the metropolitan area

- flooding of Native American Indian archeological sites

- cultural changes for local Native American tribal people who have fished the river for generations

- water for irrigation at a lower monetary cost

- potentially less (monetarily) expensive power when compared to other forms of power production, e.g. nuclear, coal, oil, fossil fuels

- potentially more (monetarily) total power bills that may be necessary to pay for construction of the dam

- loss of seven miles of prime whitewater; private and commercial raft, kayak, and canoe trips would be gone

MATERIALS

Role playing cards

PROCEDURE

1. Provide students with the background information. Generate an initial discussion with them about some of the possible costs and benefits from the construction of this dam, considering it from a variety of perspectives.

2. Ask each student to choose the role of an individual to become or represent for the purpose of this activity-or assign roles randomly. Examples of roles are included. Establish a balanced variety of roles with people having conflicting values and concerns relating to the potential impacts of this dam construction. NOTE: Teachers have copied the role descriptions and cut them apart to pass out to students.

3. Ask students to prepare for their role, developing a short position paper for use as background for the dramatization of their role.

4. Arrange the classroom to represent a meeting room for the county council in the area in which the town of Rocksburg is located. Students will role-play their position and make a presentation to the five-member Rocksburg County Council. This council will ultimately make a recommendation to the F..E.R.C. (Federal Energy Regulatory Commission) on a sitting permit for the dam.

5. After all the students have made their presentations, ask the county council to render a decision.

6. Following the council's decision, have a brief class discussion to summarize the "pros" and "cons" that emerged from the students' presentations. Identify and list the benefits, if any, and costs or liabilities, if any, as a result of building the dam. Include effects on people, plants, and animals. The list of "pros," "cons," and effects can be listed visually on a chalkboard.

7. After the role p[lay and class discussion, ask each of the students to write a brief essay describing his or her own personal recommendation for whether or not to build this dam. The students might expand their position papers, or "start from scratch" in writing their essays.

1. **Five people** chosen as members of the **County Council.**

2. **A.G. "Rick" Ulture:** a representative of the local farmers' coalition interested in the irrigation potential of the dam.

3. **Lotta Power:** a lobbyist for the municipal electrical power company interested in developing the dam.

4. **Rob or Marta Canu:** kayaker concerned with the loss of the whitewater stretch for canoeing and kayaking

5. **Sam N. Fish:** a local sporting goods store owner and avid fisherman concerned with the loss of migration routes of the fish on the river.

6. **Dan D. Lion:** the president of the "Save Our Native Plants and Wild Animals" organization.

7. **Pat "Pottery" Brusher:** an archaeology professor from the local university who has done extensive research on the archeological sites of Indian fishing camps along the river.

8. **Lynn Dripper:** the director of the municipal water quality authority responsible for providing quality drinking water for the city, and attracted to the dam's potential for providing a reservoir of high quality water useable during long hot summers.

9. **H.M. Owner:** a representative for all homeowners in the river valley below the dam who would like to see more flood control.

10. **Bobbie Lawkeeper:** the local Rocksburg sheriff concerned about maintaining police protection, peace, health and safety with only a one person staff as the sole legal authority in the region.

11. **T.M. Burr:** the owner of a lumber company whose land would be inundated by the dam.

12. **I.M. Floaten:** an owner of a whitewater rafting company who uses the river for commercial rafting. Concerned about loss of the "best seven miles of the river." I.M. argues that the best rapids would be submerged by the lake.

13. **"Sky" Soarer:** the president of the local bird club who has organized eagle-watching trips to the river every winter for the last 15 years.

14. **Sam Slalom:** an avid water skiier who sees the new lake as a real boon to skiing interests.

15. **Velma or Virgil Vigil:** a local representative of the gray panthers, a group of retired people who are concerned about any rise in power bills.

16. **"Boater" Cartop:** an older fisherperson who enjoys throwing the boat on the top of the car and putting in at the closest float spot-especially lakes!

17. **Marshal or May Flyfisher:** a long-time resident who champions the purity of fly fishing and insists on pristine habitat, noting the necessity of white water riffles.

18. **Col. "Bull" Winkle:** the president of "More Moose Now"who believes that with the lake behind the dam, more moose habitat will be created.

19. **Lap Larson:** the president of W.O.W. (Watch Our Waves).

20. **Cy or Sy N. Tist:** a respected biologist who is prepared to testify about potential effects on wildlife from the building of the dam.

21. **O.L. Slick:** a salesperson for motor boats, water skis, and other recreational equipment.

22. **Forest or Park Site:** a trained forester who has worked in the woods in the area for more than 50 years.

23. **Running Waters:** a tribal leader who is concerned about loss of native heritage from flooding the region for the dam.

24. **E. Conomy:** a local businessperson who is concerned about the long-range business potential of the area.

25. **C.D. Minium:** a wealthy land developer who has architects working on designs for lakeside condominiums and resort homes.

And so on! Create any additional roles which serve to illustrate a variety of major perspectives and interests. NOTE: Some students have dressed for their roles to heighten the dramatic quality of the experience.

EXTENSIONS

1. Change roles and conduct the council meeting again. Note any differences in the results, as well as your perceptions of the process and experience.

2. Find out if there are any proposals to create new dams or any other proposals that will affect wildlife habitat in your region. If so, investigate the "pros and cons" of one or more of these proposals, from your perspective.

3. Is there a dam in your area? Visit it. Find out about its effects on people, plants, and animals-both positive and negative, if any.

EVALUATION

Name two or more possible benefits to people if a dam were constructed on a river.

Name two or more possible negative consequences to people if a dam were constructed on a river.

Describe possible positive and negative effects on a variety of different kinds of plants and wildlife under each of the following conditions if these conditions existed as a result of the construction of a dam: water levels in the area below the dam are low for at least part of the year; water going over the dam drops a long way; very cold water is taken from the bottom of the dam and released into the river below.

TITLE: **HOW CAN WE HELP TO IMPROVE THE OPERATIONS OF THE LOCAL WASTEWATER TREATMENT PLANT?**

LEVEL: Grades 5-12

SUBJECT: Science

REFERENCES: Adapted from several previous ERIC/SMEAC activities.

OBJECTIVES: Students will be able to: (1) describe the wastewater treatment process for their community; (2) indicate actions that could be taken to reduce wastes; and (3) indicate actions that could be taken to reduce materials that are difficult to remove and toxic substances.

ACTIVITY:

1. Take a field trip to the local wastewater treatment plant. Arrange to have the superintendent or one of his workers explain how the plant works and the various steps in treatment. Develop a checklist of questions with the learners. Share this with the superintendent so he or she can be prepared with the answers.

   Questions might include:

   What are the major materials that have to be removed from the water?

   What materials are the hardest to remove?

   What are the primary, secondary and tertiary treatments and which are used here?

   What happens to toxic materials in the treatment process?

   What do you do with the material (sludge) that you remove from the water?

   What do you do with the treated water?

2. After the field trip assign the following questions to the students to research and then discuss.

   What could be done in homes to reduce the volume of wastes and to reduce materials that are difficult to remove in treatment?

   What could be done by businesses and by industries to reduce the volume of wastes and to reduce materials that are difficult to remove by treatment?

   What can be done by the community, homes, businesses, industry, schools, etc. to reduce toxic materials in wastewater?

TITLE: **CHANGING ATTITUDES**
LEVEL: Grades 5-12
SUBJECT: Social Studies, Language Arts
REFERENCES: Project WILD

OBJECTIVES: Students will be able to (1) give an example of a change in attitudes related to a wild animal and/or the environment; and (2) describe variables that may influence change in attitude.

ACTIVITY: BACKGROUND

Attitudes toward wildlife, the environment, and appropriate uses of natural resources have changed and continue to change over time. They also vary greatly from culture to culture, within subgroups of a culture, and within communities.

For example, 50 years ago in the United States, predator control was more or less taken for granted, especially in the western United States. Grizzly bears, cougars, coyotes, wolves and hawks were all hunted. There was even a bounty on many of these animals, as they were considered a threat to domesticated animals and human safety.

Today, there is still much controversy around predator control. However, it is now more generally recognized that these animals have an important place in the overall health and balance of ecosystems. At the least, they are not perceived as the threat they once were thought to be. And, much of the fear of these animals and their effects was based on myth and misinformation. Cougars and wolves, for example, are most apt to successfully kill the weak members of a deer, elk, or moose herd-serving as a ceiling factor. Most predators are now protected by law, rather than being subject to intentional destruction.

The major purpose of this activity is for students to interview members of their community to gain information concerning changes in attitudes about wildlife and the environment.

MATERIALS

Paper for taking notes and/or tape recorders and tape; information about local laws and regulations affecting wildlife.

PROCEDURE

1. Initiate a discussion with students about whether or not they think people's attitudes about some subjects might change, for example, over a generation. Fashion in clothing, furnishings, and food might serve as examples to begin. If not raised by the students, ask them if they can think of any examples of changes in attitudes about wildlife, the environment, uses of natural resources, lifestyles involving natural resources and the environment, etc. Discuss their suggestions, and list the topics they suggest.

2. Ask the students, working in groups of two to four students, to generate a list of questions relating to wildlife and the environment that they might ask of adults in their community. For example:

   - How do you feel about wildlife?
   - Does wildlife live in your neighborhood? Did wildlife live in your neighborhood when you were a child growing up? What kind?
   - What animals, if any, are no longer seen that once were? What animals, if any, are more common now than they once were? What happened?
   - What were some attitudes you remember having about wildlife when you were a youngster? Which of these attitudes, if any, have you changed during the past 20 years? What has caused these changes, if any?
   - What laws, if any, did you know about when you were young that affect wildlife and the environment? What laws do you know about now which affect wildlife and the environment?
   - What are the reasons for such laws? Do you think we need laws protecting wildlife, natural resources and the environment? Why or why not?
   - What general changes, if any, do you think there are in our society's attitudes toward wildlife and the environment-perhaps some changes you think are good and some you do not?
   - What problems, if any, involving wildlife are you concerned about?
   - What recommendations if any, do you have about solving those problems?

3. Review the questions generated by each student or group of students before they conduct their interviews. Younger students' questions may be shorter and fewer.

4. Ask the students-working alone or in groups-to interview at least one long-living person in their community. The students should be prepared to take notes, or tape the interviews. You might instruct the students to be sure to take time to listen to any of the stories the people might tell that are slightly off the subject-out of courtesy, and also in recognition that the slightly divergent topics will also be interesting and pertinent in some ways.

5. Next, ask the students to "interview" each other or themselves. That is, record their own responses to these questions as a point of contrast for looking at some changes in attitudes. Optional: Add other categories of people to interview; e.g., family members, wildlife managers, members of city council, farmers, ranchers, office workers.

6. Compile the result of the interviews. This might be done in a time-consuming way, where the interviews are transcribed, analyzed, summarized, and discussed. Shorter approaches may also be taken where each group of students is responsible for summarizing the results of their interviews in a one-page format, and then a small group of students volunteers to prepare a summary representing the findings of all of the students.

7. Discuss with the students their findings, including what changes in attitudes have taken place, if any, and what are some factors which might contribute to any changes in attitudes that they have identified.

EXTENSIONS AND VARIATIONS

1. Expand the questions to include any changes in the local community and its natural resources. Include vegetation (e.g., what plants are here that were not here previously; what plants are no longer here); water (e.g., more less, or the same in available quantity, quality); human population; etc.

2. Identify a local controversial issue involving or affecting wildlife or other natural resources. Fact find. What is the issue? How did it develop? What attitudes and information are involved? What possible solutions are available?

3. Start this activity by pretending you were settlers living 100 or 200 years ago. What animals, if any, did you see? How did you live? Day to day, week to week, season to season? After imagining yourself at that time, discuss what your attitudes might have been toward natural resources and the environment. Might they be different today? In what ways?

4. Look in literature for information about historic wildlife populations in your area, the U.S., Canada, or other parts of the world. Compare to present-day populations.

5. Explore Native American Indian attitudes toward wildlife and other natural resources-in historic times, and today.

EVALUATION

Describe how you think most people form their attitudes-what they know and how they feel-about animals.

Give two examples of attitudes about animals that you have reason to believe are based on wrong information or not enough information.

Give an example of a change in attitude about an animal that has occurred in this country during the past 100 years. How did this change come about?

If you were going to try to change someone's attitude about snakes from negative (they do not like snakes) to positive (snakes are okay and contribute to ecosystems), how would you do it?

TITLE: **EVALUATING CONSUMER PRODUCTS**
LEVEL: Grades 5-12
SUBJECT: Science
REFERENCES: Adapted from several activities reviewed.

OBJECTIVES: Students will be able to: (1) develop criteria for desirable consumer products; (2) design evaluations to compare products; and (3) use a library to obtain published data to compare to their data.

ACTIVITY:

As consumers, we often buy cleaning products based on convenience, price or advertising. An alternative to finding proper disposal methods for wastes that we generate is to limit the amount of toxic substances we use. Do we really need the products we purchase? Are there non-toxic alternatives? This activity is designed to show that simple, safer alternatives can be identified.

Teacher preparation:

Review experimental design with students.

Class Activity:

1. Have the class divide themselves into groups of three or four. Have each group choose a common household cleaning product that they would like to evaluate (scouring powder, glass cleaner, etc.)

2. Introduce the idea of a product evaluation. Each group will design an evaluation of a cleaner. They could use a glass cleaner on different classroom windows, tile cleaner on the floor, etc. They should plan to include a non-toxic alternative product, several commercial products, and a control of their choosing.

3. After deciding on a product, each group should agree to the qualities of the product that should be measured. What criteria should they use to determine a good product? Cleanliness, aroma, price, elbow grease, toxicity, and availability may be considered. Along the same order, which variables should be controlled? Will the same student clean each item? Will the items be equally dirty in the beginning? It is important to examine these questions before starting the evaluation. Checking *Consumer Reports* and *Consumer Digest* issues that include reports on similar products should provide some good suggestions.

4. The next step will be to create a data chart. How many measurements will be taken? How will quantities be measured? *Consumer Reports* and *Consumer Digests* provide suggestions in their publications.

5. Finally, the items to be evaluated should be brought from home, purchased, or mixed in the classroom. Substitute products can be found in *Activities for Teaching About Hazardous Materials in the Home* published by ERIC/SMEAC.

6. After evaluating the products, each group should briefly explain their evaluation, explain their alternative product, and describe the item they would recommend for home use.

Discussion Questions:

1. What are the advantages and disadvantages of each product?

2. Were the alternative products satisfactory?

3. Will people realistically change buying habits based on consumer information? What could the class do to change consumer habits?

Additional Activities:

1. Compare each groups results to published results in journals. Do they differ? If so, what are possible reasons?

2. Compare advertising for each product tested to determine how the advertising compares to their data and published data.

SECTION IV - SECONDARY SCHOOL ACTIVITIES (7-12)

TITLE: **TO ZONE OR NOT TO ZONE?**
LEVEL: Grades 7-9
SUBJECT: Social Studies, Science, Language Arts
REFERENCES: Project WILD

OBJECTIVES: Students will be able to: (1) identify relevant information related to the problem; (2) present relevant information in a report; (3) identify bias in information and presentations; (4) identify social and ecological considerations where human uses of land conflict with each other and with wildlife habitat needs; and (5) describe the importance of land-use planning.

ACTIVITY:

Background: This activity uses a role-play strategy for study of the importance of land-use planning. It emphasizes the complexities of decision-making where people of different points of view are involved.

The major purpose of this activity is for students to understand the importance as well as some of the complexities of land-use planning and decision-making.

Background for Students: Land use decisions affecting wildlife have become a familiar issue where housing developments are concerned. The following is an imaginary conflict that corresponds to some real life dilemmas:

Pleasant Valley is a ranching-logging community on the western slope of the Snow mountains. Silverton - a town of 20,000 - is the trade center of the area. Cramer Lumber Company is expanding its operations. This will provide 250 new jobs, but housing is very limited. A 200 home subdivision has been proposed for an 80 acre plot of undeveloped land on the south edge of town. This forested area is bordered by Rattlesnake Creek on the west. Rattlesnake Creek provides excellent fishing for rainbow trout. Fifty-three species of birds have been sighted in this area, including some rare species. In the spring and fall, the area is used by migrating waterfowl and deer feed in the area. Many nongame species such as ground squirrels and pocket gophers inhabit this land. This 80 acre plot is currently zoned for agriculture and forestry and would have to be rezoned as residential by a vote of the county commissioners. The subdivision would be on a central water system, but each home would have its own septic system.

Materials: Copies of role descriptions; props optional for role-play; room set up for hearing.

Procedure:

1. Provide the students with copies of the background information concerning this hypothetical land-use dilemma.

2. Thirteen students will be assigned (or volunteer) for roles as county commissioners, local residents, and business people-with each receiving a card describing his or her situation. The rest of the students will have roles as news reporters, outside experts, concerned citizens, etc. These students may ask questions of people testifying at the hearing. They can be required to write letters to the editor or one of the commissioners in support of a particular point of view; write news articles about the hearing or personal impact stories describing the potential consequences for local workers, residents, school children, etc.; prepare technical reports as researchers, etc. Every student should have a role-either as one of the 13 people preparing testimony for the hearing, or as active observers who prepare written questions, reports, or news articles.

3. To set the stage for the simulation, have each of the 13 participants read their personal data cards. The other students should select their role; they do not need personal data cards, although they may write their own. Students should then be given homework time to prepare their presentations as members of the inquiry; or questions, letters to the editor, and news stories as public observers. Students should be encouraged to improvise in developing their presentations and questions.

4. The day (or days) of the hearing, the chairperson of the commission is to run the meeting. It is up to him or her to maintain order. All participants must be recognized by the chairperson before they speak. After all those presenting prepared testimony have spoken and have been questioned- the reporters, researchers, and concerned citizens will be asked to read their statements (articles, reports, letters to the editor, etc.) This is an excellent way to start the final day of the simulation. After all testimony, questions, and statements, the commissioners vote and give the reasons for their decisions.

5. Suggested time line for this activity:

Day 1	Read background information and select roles (approximately 30-45 minutes)
homework	Prepare presentations
Day 2	Conduct hearing (approximately 30-45 minutes)
Day 3	Continue hearing, including reading of news items and letters to the editor; vote; discuss results

6. After the hearing and vote, discuss questions such as the following:

   - What are some things we have learned about land-use decision making?
   - What factors influence land-use decision making and planning?
   - What differences and similarities were there between how decisions were made in this activity and how they happen in our community? Other areas? Other parts of the world?
   - What responsibilities do we as citizens have in helping to make land-use decisions?
   - Why are land-use decision making and land-use planning important for people, wildlife, and the environment?

Extensions and Variations

1. Have students identify a wildlife issue in their local area, gather data, and develop their own simulation.
2. Alter the role descriptions and repeat the simulation.
3. Use copies of a topographical map as common references for everyone.
4. Bring in real expert witnesses; e.g., local people who can add their perspectives and expertise. If you do, make an effort to get a balanced range of points of view rather than hearing from only one perspective on the issues involved.
5. Adapt this activity to a debate format.

Evaluation

What are the purposes of zoning laws? How are zoning laws passed? Give an example of how a zoning law might be good for wildlife. Describe how citizens can get their opinions considered in land-use decision making processes.

PERSONAL DATA CARDS

LEN OR LINDA OLSEN, REALTOR (COUNTY COMMISSIONER)

You started your business in Silverton five years ago. Your business is doing well, but you have difficulty relating to the "old timers" like Thompson. Your real estate company is not developing this property. You have some question regarding the credibility of the developer, but you generally vote in favor of development.

DAVID OR WANDA DRESSER, MERCHANT (COUNTY COMMISSIONER)

You are 46 and own a furniture store. You are also a duck hunter. You would like to sell furniture to all the new home owners. You will lose your duck blind as the numbers of duck hunters increase, and you will have to drive 50 miles to find a new hunting area.

JACK OR JANET THOMPSON, RANCHER (COUNTY COMMISSIONER)

You are the third generation to run the "Rolling T" Cattle Company. You are proud to tell people that your grandfather was one of the first to settle in this valley. Your spread covers 800 acres and you have grazing rights to surrounding U.S. Forest Service land. You resent the increase in population of the area and, although you are involved in community affairs, you resent individuals moving into the area who do not share your values. Last winter, snowmobiles cut your fences three times and in one case your cattle wandered onto the highway and caused a traffic accident.

REVEREND MICHAEL OR MARTHA MARTIN, MINISTER (COUNTY COMMISSIONER)

You have pastored the Silverton Community Church for eight years. You are respected in the community, but this is your first term on the county commission and you are hesitant to become involved in controversy because you have members of your congregation on both sides of the issue. You are a dedicated outdoor enthusiast, enjoying hunting, fishing, and bird watching. Your spouse is an active member of the state affiliate of the National Wildlife Federation.

ELMER OR BERTHA WILLAS, RESIDENT

You are a 78 year old "old timer" living on the land proposed for the subdivision. You have lived on Cornwall's land for 45 years, built a home there with Cornwall's permission, and have raised seven children. You raise bees and chickens out back and your garden covers one-half acre. You are settled in the middle of the area proposed for the housing development and there is no question that you will have to be evicted and your house torn down. You have no legal claim to any of the land, but have nowhere else to go.

JAMES OR ERMA "FROSTY" WHITE, SNOWMOBILER

You are 30 years old and have just been elected president of the "Rattlers," the local snowmobile club and you feel that you should defend their interests in the area. The cost of gas is high, and your club doesn't want to have to drive long distances to ride snowmobiles. You would like to open a snowmobile repaid shop, but you might get a job at the new lumber mill.

TOM OR MARY BENNETT, PRESIDENT OF CHAMBER OF COMMERCE

This is your tenth year as president of the Chamber of Commerce. You own a grocery store in the middle of town. Your greatest concern is the weak business climate in your community. The Chamber recently hired Smith & Wittigen, a business consulting firm, to evaluate the retail potential of Pleasant Valley. Their findings indicate that the business community has overbuilt. Your profits and those of your fellow merchants have been steadily declining. You see this new lumber mill as the salvation of your business.

OSCAR OR JAN SPARROW, LOCAL AUDUBON PRESIDENT

You represent over 300 active Audubon members, and are director of the annual bird count competition. You have a list of 15 rare bird species found in the Rattlesnake Creek area. You are 37 years old, and work at the lumber mill.

GEORGE OR ALICE LONG WINGS, NATIVE AMERICAN INDIAN LEADER

You have an interest in the sanctity of the area in question as it is an ancient site for ceremonial sweats for the healers of your tribe.

CHARLIE OR CHARLOTTE JACKSON, HUNTER

You are a 53 year old "old timer" and an avid hunter and fisher. You have four boys and hunting has always been an important family activity. You are an influential member of Ducks Unlimited, and the 80 acres proposed for development contains one of the prime duck hunting areas close to town.

WALLACE OR WILMA CRAMER, LUMBER MILL OWNER

You own the nearby lumber mill. Operations have expanded and you need inexpensive housing for new employees coming to the area. The wood milled is used locally and transported throughout the state. It provides an important source of income to the town.

HARVEY OR GLADYS CROW, BANKER (COUNTY COMMISSIONER)

You are 50 years old, and, as a banker, are willing to finance new home loans. You are an art collector and former president of the local chamber of commerce. You also love bird watching and fishing.

HAROLD OR CORNELIA CORNWALL, LAND OWNER

You are a 63 year old retired business person. You want to sell your land, move to Palm Springs, and live happily ever after under sunny skies. You want cash, but your asking price is very reasonable. You own 80 acres of prime wild land south of town.

MARTIN OR ETHEL HIGGINS, DEVELOPER

You are a big time developer in the area and can afford to buy the land outright. You will make a substantial profit if the housing that is needed for the lumber mill employees is built. You are successful and fairly competent, but you have been criticized more than once for a lack of attention to landscape detail and design.

TITLE: **WHO DECIDES?**
LEVEL: Grades 7-9
SUBJECT: Social Studies, Science, Language Arts
REFERENCE: *Environmental Education Activities Manual--Junior High Activities*

OBJECTIVES: Students will: (1) identify relevant information related to an issue; (2) separate facts from opinions; (3) consider pros and cons related to an issue; (4) be able to communicate their ideas in writing and/or verbally regarding an issue; and (5) use information gathered and analyzed to recommend a decision regarding an issue.

ACTIVITY: Select an issue of local environmental concern that has been recently covered or is currently being covered by local newspapers, radio, or television. Have the group gather and/or list all the information they can on the selected issue.

Divide the group into teams to seek out all the information from the local sources, not only the media listed above but government agencies, citizen groups, businesses and industries.

After each group has selected a specific information source to investigate, discuss the various ways for each group to use in their investigations, such as:

1. Use the telephone. When using the telephone, make clear with an outline the main points you are interested in discussing with a representative for the particular information source you are calling. Mention your particular interests and key questions and ask for an interview time, either in person or on the telephone. If possible, arrange for that representative person to come and talk with the group.

2. When looking for information from a newspaper, be critical. That is, be aware that newspapers align themselves toward certain groups of people: rural, urban, businessmen, political parties,... and therefore present information relevant to your issue, and try to see who the readership for a particular newspaper is.

3. Write letters, if time permits. Ask for specific information from the person or group you are writing. This makes it easier for them to give you relevant information by a particular time.

4. Whenever possible, meet with people directly. You can usually get the best information this way. Allow yourself to be flexible and open-minded when you speak with someone. Remember, you are seeking information from someone, so be a patient, but questioning listener.

5. If your issue is being considered in a local meeting, such as a school board meeting, city council meeting, or public hearing (many environmental issues are openly discussed in local public hearings), try to send a representative from your group to that meeting.

6. When looking at radio and television stations, first call them and see if they have anyone reporting or editorializing on that issue.

7. Whenever you speak with anyone about your selected issue, ask them if they know of other people or groups you might contact to gain more information about your issue. People-contacts often prove to be the most informative sources.

As groups obtain information, compile an outline on which they can jot down the contacts they've made and a brief statement or so about the information the group obtained.

The length of any such issue-investigating activity is flexible and can take a few days to a week or longer, especially if letters are written. After most or all of the investigative work is completed (it is best to set a date by which every group will complete its initial investigations), outline on a big chart or blackboard all of the possible alternatives to the problem selected.

Have a representative for each alternative present the pros and cons, as he/she sees them, of the particular alternative. A good way to do this is to have the group act as a council meeting to decide upon which alternative appears best for your community, county, state, etc. You may want to expand this phase by bringing in outside speakers to present viewpoints to the group.

Have the group evaluate each alternative, its consequences, and the trade-offs (costs vs. benefits). Then the group should decide upon the best alternative (a ballot vote is useful here). The group may then wish to write the local editor, or appropriate government agencies, to express views and rationale.

Review through a group debriefing the things you did. What sources of information were explored? Which ignored? Can you identify the people that makes up the constituency of each of your sources? What groups of people have the most power in making a decision on the issue? Did you have an opinion on the issue before the investigation? Did it change as a result of the investigation? Do you feel the issue is being considered fairly in the community, by viewing all alternatives and the consequences of each alternative, or do you feel this issue is being decided in favor of one group of people over other groups?

TITLE: **WHO FITS HERE?**
LEVEL: Grades 7-9
SUBJECT: Science, Language Arts
REFERENCE: Project WILD

OBJECTIVES: Students will be able to: (1) identify characteristic life forms in ecosystems; (2) match appropriate life forms to ecosystems; and (3) generalize that each ecosystem has characteristic life forms adapted to live there.

ACTIVITY:

BACKGROUND

Each environment is suitable to those life forms that have adapted to its climate, soils, water, vegetation, other life forms, and to other ecological factors over a number of years. Plants and animals tolerant of heat and little moisture are adapted to the desert; mountain goats to craggy hillsides and cold temperatures; and polar bears to ice fields and snowy vistas.

MATERIALS

Posterboard for 10 posters; crayons, paints, or magazine photos for posters; posterboard, index cards, or construction paper for 50 adaptation cards.

PROCEDURE

1. Divide the class into two equal groups. Explain that each group will make a game for the other. The object of the game will be to match animals to the environment in which they live.

2. Ask each half of the class to choose five ecosystems they would like to know more about; e.g. desert, hardwood forest, coniferous forest, alpine, marine. Divide each half of the class into the five groups, one per ecosystem. Have each group research their ecosystem, learning its characteristic life forms including adaptations of the animals that enable them to survive in that environment.

3. Ask each student group to make a poster showing the characteristic vegetation, terrain, etc., in the ecosystem they are studying. Posters of each ecosystem can be made with crayons and paints or magazine cut-outs.

4. For each ecosystem, students should make five cards, one per each of five species of animals characteristic of the ecosystem. Put a description of the animal's adaptations to its environment on one side of the card, and a coding number on the other side, so that the animal described can be identified later. Do not write the name of the animal on the card. The cards should describe adaptations that enable the animals to survive in the ecosystem. For example, for the desert environment, the five cards could read:

"Hunts at night for warm rodents and sleeping birds; can climb loose, sloping sand by throwing loops of its body up like coils." (sidewinder rattlesnake)

"Relies on agility and speed to escape predators; needs little water; gets water from plants it eats." (cottontail rabbit)

"Hunts at night lives in burrows of animals like gophers." (burrowing owl)

"A bird which hibernates in winter to avoid desert cold." (nightjar)

"Larvae feed on yucca flowers." (yucca moth)

5. When posters are made and cards completed, students in each half of the class should make a master list of the five ecosystems and animals their cards represent. Next, they shuffle all their cards for their five ecosystems together into one pile.

6. Each half of the class then exchanges posters and cards with the other half.

7. Each half of the class then tries as a group to decide to which ecosystem each card belongs.

8. Next give each half of the class the master list for their posters. One student per group can read off the animals that correspond with each card for each poster.

9. Has each animal been placed in its proper ecosystem? If not, why? Were there any animals found in more than one ecosystem? Are these ecosystems varied? How can some animals live in more than one ecosystem, and not others? What are similarities and differences among the ecosystems and characteristic life forms? What are some of the most interesting animal adaptations? What functions do these adaptations serve? How do they relate to the nature of the physical environment? Ask the students what characterizes animals and the environments in which they live (Each environment has characteristic life forms. These animals and plants are adapted to live where they do.)

EXTENSIONS

1. Look for rare, threatened, and endangered species in each ecosystem. Are there any? If not, why not? If yes, why? (usually habitat loss).

2. Compare and contrast additional ecosystems and life forms from a variety of places on the planet.

VARIATION FOR GRADES 10-12

Make an Ecosystem Quiz Show. Have students research the ecosystems, life forms, and adaptations-and then use a game show format to guess the animal and its environment.

EVALUATION

Pick any three animals. Describe the ecosystem in which each animal lives, including identification of the animal's habitat requirements. Describe the importance of adaptation in animals.

TITLE: **BEHIND THE FAUCET**
LEVEL: Grades 7-9
SUBJECT: Science
REFERENCES: Adapted from previous ERIC/SMEAC activities.

OBJECTIVES: The student will learn to (1) identify and collect relevant information; and (2) infer possible implications of information obtained.

ACTIVITY: Determine whether the main water source is from surface waters or groundwater. Then do either Activity A or B. In some communities it may be appropriate to do both.

ACTIVITY A: SURFACE WATERS

Construct a map of the watershed that supplies water for your community. Use a topographic map and trace the outlines of the watershed. On the map identify the following items:

(1) Source of input and/or treatment facility (waterworks).
(2) Location of nearby communities (including population figures).
(3) Location of industrial sites.
(4) Potential sources of pollution of effluents which might affect the water supply.
(5) Location of any water impoundments.

Explore the watershed and locate and map forests, marshes, grasslands and other features that help hold water in the watershed. Locate sources of erosion that could silt up impoundments. Find out what laws and regulations help protect the water quality in the watershed. How well are these laws enforced?

ACTIVITY B: GROUNDWATER

Invite a well driller, or geologist, to speak to your group about groundwater aquifers of the area and how these aquifers are recharged as water is taken from them. Using local topographic maps, groundwater availability maps, and geologic maps, have the learners create a map of the possible aquifers found in the area. On the map locate what homes and/or industries are tapping the various aquifers. Find out if possible the potential groundwater flow in gallons per minute for each aquifer. Find out if there are any potential development plans that might affect the recharge areas of the aquifers.

Is there any storage of toxic chemicals or road salt where they might leach into the groundwater supply? What is the water chemistry of the water from each aquifer (pH, hardness, etc.)? What laws and regulations exist to protect the quantity and quality of the groundwater supply? How well are these laws enforced?

TITLE: **HOW CAN WE PRESENT OUR IDEAS EFFECTIVELY TO OTHERS?**
LEVEL: Grades 7-12
SUBJECT: Language Arts, Social Studies
REFERENCES: Adapted from several activities suggested by teachers

OBJECTIVES: Students will be able to: (1) indicate the key elements of a successful advertisement; and (2) design an advertisement based on these elements.

ACTIVITY:

1. Have the students study advertisements in newspapers and magazines to determine various types of advertisements and to identify what they believe is effective in an ad for different audiences and different products.

2. Invite a staff member from a local newspaper or TV advertising department to present information on how advertisements are designed. A list of questions should be developed by the class from activity one and should be given to the speaker in advance.

3. Have students work in small groups to design an advertisement for an environmental idea or project. Determine whom you are trying to influence and identify their likes and dislikes. Design the ad. Have people from the target audience react to your ad. How did your design anticipate their reactions?

TITLE: **SITE SELECTION BY LOCAL BUSINESS**
LEVEL: Grades 7-12
SUBJECT: Social Studies, Language Arts
REFERENCES: Adapted from previous ERIC/SMEAC activities.

OBJECTIVES: The student will learn to: (1) identify and collect relevant information; (2) identify patterns in data; and (3) infer possible implications of information obtained.

ACTIVITY: Have each team of two learners select one local business for study.

Phone or visit the business and obtain permission to visit and ask questions about the topic. Make arrangements to visit on a specific day at a given time.

Draw a sketch map of the area in which the business is located and mark on the map the location of the business to be studied and other businesses in the immediate vicinity.

Stand in the vicinity of the business and observe the customers. Do they drive or walk to the business you are studying? From what directions do they come? Are they mostly men or women? Do the customers go directly to the business or do they visit several businesses?

Visit the businessman (owner, manager) and ask questions such as the following:

a. When did you locate at this site?
b. Why did you choose this site over others?
c. Where do your customers come from?
d. What attracts customers to your place of business?
e. At what times of the day/week are you busiest?
f. Do the other businesses in the area help or hinder your business? In what ways?

At a group meeting have the various two-person teams share what they learned. Can you discover a pattern of location for different types of business? What conclusions can you draw regarding business locations based on your field work?

TITLE: **FOR THE ENJOYMENT OF FUTURE GENERATIONS**
LEVEL: Grades 7-12
SUBJECT: Science
REFERENCES: Adapted from the CLASS Project

OBJECTIVES: Students will learn to: (1) analyze points of view; (2) identify bias in points of view; and (3) identify variables that must be considered in solving an overpopulation problem.

ACTIVITY: SETTING THE STAGE

Begin this investigation by introducing your students to a hypothetical problem-managing a large herd of elk in a national park. The elk are protected in the park and tend to be somewhat less shy of people and more commonly seen than they generally are in the wild. They attract visitors to the park, but the size of the herd is a problem. The park presently has a population of about 1800 elk, but it can support only 800 elk on a year-round basis without harming the habitat.

The elk eat a variety of foods, including the leaves and twigs of aspen in the park. Other tree species are being affected, although to a lesser extent. Some biology researchers feel the elk population must be reduced or the aspen in the park will be completel, destroyed in ten years. This would adversly affect other animals, such as beaver and deer, that also depend on aspen for food.

In summer, the elk can feed on extensive range high in alpine tundra in the park. In winter, however, snow prevents the elk from feeding on this range, and there are few other areas in the park where abundant food is available to them. The elk are overfeeding on the available winter range and damaging the vegetation,, The herd's seasonal movement to feeding areas outside the park is restricted by the human population living in nearby towns and by hunters in the fall. Because hunting is not allowed in national parks, the elk tend to stay within the park boundaries where they are protected from people who hunt in area surrounding the park.

Elk compete with other wildlife for available habitat in the park. The park supports mule deer, bighorn sheep, and many small animals, such as beaver, gopher, and ptarmigan. A few cougars live in the park, but the absence of other predators of the elk, such as wolves and grizzlies, contributes to the overpopulation problem.

PROCEDURE

1. Divide your class into small groups. Each group must work together to find a solution to the problem of overpopulation of elk in the national park.

2. Allow your students about 20 minutes to come up with as many different ways to solve the problem as they can. Try not to limit their thinking in any way. These questions may help them in the process:

    a. What can we do to decrease the number of elk in the park?

    b. What ways to decrease the population involve the least obvious human intervention?

3. After 20 minutes, write all of their solutions to the problem on the board. Use the following questions to discuss each solution:

    a. Which plans do you think will not work? Why?

    b. What additional pieces of information do you need to decide whether each is possible or not possible? (Make a list of this information.)

    c. Which plan seems to be the most effective way of dealing with the problem? Why?

4. Now, give a set of the role cards to eachgroup. Each group should analyze the roles and answer these questions:

    a. Which solutions suggested in the role cards are similar to those suggested by the group?

    b. Which statements made by each person are facts and which are opinions? (Make them aware that sometimes opinions begin with phrases such as "Some people think," "I think," and "I feel.")

    c. Which of the solutions suggested in the role cards appears to be the best?

    d. Can you combine your solution and solutions suggested on the role cards to form an even better solution? What is it?

5. Once each group has analyzed the roles and come up with another solution or confirmed the group's first solution, have each group present its solution to the other members of the class. Discuss each solution and allow other class members to ask questions.

6. The class should now vote to decide which solution appears to be the best. Their choice may be the original solution, one of the solutions arrived at after reviewing role cards, or a combination of two or more. Make sure the class as a whole is given the option of deciding to reject all or to combine parts of several solutions into one choice.

ROLE CARDS

President of "Elks Alive"

"We think the only solution is to relocate the extra elk to other habitats around the country. Elk once occupied areas where they are not now present. We could raise funds to carry on the relocation this year. It will cost us $200 per elk, but we could provide the funds with which to live-trap the elk and move them elsewhere. We're not sure that we could pay for relocation year after year, though. A hunting season should not be started in the park. Overpopulation of animals sometimes results from certain management practices, such as planting feed for animals or setting out hay and other food for them. If we start a hunting season in the park, that management style might continue and force the park to have a hunting season every year. This might interfere with the enjoyment of visitors to the park because the elk in the park will be more shy of people. Our national parks are set up to be places where people can go to see wildlife, and we think those opportunities should be preserved at all costs."

Wildlife Biologist

"We must remove at least 1000 of the elk from the park or the aspen and other vegetation they eat will be destroyed, not only on the winter range, but if the herd continues to grow, on the summer range, as well. Other kinds of wildlife in the park that eat aspen will also be affected. Beavers need aspen, too. Without aspen, the beaver population will disappear, and that's just one of the species the elk are affecting. There are several different ways to solve the problem, but we have to find the one that works best for this park. We could try to acquire other range areas for winter feeding. Hunting is recommended in many areas by wildlife managers, and it is an effective means of helping to control overpopulation. Live-trapping is recommended in other areas. I think we should trap the elk and then kill them. The meat can be given to charity, and trapping will not cause the other elk to become afraid of human beings. National parks were set up to be places where people can go to see wildlife, and a hunting season in this case may not be the best solution since it might make the elk less tolerant of people."

Owner of the Local Photography Shop

"I depend on tourist trade here in my business, and elk are a big attraction in this park. If we don't get visitors here to see the elk, we won't be able to make a living, but the hunters have a tendency to kill all the "pet" elk that pose for pictures. This gives hunters a bad name and causes some of us a lot of personal grief. Starting a hunting season in the park would also set a bad precedent. What if we start doing that in other parks as well? There should be some places left for people who want to see animals. Hunters already have plenty of places to hunt."

Local Farmer

"We must do something about the elk. They are eating the hay I harvest for my livestock. I don't like the idea of introducing predators -- mountain lions, wolves, and grizzly bears -- into the area. If you bring predators into this area, they're going to get to my livestock. That's going to hurt me economically and it may even pose a threat to my family. I don't want these dangerous animals in the area, and I certainly don't want them near my livestock and family. Why not just have an open hunting season?"

SUMMARY

This investigation is designed to help your students understand the interrelationships of organisms within the environment and the complexity of managing these resources - there are no easy solutions. The best solution provides the greatest good for the greatest number of people and wildlife while also considering the importance of conserving our natural resources. These questions may be used to summarize the investigation:

1. Are there any contradictions in the individual statements made on the role cards?

2. Look at each statement. Are there enough facts in each one to make an intelligent assessment? What other facts do you need to make an intelligent assessment? What information that students feel they needed when they suggested their first solutions is given on the role cards?

3. How, if at all, are the statements on the role cards biased?

4. Are there some choices that appear effective for the short-term solution, but do present some long-term problems? What are these long-term problems?

As a follow-up, you may want to invite a wildlife manager from your local area to your class to discuss the problem as it relates to your locality. A similar wildlife management problem may exist in a local park or wildlife refuge.

TITLE: **WHAT ENVIRONMENTAL ISSUES ARE CONSIDERED IN YOUR PAPER?**
LEVEL: Grades 7-12
SUBJECT: Language Arts Science, Social Science
REFERENCES: Adapted from suggestions of several teachers.

OBJECTIVES: Students will be able to (1) identify editorials addressing environmental topics, (2) identify the issues presented, and (3) analyze the author's statements to determine if the points can be substantiated.

ACTIVITY: Ask your students to check the editorials in your local newspaper(s) that express viewpoints on controversial environmental issues. After they have collected a sufficient number of editorials, ask them to carefully read the editorials, state the issues addressed and list any convincing points the author makes to influence the reader. Have students research the issues to determine if the author's points are substantiated. Select a few of the editorials for analyses and discussion by cooperative learning procedures. Use small groups to analyze the editorials and then have them compare and discuss their results.

TITLE: **FACTS AND FALSEHOODS**
LEVEL: Grades 7-12
SUBJECT: Language Arts, Social Studies, Science
REFERENCES: Aquatic WILD

OBJECTIVES: Students will be able to (1) develop criteria for evaluating the quality, balance, and fairness of an informational presentation; and (2) evaluate the balance and fairness of informational presentations designed to represent points of view about an environmental topic.

ACTIVITY: BACKGROUND

People have many different points of view, particularly concerning issues. It is difficult at times to discern fact from falsehood, objectivity from subjectivity, and accuracy from exaggeration. Sometimes people are knowingly selective in what information they present about a topic. Other times they do not realize that they are presenting only a narrow view of the topic-that the way they see the world is not the only possible way to see it.

Everything is probably somewhat subjective. That is, everything is subject to an individual's personal filters and perspective. Objectivity is one goal of science. Even in the precise world of scientific measurement, pure objectivity without some influence on the part of the observer may be beyond reach. So objectivity is a goal; it is difficult, if not impossible, to achieve in a pure and technical sense.

If objectivity is so difficult to achieve, what can we do to develop our own skills of objectivity? One way is to become more discerning about balance and fairness. When you hear a speaker presenting information on a topic-particularly a controversial topic-is that person making an effort to describe the topic as a whole? Or, is the speaker selectively describing only is or her view? Does the speaker acknowledge that there are any other differing points of view? Is the speaker presenting accurate information, or opinion as if it were factually based? These are some of the questions this activity is designed to address. To provide a focus, the activity will emphasize the kinds of informational presentations that students might encounter in public settings-especially those related to the environment, and specifically aquatic environments.

Providing information about the environment is a widespread activity in settings as varied as classrooms, national parks, reactor sites, industrial complexes, and wilderness preserves.. Some information is provided by the distribution of printed materials. In other cases the information is provided through a presentation, possibly using many media and involving audience participation. The latter often combines people's passion for entertainment and recreation with their desire for self-education. Agencies of local, state, and national governments, as well as private entities, have recognized the economic benefits of attracting the public to natural and cultural sites of interest. Prepared lectures, exhibits, and handouts

contain ecological, recreational, scientific, and historical information. The main purpose of those who prepare the materials and presentations is to inform the public. Part of the effort to inform in such settings may also focus on justifying the site or the development of the site and what this offers. The result may be a mixture of information, entertainment, and subtle justifications of policy offered in a palatable form. Sometimes the exhibits, programs, and materials offered at such sites-even those under the administration of public agencies-become fairly one-sided and possibly even closed about other options or viewpoints. Clearly this may not be intentional, but the effect may be more to propagandize than to inform or educate.

Sometimes the distortion of information, or at least its lack of completeness, may be intentional. At other times the limitations are a reflection of emerging and conflicting perspectives about what is accurate concerning the topic. Science itself is not free from controversy. Physicists argue about whether light is a wave or a particle. Biologists debate whether or not wolves should be re-introduced to their former habitats, or whether Inuit should be allowed to kill Bowhead whales. Aquatic biologists are on both sides of the fence regarding the introduction of exotic fish species; for example, controversy exists about those fish introduced to North American waters from other parts of the world. Those who sponsor the construction of dams, canals, aqueducts, locks, and those who propose large-scale diking and dredging projects, all must wrestle with the impact that the project may have on the aquatic habitat and its life forms.

The major purpose of this activity is for students to develop and use their own set of criteria for evaluating the quality, balance, and fairness of informational presentations. Special emphasis here is placed on information concerning aquatic environments; however the process also applies to other topics.

MATERIALS

Collections of sample print informational brochures and publications, especially concerning the aquatic environment; sample advertisements and articles from popular tabloid publications; art materials: markers, poster paper, display boards, a display area; video or still cameras (optional); darkroom facilities (optional).

PROCEDURE

1. Assemble a file of sample informational brochures from various public or private agencies and organizations. The brochures may cover a range of topics; make sure some address aquatic topics or issues. Examples might include acid rain, water pollution, conservation, sewage treatment, and hydroelectric power. Articles concerning water issues-including water quality, the development of aquatic resources, and water use-from local news media would also be of potential use.

2. Also before beginning this activity with students, obtain several issues of popular, sensational, tabloid publications. These are widely available at the checkout counters of convenience stores and supermarkets. We do not recommend that you take any of these publications in their entirety to school. Cut out selected articles, feature stories, and even advertisements from these tabloids. Choose those that deal with science; health; the environment; new technology; new products or inventions; and discoveries as being most suited to this activity. Prepare a student assignment sheet with some of the following questions. (Feel free to add others suited to your setting.)

   - Does the article or advertisement cite or list facts? What are they?

   - Does the item make a claim? Is the claim based on or supported by facts, or by some sort of evidence? Describe the claims and the supporting facts and evidence.

   - Does the item or article base its claim or story on some part of science or technology? Is a scientific law or principle used to support the claims? If yes, what are they? Is a scientist or engineer cited as an authority? Who is he or she and how is his or her expertise established? Which fields of science or engineering are employed?

   - Is there any indication that the writer of the article stands behind its accuracy or validity? Will the publishers or editors of the tabloid support the claims? Will the advertisers back up their products?

   - How could you go about checking or verifying the claims and facts in the article?

   - What is your overall assessment of the accuracy of the article or advertisement? Exceptionally accurate? Generally accurate? Somewhat accurate? Generally inaccurate? Exceptionally inaccurate?

3. Divide the class into pairs or teams. Give each group an article from the tabloid and a student assignment sheet listing the questions. Ask the students to review the article or item and to answer the questions on the sheet. Encourage the students to develop any other questions that they think might usefully be asked. Discuss the students' results. What do they think about the overall quality of what they read? Do they believe the article? Would they buy the advertised products? Why or why not?

4. Next distribute the samples of informational brochures, handouts or pamphlets that were collected and are related to aquatic and other environmental topics. Provide at least one brochure to each of the teams. Ask the students to analyze and evaluate these materials in the same way they did the tabloid items. Provide the students with another copy of the assignment sheet with the same questions. Again encourage them to add questions of their own. In addition, ask the students to consider:

   a) whether or not the publication acknowledges different points of view or opinions about the topic, where these exist.

   b) whether information or facts have been selected in order to support a view or develop a perspective. Does the material try to persuade the reader in some way, or is the reader invited to make up his or her own mind? What evidence can the students find to support their viewpoints?

5. Ask each group to report on their findings. They can summarize their findings by giving the brochure an overall rating-using the five categories from "exceptionally accurate" to "exceptionally inaccurate" Ask them to support their evaluation with some evidence and reasons for their view.

6. Now have the students work as a whole group to develop a "checklist" that they can use to evaluate informational materials, exhibits, or presentations. What, in their view, should be the characteristics of an informational presentation of quality? of balance? of fairness?

7. After the checklist has been developed in draft, open the discussion to a few more questions. For example, ask the students whether or not it is possible to be forceful and effective in expressing one's view without becoming unfair or biased. Is it possible to separate one's own view point from a publically neutral position? To what extent do government agencies, citizen's groups, businesses, interest groups, and individual citizens have a responsibility to acknowledge other points of view concerning their policies and practices? After discussion, see if the students want to make any changes in their "Checklist for Quality, Balance, and Fairness in Informational Presentations." Make any changes that they recommend. Post the final checklist in a visible place in the classroom. Also provide each student with a copy of the final checklist for personal use.

8. OPTIONAL: Prepare a set of assignments in which groups of students are to act as the designers and developers of an informational brochure or program. Have the students draw assignments at random. Each team will prepare an informational presentation having two components:

   •a verbal presentation (10 minutes maximum).

   •a display or prepared print brochure.

   In each case the remainder of the class will apply the criteria from the checklist for quality to the presentations. Following each presentation, the other class members will suggest improvements and changes to add to the quality.

EXTENSIONS

1. Visit a site where information is provided that is related to the environment in some way. Using your criteria, evaluate whether the programs, exhibits, and printed materials appear to be balanced and fair.

2. Choose an aquatic wildlife issue in your own community. Write an article for a newspaper or develop a presentation to make in informal educational settings (garden clubs, Kiwanis, Chamber of Commerce, etc.). Make sure your article or presentation reflects your standards for quality, balance, and fairness.

3. Think of five things you could do to enhance the public's understanding of aquatic wildlife and habitats in your own community without using propaganda.

EVALUATION

Select one of the following topics and describe the types of information that should be included in an informational presentation designed for students your age: recreation area, sewage treatment plant, whaling museum.

Why is it, or is it not, important for informational presentations to be accurate, balanced, fair, and of quality?

The visitor area of a dam in a state has two informational displays. One explains how water is taken from the basin and used for irrigation for agriculture and for city water supplies. The second shows property damage from floods before the dam was constructed. What other information, if any, should be provided for visitors?

TITLE: **PHILOSOPHICAL DIFFERENCES**
LEVEL: Grades 7-12
SUBJECT: Language Arts,Social Studies, Journalism, Communication
REFERENCE: Project WILD

OBJECTIVES: Students will be able to: 1) identify points of view of groups and organizations concerning environmental and natural resource issues; and 2) describe possible effects of various groups and organizations having differing points of view about environmental and natural resource issues.

ACTIVITY: One definition of the word "philosophy" describes it as a "system of principles for guidance in practical affairs." Private and public organizations and agencies frequently have an identifiable philosophy. Most organizations involved with natural resource and environmental issues support their actions and recommendations with statements of their philosophy. These may be made available in the form of speeches, newsletters, news releases, goal statements, and position and policy papers. The organizations and agencies may not clearly identify their underlying philosophical perspectives, but they can be recognized after analysis of the groups' written and spoken statements and actions.

The major purpose of this activity is for students to recognize that organizations and groups may have differing perspectives with respect to environmental and natural resource issues, and to describe possible effects of several different points of view.

MATERIALS

Newspapers, magazines, or other sources of news; writing materials.

PROCEDURE

1. Ask students to identify a wildlife or other environment-related issue in the news. They might read newspapers and magazines, or watch television newscasts, on a regular basis for one or two weeks to identify an issue and acquire some information about the issue. They could go directly to local resource managers, private conservation groups, etc., for assistance in identifying an issue, as well as for background information. Ask all the students to bring in information about any issues they have identified. After reporting and discussion by the students, ask them to select one issue that seems most interesting to them, and which involves various - if not clashing - philosophies on the part of individuals, groups, and organizations with respect to the issue that is identified.

2. List pertinent information about the issue on the chalkboard. Identify the individuals, organizations, agencies, and other groups who seem most involved. Ask the students to select several of the groups, trying to identify those groups that seem to have strongly different points of view on the issue. Ask the students to divide themselves into working groups,

with each group of students selecting one of the interest groups to investigate further. Ask each student group to try to predict and describe the philosophical point of view of the interest group or organization they have selected to study.

3. Ask each group of students to draft a letter to be sent to their interest group. The letter should ask what the organization's point of view (policy or position statement) is with respect to the particular issue involved, the reasons the organization is taking that point of view, and a general statement of the goals of the organization, if available. Assist the students in making sure their letters are clear, grammatical, neat, and correctly spelled.

4. Mail the letters.

5. While waiting for a response, ask the student groups to write a brief written statement that predicts the point of view they think they will receive from their group.

6. When the letters have all been received, ask the students to compare the responses to their own predictions. Were there any differences between what the students' predicted, and the responses they received from the various groups? Were there any differences between past actions and statements from the groups, and their present statements? If so, what were these differences and do they represent actual philosophical and policy changes in the groups or organizations? Do all or most members of an organization necessarily agree with its philosophy?

7. In summary, ask the students to identify and describe points of view, if any, which some or all of the groups share in common, and points of view, if any, in which the groups strongly differ. In what ways, if any, is it healthy for there to be groups with differing points of view? In what ways, if any, might it be damaging? What possible effects are there from individuals, groups, and organizations having differing points of view with respect to the environmental and natural resource issues?

EXTENSIONS AND VARIATIONS

1. Skip the letter writing phase and just get and use position statements from different groups on one issue.

2. Invite local members or representatives of the various groups to present their points of view in person!

3. Invite the students - as a group or as individuals - to decide (write, discuss, or present orally) their **own** position statement of the issue. How is it like, unlike others?

4. Emphasize the potential for communications skills, including analysis of points of view, in this activity. For example, analyze the stated positions of each group according to the following criteria:

   - substatiated beliefs; i.e., the scientific community accepts these as accurate
   - questionable benefits; i.e., there is some evidence, but it is inconclusive
   - inaccurate beliefs; i.e., rejected by the scientific community

To what degree are groups with opposing views similar and different, when analyzed by these criteria? Are there areas where it is appropriate and feasible to work for compromise? Why or why not?

EVALUATION

Little is known about the California Condor, an endangered bird species. Possibly as few as 20 of these birds exist in the wild today. Some people feel that research must be conducted to learn more about the species. Some worry that any direct human contact will accelerate the birds' population decline. Some feel habitat loss is the real problem and that no research specific to the birds' characteristics is needed at this time. Some think propogation in captivity is the only means of achieving a viable population. Some way that the species is going to become extinct anyway, and therefore any available funds should be spent on those species with a better chance for survival. Predict and describe the points of view each of the following groups would be likely to have concerning this issue: American Ornithologists Union, California Department of Fish and Game, Friends of the Earth, National Audubon Society, National Wildlife Federation, Sierra Club, U.S. Fish and Wildlife Service. Describe and evaluate at least three possible effects of differing views concerning this issue.

TITLE: **A LOOK AT CONFLICTING VIEWPOINTS**
LEVEL: Grades 7-12
SUBJECT: Science, Language Arts
REFERENCE: Adapted from the CLASS Project

OBJECTIVES: In this investigation your students will develop their data collecting, measuring, analyzing, inferring, valuing, and communicating skills by: (1) researching the nuclear power issue; (2) learning to distinguish between facts and opinions; (3) analyzing results of a schoolwide referendum on nuclear power.

ACTIVITY: SETTING THE STAGE

Only a few years ago nuclear power seemed to be the answer to our energy needs, while today its opponents and proponents are locked in a sometimes confusing and often emotional battle over its use. The controversy stems from questions about the safety of nuclear power plants and the problems of radioactive waste disposal, issues about which even nuclear scientists disagree. In this issue, as in others that are complex and emotionally charged, people can sometimes assert their opinions with such authority that their audiences may accept them as facts, rather than examining them critically. Learning to distinguish among facts, opinions, and opinions stated as facts will be important to your students as they conduct their investigations into the nuclear power issue. Facts will not lead the audience to any particular set of values or judgement. They are neutral regarding issues, and will usually simply enumerate things. Opinions, on the other hand, express conclusions which may have been drawn from facts. They will definitely lead the audience toward a point of view.

Ask your students to determine whether the following statements are facts or opinions. If there is disagreement among students, examine the statements carefully to discover whether or not they are opinions being disguised as facts.

1. "In 1978 nuclear energy produced nearly 300 billion kilowatt-hours of electricity."

2. "I believe we need nuclear power to supply our electricity needs."

3. "One-fourth to one-third of the fuel rods in a nuclear plant are replaced once a year."

4. "I think nuclear power plants are not safe to operate."

5. "Recent increases in our electric power consumption point to the need for nuclear power to meet our needs."

6. "Over 70 nuclear power plants have been licensed to operate in the United States."

7. "We have the scientific and technological knowledge to proceed with the development of nuclear power plants."

Your students should also be aware that advocates of certain sides of issues often do not directly address the areas that opposing groups disagree with them about. For example, if one group complains that nuclear power plants overheat the water they use, while another group replies that they do not pollute the air, the second group has sidestepped the first group's issue. It is therefore important for students to be able to analyze literature from different groups to learn where questions can be asked and where flawed reasoning may appear.

Ask your students if in their travels they have seen advocates of different issues distributing their literature and trying to persuade passers-by to adopt their points of view. Let them know that in this investigation they will be conducting a similar campaign in the school. They will distribute both pro- and anti-nuclear information to students and teachers in the school. After a two-week campaign, the entire school will vote on whether or not nuclear power should be used as a source of electricity. Let them know that similar references are being raised for ballot in some states in the United States.

PROCEDURE

1. Divide your class into two groups, pro-nuclear and anti-nulcear. Try to put students who are already predisposed toward one or the other side of this issue on that particular side.

2. Each group should develop its own point of view by collecting information from organizations and magazines. Organizations contacted should include a variety of positions such as The Sierra Club, Edison Electric Institute, and the U.S. EPA.

   Magazines should include both general interest publcations such as Newsweek, Time, U.S. News and World Report and also technical publications.

3. Each group should then prepare literature and posters for its campaign. The groups should first prepare an information bulletin for other teachers and students, telling them that a vote will be held in two weeks on the nuclear power issue. Within the two-week period, information about nuclear power will be distributed to all teachers and students.

4. During the two-week "campaign," students should distribute their pro- and anti-nuclear leaflets and conduct their campaigns for or against nuclear power. Let their imaginations guide them to ways to conduct their campaign. Some groups might make posters or send students to talk to other students during lunch and other free periods, while others may want to be more ambitious in their efforts.

5. The emotions of many people run high when discussing nuclear power. Your students may find they will be subjected to "emotional attack" from others during their campaign. Prepare them for this by discussing or role-playing various responses to possible emotional scenes. Also make sure that other teachers understand that students are supporting the side of the issue they have been assigned and may not necessarily agree with their roles.

6. At the end of the two-week period, your class should prepare ballots for all students and teachers in the school and distribute them to each teacher. The results of the referendum could be announced over the school public address system.

SUMMARY

When your class campaign has been completed, ask your students how they feel about the process. These questions may help:

1. How does the literature prepared by pro and anti groups present facts and opinions?

2. Does the class feel there are any unresolved issues about nuclear power and it's use? If so, what are they?

3. What alternatives to nuclear power are being suggested by groups who do not want it to be used as a source of energy?

4. What groups or industries are supporting the use of nuclear power? Why are they supporting it?

5. What groups are against the use of nuclear power? Why are they against it?

6. As a result of the campaign, have any of the students changed their points of view about nuclear power?

TITLE: **MODEL OPINIONNAIRE--OPINIONS ON LITTERING**
LEVEL: Grades 7-12
SUBJECT: Sciences, Social Studies, Language Arts
REFERENCE: Adapted from several activities.

OBJECTIVES: Students will learn how to: (1) design a survey instrument to collect data (opinions) related to environmental issues; (2) record data; (3) analyze data; and (4) make inferences and recommendations based on data.

ACTIVITY: This is a model opinionnaire. Your students may prefer to make up their own based on other issues in their community. The following rules should be discussed before making up your opinionnaire:

1. Carefully decide the exact information to be collected.
2. Specify the exact geographic area in which data are to be collected.
3. Collect enough data to make sure the information is representative of the problem in question.
4. Record all data carefully and completely.
5. Work out a system that will accurately communicate the data to others, e.g., charts, graphs, tables.
6. Make sure that all conclusions, inferences and recommendations are substantiated by the data collected.
7. Members should be prepared concerning the basic rules of courtesy and understand that there are people who resent being asked such questions and may be rude to them when asked the questions.

This opinionnaire is designed to collect citizens' opinions and concerns about certain aspects of littering. It is suggested that samples be taken from several segments of the population, i.e., junior high students, high school students, people aged 20-30, and people over 30. It should be read to the persons being surveyed. A minimum of 25 persons per sample is recommended.

In order to summarize the results of your opinionnaire, make up a summary sheet as follows:

	Yes	No	Undecided	Males	Females	Totals
Question 1 Question 2 Question 3 etc.						

Use different summary sheets for each age group.

For evaluation, consider the following questions:

A. Are those values expressed by citizens consistent across the populations which were sampled? Why is this the case, or why not?

B. Do you believe that different opinions should be shaped concerning littering in your community?

C. If a problem exists in your community, what recommendations could you pose for helping resolve the problem? Do you believe this problem could be solved with one single action or a combination of actions?

MODEL OPINIONNAIRE

Introduction: Hello, my name is _____. I am a member of the (Class or group name) in (name of community). We are collecting information about how people feel about littering (or other issue).

Initial Data:

Sex: M _____ F _____

Age: _____ Jr. High
_____ Sr. High
_____ 20-30
_____ Over 30

Questions: Answer Yes, No or Undecided.

Yes	No	Und	
☐	☐	☐	1. Do you consider the littering of public and private property to be a problem in this community?
☐	☐	☐	2. In your opinion, does littering have any ill effects on the beauty or asthetic quality of this community?
☐	☐	☐	3. Does littering have any public health impact on the community.
☐	☐	☐	4. In your opinion, does litter clean-up cost this community much money?

5. In which of the following places is the community do you think littering is at its worst:

_____ schools
_____ public Streets
_____ shopping areas
_____ private property
_____ gas station, drive-ins
_____ other

6. What age persons do you believe are the most responsible for littering?

_____ Junior high

_____ Junior high and senior high

_____ College age

_____ Over 21

7. Which of the following would you be willing to throw away on public or private property?

_____ Cardboard box full of empty cans or bottles

_____ A sack of wastepaper from a drive-in

_____ One empty bottle or can

_____ A paper soft-drink container

_____ A wrapping from gum or candy

_____ None of these

8. Which of the following statements concerning law enforcement do you agree with most?

_____ Law enforcement officers should ignore people who litter.

_____ Law enforcement officers should enforce anti-littering laws only in cases of extreme or severe littering.

_____ Law enforcement officers should enforce anti littering strictly to the letter of the law.

☐☐☐ 9. Would you ever consider reporting a severe case of littering to the police?

☐☐☐ 10. Have you ever reported a severe case of littering to the police?

☐☐☐

11. Do you personally wish that fewer people would litter?

12. In your opinion, what is the most important reason for the litter problem as it exists today? (record answer)

This is the end of our opinionnaire. Thank you very much for your help!

TITLE: **PROTECTING ENDANGERED SPECIES**
LEVEL: Grades 7-12
SUBJECT: Biology, Environmental Studies, Social Studies
REFERENCES: Adapted from previous ERIC/SMEAC activities.

OBJECTIVES: Students will be able to: (1) identify variables and patterns of variables that lead plant and animals to endangered status and (2) evaluate protection and management options for endangered species.

ACTIVITY:

1. Distribute a current list of endangered and threatened species to each participant. Suggested sources for obtaining such a list include: U.S. Office of Endangered Species, U.S. Fish and Wildlife District offices, State Department of Natural Resources, Audubon Society, Sierra Club.

2. Have each participant select one species from the list, trying to avoid repetition of species. Make sure that plants as well as animals are selected.

3. Allow research time, and ask each to prepare a one-page summary on the status of his or her chosen species. The summary should include: the name of the species, the location in which it is found, its status (threatened or endangered), numbers in existence, major causes for the dangers the species faces, and current management and protection practices. If possible, pictures of the species should also be included.

4. Create a display of the summary sheets. Try to obtain permission to put the display in a public place, such as a local school or community center. (You may want to obtain this permission in advance.)

DISCUSSION:

1. What are the major causes resulting in endangered or threatened status for plant and animal species?

2. What role do people play in bringing about the changes that cause endangerment?

3. How does the extinction of a species affect the rest of the world ecosystem?

4. Does the extirpation (extinction in one state, where the species still exists in other areas) of a species have the same effect?

5. What can individuals do to help protect endangered species? Do individuals have a responsibility to take part in the protection of endangered species?

EXTENDING THE ACTIVITY

Invite representatives from organization such as the local Garden Club or Greenpeace to speak to the group about their efforts to save a particular endangered species.

Compare the content of their presentations to information obtained by students.

TITLE: **A TOXIC WASTE CASE**
LEVEL: Grades 7-12
SUBJECT: Science
REFERENCES: Adapted from previous ERIC/SMEAC activities.

OBJECTIVES: Students will be able to: (1) identify relevant data; (2) identify patterns of data; and (3) identify need for additional data.

ACTIVITY:

1. Divide the group into teams of five to six members.
2. Distribute copies of the handout, and allow discussion. Have each group arrive at one plan of action.
3. Bring the teams together and share the results.
4. Debrief.

DISCUSSION:

1. Which data are relevant to the potential problem?
2. What patterns of observations and behaviors are evident?
3. What additional data are needed?
4. What action(s) should be taken?
5. Do the residents have a responsibility to people in surrounding countries? Why or why not?

A TOXIC WASTE CASE (Handout)

You live in a town that is hundreds of miles away from any industrial center (like Detroit or Chicago). The town has a population of 3000. The major income of the town has been tourism due to Blue Lake, a beautiful clear wilderness lake which is nearby.

Forty years ago, in the early 1950s, your town convinced a chemical company that was looking for a site to build its plant in your town. The new plant would create 125 new jobs and bring in an $11 million tax base. In the early 1950s the resources of the lake seemed endless, while the prospects for economic growth of the town appeared all too limited.

Following is a chronology of events that occurred after the company broke ground:

1952 - Company breaks ground. Water Resources Commission grants waste disposal permit. Department of Natural Resources (DNR) conducts Blue Lake biological survey, finds healthy aquatic environment.

1955 - Chemical company calls waste disposal "major problem, due to local and state ordinances."

1956 - Company finds that soluble contaminants on the surface will quickly run into groundwater. Company prepares to manufacture C56, basis for pesticides Kepone and Mirex. State requests data on five chemicals discharged in C56 process. Company says it sent toxicity data; state says it never arrived.

1956-79 Company produces 25,000 tons of C56 per year. No state regulator asks about residues. Meanwhile, company stacks 20,000 55-gallon reside drums in woods north of plant.

1973 - DNR surveys Blue Lake, finds trouble.

1975 - Company hires outside consultant to study groundwater. Tests show 10 per cent concentration of firm's discharge water kills fish within 15 minutes.

1988 - Members of community that live downwind of plant become more and more concerned about odors wafting from the plant. It smells odd, like laundry bleach and geraniums mixed together.

What do they - and you, as members of the community - do?

TITLE: **DEVELOPING AN ENVIRONMENTAL ETHIC**
LEVEL: Grades 7-12
SUBJECT: Language Arts, Science, Social Studies
REFERENCE: Adapted from other SMEAC activities.

OBJECTIVES; Students will be able to: (1) state what an ethic is; (2) evaluate statements related to needs; and (3) evaluate possible conservation action.

ACTIVITY: Ask each of your students to develop a written description of his/her own "Personal Energy Conservation Ethic." The purpose of the "Ethic" is to guide the student's daily use of energy.

Before the actual writing, the students should discuss the following, then keep them in mind when writing their individual ethics:

1. What is an ethic?
2. What is energy conservation?
3. What are the differences between essential needs and nonessential desires?
4. What are some examples of both good and poor energy conservation actions?
5. What are you willing to do for the sake of energy conservation?

After it is written, students may want to share their ethic with the class. The class could then discuss the following:

1. What factors might change your energy conservation ethic in the future?
2. How can you encourage other people to develop and practice an energy conservation ethic?

TITLE: **KEY MANGROVE: A SYSTEM IN CONFLICT**
LEVEL: Grades 8-12
SUBJECT: Science
REFERENCE: Adapted from the CLASS Project

OBJECTIVES: Students will be able to: (1) critically use information sources; (2) identify ways in which people have changed wetlands; (3) identify benefits or harm caused by changes to wetlands; (4) identify changes in wetlands as temporary or irreversible; and (5) design a plan for development.

ACTIVITY: SETTING THE STAGE

The maps on pages 117 and 118 depict changes that have occurred over a period of 30 years in a hypothetical wetlands area, Key Mangrove. Introduce the first map using the information given under "Change in a Mangrove Ecosystem." All the changes which occurred in this wetland area over the 30-year period are listed for you, but allow your students the opportunity do discover the changes themselves.

A mangrove swamp offers just one example of a wetlands ecosystem. You may prefer to adapt this exercise to focus on other wetlands types, like prairie potholes or bogs, instead.

PROCEDURE

1. Examine all four maps with your students. Use these questions to guide their observations and draw conclusions about the development that has taken place on the island.

   a. Look at the first map. About what percentage of Key Mangrove was covered by mangrove swamp 30 years ago?

   b. Look carefully at the development that has taken place at each ten-year interval. In each case, how has transportation increased? What industries have been added or expanded? How has the residential development increased? What recreational facilities have been added? What public services have been added to meet the needs of the residential and industrial development? What have been the effects of the mangrove swamp on the key itself? Why is the swamp important?

   c. Compare Map #1 with Map #4. What is the percentage of mangrove swamp that remains? (Divide the areas to be compared into grids, then calculate the percentages from the number of grids in each area.)

   d. What percentage of the original mangrove swamp was filled in at each ten-year interval?

   e. What was built first? How did this stimulate the rest of the development?

f. What has been the effect of this development on the wetlands and the animals living and breeding there?

g. Do you think the shrimp industry has been affected by the increase in development? In what way?

h. In what ways could people use the mangrove swamp in its natural state for recreation? In what ways have people altered the mangrove swamp for recreational purposes? How have the recreational uses of the island changed over time?

i. What immediate benefits are the result of development of the wetland? What are the long-term benefits of this development? Who or what has been adversely affected by the development of the wetlands?

j. Where could development have taken place on this island without destroying the mangroves? Why do you think more development didn't take place in these areas?

k. Do you think people who moved in 30 years after development began really know why the island was named Key Mangrove?

2. Now your students are ready to create their own management plans for the island using the first map as their starting point. Generally, their plans should allow for the orderly development of the island and the conservation of its natural features.

   a. Their plans must provide for human needs such as housing, food, schools, recreation, and waste disposal.

   b. Their plans must still protect the natural system, recognizing its aesthetic, economic, and ecological importance.

SUMMARY

When students have completed their plans, share them as a class and use these questions to help them understand the process they used in developing their plans:

1. What development was **not** included in your plans? Why not?

2. Whose needs did you think were most important to consider as you developed your plan?

3. Did you have problems finding a balance between development and conservation?

4. Who do you think would object to your plan? Do you think their objections would be legitimate or would be raised simply to further their own interests?

5. Did you find cases in your planning processes in which the wishes of an individual or small group became more important than those of the whole group? In which cases?

6. What compromises did you make?

7. Look at the original maps. What changes would you make at each ten year interval? Why?

CHANGE IN A MANGROVE ECOSYSTEM

You will notice that 30 years ago the hypothetical island, Key Mangrove, was largely uninhabited. Only four vacation estates had been built on the island. Much of the area was covered by mangrove swamp.

Red mangrove, a tree species adapted to brackish or salty water, covers large portions of this type of swamp. These trees grow easily in water and can be recognized by their arching, silt-like roots, which are at least partially responsible for the growth of the island itself. The roots trap materials carried by ocean currents and protect the accumulating land mass from ocean waves or hurricanes. The mangrove drops leaves which provide nutrients for the accumulating soil. These dropped leaves also provide habitat and food for the plentiful animal life, from invertebrates to fish, birds, and occasionally, mammals.

A mangrove swamp is a breeding area and habitat for many marine animals, especially shrimp. Many varieties of birds live and breed here. Herons, woodstorks, and other wading birds nest here in great numbers. Mollusks, such as coon oysters and Florida hornshell, live in these swamps. Bonefish come in with the tide to feed on the crab and mollusks living in the shallow water.

Because of the abundance of wildlife and marine life, Key Mangrove was a fisherman's and seafood lover's paradise for years. Shrimpers from a coastal town on the mainland fished the waters of Key Mangrove and took their catch to a large packing firm on the mainland for processing. The mangrove swamp is a fragile ecosystem, and its basis, the red mangrove trees, may be affected by slight variations in salinity and in nutrients carried in the water.

TEN YEARS LATER

-The ferry has been replaced by a bridge allowing easier access to the mainland.
-Some shrimp fishermen have moved permanently to the island now that a bridge connects it to the mainland.

STUDENT ACTIVITIES

-A shrimp packing plant has been built.
-A housing development has been built which furnishes homes for the workers at the shrimp packing plant.
-A sewage treatment plant has been built.
-A supermarket and a drug store have been built on the island.

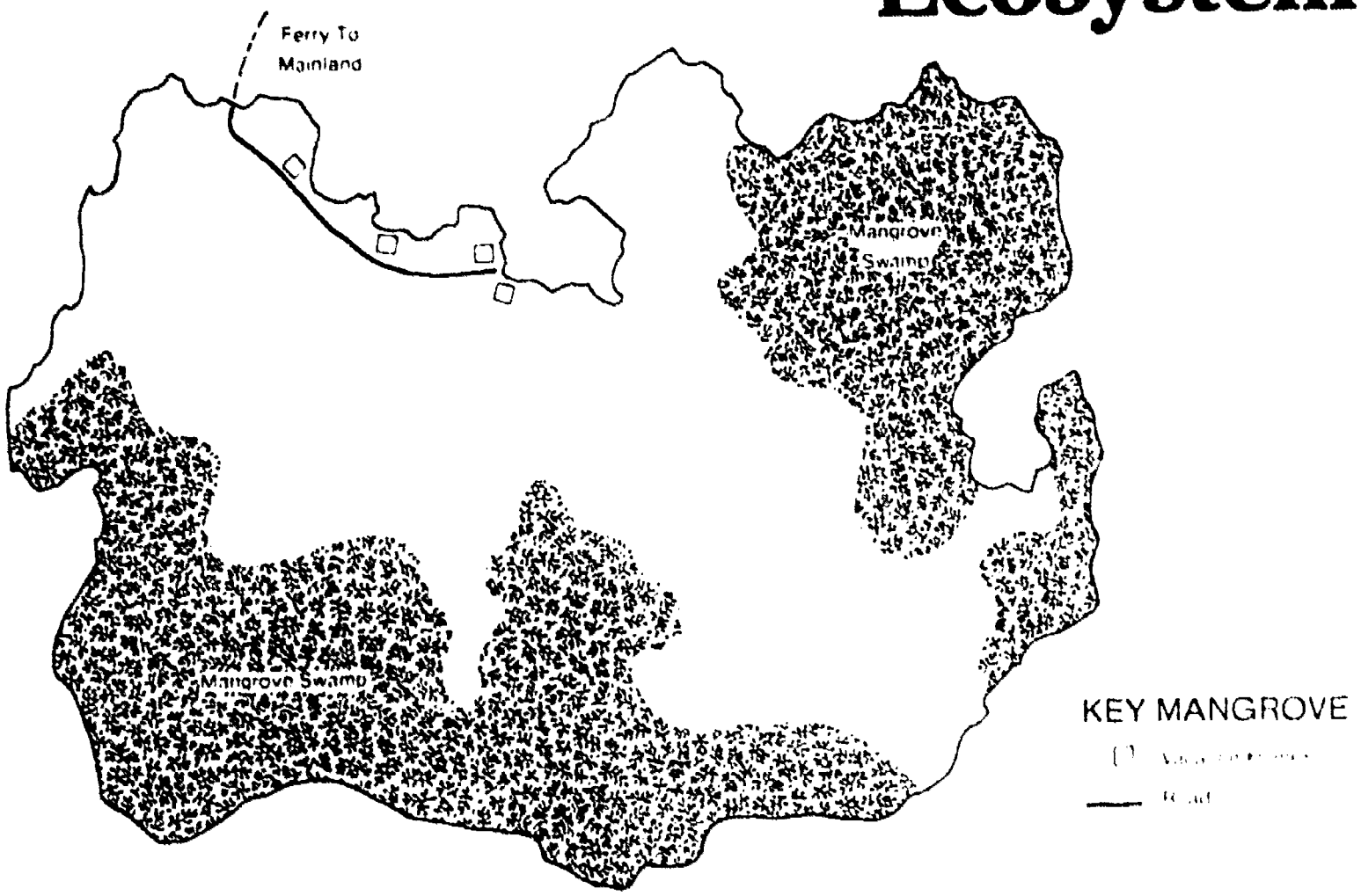
TWENTY YEARS LATER

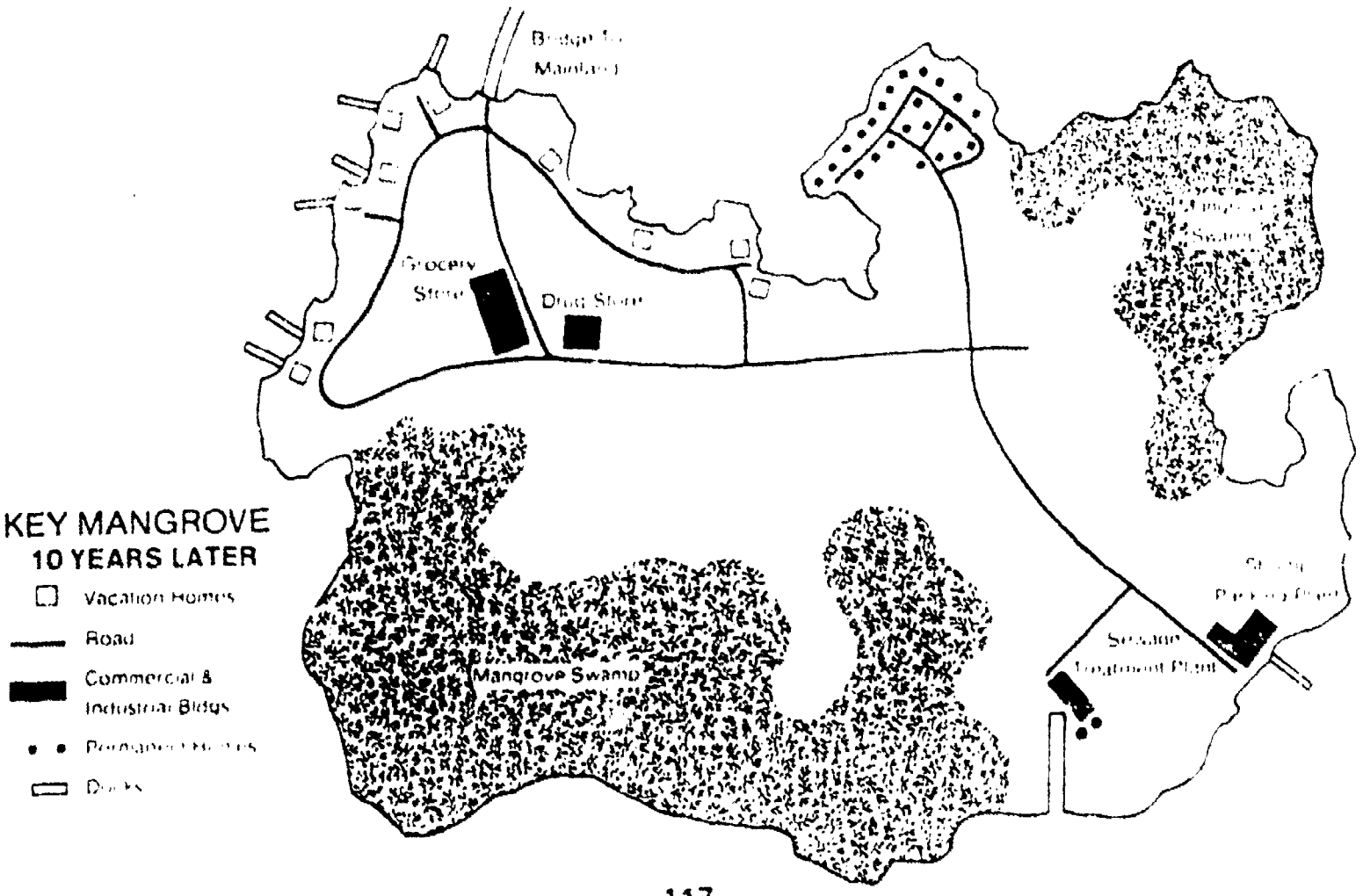
-An oil company has built a refinery on the island.
-The shrimp packing industry has grown and more workers are needed.
-A sanitary landfill has been established.
-More housing has been built for workers at the new plants.
-A shopping mall has been built.
-Two hotels and a marina have been built, increasing tourist trade.
-A school has been built near the new housing development.
-A golf course has been built.

THIRTY YEARS LATER

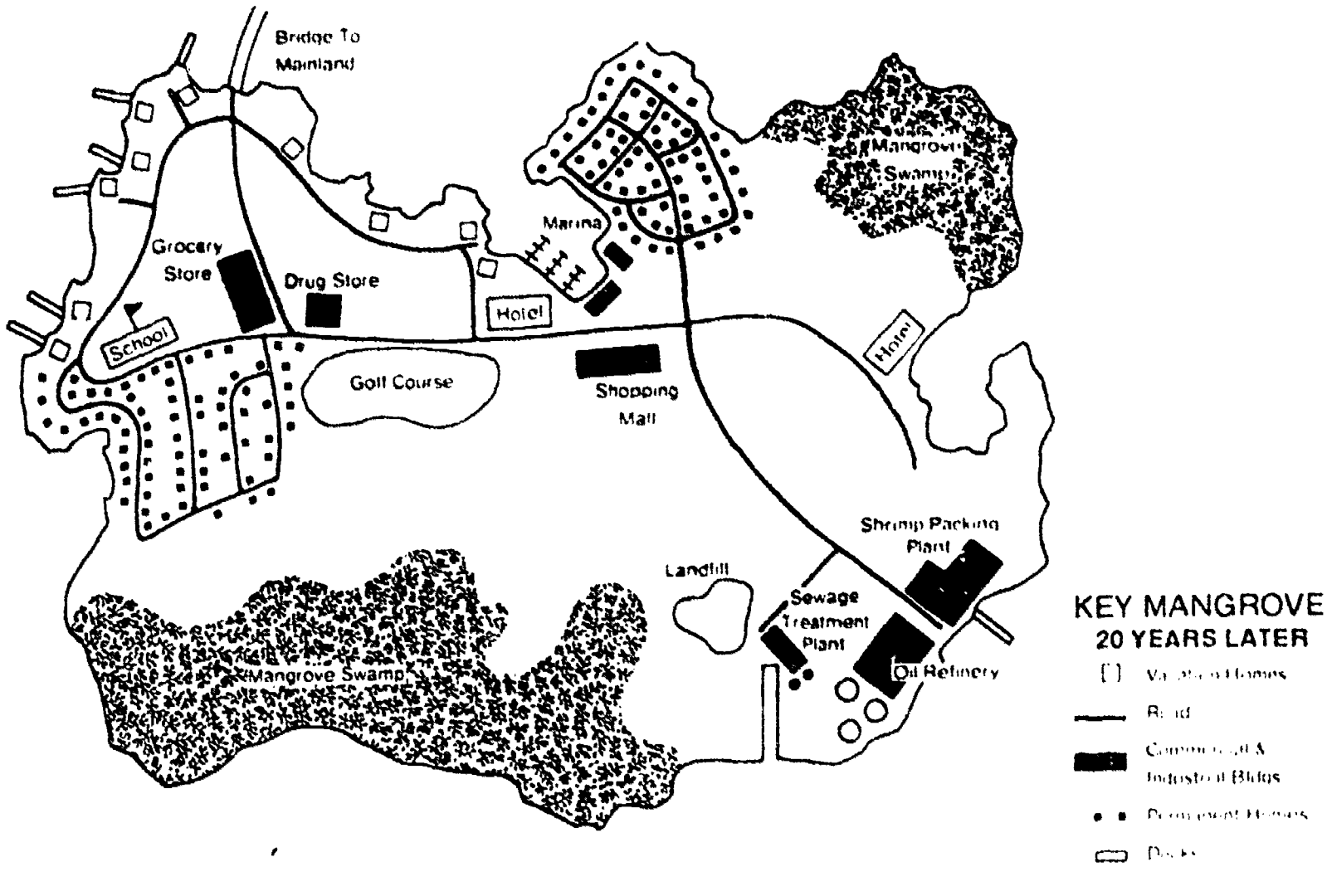
-Two more hotel complexes have been added and the area is becoming more popular as a vacation spot.
-A large public marina has been opened.
-Another golf course has been built on the eastern side of the island.
-The sanitary landfill has been enlarged.
-A housing development with boat ramps, attractive to sport fishermen and water enthusiasts, has been built.
-Another school has been built to serve the growing population.
-A pond has been dredged on the golf course to attract migratory birds.

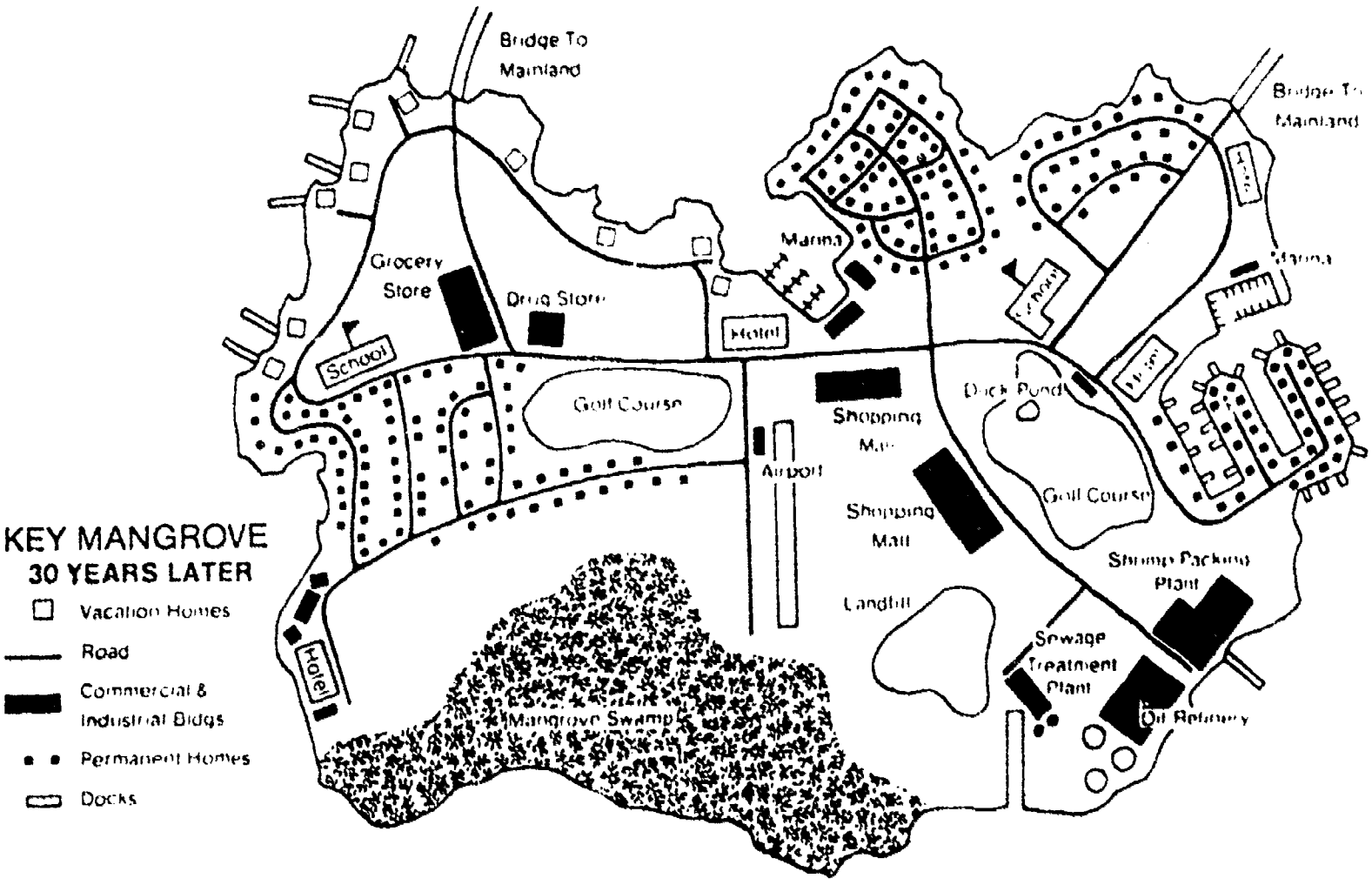
Change In A Mangrove Ecosystem





121


Bridge To Mainland
Mangrove Swamp
Marina
Grocery Store
Drug Store
Hotel
School
Golf Course
Shopping Mall
Hotel
Shrimp Packing Plant
Landfill
Sewage Treatment Plant
Oil Refinery
Mangrove Swamp
KEY MANGROVE
20 YEARS LATER
Vacation Homes
Road
Commercial & Industrial Bldgs
Permanent Homes
Docks


Bridge To Mainland
Bridge To Mainland
Marina
Marina
Grocery Store
Drug Store
School
Hotel
Golf Course
Airport
Shopping Mall
Shopping Mall
Golf Course
Shrimp Packing Plant
Landfill
Sewage Treatment Plant
Oil Refinery
Mangrove Swamp
KEY MANGROVE
30 YEARS LATER
Vacation Homes
Road
Commercial & Industrial Bldgs
Permanent Homes
Docks

TITLE: **HOW CAN WE IMPROVE LAND USE POLICY?**
LEVEL: Grades 9-12
SUBJECT: Social Studies, Science
REFERENCES: Adapted from previous ERIC/SMEAC activities.

OBJECTIVES: Students will be able to: (1) demonstrate an understanding of the watershed concept of land use management; (2) demonstrate a knowledge of variables influencing land use policy; (3) indicate how changing political boundaries could help improve land use; and (4) suggest actions needed to improve land use when political boundaries can not be changed.

ACTIVITY: BACKGROUND

Political boundaries cut across watershed boundaries, often dissecting a single watershed into many political units, each autonomous from the others. Counties often use major rivers as boundaries, creating a split down the middle of the watershed, in which those with authority on each side of the river have different ideas about how to use it. Regional planning districts often include parts of many watersheds but seldom the entire watershed of any major stream. Under these conditions, it is obvious that any attempt to clean up water in a town downstream would have, without equal commitment from all towns upstream, little chance to success.

Watershed studies are investigations of the use and misuse of the land which drains into a stream. Water quality in the stream draining the land is an index of land use quality, and as such is only part of a watershed analysis. It is important that a watershed study begin with a general overview of the entire watershed - its land use, people, potential problems, and stream survey, not just the latter. The watershed is a geographical region in which you begin. Once the problems are identified and understood, the search for answers may extend well beyond the boundaries of the watersheds, possibly into studies of:

- laws and potential laws that could alleviate the problems at the local, county, state and federal level;
- the processes in society that create the problems and alternatives available to solve them;
- costs and benefits of alternative solutions;
- history of the prob ns and peoples' attitudes toward them; and
- ways of stimulating people to correct the problems

all of which involve social science and none of which are concerned with water pollution per se.

STUDENT ACTIVITIES

1. Using topographic maps, determine the boundaries of the watershed(s) in your community. Locate your home and/or your school within the watershed(s). (NOTE; This is often extremely difficult, perhaps impossible, in large urban areas).

2. Make a watershed map of your community and its surroundings. Superimpose on it political subdivisions--county lines, city limits, township boundaries, and the like. Determine why, or speculate as to why political boundaries were drawn as they were, and how they relate to watershed boundaries.

DISCUSSION

1. What advantages might there have been, had watershed boundaries been used locally in determining political boundaries?

2 How does land use in an upstream area have implications for those living downstream? Extend this to environmental considerations, such as water pollution.

3. If political boundaries were identical with watershed boundaries, what advantages might exist for community land use management?

4. What special issues are created in management of international watersheds? Are these issues normally considered in resource management? In what areas of our country are these issues significant?

TITLE: **PLAN YOUR COMMUNITY'S FUTURE**
LEVEL: Grades 10-12
SUBJECT: Social Studies, Language Arts
REFERENCE: Project Learning Tree

OBJECTIVE: Students will be able to state land-use planning goals, classifications, and criteria, and will be able to use these goals, classifications, and criteria in developing comprehensive community land-use proposals.

ACTIVITY: Initiate a discussion with your students based on what they want their community to be like in the future. Then ask the students to develop some long-range planning goals for their community, putting these goals in writing. Suggest that they consider, as they formulate their goals, what they think would be the optimum situation regarding such issues as population size and density, percentage of open space, provisions for housing, energy sources and uses, transportation systems, educational and recreational facilities, ecological conditions, and types of industry to be allowed or discouraged.

After they have decided upon a set of goals - working individually, in small groups, or in one large group - ask the students to draw up a list of classifications for current and proposed community land uses; for example, *high density residential, light industrial, commercial.* (*Note:* These are commonly used terms; but do not discourage students from inventing their own new classifications.) Assist them in developing criteria for each classification, including the land uses which would be permitted under it. If students decide to use a zoning system, these classifications could become the zones. Assist the students in identifying factors which should be considered in determining suitable land uses. Example factors to be considered are environmental impact, economic costs and benefits, and social needs. Once these factors have been identified and researched, the information gathered can be used to establish criteria by which the various classifications can be defined. The criteria and classifications should be consistent with the community's goals.

Next, ask the students to take a detailed look at current land uses. This could be done either by obtaining a land-use map of the community (usually available from a local planning agency) or by conducting a walking land-use survey of the community. A suggested procedure for the walking survey would be to:

1. Make large scale maps of small sections of the community. (Resource: local government engineer will have plot maps.)

2. Distribute the maps to members of the class.

3. From on-site observations, designate land uses as defined previously by the class (adding classifications if necessary) and using some kind of key or color-coding.

4. Compile a master map of current community land uses.

At this point it might be useful for students to split up into teams of three to five persons, with each team focusing on one of the goals designated as a priority by the class. Given the information about the current status of community land, and the land use classifications and criteria they have developed, ask them to develop a community land use proposal that would accomplish the goal their group has chosen to work on. After they have had sufficient time to draft or sketch a proposal, the teams can take turns making preliminary presentations outlining their ideas. In this way, two or more teams may find other proposals with which theirs can easily be combined. These teams can work together, possibly delegating various tasks such as making sketches, drawing maps, and composing written explanations, to create ever more comprehensive planning proposals. Eventually, the class may come up with one or more proposals addressing several of the goal statements they set out to accomplish.

Looking at each plan, discuss how it looks in terms of such considerations as:

Provisions for population increase. For example, housing, industrial growth.) If there are none or few, does this fit with the group's goal concerning optimum population?

Transportation systems. Are they designed primarily for individual or mass transit, or a combination?

Efficiency of energy use. Is the energy base renewable or nonrenewable, or both?

Balance of nature. Have natural cycles been taken into account? For example, are there provisions for plant and animal communities to exist with or near the human community?

Balance of economic, social, and environmental good health. Is it possible for people to live here, make a living, and enjoy their life in harmony with the environment?

Change it represents from the present community land-use situation. What might be implications of the proposed changes in terms of the environment, the local economy, the type of people who live here, and what these people do?

From this the class can proceed to a more general discussion of land-use planning. For example, is planning necessary? Why or why not?

In practical terms, how far ahead can people plan? Should planning be short-term, long-term, or both?

How may land-use planning affect the individual, the family (consider all members separately), the people on fixed incomes, the property owner, the business person?

Assuming the plan(s) developed by the students are based on their priorities for members of the whole community, ask the students to discuss and evaluate the process of land-use planning

they experienced. If they were decision-makers for a community, how much input would they want from community members as to their desires for community land-use, and how much weight would they give their opinions? If they did want input, how would they get it? How can an individual in a community most effectively and responsibly affect community planning?

EXTENSION

Take your students to your local planning office to examine the current land-use or zoning map. Compare the plan with those developed by the students, noting the differences and similarities. Invite the students' recommendations to improve the present plan. Find out whether there is a way for students to contribute to future land-use plans.

SECTION V - BIBLIOGRAPHY

Aquatic Project WILD, Project WILD, Boulder, CO, 1987.

Baron, J. B. and R. J. Sternberg, eds. *Teaching Thinking Skills: Theory and Practice*, Freeman, New York, 1986.

Bennett, S. *New Dimensions in Research on Class Size and Academic Achievement.* National Center on Effective Secondary Schools, University of Wisconsin, Madison, WI, 1987. ED 288 854.

Bransford, J. D. and B. S. Stein. *The Ideal Problem Solver A Guide for Improving Thinking, Learning, and Creativity.* Freeman, San Francisco, CA, 1984.

Carey, S. "Cognitive Science and Science Education." *American Psychologist*, 41, p 1123-1130, 1986.

Cohen, Michael and Larry Flick. *Expanding Children's Thinking Through Science*, ERIC Clearinghouse for Science, Mathematics and Environmental Education, Columbus, OH, 1981.

Costa, A., ed. *Developing Minds: A Resource Book for Teaching Thinking.* Association for Curriculum and Supervision, Arlington, VA, 1985. ED 262 968.

Halpern, D. F. *Thought and Knowledge: An Introduction to Critical Thinking*, Erlbaum, Hillsdale, NJ, 1989.

Heiman, Marcia and Joshua Slomianko. *Critical Thinking Skills. Analysis and Action Series.* National Education Association, Washington, DC, 1985. ED 265 501.

Heiman, Marcia and Joshua Slomianko. *Thinking Skills Instruction: Concepts and Techniques. Building Student's Thinking Skills Series*, National Education Association, Washington, DC, 1987. ED 306 559.

Howe, Robert W. and Charles R. Warren. *Teaching Critical Thinking Through Environmental Education*, Environmental Education Digest Number 2, ERIC Clearinghouse for Science, Mathematics, and Environmental Education, Columbus, OH, 1989. SE 051 459

Iozzi, Louis A. *Science-Technology-Society: Preparing for Tomorrow's World.* Sopris West, Longmont, CO, 1987. ED 289 737.

Jones, Beau, Annemarie Palinisar, Donna Ogle and Eileen Carr. *Strategic Teaching and Learning: Cognitive Instruction in the Content Areas, Association for Supervision and Curriculum Development, Alexandria, VA,* 1988.

Keating, Daniel. *Adolescents' Ability to Engage in Critical Thinking*, National Center for Effective Secondary Schools, Madison, WI, November, 1988. ED 307 508.

Kuhn, D., E. Amsel, and M. O'Loughlin. *The Development of Scientific Thinking Skills*, Academic Press, San Diego, CA, 1988.

Marzano, Robert J., Ronald S. Brandt, Carolyn Sue Hughes, Beau Fly Jones, Barbara Z. Presseisen, Stuart C. Ranken, and Charles Suhor. *Dimensions of Thinking: A Framework for Curriculum and Instruction*, Association for Supervision and Curriculum Development, Alexandria, VA, 1988. ED 294 222.

Marzano, R. J. and C. L. Hutchins. *Thinking Skills. A Conceptual Framework*, Mid Continent Regional Education Laboratory, Kansas City, MO, 1985. ED 266 436.

Nickerson, R. S., D. N. Perkins, and E. E. Smith. *The Teaching of Thinking*, Erlbaum, Hillsdale, NJ, 1985.

Ohio Department of Natural Resources. *SuperSaver Investigators*, Ohio Department of Natural Resources, Columbus, OH, 1988. SE 051 286.

Project Learning Tree: Supplementary Activity Guide for Grades K through 6. The American Forest Institute, Inc., Washington, DC, 1975. ED 290 612.

Project WILD Elementary. Project WILD, Boulder, CO, 1983.

Resnick, Lauren B. *Education and Learning to Think*, National Academy Press, Washington, DC, 1987. ED 289 832.

Resnick, L. B. and L. E. Klopfer. *Toward the Thinking Curriculum: Current Cognitive Research - 1989 ASCD Yearbook*, Association for Supervision and Curriculum Development, Alexandria, VA, 1989.

Stiggins, Richard J., Evelyn Rubel, and Edys Quellmalz. *Measuring Thinking Skills in the Classroom. Revised Edition,* National Education Association, Washington, DC, 1988.

The Class Project. National Wildlife Federation, Washington, DC, 1984.