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ABSTRACT

This publication presents a variety of participation oriented environmental education activities for teaching natural resources education. Activities are divided into five categories: (1) Elementary School Activities; (2) Elementary-Junior High School Activities; (3) Junior High School Activities; (4) Junior-Senior High School Activities; and (5) Senior High School Activities. Most activities include a purpose, level, subject areas, reference of the source of the activity, and the activity itself. A variety of experiences are included for most school subject areas. (RH)

Selected and developed by
Mary Lynne Bowman

Introduction

by

Rudolph J. H. Schafer

Teaching Natural Resource Management Through Environmental Education Activities

ERIC Clearinghouse for Science, Mathematics
and Environmental Education
The Ohio State University
College of Education and
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1200 Chambers Road, Third Floor
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December 1981

ENVIRONMENTAL EDUCATION INFORMATION REPORTS

Environmental Education Information Reports are issued to analyze and summarize information related to the teaching and learning of environmental education. It is hoped that these reviews 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.

John F. Disinger
Associate Director
Environmental Education

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FOREWORD

The ways in which we manage our natural resources and their products are critical in determining our present and future quality of life. Indefinite use of our natural resources without proper management can only lead to severe consequences to our standard of living.

Wise management of natural resources is not just the responsibility of the scientist. It requires the knowledge, skills and commitment of all people. We cannot afford to have a single segment of our society ignorant of the contributions and limitations of the resources so basic to our survival.

One way to develop awareness of the importance of wise management of our natural resources is by teaching environmental and natural resource management in the schools throughout the nation. It is no longer enough to read about what our resources are, where they come from and how we use them; we need to extend learning to include impact of man's use of resources, consequences of lack of sound management practices, and concepts and considerations of management choices.

State natural resource management agencies have expertise that is available to the general public, including teachers. This ERIC publication is an example of a cooperative effort between ERIC/SMEAC and the School of Natural Resources at The Ohio State University, with assistance provided by various divisions of The Ohio Department of Natural Resources.

The Ohio Department of Natural Resources is pleased to have had the opportunity to contribute to an effort of this nature as a demonstration of our commitment to the education of youth in sound natural resource management practices.

Robert W. Teater, Director
Ohio Department of Natural Resources

December 1981

ABOUT THE AUTHORS

Mary Lynne Bowman is an Associate Professor of Environmental Education in the School of Natural Resources and a Research Associate at the ERIC Clearinghouse for Science, Mathematics, and Environmental Education at The Ohio State University. Dr. Bowman teaches Natural History, Natural Resource Education Programs in the Urban Setting, and Environmental Education in the Park Setting, and has conducted many Environmental Education workshops for teachers. Her publications include Environmental Education 1975: A State-by-State Report, Environmental Education in the Urban Setting, Land Use Management Activities for the Classroom, Energy Activities for the Classroom Volume II. Values Activities in Environmental Education, Teaching Basic Skills through Environmental Education Activities, and Environmental Education in Action IV: Case Studies of Teacher Education Programs for Environmental Education.

Rudolph J. H. (Rudy) Schafer is Program Director for Environmental/Energy Education for the California State Department of Education, a position he has held since 1969. In this position, he works with schools, resource management agencies, the private sector, and others to produce worthwhile programs and materials for classroom use, and administers a $500,000 local assistance grant program. Prior to entering state government, he was a teacher, assistant principal, public information officer, and conservation education specialist with the Los Angeles City Schools. For 11 summers he worked as a seasonal ranger for the National Park Service. Mr. Schafer is a graduate of University of California-Santa Barbara and has an M.S. in education administration from University of Southern California. He was founder and is current president of the Western Regional Environmental Education Council, co-founder and past president of the Alliance for Environmental Education, and currently serves on the Board of Directors of the National Wildlife Federation. The author of a number of papers and articles in The Journal of Environmental Education, Environmental Education Report, and various other publications, he also edited the reports of the 1975 Snowmass Conference on Environmental Education, of which he was organizer and General Chairman.

PREFACE

Natural resource management requires both knowledge of the resource(s) and understanding of management techniques. In some instances, it was not feasible to include in a single activity the necessary information needed to manage a resource plus appropriate management exercises. Thus, many of the activities contained in this booklet have been developed into mini-units. The first activities in each mini-unit focus on increasing the knowledge of the resource to be managed, while subsequent activities provide appropriate management applications.

The activities, designed for student use in elementary through high school classes, are "action-oriented" and involve student participation. Each has been classified by the author according to appropriate grade levels and subject matter. In addition, each contains a statement of purpose designating how the activities relate to natural resource management concepts and concerns.

It is hoped that the teachers who use these materials will recognize that the classified categories and statement of purpose serve only as a guide in selecting appropriate activities and should not be considered a fixed structure. In fact, it is recommended that teachers check for activities in the other grade level sections and subject areas that may be appropriate for use or to adapt for use for their own particular set of learners. It is also not necessary to use any total unit. Teachers may wish to select specific activities from the various mini-units.

This booklet of natural resource management activities draws on ideas suggested by personnel in various divisions and offices of the Ohio Department of Natural Resources as well as materials developed by public school teachers which have become a part of the bank of teaching resources collected by the ERIC Clearinghouse for Science, Mathematics and Environmental Education.

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Documents bearing SE numbers are in the local collection of the Information Reference Center for Science, Mathematics, and Environmental Education, and have not been announced through Resources in Education as this volume goes to press. Persons wishing to secure such materials should locate them from other sources; in most cases this will be the listed publisher or organization.

The author wishes to express particular appreciation to the following personnel from The Ohio Department of Natural Resources for their assistance in obtaining materials and suggestions of specific activities:

Robert W. Teater, Director;

Richard E. Moseley Jr., Chief, Natural Areas and Preserves;

Stephen W. Goodwin, Administrator of Staff Operations, Natural Area and Preserves;

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Norbert Lowder, Environmental Technician, Oil and Gas;

Lori Hunter, Training Officer, Reclamation;

Donna L. T. Szuhy, Education Supervisor, Public Information and Education;

Dan Atzenhoefer, Youth Conservation Corps Program Manager.

The references cited in this volume should be useful to persons interested in obtaining more ideas and activities.

Mary Lynne Bowman

December 1981

NATURAL RESOURCE MANAGEMENT CONCEPTS
IN ENVIRONMENTAL EDUCATION

Selected from Roth, Robert E., Environmental Mangement Concepts - A List. University of Wisconsin, Research and Development Center for Cognitive Learning, Madison, 1970. ED 045 376.

The following natural resource management conceptual objectives guided the selection and development of the teaching activities included in this publication:

1. The management of natural resources to meet the needs of successive generations demands long-range planning.

2. Natural resources management involves the application of knowledge from many different disciplines.

3. Options available to future generations must not be foreclosed.

4. Resource depletion can be slowed by the development and adoption of alternatives.

5. Social and technological changes alter the interrelationships, importance, and uses for natural resources.

6. Man has ability to manipulate and change the environment.

7. Increased population mobility is changing the nature of the demands upon some resources.

8. The management of natural resources is culture bound.

9. Management of habitat is considered to be an effective technique of wildlife management when the desire is to increase numbers of particular populations.

10. Esthetic resources and recreational facilities of economic and noneconomic value are becoming increasingly important in leisure-time activities.

TABLE OF CONTENTS

INTRODUCTION

EDUCATION AND RESOURCE MANAGERS:

A PARTNERSHIP WITH A FUTURE

by Rudolph J. H. Schafer

Flying can be an instructive and rewarding experience for one sensitive to environmental and resource use concerns. Spread out below is an ever-changing panorama of mountains, cities, forests, agricultural lands, waters, waterways, and deserts. This view from above helps one gain a better perspective as to how we as humans relate to our earthly home and its resources.

It is a mixed picture, to be sure. There are well-planned and spacious communities, and there is the sleaze of uncontrolled urban sprawl. Lush green farmlands which provide a myriad of useful products may be seen gradually giving way to eroded, overworked and submarginal agricultural areas. Well-managed commercial forests as well as parks and wilderness areas in which wildlife flourishes and the waters run fresh and clear are balanced by crowded freeways and pollution-laden industrial areas. Waterways run clean and clear to pristine bays in some places, while others are merely open sewers. It's all there, the good and the bad.

What we see below tells us a lot about who we are and what we are--both as individuals and as people. We have been blessed with a rich and productive land and have applied to it a technology which provides for us those things which we prize and value. Quite literally we have used and are using our technology to carve upon the land a likeness of ourselves. If there is ugliness there, it is our ugliness. If there is beauty, it is our beauty. And we are still free to choose.

Fortunately for us, the land can be to some extent forgiving. The misuse and abuse of the past, as we have seen in many instances, can be erased or at least alleviated if we are willing to direct our technologies toward these ends.

A concern for the land and its resources is basic to our survival, both as individuals and as a nation, for we cannot live apart from it. Environmental health and well-being are therefore human health and well-being as well.

And what of the future? What will our land be like twenty, forty, a hundred years from now? No one can really be certain, but the trends are there, and we are gaining in our knowledge of environmental cause and effect. We can be sure, however, that our environmental future is to a large degree in our hands. We have our technologies and we are gaining in our ability to manipulate the physical environment and its resources for better or worse. The directions we take with our technologies are very much dependent upon the values we hold and the choices we make, individually and societally.

Two elements of society play key roles in shaping future environments: resource management and education. Both are concerned with the future. The goal of education is the highest and best use--or conservation--of the human resource. The goal of resource management is the highest and best use--conservation--of natural resources. These goals are interdependent.

What is it that we should expect, environmentally speaking, of these two key elements of society? The major goals of resource and environmental management may be summarized as:

- Creating and maintaining a physical environment which promotes human health and well being.

- Making available to society a sufficient supply of natural resources to enable us to meet our reasonable, repeat reasonable, needs and expectations, now and in the future.

- Creating, preserving and enhancing the amenities which give meaning and purpose to life: well-planned recreational areas, wildlife and natural areas, historical resources, clean and well-planned cities, and the like.

And what should be expected of educators in respect to resource and environmental conservation? We must accept responsibility for providing nothing less than a comprehensive preschool-through-graduate-level program directed toward achieving two major goals:

- Helping each individual develop a life style which is compatible with a healthy and productive ecosystem. A myriad of factors must be considered by the individual in developing such a life style. Family planning, food, clothing and housing options, transportation and recreation choices, career selection, habits, attitudes and behaviors in the work environment, one's appetite and demands for goods and services--all these and more such choices must be weighed with respect to their effects upon the physical environment and its resources. An educational program to help students make such choices should permeate all areas of the curriculum at all levels, and involve community support and participation as well.

- Encouraging responsible social behavior which is supportive of good resource management and environmental conservation and carries with it a commitment to effective action. Individual action is not enough. We must work together through our social institutions, and be willing to get involved, personally if necessary, to create and maintain an environment which promotes human health and well-being. It is encouraging to note that since the early '70s, there has been strong public support for environmental and resource conservation, and that attempts by latter-day politicians to reverse the trend have been met with strong resistance.

Fortunately the view that resource management professionals and educators share a common goal and should be working together is not a great new discovery to many people active in both fields. Worthwhile things have been happening over the past several years, even decades--enough so that some generalizations are possible.

BASIC PROGRAM SUPPORT

Resource management professionals and their agencies are usually more interested in and supportive of conservation/environmental education than is the professional education establishment. In California, pressure by the Secretary for Resources and a number of conservation organizations precipitated legislative hearings which resulted in the establishment of conservation-directed curriculum requirements and an office for Conservation Education in the State Department of Education. Funds for local assistance programs are allocated to the department from the Environmental License Plate Program fund, which is controlled by the Secretary for Resources.

In Colorado, financial support for a full-time conservation education professional comes from the State Division of Wildlife. The state program in Florida is strongly supported by a coalition of citizen conservationists and resource management agencies.

Any successes which may be attributed to the Subcommittee on Environmental Education of the Federal Interagency Committee on Education has been due to the work and leadership supplied by federal resource management agencies.

WORKING WITH RESOURCE MANAGEMENT PEOPLE

Although resource management agencies and interests generally support Conservation/Environmental Education, they do not always know how to translate their enthusiasm into effective classroom materials, programs, and activities. It is the obligation of professional educators to work with these good people so that they will understand, support, and participate in programs and activities which are based on sound educational principles and practices.

Without such assistance, resource management people often become involved in educational programs and activities of questionable or marginal value.

Some examples:

--equating "telling the agency story" with education. Good education involves presenting issues and helping youngsters develop the skills, knowledge and attitutes to make good decisions. Opinion and/or agency policy may be presented as a part of an educational program or activity, but it should always be identified as such.

--the "one-shot" classroom presentation. A great many agency people spend much of their time doing "one-shot" classroom programs which involve no pre-visit or follow-up learning activities and, more often than not, do not relate to the regular classroom program. These are of little value and are not cost-effective. How many agency people working how many years would it take to reach California's 4.5 million public school students this way? Classroom visits by resource professionals should only be done when

(1) there are definite goals and objectives to be met by the visit which are mutually agreed upon and understood by the classroom teacher and the resource professional; (2) there are pre-visit and follow-up student activities; and (3) the teacher works with the professional during the classroom visit.

--"floating in space" materials and programs. Effective educational programs/materials must connect to the ongoing school program in many ways. Reading-grade level relationships, the regular curriculum, teacher usability, and compatibility with state and/or district policies are among the many factors which must be taken into account in developing usable classroom programs and materials.

All too often, resource management agency people, unaware of these factors, produce materials which are of limited or no value to teachers.

--equating mailing out materials with good program implementation. Teachers and administrators receive lots of mail, and much of it ends up in the round file. In other instances, that nice book or study guide lovingly prepared by an agency ends up on a shelf somewhere to be read "when time permits;" as we all know, time never permits. Producing good materials is only half the job. An effective implementation plan is absolutely necessary if an educational program is to be a success.

--working at the "retail level" with the schools. California has 8,500 elementary and secondary schools, 160,000 teachers, and 1,100 school districts. Similar numbers exist in other states. If you want to go up against those kinds of numbers on a teacher-by-teacher or school-by-school basis, lots of luck. Each state has a delivery mechanism of some sort--usually the state education agency--through which one can reach every school. Obviously, taking advantage of existing delivery systems is the smart way to go.

Recently, I worked with the California Energy Education Forum--an association of educators, energy management professionals and others--to develop the following educational materials and programs policy statement as a useful guide for people outside the education profession. This statement has been modified by the Alliance for Environmental Education, and has proved most useful nationwide.

GUIDELINES FOR THE PRODUCTION, DISTRIBUTION, AND USE OF SCHOOL MATERIALS, PROGRAMS AND ACTIVITIES

As an association of educators, resource management agency personnel, citizen conservationists, and representatives of business and industry, the California Energy Education Forum has demonstrated that people of widely differing interests and expertise can work together on effective programs and activities of benefit to students, their families, and the community. Our membership considers such cooperative involvement with the education *community to be in the best interests of us all and an important means of helping students understand and deal with energy prospects, problems and choices.*

In order that programs, materials, and activities produced for schools by community agencies be of the highest quality and maximum effectiveness, we endorse the following guidelines and further urge their adoption by all CEEP member agencies.

General Consideration

Worthwhile and effective energy education programs, activities and materials:

- *have clearly stated goals and objectives stated in terms of expected student behavior;*
- *are directed toward the best interests of teachers, students, their families and the community;*
- *treat controversial issues fairly and honestly and do not advocate any one particular point of view;*
- *are concerned with helping students learn how to think, not what to think;*
- *clearly identify opinion and company or agency policy, if included;*
- *are not used to sell products, agency policies or political points of view;*
- *are sensitive to human values and avoid racial, sexual, occupational, regional and other stereotypes.*

Design and Production of Materials

Better, more usable educational programs and materials result when:

- *clearly stated and measurable goals and objectives are established early in the developmental process;*
- *those who will be using the materials--students, teachers, administrators--are involved in the process;*
- *they are designed to mesh with ongoing educational activities and are compatible with adopted courses of study, and state frameworks;*
- *provision is made for student-teacher creativity and innovation;*

- *they are targeted to specific grade levels and subject matter;*

- *consideration is given to the physical design and packaging of materials so that they are attractive and convenient to use.*

Program Implementation

An effective implementation plan is needed if educational programs and materials are to be of maximum effectiveness. A good implementation plan:

- *makes use of the services available through professional associations, teacher training institutions, staff development centers, county offices of education, the State Department of Education and other related agencies;*

- *includes provision for the instruction of those who will be using the materials.*

Evaluation

The value of all programs and materials is determined by their effectiveness with students. Evaluation is therefore a key program element, and should provide for:

- *field testing and evaluation of all programs and materials in terms of stated goals and objectives by students and teachers prior to wide-scale implementation;*

- *provision for continuous feedback and modification as needed once a program is underway;*

- *test instruments and evaluation suggestions for classroom use.*

WORKING WITH EDUCATORS

Now that we've looked at some of the concerns educators have in working with resource management people, let's reverse the process and look at some of the problems resource management agencies have in working with educators. Certainly these problems exist. Here are a few examples:

--ineffective use of a resource person's time. As noted above, a good learning experience for students has definite goals and objectives, and is carefully planned and carried out. Unfortunately, there are some teachers who will invite nearly anyone with any kind of a presentation to visit their classrooms. All too often, there is no preplanning or follow-up, and in some cases the teacher leaves the classroom while the presentation is in progress! Sad to say, some of my resource agency friends accept this sort of unprofessional conduct as fairly normal operating procedure.

--the unplanned visit. A number of parks, nature areas, and historic sites open to the general public are sometimes considered fair game by educators for an unplanned and unannounced drop-in visit. Two or three busses pull up, a hundred or so youngsters pile out and--well, you can imagine the problems. The situation is often compounded by the teachers going off somewhere for a cup of coffee while the facility personnel attempt to handle the situation as best they can. Needless to say, such visits are of little or no educational value to the youngsters and are really an unfair imposition on those who have to cope with the situation. Visits should be arranged in advance and contact made with the facility staff so that appropriate plans may be made. Teachers should always stay with the students on such visits, and work with the staff to ensure a good educational experience for the students.

Naturally, teachers should be alert to such problems of litter, vandalism, and other unnecessary damage to study sites before and during the visit.

--"give me 30 of everything you have." Teachers are good at obtaining lists of agencies which offer freebies, requesting great masses of things which they may or may not use. The idea seems to be, "Well, it is all free. I'll look it over, use what I want, and dump the rest." Did it ever occur to such people that one ought to practice good conservation in gathering the materials with which to teach it?

It costs nearly $5.00 for an agency to prepare and mail a letter. Educators should consider this in contacting agencies for assistance. Class letters should be mailed in one envelope so that one general reply will suffice. Class, school, or district orders should be combined in order to save shipping and handling costs.

--the Santa Claus syndrome. Many educators see resource management agencies and the private sector as vast reservoirs of money and materials, all of which is theirs for the asking. Certainly there are resources which can be drawn upon, but requests must be reasonable, and the anticipated outcomes evident. For example, it is much easier to obtain funds to print a handbook, guide, or whatever, than it is to fund the research and development required. Similarly, chances for success in obtaining funds for teacher travel, materials and services for a teacher workshop are much better than asking for the funds to organize the meeting and develop the syllabus. The point here is that most "sources" feel more comfortable being a part of a project in which you and others are contributing, rather than being the "Santa" who pays for everything.

SOME SUCCESS STORIES

Western Regional Environmental Education Council

In 1970, I contacted a number of people in the western region who had state level responsibilities for environmental education to see if we might get together to compare notes on our respective programs, and explore ways in which we might help each other. Out of this meeting grew the Western Regional Environmental Education Council (WREEC), an organization which includes educators and resource management agency personnel from 13 western states. WREEC meets regularly. Members exchange notes and information and work on projects and activities of benefit to all. In its early days, WREEC was supported by a grant from the U.S. Office of Education, but since 1975 membership dues and projects for which the group contracts have provided operational funds.

One of our most successful accomplishments is Project Learning Tree. In 1973, the American Forest Institute (AFI) asked our help in producing an environmental education program emphasizing the forest resource. WREEC agreed to produce the materials and shortly thereafter organized a conference of educators, foresters, and forest industry people to develop a program content outline. Once an acceptable outline was completed, three writing conferences were arranged and classroom teachers were invited to write learning activities based on the content outline. Resource persons from industries, agencies, and private conservation organizations assisted the teachers in preparing a first version. The teacher-written materials were edited and field-tested, and those which were found to be effective went into a revised edition: a set of two supplementary curriculum guides, each containing close to 100 learning activities. Prior to final publication, a number of education and citizen conservation associations were asked to review the materials for factual accuracy and bias. Some minor changes were recommended, most of which were made.

Following completion of the guides, a system was worked out to introduce the materials through workshops in ten western states, utilizing resource management agency, education agency, and industry personnel. Project Learning Tree is now at work in over 30 states. More than 1000 people have been certified as workshop leaders, and more than 40,000 educators have been trained in the use of the materials. In addition to the materials and workshops, a newsletter is produced and distributed and evaluative activities conducted, along with other services and activities to further the program. Two full-time staff implementation specialists and three part-time professionals are employed by AFI to provide these services.

Project Learning Tree represents one of the major success stories in industry, resource management agency and educator cooperation to produce really effective environmental education programs and materials and introduce them into the classroom. Several Project Learning Tree activities are included in this volume.

It is worth pointing out and underscoring some of the factors which made Project Learning Tree the continuing success that it is:

- Through its members, WREEC offered both resource and educational expertise as well as a means of access to the educational establishment of 13 western states.

- The basic content outline had broad input from a variety of sources--educators, foresters, environmentalists, industry people, etc.

- Even though AFI, an industry association, supplied the financial resources, its role was and continues to be one of equal partnership with the educators. There were no hidden or overt agendas on anyone's part, other than that the program should be honest and of the highest quality. WREEC retained final editorial authority over all materials and activities; no one has ever successfully challenged their honesty or accuracy.

- Classroom teachers were involved to a major degree. Not only did this assure that the materials would be useable at the classroom level, but it also gained the involvement of teachers as advocates and supporters of the program.

- All recipients of the materials attend at least one six-hour workshop in which they gain experience in using the activities. In some cases, classroom teachers conduct the workshops. Follow-up studies indicate that this method assures effective and long-term use of the materials.

WREEC has joined with the Western Association of Fish and Wildlife agencies to produce a similar program focusing on the wildlife resource, which will be called Project WILD. An outline has been produced, teacher material has been written, and field testing is underway.

EE Guides

For the past several years the California Department of Education and the California Resources Agency have worked together on various educational programs and activities. Two years ago there was agreement that a curriculum publication based on our mutual experience gained over the past ten years plus that of the field should be produced. A special one-time-only grant of $150,000 from the California Environmental License Plate Program funded the project. This program raises approximately $6,000,000 per year through the sale of personalized license plates for various environmental projects, including $500,000 annually for environmental education.

The first step in the process was to hold a meeting of teachers, curriculum writers, resource agency people and citizen conservationists to determine exactly what kinds of materials should be produced, and what kinds of organizational plans would assure maximum usability. Following this conference, we contracted with the Alameda County Office of Education to produce the publication under direction of the Department of Education with the input of the teachers and resource management agency people. The final product is a set of four EE Guides which:

- Outlines a K-12 environmental education program in which EE is viewed as a theme having implications in all subject matter areas rather than as a separate subject;

- Includes a selection of exemplary learning activities for use at all grade levels which were selected by a number of classroom teachers. The materials emphasize the use of community resources and the outdoor environment and address a variety of teaching styles and techniques;
- Describes in some detail the work, problems, and management techniques used by the various state resource agencies in carrying out their legally mandated programs;
- Lists all of the sources from which teachers chose exemplary materials;
- Lists and indicates most effective classroom use for all state resource agency materials offered to schools;
- Offers suggestions and recommendations for planning a class, school, or districtwide program.

The guides were completed and distributed late in 1981, and a number of implementation activities are underway. It was agreed that a revision would be made in three years; we are already gathering materials and ideas for the 1985-88 edition. Several California EE Guide activities are included in this volume.

QUID PRO QUO?

We have gone from the general to the specific in describing the nature and providing examples of cooperation among resource management agencies, educators, and to some extent, responsible elements of the private sector. A joint policy statement signed by Wilson Riles, California Superintendent of Public Instruction, and Huey D. Johnson, California Secretary for Resources, appearing in the California EE Guide, says in part:

> "The Department of Education and the Resources Agency share responsibility for encouraging the development and maintenance of an effective environmental/energy education program for the schools of California. In recognition of this responsibility, we, the Superintendent of Public Instruction and the Secretary for Resources, agree to provide appropriate services, materials, and expertise to the schools and to coordinate our efforts in a statewide program.
>
> "We further urge educators and resource management personnel at all levels to work together for the benefit of the most precious resource of all, the youth of California."

Hopefully this essay and the materials in this publication will serve to encourage and facilitate good working relationships between these and other elements of society. Working together, we can do important things for the coming generations of Americans. Not working together is at best wasteful of available, valuable resources.

ELEMENTARY SCHOOL

NATURAL RESOURCE MANAGEMENT ACTIVITIES

PURPOSE: To show how contour farming can help prevent erosion.

LEVEL: Elementary School

SUBJECT: Science

REFERENCE: Albert B. Foster & Adrian C. Fox. Teaching Soil and Water Conservation: A Classroom and Field Guide. U.S. Department of Agriculture, Soil Conservation Service, August, 1970. ED 067 218.

MATERIALS: Two boxes about 16 inches long, 12" wide & 4" deep or two round dishpans, two sprinklers, two fruit jars, plastic material, tin or tar paper.

ACTIVITY:

Contour farming is one of the easiest and most widely accepted conservation practices. It is the use of implements along the slope of the land; that is, on the contour. When a farmer farms on the contour he disregards the usual straight field boundaries and straight-rows and follows curved lines whenever necessary to stay on the contour.

Contour farming should be used in combination with crop rotations, grass waterways, fertilizers, and returning organic matter to the soil. Contouring alone will not stop erosion. But it reduces soil erosion as much as 50 percent on a wide range of soil and slope conditions. Steepness and length of slope are important, as well as the crop grown and the condition of the soil.

There are other advantages of contour farming. In low-rainfall areas it helps hold and conserve rainfall. Farmers have found that it saves power, time, and wear on machinery because the equipment is working at peak efficiency all the time instead of being overloaded going uphill and underloaded coming downhill.

Cultivation on the contour helps prevent erosion and saves rainfall in gardens on sloping land.

Fill both boxes with soil taken from the same place. Make them watertight by lining them with plastic material, tin or tar paper.

Set them on a table and place the sticks under the end to make a slope. Place fruit jars below the spouts of the boxes. Using your finger or a pencil, make furrows across the soil in one box and up and down the soil in the other.

Fill two sprinklers with water and slowly sprinkle the two boxes at the same time. Hold the sprinklers the same height above the soil and pour at the same rate. Compare the rate of flow into the two jars and note the difference in their contents.

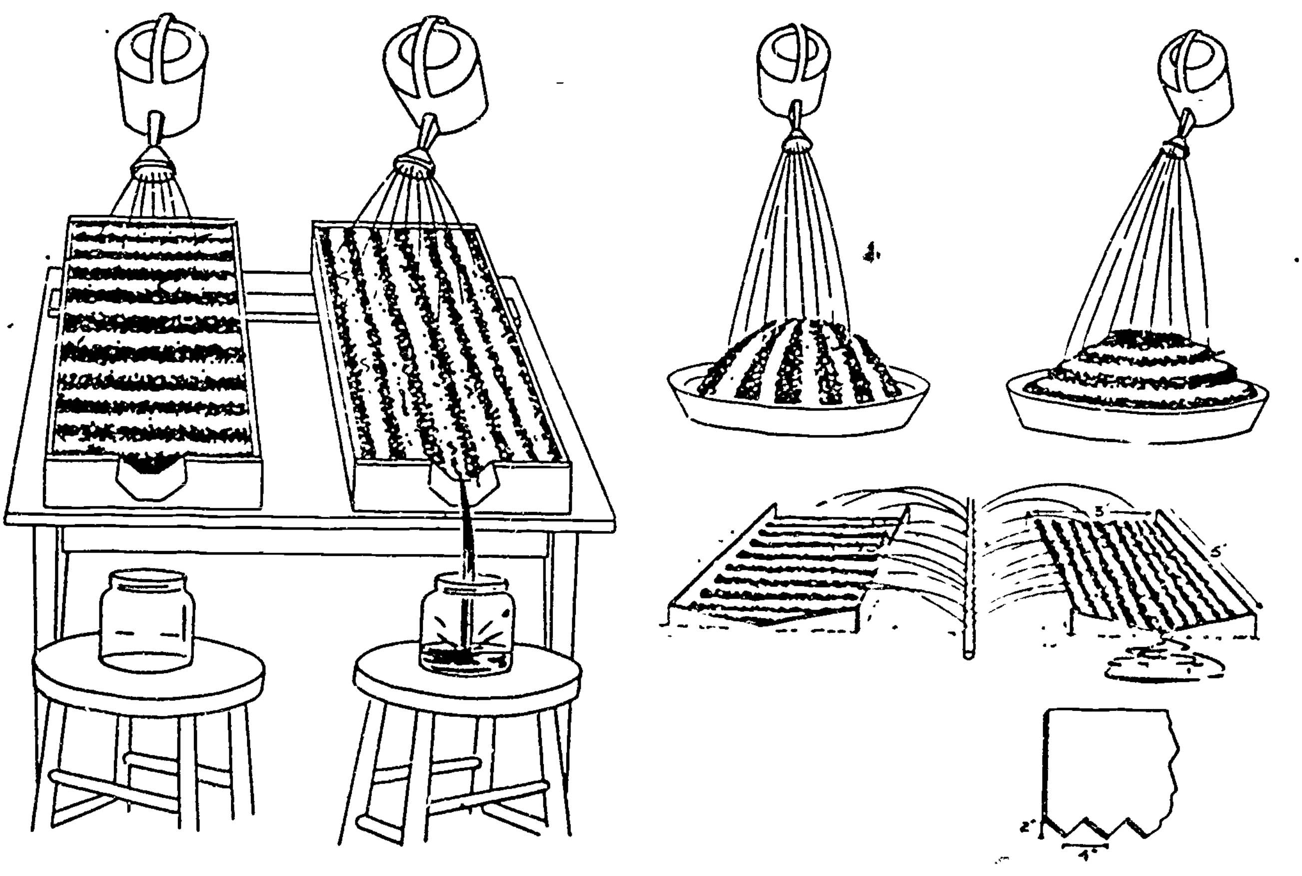
Another way to do this is to put mounds of soil in the middle of the boxes or in two large round low dishpans. With a pencil or your finger make furrows up and down one of the mounds and circles around the other mound. Sprinkle an equal amount of water on each mound and observe the water. Remember though, that such mounds probably have much steeper slopes than most cultivated land.

You can do this in the yard if you have a sloping area where there is no grass or where the grass is badly worn by walking or playing. By doing this outdoors, you can use a larger area. Make two plots 3 feet wide and 5 feet long with 1 or 2 feet between them.

With a regular garden hoe cut grooves 4 inches apart and about 2 inches deep across the slope on one plot and up and down the slope on the other. Notches cut in the edge of a 1- by 12-inch board (as shown in the drawing) can make the grooves.

Lay a perforated lawn-sprinkling hose between the two plots and turn it on so that a steady shower falls on both plots with equal intensity.

Make careful notes of what happens on both plots.



PURPOSE: To be aware of the key factors in the world today that have contributed to the decreased availability and quality of all natural resources.

LEVEL: Elementary School

SUBJECTS: Science
Mathematics
Social Studies

REFERENCE: California Environmental Education Guide, 1981-1984, Volume 1, pp. 75-76. Hayward, CA: Office of the Alameda County Superintendent of Schools, copyright 1981. Reproduced by permission. SE 036 093.

ACTIVITY:

Be sure the group understands the meaning of "increase" and "decrease" by doing the following optional preliminary exercise:

° Give each student strips of paper of different lengths. "Arrange the strips from shortest to tallest. The strips should get increasingly taller as our eyes move along the line." (Repeat, using bottles.)
° Watch a balloon slowly deflate. "Is it increasing or decreasing in size?"
° Use the volume control on the record player to demonstrate increasing and decreasing noise levels.

Allow students to choose partners to work with. Give each pair a 8"x11" (20x28 cm) felt rectangle or a piece of construction paper (all pairs should have the same thing). Give each pair eight rectangular pieces of paper approximately 1"x1" (2.5x2.5 cm) and at least 25 paper or plastic counters (or beans).

"Once upon a time there was a village where the people were happy and well cared for. They had nice homes (put two rectangles on your square to represent two five-person homes), nice schools (put another rectangle to represent the school), and a movie theater (put a rectangle on your square to represent the theater). They still had plenty of space left over on their land to plant, to farm, and grow food, and space for plants and animals to live. (Count out ten beans. These will be the people. Put them on your land, maybe in school, or out working on a farm.) Other folks heard about this village and moved to the land. Add ten more people on your land."

Questions for Discussion:

1. What will happen at the school? At the theaters? At home? They needed more homes, more schools, and more theaters! (Add two homes, one school, one theater.)
2. What has happened to the amount of space we use for farms, hiking, playing, etc.?

3. Will we be able to grow more food now that we have more people?
   Will we be able to have more room to play for the increased number of people? The villagers were becoming increasingly dissatified and decreasingly happy.
4. Now let's finish the story together. What might happen to make the story end happily?
5. What might be an unhappy ending to the story?

FOLLOW-UP:

1. Choose ten students to be the village people. Have them sit in a semicircle, facing the rest of the class. Put a bowl of ten apples in front of them. Have each student take one.
   Q: Is there food for each member of the village? (Yes)
   Add ten people to the semicircle.
   Q: Is there still enough food for everyone? What can we do to give everyone some food? (Cut apples in half, get more apples, etc.) Discuss consequences of each possibility.
2. Find examples of things outside that are increasing (number and size of buds on trees, number of clouds in the sky, etc.), and decreasing (something decaying, soil that is being washed away).

PURPOSE: To demonstrate the necessity of managing the use of fossil fuels.

LEVEL: Elementary School

SUBJECT(S): Science

REFERENCE: The Energy We Use: Grade 1. National Science Teachers Association and U.S. Department of Energy, Technical Information Office, P. O. Box 62, Oak Ridge, Tennessee 37830. ED 153 846.

ACTIVITY:

Share with your class the following:

Coal, oil and natural gas are called fossil fuels. These fuels were formed long ago before people lived on the earth.

Long ago these plants and animals lived and died and fell to the ground. More and more of these large trees grew, and they in turn fell to the ground and covered the first ones. Sometimes the land sank and was covered with water and at times it would rise again. More and more trees grew in the swampy forests, only to fall as they grew old and died.

Through the ages the materials on top became heavier and heavier and the plants and animals were pressed harder and harder. Gradually they changed into coal, oil and natural gas. This process took millions and millions of years.

Since this all happened before there were people on the earth, how do we know about these plants and animals which lived so long ago? Sometimes they leave records. These records are called fossils.

Next, display and examine samples of oil and coal and remind the children how long ago this was made. Once used it is gone forever. We cannot get it back. We say it is non-renewable.

Place two crackers in a plastic bag. Let the class examine the crackers. Then have a number of children eat up the crackers. Look again at the plastic bag. All the crackers which were in the bag are gone. Those two crackers are gone forever. In a similar way, we have a certain amount of coal, oil and gas on the earth. When we use it up, it is gone forever. We say that our coal and oil and natural gas are non-renewable. Once used up they are gone forever.

Burn a candle in an aluminum pie pan. Under careful supervision, allow students to feel the heat energy. Observe the light energy. Once the candle is completely burned down, its energy is gone - it is used up.

Discuss with the class that in times of emergency the government has managed the use of fuels by rationing. For example, during World War II, gasoline was rationed. A typical family was allowed a basic ration of four gallons of gasoline a week. If we faced an emergency or if our fossil fuel supply diminished to an alarming point, the government would very likely again ration our use of fuels.

If such a situation were to occur, how could individual families manage their use of gasoline? What would we have to give up?

PURPOSE: To be aware of the importanc of nonrenewable resources for maintaining our lifestyles.

LEVEL: Elementary School

SUBJECTS: Mathematics
Science

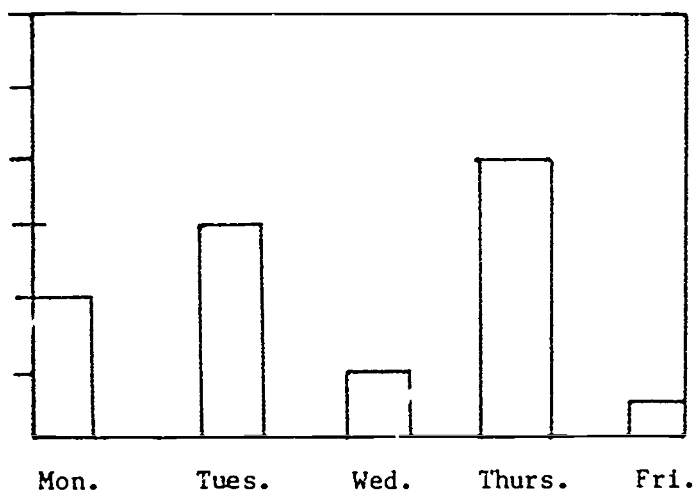
REFERENCE: California Environmental Education Guide, 1981-84, Volume 1, pp. 77-78. Hayward, CA: Office of the Alameda County Superintendent of Schools, copyright 1981. Reproduced by permission. SE 036 093.

ACTIVITY:

Set up a system for monitoring water use in the classroom. This can be done by putting a dishpan in the sink to catch all the excess water. Keep a jar or pitcher next to the sink to measure water at the end of the day. Prepare method for charting daily water use.

Sample:

Number of jars of water in sink



1. Discuss what water is used for 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. Set up a system for collecting classroom waste water (see suggestion above). This would be a good time to discuss the importance of water--for growing plants, water transportation, etc.

3. At the end of each day, measure the amount of waste water collected in the sink. Record the results (see suggestions above) for one week.

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

FOLLOW-UP:

1. Take a walk around the school. Observe other uses of water and evidence of water being wasted. Brainstorm ways for reducing water waste.
2. Discuss ways we use water at home and what we can do to reduce the amount of water being wasted.
3. Although water is á renewable resource by strict definition, it is much overused in some areas, and is in dwindling supply much as if it were a nonrenewable resource. You may want to discuss these two classifications of resources with your second or third graders and bring out the point that water, in many places, is a special case.

PURPOSE: To construct a model of a farm, ranch or suburb utilizing good land use practices.

LEVEL: Elementary School

SUBJECT: Fine Arts
Science
Math

REFERENCE: Albert B. Foster & Adrian C. Fox. Teaching Soil and Water Conservation: A Classroom and Field Guide. U.S. Department of Agriculture, Soil Conservation Service, August, 1970. ED 067 218.

ACTIVITY:

Building a model of a farm, ranch or suburb utilizing good land use management practices can be an excellent culminating activity following the study of land use management.

If the farm or ranch model can be based on local land use problems and conservation needs, it will be most effective in helping children relate conservation to their own home and community welfare. Teachers in city schools can relate wise use of soil and water to the everyday lives of urban children by pointing out that food, lumber, wool, cotton, and other necessities come from the soil.

Your model farm can represent the conservation plan on the farm you are studying.

The successful conservation farmer follows a plan that was designed for his particular farm much the same way a tailor cuts and fits a suit to a particular man.

The first step in preparing this conservation plan is to find a good use for each acre on the farm. The physical characteristics of the land, in combination with the climate, limit how the land can be used safely.

No two acres of land are alike. The differences include variations in slope, soil depth, inherent productivity, stickiness, wetness, texture, amount of erosion, and many other features.

Some soils may be so shallow that cultivated crops will not yield enough for profit. This kind of soil is naturally best suited to grass or trees.

Some soils are sticky when wet and form hard clods when dry. Such soils are hard to farm and may take more work to prepare for seeding and cultivating. They let water in slowly and give it up to plants slowly. This characteristic may determine what the use should be.

How much soil has been lost by erosion has a lot to do with how land can be used safely. Severely eroded slopes will need maximum plant-cover protection. Grass and trees or shrubs for wildlife are usually the best use here, although some eroded land can be reclaimed for cultivated crops if the soil is deep enough and if the slope is not too steep.

Some land slopes so much that any cultivation of the soil will result in serious erosion in spite of all the farmer can do to protect it with mechanical measures. Even just a little too much grazing or too heavy cutting of timber will have bad effects. Steep slopes will be more profitable to the farmer in the long run if used for grass or trees.

Gentle slopes, provided the soil is satisfactory in other ways, can be safely cultivated and used for crops like corn, cotton, and truck crops.

Level land that is well drained, does not overflow, has deep soil, and has no physical impediments like outcropping rock makes the best land for growing cultivated crops. Such land can be worked frequently without serious erosion hazard. Even this land needs good management to keep it productive.

After a careful study of the land and soil characteristics the farmer makes a plan to use each part of his farm within its capability as imposed by nature. This plan becomes the farmer's blueprint for his farming operations. It includes a field arrangement that puts each acre of land to work at a safe use. The field arrangement takes into consideration convenience of work for the farmer. It provides for separating cropland from grassland and from woodland. Some wildlife may be separated but all the land on the farm will be used by wildlife in some way.

After the farmer plans for the safe use of each acre of land he then plans the necessary supporting conservation practices like crop rotation, and woodland protection.

Such planning as this makes a soil conservation plan for a farm--a plan that fits the farm because it was made according to the physical nature of the land and a plan that suits the farmer's needs and abilities.

A model is the kind of activity in which all pupils in a schoolroom can participate. It should be planned in detail under your guidance as teacher. Decide what construction materials are needed, what soil and water conservation measures are to be applied, and how structures such as dams, terraces, bridges, fences, and buildings are to be modeled. The assignment of various construction details on the basis of age and grade makes it possible for all the children to share in the work.

In making plans for this project consider the sources of outside information and assistance. Where can you find out what the local soil-erosion problems are and what conservation measures are in use? What visual aids and references are available? Local representatives of State and Federal conservation agencies and organizations, including conservation farmers and ranchers, can be helpful.

The model can be a replica of the general terrain of the community in which the school is located. Or you can select a nearby farm or ranch that the class can study firsthand. Let the students see the erosion problems, then build a model showing the land as it should be used.

Models are usually built of fiber insulation board, papier-mache, or a salt-flour mixture on a sturdy base. One good method is to use pieces of thick fiberboard cut to match the outlines of the different contours of the land. The pieces are stacked in the order of succeeding elevations and glued together. The edges of the layers are then filed off with a wood rasp to make the slopes smooth and even.

If you want to make a model of an actual farm or ranch, your first step is to get a contour map of it. You can see the local Soil Conservation Service technician for sample maps of local farms. He can also give you suggestions about reproducing the contours to scale on the model. If the terrain is flat you may need to exaggerate the steepness 2 or 3 times.

Make a base for the model from 1-inch lumber the size and shape of the farm. An 80-acre farm could be 2 feet by 4 feet. The first layer of insulation board should be the same size as the base.

Then cut the succeeding layers according to the contour lines and glue them together. You may be able to save material and reduce the weight of the model by having the layers overlap only a little so that the inside is hollow.

Plastic crack filler or papier-mache may be useful during the final shaping. You may want to make some minor cuts and fills for roads, gullies, and other physical features.

As the first step in decorating the model, paint it with glue. While the glue is still tacky, sprinkle screened sand over it. This surface has a texture that will make it look like fields and pastures when painted suitable colors.

In deciding on the scale for the other items on the model, it is a good idea to start with the buildings. They need not be the same scale as the land; usually they can be somewhat larger. But other items such as fences, machinery, and livestock should be in scale with the buildings.

Buildings--Cut buildings from balsa or other softwood. You can do some carving but windows and doors can be painted in.

Fences--Drive dark nails or pins for fence posts and cut them off at a suitable height. For barbed wire, use fine wire fastened by a loop around each post. For woven wire cut strips of screen and push them into the modeling material; fasten with airplane glue.

Clover, alfalfa, and grass--The best way to simulate these crops is to paint the areas and sprinkle sawdust of appropriate colors over them. Sawdust coming from different kinds of machines, such as sanders, saws, chippers, and jointers, has different textures. The texture can be altered by screening. Coarse-textured sawdust is best for crops like alfalfa and clover; fine sawdust would be best for grass. Color the sawdust with a mixture of about one-fourth paint and three-fourths turpentine. Pour this over the sawdust and then spread it out to dry.

Bare soil--Fine sawdust, or the modeling material itself will give about the right texture if painted the right color.

Terraces--Loosely twisted heavy cord or small rope can be glued to the model. The areas above and below the cord or rope can be filled with crack filler shaped to give the form desired.

Corn--You can represent young corn by gluing strips of stiff burlap vertically in rows. After the glue has set, pull out the horizontal threads. Then split and curl the remaining vertical threads.

Shrubs--Cut sections from colored sponge and glue them in place. You can make isolated trees in the same way, but to represent a woodlot treat the whole area as a mass, using colored sponge.

Models of farms can also be made with papier-mache. On a sturdy base make the shape of the farm you want by bending and shaping chicken wire. Then cover it with layers of paper dipped in paste, until you have the right amount for strength and form. Add the buildings, fences, and crops as explained above.

For younger children, don't overlook the sandbox. It offers a good opportunity to make a less elaborate model. Even with sand, it is best to copy an actual farm even though you will need to exaggerate the topography.

PURPOSE: To identify the complexities of international trade in energy producing natural resources.

LEVEL: Elementary School

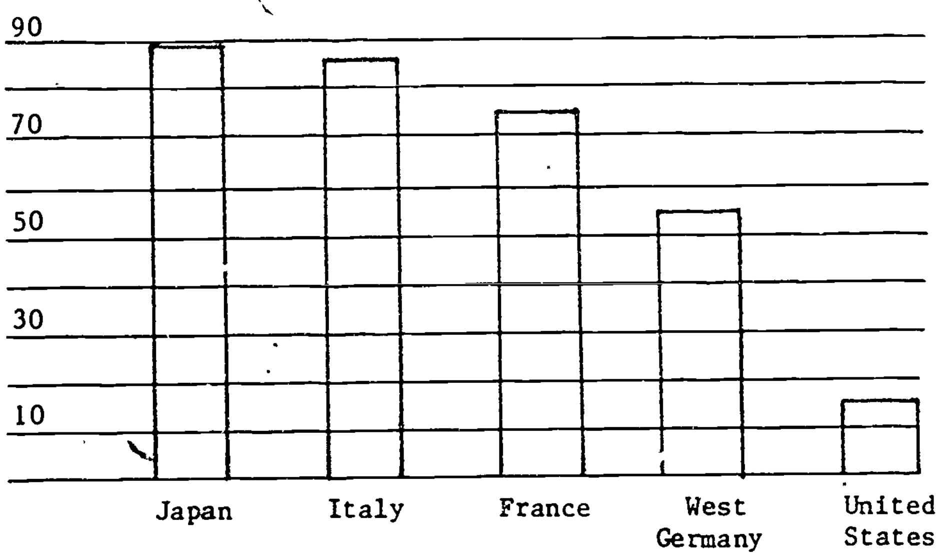
SUBJECTS: Mathematics
Social Studies

REFERENCE: Energy in America: Progress and Potential, a 1981 publication of the American Petroleum Institute, Publications and Distribution Section, 2101 L Street NW, Washington, DC 20037. SE 036 092.

ACTIVITY:

Demands for energy by industrialized nations have increased as technologies have expanded, to the point that those nations which are most highly industrialized have become more and more dependent on other nations for their energy resources. The graph below summarizes percentages of dependence on imported energy resources of all kinds for several industrialized nations in 1980.

Dependence of Selected Countries on Imported Energy in 1980
(imported energy as percent of total energy use)



Sources: European Economic Community, Department of Energy and Business Information Display, Inc.

The following questions, and related ones, may serve as the basis for further research and discussion:

1. What percentages of total energy used by each of these nations was domestically produced in 1980?

2. From what other nations do these industrialized nations import energy resources? What specific raw materials are involved in international trade?

3. In 1973, several of the nations which export energy resources (in this case, specifically crude oil) cut back on the amounts they were willing to export. At the same time, the price of crude oil increased.

   a. Which were the exporting nations which did this? Are they themselves industrialized?

   b. For what reason, or reasons, did they cut back on their exports?

   c. What problem, or problems, did this action create in the industrialized nations which import crude oil?

   d. Is this problem resolved? If not, how might it be resolved? (To respond appropriately to this question, the perspectives of both energy importers and energy exporters must be considered).

ELEMENTARY - JUNIOR HIGH SCHOOL

NATURAL RESOURCE MANAGEMENT ACTIVITIES

PURPOSE: To examine and test methods of slowing the rate of shoreline erosion.

LEVEL: Elementary - Junior High School

SUBJECT(S): Science

REFERENCE: Beth A. Kennedy and Rosanne Fortner. Coastal Processes and Erosion. Ohio Sea Grant Program, The Ohio State University Research Foundation, 1980. ED 179 356.

MATERIALS NEEDED:

Each lab team should be supplied with three rectangular plastic dishpans or plastic shoe boxes; one piece of board (2x4 or plank) as long as the dishpan is wide; one piece of 2x4 half as long as the width of the pan; about 1 liter of sand; a 3x5 note card; a ruler to measure wave heights; and access to a supply of water. Each student will need a pencil or pen for recording data and answering questions.

If sand is to be re-used for several classes, have on hand a fine mesh screen or collander lined with gauze. When water is poured off at the end of class, these screens will serve as sediment filters.

ACTIVITY I.

Share with your students the following information:

Shorelines of lakes and oceans are subject to the attack of winds, waves longshore currents, ice and floating debris which often results in erosion and other damage.

For instance, at Minot's Ledge in Massachusetts, waves from severe storms destroyed a lighthouse several times during its construction. In 1851, when the lighthouse was finally completed, waves brought the entire structure tumbling into the sea, killing its two keepers and leaving little evidence that the lighthouse had ever been there.

Much of the erodible shoreline is privately owned and it is the landowners' responsibility to protect their land.

Methods of erosion prevention involve attempts to keep the force of the waves away from the bluffs. By chance, nature protects shorelines by building sand beaches where the waves can break and use up their energy before reaching the bluffs. People can construct devices which duplicate the effectiveness of natural sand beaches.

Erosion cannot be permanently stopped, but construction of the proper devices can slow erosion down.

Next discuss each of the three following methods of shoreline protection:

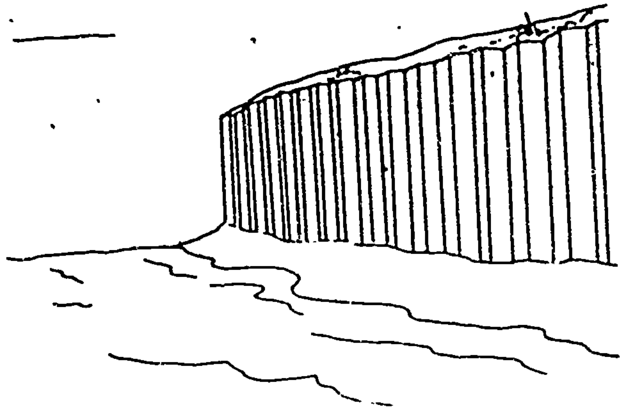
(1) One method of shore protection involves the use of concrete, wood or steel structures built directly against and parallel to the shore. These structures are designed to help keep currents and waves from reaching the erodible shoreline. Some of these structures also serve as docking facilities.

(2) A second method of beach protection is the construction of a device perpendicular to the shore and connected to it. This device traps the sand moving with the littoral drift. A beach is formed, which is excellent protection against shore erosion.

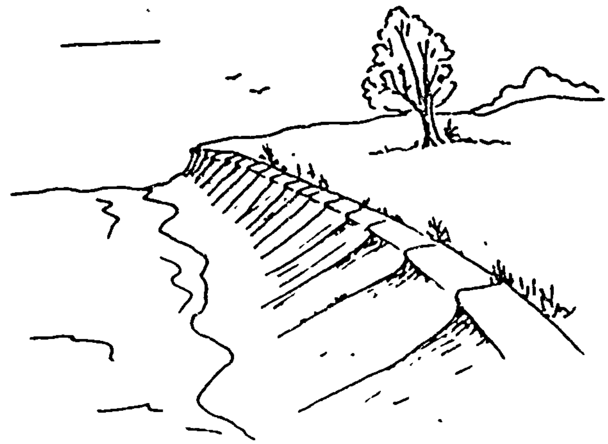
(3) The third method of shore protection is an offshore structure. It usually consists of fairly large stones which are piled away from but parallel to the coastline. The wall of stone reduces wave attack on the shoreline much as a natural sand bar would.

Give each student the diagrams on the following two pages and ask them to carefully examine, then label, each by number (1, 2, 3) according to the method of shore protection which each one shows.

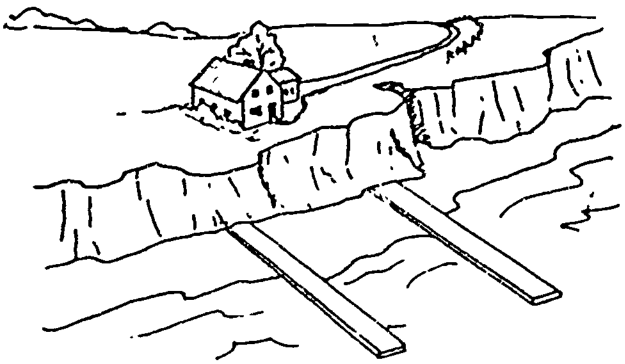
Answers:		
	Sea Wall: sheet pile	1
	Sea Wall: cement	1
	Gain: cement	2
	Breakwater: piled stone	3
	Grains: sheet pile	2
	Breakwater: steel pile	3
	Stepped Reutment	1
	Sea Wall: concrete	1



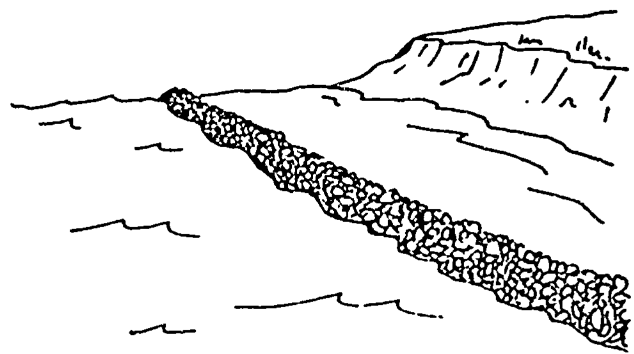
Sea Wall: sheet pile



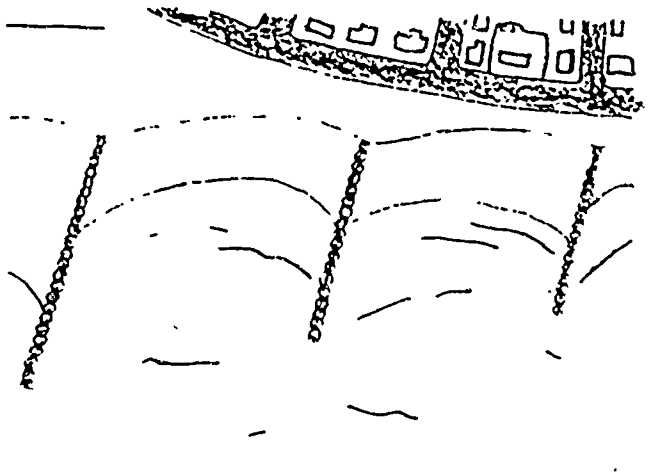
Sea Wall: cement



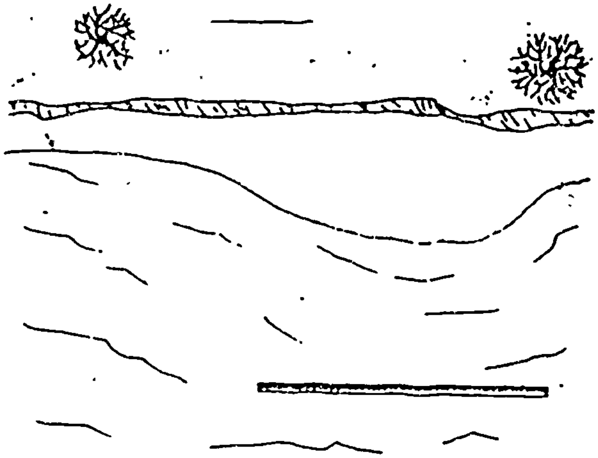
Groin: cement



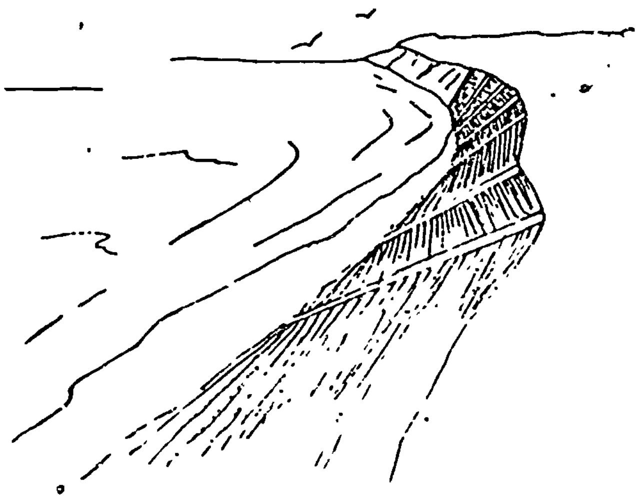
Breakwater: piled stone



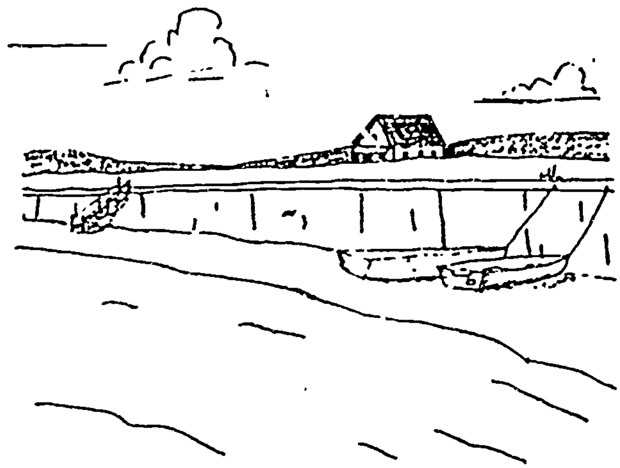
Groins: sheet pile



Breakwater: steel pile



Stepped Revetment



Sea W ll: concrete

ACTIVITY II.

After students have completed labeling the diagrams and checking their labels, invite them to test the effectiveness of some of these shoreline protection devices. Divide the class into lab groups of about 6 or 7 students. Give each group a set of the materials previously listed and the following instructions:

1. Build a beach bluff at one end of the lake as follows:

   A. In the end of one of the plastic pans place three handfuls of wet sand.

   B. Using a piece of board, mash the sand up against the end of the pan and flatten the top. Make this "beach bluff" about as wide as it is high.

   C. Hold the piece of board up against the sand bluff to protect it while you slowly add water to the empty end of the pan. Create a lake about 1-1.5 cm deep. Remove the board gently when the lake water is still.

   D. Gently place a strip of note card flat on top of the bluff.

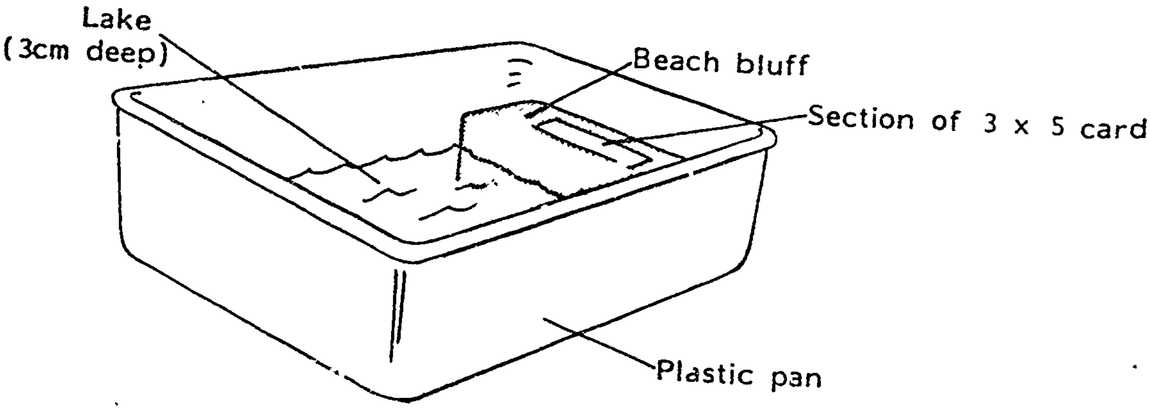


Figure 1. Shoreline Model

2. Put a short section of 2x4 firmly up against the bluff to act as a seawall.

3. You are now ready to act as the wind, making waves and causing erosion on the shoreline. Using a ruler or the piece of board, make waves that move toward the beach bluff from the opposite end of the lake. Record the condition of the bluff after 5 waves and again after 10 waves.

SEAWALL EFFECTS

Number of waves	Effects on Bluff: Behind seawall	Effects on Bluff: Unprotected
5		
10		

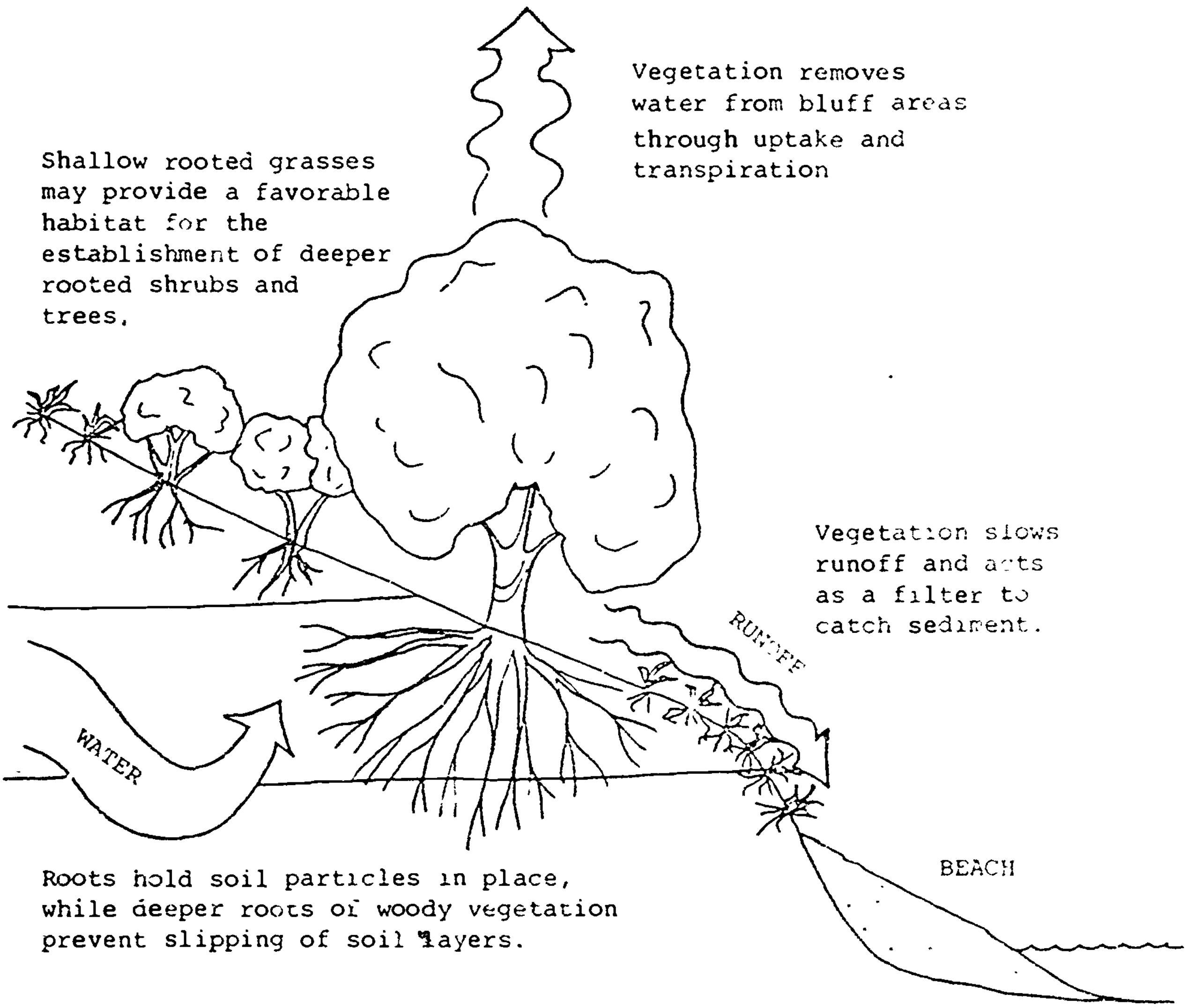
E. Repeat step A above. This time place the short 2x4 in the center of the basin to form a breakwater about 5 cm from the sandy bluff.

F. Make some waves again, and record what happens to the bluff after 10 waves.

BREAKWATER EFFECTS

Number of waves	Effects on Bluff: Behind breakwater	Effects on Bluff: Unprotected
5		
10		

4. As you may have observed, the water within your sand bluff may have weakened it before wave erosion began. Groundwater and surface streams do the same thing on real lake shores. For this reason, trees, grasses, and shrubs are sometimes planted to go along with some other shore protection device. The life processes of plants remove ground water, the roots hold soil in place, and beach grasses trap sediment to actually help build the beach. (See Figure below.)



The Role of Plants in Erosion Control

5. Follow up the activity by discussing that in recent years there has been growing concern about the uncontrolled construction of shore protection devices such as groins, seawalls, revetments, and bulkheads. Many people interested in maintaining and improving the environment are concerned about the placement of multiple bulkheads along stretches of

shoreline. Evidence strongly indicates that groins speed up erosion in nearby areas and that bulkheads cause shore loss and water turbidity. Some argue, "What harm does a single 50-foot or 100-foot bulkhead do to the environment?" There are many miles of bulkheads, seawalls, and other protective devices added to shorelines every year. Long-term and the cumulative effects of these structures vary.

There are advantages and disadvantages to each of the construction alternatives for shoreline protection. Construction costs, maintenance problems and beach changes associated with some devices make them unsuitable or undesirable for use by private landowners. Legal responsibilities to owners of adjoining land may also be factors in determining which shoreline protection method is used. To examine the pros and cons of each type of structure you may wish to send for a free wall chart entitled "Help Yourself: A discussion of the critical erosion problems on the Great Lakes and alternative methods of shore protection" from:

U. S. Department of the Army
North Central Division
Corps of Engineers
536 South Clark St.
Chicago, Illinois 60605

PURPOSE: To discover some of the problems connected with the production of oil and gas.

LEVEL: Elementary School - Junior High School

SUBJECT(S): Science

REFERENCE: Suggested by Linda L. Goodwin, Training Officer, Division of Oil and Gas, Ohio Department of Natural Resources, Fountain Square, Columbus, Ohio.

ACTIVITY I:

Explain to your class that although we do not know for sure where oil and gas come from, it is generally believed that petroleum comes from the remains of plants and animals that lived in ancient seas. Evidence exists that indicates much of our present land area in the world was once covered by water. Over time, plants and animals that lived and died in these waters plus other sediments such as sand built up in the sea. The weight of these sediments squeezed lower levels of sediments together so that eventually the lower levels became rock. The remains of the plants and animals - organic substances - were covered by layers of sediments over thousands of years.

Show your class a piece of sandstone and ask them to observe the tiny spaces between the grains.

Next explain to the class that the remains of the organic substances held carbon and hydrogen which formed a liquid substance -- petroleum. This mixed with the water seeped through the tiny spaces in the rock. - Because of the gas petroleum always moves upward.

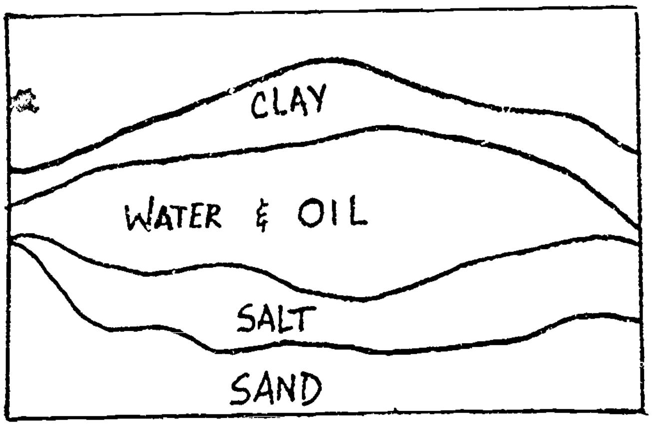
Demonstrate the holding capacity of sand by taking a cup of colored water and pouring it into a cup of sand. Notice how little of the colored water is left.

Explain that the petroleum is made up of oil and gas and that oil, gas and water have different weights. Thus they tend to separate with the gas rising to the top, the oil in the middle and the water below. Take a jar of water and pour some vegetable oil in it. Shake and observe how the oil eventually rises to the top.

Now show students a piece of quartz and have them compare it with the sandstone. Notice that the quartz does not have tiny spaces between granules. Suspend the quartz halfway down in the jar that contains the vegetable oil and water to demonstrate that all of the oil won't get to the top of the fluid; i.e., some will accumulate below, simulating reservoirs similar to the reservoirs of gas, oil and water in the earth.

Next explain that the earth is composed of many layers of different materials such as sand, salt, water, oil and gas. These layers are not level nor are they of equal volume. Generally, the volume of water will be many times greater than that of oil. The sediment materials such as sand and salt mix with the fluid materials -- water, oil and gas.

To simulate the various layers in the way they mix, take a terrarium and place an uneven layer of sand. Next place an uneven layer of salt. Then cover with clay with a rounded hump to simulate a reservoir.



Next mix water and vegetable oil, each colored with different food coloring. Inject this mixture through the clay with a syringe. Notice that the fluid mixes with the sediments and that the oil eventually rises to the top.

In order to get the oil out of the earth very complicated drilling procedures are utilized. One of the problems confronting oil producers is the fact that the salt mixes with the water and the oil and it is impossible to pump only the oil out of the earth. To demonstrate this, stick a heavy plastic straw or a pea shooter through the clay in the terrarium and suction up the fluid. Notice how salty it tastes.

As previously demonstrated the oil will separate out from the brine water but there remains the problem of what to do with the brine. This brine can contaminate ground water sources and turn fresh water into salt water. Very severe damage to neighboring areas can occur if this brine is not properly collected and disposed of.

Have students taste a glass of salt water and ask how they would like it if some oil producer down the road from their home neglected to dispose of this brine and their home supply of water now contained salt.

Farmers in the area could lose water supplies for their animals and crops. Take a healthy plant such as a bean plant and pour salt water in the pot. Observe what happens to the plant over time. Explain to your class that if a farmer's land is contaminated by brine, it takes approximately four years of fertilizing to restore the land to a suitable condition for healthy crops.

ACTIVITY II:

Explain that most oil drilling states now have regulations for drilling procedures. Oil drillers must apply for a permit to drill and state how they will collect and dispose of the brine. They must also restore the area. Following is a sample permit restoration plan and a sample investigation form from the state of Ohio. Notice on the permit in Section 36 the attention paid to the disposal of the brine. The restoration plan indicates the many concerns and potential problems caused by drilling for oil.

APPLICATION FOR A PERMIT
OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL AND GAS

1. OWNER # | Instructions on reverse side | FORM 1: Revised 06/01/81

2. I, We (applicant) ______________________, (phone#) ____ - ____ - ____
(address) ______________________
hereby apply this date ______________, 19__ for a permit to:
____ Drill ____ Plug Back ____ Plug & Abandon ____ Convert ____ Reopen ____ Deepen
____ Reissue ____ Reissue & Revised Location

3. TYPE OF WELL:
____ Oil & Gas ____ Brine ____ Artificial Brine ____ Disposal ____ Core Hole
____ Storage of ______________ : □ Injection □ Extraction □ Observation
____ Secondary Recovery: □ Input □ Production □ Water Supply
Other: Explain ______________________

4. MAIL PERMIT TO:

5. COUNTY:
6. CIVIL TOWNSHIP:
7. SECTION: 8. LOT:
9. FRACTION: 10. QTR TWP:
11. TRACT/ALLOT:
12. WELL #:
13. LEASE NAME:
List all permit numbers that have the same volume and page number for this lease on back
14. RECORDED VOLUME: 15. PAGE #:
16. MICROFICHE # (if applicable):
17. PROPOSED TOTAL DEPTH:
18. GEOLOGICAL FORMATION:
19. DRILLING UNIT IN ACRES (must be same as acres indicated on plat):
IF PERMITTED PREVIOUSLY
20. API #: 3 4 _ _ _ _ _ _ _ _ * * 1 4 _
21. OWNER
22. WELL #:
23. LEASE NAME:
24. VOLUME: 25. PAGE #:
26. MICROFICHE # (if applicable):
27. PREVIOUS TOTAL DEPTH:
28. PREVIOUS FORMATION:
29. ROYALITY INTEREST
Name ______________
Address ______________
Name ______________
Address ______________
Name ______________
Address ______________

30. TYPE OF TOOLS
____ Cable ____ Air Rotary
____ Fluid Rotary ____ Air/Fluid Rotary
____ Cable/Air Rotary
____ Cable/Fluid Rotary
____ Cable/Air Rotary/Fluid Rotary

31. PROPOSED CASING PROGRAM: ______________

32. IF SURFACE RIGHTS ARE OWNED BY THE STATE OF OHIO:
Department ______________
Telephone ______________

33. FIRE AND MEDICAL DEPT. TELEPHONE NUMBERS
Closest to Well Site:
Fire ____ - ____ - ____
Medical ____ - ____ - ____

34. MEANS OF INGRESS
CO Rd ______________ TWP Rd ______________
Municipal Rd ______________
State Hwy ______________

35. MEANS OF EGRESS
CO Rd ______________ TWP Rd ______________
Municipal Rd ______________
State Hwy ______________

36. FINAL DISPOSAL If annular disposal is checked, an alternate plan must also be indicated; if trucking will be used in any phase of final disposal, item (f) must be completed:
a. ____ Annular Disposal b. ____ Drilling Operations
c. ____ Salt Water Disposal Well: County ______________ Permit # ______________
d. ____ Dust/Ice Control: County ______________ Township or Municipality ______________
e. ____ Secondary Recovery: County ______________ Permit # ______________.
f. ____ Salt Water Haulers' names and telephone numbers:
1. ______________
2. ______________

I the undersigned, being first duly sworn, depose and state under penalties of law, that I am authorized to make this application, that this application was prepared by me or under my supervision and direction, and that date and facts stated therein are true, correct, and complete, to the best of my knowledge.

I the undersigned, further depose and state that I am the person who has the right to drill upon the tract of land or drilling unit, described in this application, and that I have the right to produce oil and gas from a pool thereon, and to appropriate the oil or gas that I produce therefrom either for myself or others. And furthermore, I the undersigned, being duly sworn, depose and state at this time I am not liable for a final nonappealable order of a court for damage to streets, roads, highways, bridges, culverts, or drainageways pursuant to Section 5577.12 of the Ohio Revised Code, and that all requirements of any political subdivision having jurisdiction over an activity related to the drilling or operation of this oil or gas well that are in effect at the time of this application and on file with the Division of Oil and Gas, including but not limited to zoning ordinances and the requirements of Section 4513.34 of the Ohio Revised Code, will be complied with until abandonment of this well, and that a plan for restoration of the land surface disturbed by drilling operations shall be filed with the Division of Oil and Gas. Such plan shall comply with the restoration requirements of Section 1509.072 of the Ohio Revised Code and any rules adopted by the Chief of the Division pertaining to such restoration, and if applying for a permit to plug and abandon a well, I hereby certify that the written notices, as required in Section 1509.12, Ohio Revised Code, have been given.

That I hereby agree to conform with all provisions of Chapter 1509 of The Ohio Revised Code, to all orders and rules issued by the Chief, Division of Oil and Gas.

Signature of Owner/Authorized Agent ______________________________

Name (Type or Print) ______________________ Title ________________

If signed by Authorized Agent, a certified copy of appointment of agent must be on file.

SWORN to and subscribed before me this the _____ day of ______________ 19____.

____
(Notary Public)

____
(Date Commission Expires)

(SEAL)

Before this application can be processed, Form 9 (Authority and Organization Form), indicating the exact owner name on this Form 1, and proof of compliance with the surety requirements of Chapter 1509, O. A. C. must be on file with the Division of Oil & Gas. If a new owner name, i.e. one not previously filed with the Division, is used, a Form 9 and evidence of meeting the surety requirements must be filed with this application.

All information requested on this form must be provided unless exempted by the instructions below. Incomplete applications, it will be returned to the applicant. An application for a permit requires the following:

a. Original and (2) copies of the application;
b. Original and (4) copies of an Ohio Registered surveyor's plat;
c. Original and (1) copy of the restoration plan;
d. $95.00 check or money order for a permit fee to drill, reopen, reissue, deepen, and plug back; or $20.00 check or money order for a permit to plug and abandon.

Item 1. Indicate owner number in blank. If owner number is not known, ensure that the owner name is identical to owner name that is on the Form 9 (Authority and Organization Form) that is on file with the Division.

Item 2. Provide requested information.

Item 3. Indicate the type of well for which the application is being submitted.

Item 4. Provide name, address, city, state and zip code where the permit is to be mailed.

Items 5 - 13. List volume and the first page number (or microfiche number in item 16) of lease as recorded in County Recorder's office. List other permit numbers included in this lease:

_________ _________ _________ _________ _________

_________ _________ _________ _________ _________

Items 17 - 19. Provide requested information.

Section 20. Complete when application is for a permit to reopen, deepen, reissue, plug back, convert, or plug and abandon. If API # is unknown indicate previous permit number.

Items 21 - 28. Complete if application is to reissue a previous permit, or to plug back, convert, deepen, reopen or plug and abandon an existing well.

Item 29. List names and addresses of royalty interest holders. Names must match those shown on the designated unit or subject tract on the surveyor's plat or an explanation must be included. (Overriding royalty and working interests are not required.)

Item 30. Indicate type of tools to be used.

Item 31. Indicate size and amount of casing to be used.

Item 32. Complete if surface rights are owned by the State of Ohio.

Item 33. Indicate fire and medical department emergency telephone numbers closest to the well site.

Items 34 & 35. List all County, Township, and/or Municipal roads, streets and highways by name of number that applicant anticipates to use as means of ingress and egress from the well site.

Item 36. Indicate final disposal plan for saltwater and other waste substances (except on applications for plug and abandon).

For use by DIVISION OF OIL AND GAS and DIVISION OF MINES

Is location with a coal bearing township? Yes____ No_____
Application referred to Division of Mines? Date__________ By_______
Approved by____________________________ Date__________
Disapproved by__________________________ Date__________
Explanation____

R E S T O R A T I O N P L A N
OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL AND GAS

1. DATE OF APPLICATION:	FORM 4: Revised 06/01/81
2. OWNER NAME, ADDRESS, & TELEPHONE #'s:	3. API #: 3 4 ____ ____ * * 1 4 _ 4. WELL #: 5. LEASE NAME: 6. PROPERTY OWNER: 7. COUNTY: 8. CIVIL TOWNSHIP: 9. SECTION: 10. LOT:
11. CURRENT LAND USE: ___ Cropland ___ Commercial ___ Pasture ___ Idle Land ___ Wetlands ___ Recreational ___ Residential ___ Industrial ___ Unreclaimed strip mine ___ Woodland: Circle Broad-leaved or Needlelike	17. TYPE OF WELL: ___ Oil ___ Gas ___ Other 18. STEEPEST SLOPE GRADIENT CROSSING SITE: ___ 0 to 2% ___ 2.1 to 8% ___ 8.1 to 10% ___ 10.1 to 24% ___ greater than 24%
12. SLOPE GRADIENT & LENGTH DETERMINED FROM: ___ Ground measurement ___ U.S. Geological Survey Topographical Maps ___ Other, explain ______	19. LENGTH OF STEEPEST SLOPE CROSSING SITE: ___ 1 to 100 ft. ___ 101 to 200 ft ___ 201 to 400 ft. ___ greater than 400 ft.
13. TYPE OF FALL VEGETAL COVER: ___ Little or no vegetal cover ___ Short grasses ___ Tall weeds or short brush (1 to 2 ft.) ___ Brush or bushes (2 to 6 ft.) ___ Agricultural crops ___ Trees with sparse low brush ___ Trees with dense low brush	20. RESTORATION OF DRILLING PITS: ___ Haul drilling fluids and fill pits ___ Use steel circulating tanks ___ Proposed alternative ______ 21. BACKFILLING AND GRADING AT SITE: ___ Construct diversions channelled to naturally established drainage systems ___ Construct terraces across slopes ___ Grade to approximate original contour ___ Grade to minimize erosion & control offsite runoff ___ Proposed alternative ______
14. SOIL & RESOILING MATERIAL AT WELLSITE: ___ Stockpile & protect topsoil to be used when preparing seedbed ___ Use of soil additives (e.g.lime,fertilizer) ___ No resoiling planned ___ Prosposed alternative ______	22. VEGETATIVE COVER TO BE ESTABLISHED AT SITE: ___ No seeding plan proposed ___ Sod ___ Agricultural crops ___ Trees &/or Bushes ___ Proposed alternative ______
15. DISPOSAL PLAN FOR TREES AND TREE STUMPS: ___ No trees disturbed ___ Haul to landfill ___ Cut into firewood ___ Sell to lumber co. ___ Bury with landowners approval ___ Mulch sm trees and branches,erosion control ___ Use for wildlife habitat ___ Proposed alternative ______	23. TEMPORARY SALTWATER STORAGE FACILITY: ___ Properly constructed & maintained liquid tight pits surrounded by an embankment to prevent surface water from entering ___ Steel tanks with approved internal lining or coating ___ Install liquid tight cement storage vaults* ___ Install liquid tight fiberglass tanks* ___ Prosposed alternative ______ *Permission required for burial
16. SURFACE AND SUBSURFACE DRAINAGE FACILITIES: ___ No existing drainage facilities for removal of surface and/or subsurface water ___ Tile drainage system underlying land to be disturbed ___ Drain pipe(s) underlying land to be disturbed ___ Surface drainage facilities on land to be disturbed	24. ADDITIONAL HOLES: ___ Rat/Mouse, if used, will be plugged.

25. PROPOSED OR CURRENT LENGTH OF ACCESS ROAD: ____ 100 ft. or less ____ 101 to 500 ft. ____ 501 to 1500 ft. ____ greater than 1500 ft.	28. PATH OF ACCESS ROAD TO BE DETERMINED BY: ____ Landowner ____ Contractor ____ Existing access road ____ Operator
26. CURRENT LAND USE OF PATH OF ACCESS ROAD: ____ Cropland ____ Pasture ____ Commercial ____ Idle land ____ Wetlands ____ Recreational ____ Industrial ____ Residential ____ Unreclaimed strip mine ____ Woodland(Circle Broad-Leaved or Needlelike)	29. GRADING & EROSION CONTROL PRACTICE ON ROAD: ____ Diversions ____ Water breaks ____ Drains ____ Outsloping of road ____ Open top culverts ____ Pipe culverts ____ Filter Strips ____ Rip Rap ____ Proposed alternative ____________
27. SURFACING MATERIAL FOR ACESS ROAD: ____ Gravel ____ Brick and/or tile waste ____ Slag ____ Crushed stone ____ No surfacing material to be used ____ Proposed alternative ____________	30. STEEPEST SLOPE GRADIENT ON ACCESS ROAD: ____ 0 to 5% ____ 6 to 10% ____ greater than 10% 31. APPROX. LENGTH OF STEEPEST SLOPE ON ROAD: ____ 0 to 100 ft. ____ 101 to 200 ft. ____ 201 to 400 ft. ____ greater than 400 ft.
32. HAS LANDOWNER RECEIVED A COPY OF THIS RESTORATION PLAN? ____ Yes ____ No	

The undersigned hereby agrees to implement all restoration operations identified on this form, and conform to all provisions of Section 1509.072 of the Ohio Revised Code, and to all orders and rules issued by the Chief, Division of Oil and Gas.

Signature of Owner/Authorized Agent ____________________

Name (Typed or Printed) ____________________ Date ____________

Restoration Plan must be submitted to the Division in duplicate.

(SAMPLE)

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL AND GAS
ATTN: ENFORCEMENT SECTION
FORM 57: REVISED 12-10-80

REPORT OF INVESTIGATION

DIVISION USE ONLY

81 - 1 - 1 - 0011
Year Region Dist. Case No.

API WELL NO. 3 4 1 7 3 2 Old Well / Permit No. * * 1 4

Date of Complaint 2/4/81 Complainant Farmer, Joe

Address Custrad Road, Highland County

Telephone No. 217 (area code) 369-0324 (number) Hours Available 10:00 AM

LOCATION:
County Highland Twp. Wood Sec/Lot 17 OWNER Doe, John

Address Gas City, Ohio Telephone No. 300-000-0000 (area code number)

PERMIT NO(S) none Well No(s) 1 Lease Name M. Pierce

Directions to Location: US 50 to Mermill Road; East on Mermill Road 1/2 Mi. to well on north side of road (600' No. of Mermill Road).

BRIEF DESCRIPTION OF COMPLAINT: Salt water in branch of Wood River coming from well on M. Pierce Farm.

Complaint Taken By: Betty Inspector Referred To: Inspector Date/Time 2/4/81; 10:00

ARRIVED AT SCENE: 2 / 4 / 81 (mo. day yr.) TIME (24 HR. Clock): 13:00 ACCOMPANIED BY: Alone

ON SITE DESCRIPTION: (USE ADDITIONAL SHEET IF NECESSARY) Old Well without a Permit No. has been put back into operation, Brine is being discharged into a pit, Pit is leaking brine into a field tile, Tile empties into drainage ditch, Drainage Ditch empties into branch of Wood River. (Well hasn't produced for several years).

SUMMARY OF INVESTIGATION: (USE ADDITIONAL SHEET IF NECESSARY) I arrived at the operating area of the well at the above date and time. Drew a sketch of the operations and checked the waters in the drainage ditch. Water up-stream from the field tile was fresh and water down-stream from the tile was salty. I followed the drainage ditch down-stream from the operating area and found it emptied into a branch which was a part of the head-waters of Wood River. With darkness approaching I returned to may car and will continue the investigation tomorrow 2/5/81 assisted by the Regional Supervisor. Form 59 to follow.

(over)

(SAMPLE)

FORM 57: REVISED 12-10-80
PAGE 2 of 3

DATE(S), NUMBER(S) AND TYPE OF EVIDENCE COLLECTED: (NOT TO INCLUDE PHOTOGRAPHIC)

(see continuation of initial investigation)

PHOTO(S) TAKEN: YES ____ NO ____ TYPE OF CAMERA (LENS) (see continuation of initial inv.)

DATE(S), NUMBER(S) OF PHOTO(S) TAKEN: (see continuation of initial investigation)

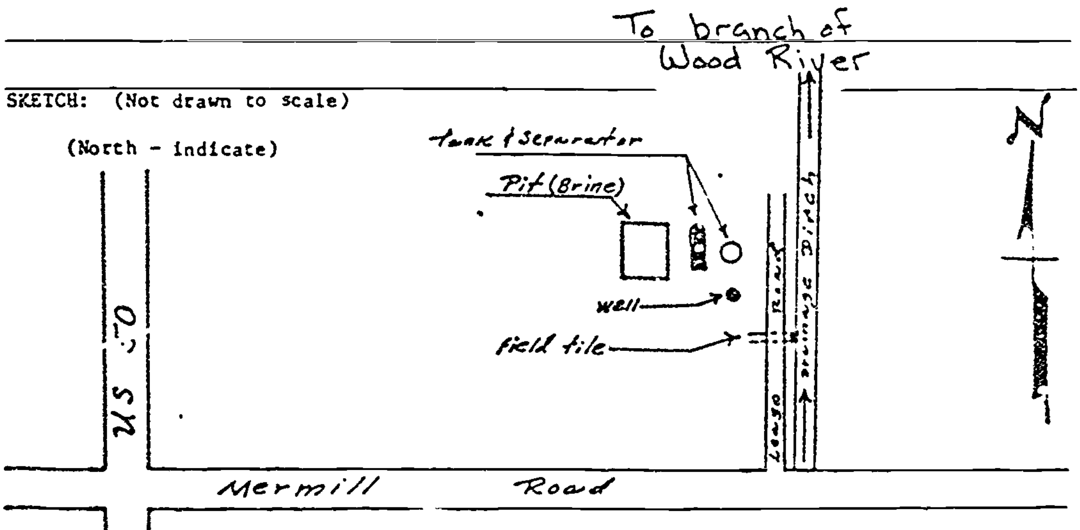
VIOLATION: SECTION/RULE 150 9 , 2 2 Contamination of water prohibited

TIME GIVEN FOR COMPLIANCE: (see continuation of initial investigation)

REMARKS: This well has been abandoned approximately twenty (20) years. The present owner leased the land recently, reworked the well and put it back into production. Which is the reason the well has no Permit Number.

SKETCH: (Not drawn to scale)

(North - indicate)



ATTACHMENTS: (if any)

None

/s/Betty Inspector, Investigator
SIGNATURE AND TITLE

2/4/81
DATE SIGNED

(SAMPLE)

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL AND GAS
ATTN: ENFORCEMENT SECTION
FORM 58: REVISED 12-10-80

FOLLOW-UP INVESTIGATIO

FOR DIVISION USE ONLY

81	-	1	-	1	-	0011
Year		Region		Dist.		Case No.

API WELL NO. 3 4 1 7 3 2 [Old Well Permit No.] * * 1 2

RE: COMPLAINANT Farmer, Joe OWNER Doe, John

PERMIT NO. None WELL NO. 1 LEASE NAME M. Pierce

DATE OF ORIGINAL INVESTIGATION 2/4/81 LANDOWNER (if not lease) ______

2/6/81 — Returned to the scene accompanied by the owner, Mr. Farmer, and explained the Oil & Gas Law. R.C. 1509:22 to him. He agreed to have the operating condition s in compliance by February 13, 1981. I accepted his invitation to accompany him to the other leases he operated in the area and from all appearance he is running a very good operation. The leases were clean, well kept, and no oil spills observed; also, no visable brine scalds at this time. Will continue this follow-up 2/13/81, with Form 59.

ATTACHMENTS: (if any)

None

/s/ Betty Inspector, Investigator
SIGNATURE AND TITLE

February 6, 1981.
DATE SIGNED

Assign students to write to different states requesting information about the amount of oil produced in each and the required oil drilling procedures. Compare and contrast the information from the various states. How do they enforce regulations?

ELEMENTARY - JUNIOR HIGH SCHOOL

NATURAL RESOURCE MANAGEMENT ACTIVITIES

PURPOSE: To investigate the quantities of raw materials required for each individual in the United States.

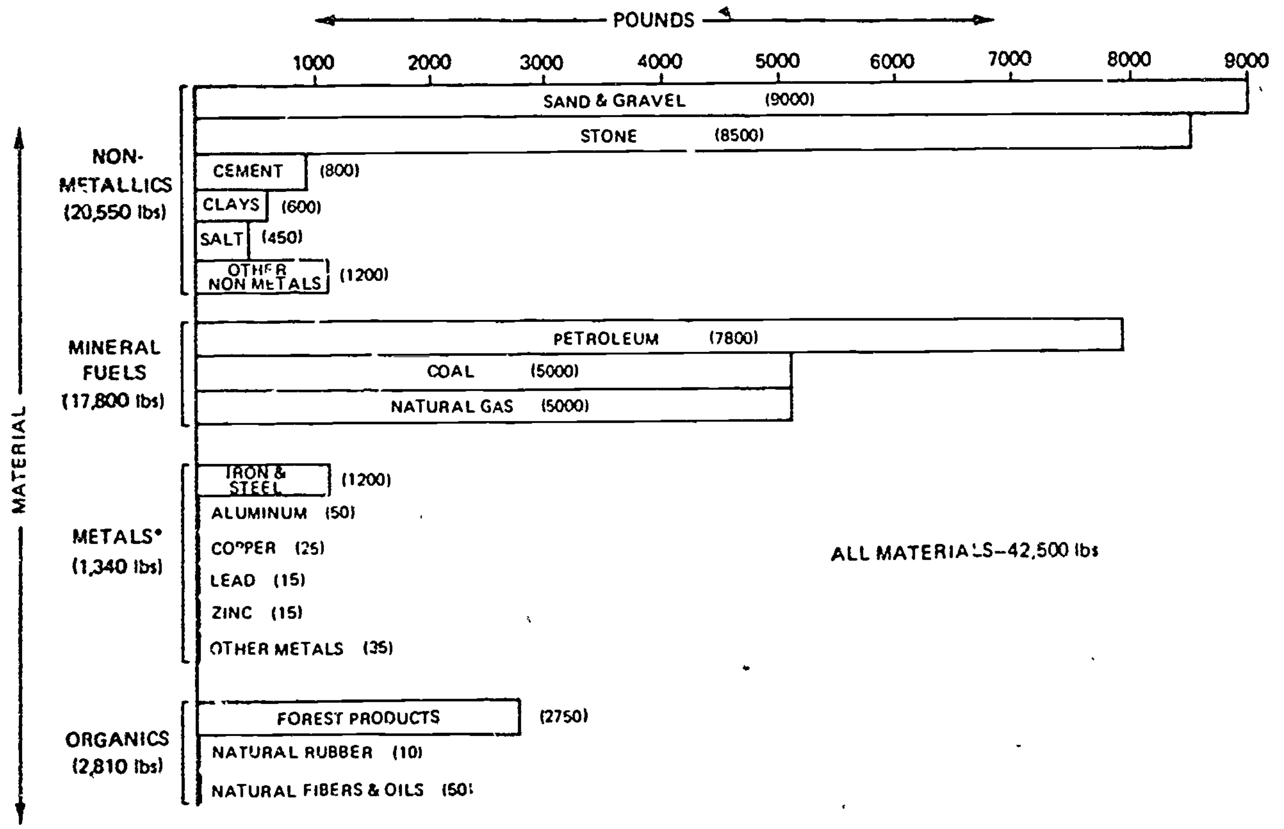
LEVEL: Junior High School

SUBJECTS: Social Studies

REFERENCE: National Commission on Materials Policy, Final Report. Material Needs and the Environment, Today and Tomorrow. Washington, DC, June 1973.

ACTIVITY:

The quantities of natural resources needed to support the "average" individual in the United States is graphically depicted by the diagram below, prepared by the National Commission on Materials Policy based on 1972 data:



*Metals, unlike many of the other mineral materials, may require the handling of hundreds of pounds of rock per pound of pure metal.

Questions for discussion, perhaps for further investigation, may include:

1. Individuals do not use such quantities on a direct, individual basis. How might these totals have been determined?

2. Is it "fair" to use such methods in determining the needs of individuals? Explain why, or why not.

How do these averages compare with the averages of individuals in other nations, such as Japan, Western Europe, Communist nations, and the "Third World"? (It is unlikely that, without exhaustive research, students will be able to make comparisons in all categories. As a practical matter, such comparisons as may be made without excessive research should be sufficient).

4. In what categories is it likely that resources will be exhausted first, assuming continuation of these usage rates? What methods may be employed to delay dates of exhaustion, or even to preclude them?

PURPOSE: To participate in wildlife management projects.

LEVEL: Junior High School

SUBJECT(S): Science
Social Studies

REFERENCE: Charles E. Fox. Activities for Teaching Forest Conservation, Grades 5 through 9. Forest Service, U.S. Department of Agriculture, January, 1958.

NOTE:

The activities suggested require detailed information which can be obtained from the habitat - improvement bulletins issued by the conservation department of your state. Other useful bulletins are:

"Improving the Farm Environment for Wildlife," Fish and Wildlife Service, U.S. Department of the Interior, Washington, DC; and "The Farmer and Wildlife," Wildlife Management Institute, Washington, DC. A local conservation officer should also be consulted. In any rural or city-perimeter school, the following projects can be carried out close at hand, making it possible for pupils to participate and check on results.

ACTIVITY I:

Wildlife foodpatch. A patch of food for use in winter by wildlife may be either planted specially, or a portion of a farm crop may be left unharvested and protected from domestic livestock for use by wildlife. To be effective, the patch must be at least 1/4 acre in size, and a better minimum is 1/2 acre. Corn and soybeans are the staple foods. Be sure the food lasts through the winter; birds will learn to be dependent upon your supply.

ACTIVITY II:

Feeding stations. When little natural food is available as during sleet storms, heavy snows, and in depleted areas, artifical feeding stations are needed for songbirds; for gamebirds such as bobwhite quail, pheasants, and grouse; and for rabbits and squirrels. These stations provide food, shelter, and protection from predators. There are various types: lean-tos, boxes, tepees, brush piles, down-timber.

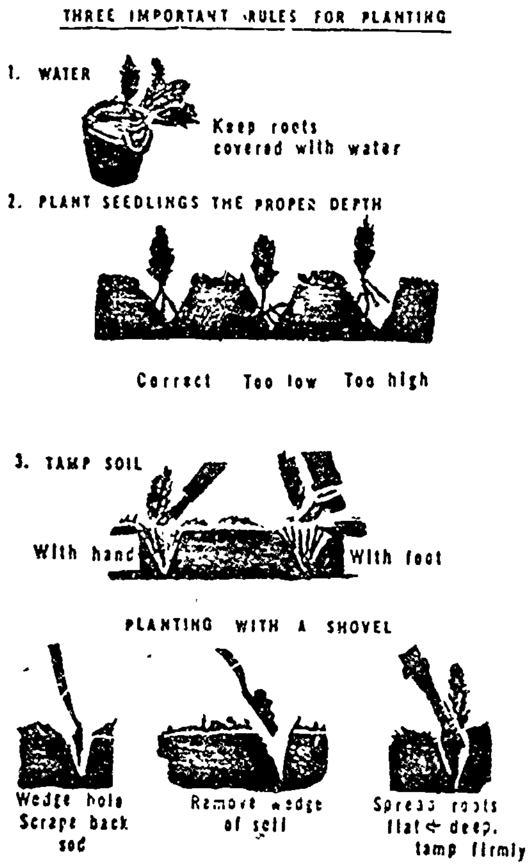
Food may be provided in a number of ways -- scattered in chaff or straw, ear corn impaled on spikes or placed in a hogwire basket, etc. Grit (quartz from poultry feed store or fine gravel) should always be supplied along with the food. Feeding should be started in November as "bait" so that the animals will know where to find food when "hard times" come in winter or early spring.

ACTIVITY III:

Wildlife planting. Improve an existing windbreak or forest planation by adding plants for wildlife food and cover. Useful shrubs are grape, viburnum, highbush cranberry, dogwood, mulberry, elderberry, and hazelnut. A helpful reference is A Book of Wayside Fruits by Margaret McKenney, Macmillan Co. Consult local game warden or forester for advice on species, when to plant, source of planting stock. Most state conservation departments furnish wildlife-planting material free or at cost. Roadside plantings, natural timber patches, forest planations, and farm windbreaks are usually inadequately stocked with useful wildlife plants. There is sure to be an area near any school waiting for just such a development -- except possibly a school in the heart of a big city, and even there, parks may provide an opportunity. Trees, and shrubs together will provide an excellent combination. If the trees are all hardwoods, the planting of conifers should be included in the plan.

ACTIVITY IV:

Improve the school grounds. Obtain permission from school officials to plant a wildlife cover of trees and shrubs, plant a multiflora-rose hedge, a windbreak of conifers, a memorial grove in honor of a school or community conservation leader, or something similar. Consult conservation officers for information on species, when and how to plant. If possible, arrange for a little dedication ceremony after the area is planted.



PURPOSE: To learn how to interpret a topographic map and to suggest ways these maps may be useful to land use planners.

LEVEL: Junior High School

SUBJECT(S): Social Studies
Science

REFERENCE: The Changing World: The Surface of the Earth, Student Manual for Junior High School Science, Board of Education of Baltimore County, Towson, Maryland, 1970. ED 064 036 (Not available from EDRS.)

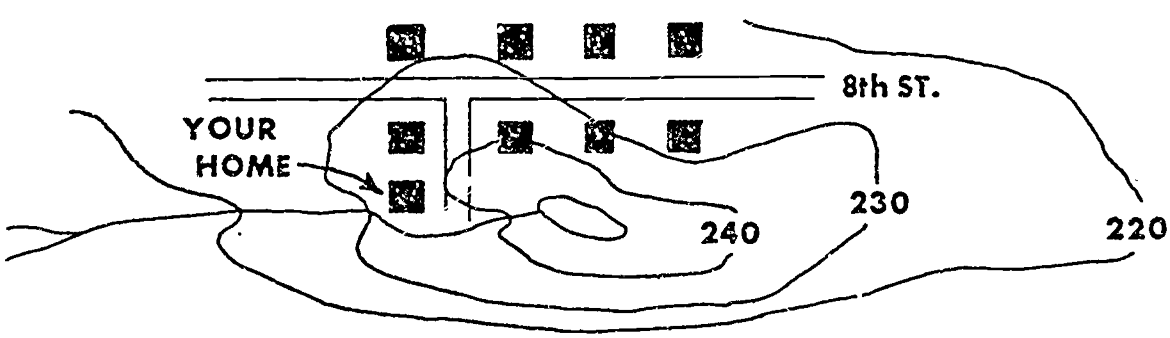
MATERIALS NEEDED:

topographic map of your community
hand magnifier
sheet of paper

ACTIVITY:

Share with your students the following:

Any map that shows the shape of hills and valleys and other landforms is called a topographic map. Maps that contain contour lines show these things. They are the most common kinds of topographic map. Suppose you were to look for your home on a topographic map. It might be shown as in this diagram:



You can tell several things about the area in which you live by looking at this map. Can you determine:

a. the elevation of your home?
b. the type of landform on which your home is located?
c. whether there is a stream nearby?

Instruct students that in this investigation they will observe contour lines that relate to some of the landforms in the area surrounding your school. They will also measure some distances in your local area.

Give each student a topographic map of your community and the following tasks:

1. What is the title of the map?

2. Who prepared this map?

3. In what color are the contour lines shown on this map?

4. Can you find the community where you live?

5. What does the blue color represent?

6. Find the term "Scale 1:24000" at the bottom of the map. This means that one unit of measurement on the map equals 24,000 of the same units on the earth. Therefore, if you measure one centimeter of distance on this map, you are measuring 24,000 centimeters of distance on the earth. The scale can be used with any system of measurement.

   One inch of distance on the map would represent____________ inches of distance on the earth.

7. It is convenient to have the scale shown in some commonly used units of measurement. Just below the term "Scale 1:24000" find the scale of miles. Below this find the scale of feet. Below the scale of feet, find the scale of kilometers.

8. Lay the edge of a sheet of paper along the scale of miles. Copy the scale on the paper by making marks that correspond to the points on the scale. Identify each of the 10 divisions on the left half of the scale. What part of a mile does each division represent?

9. Use the scale of miles to find the straight-line distance from your home to school. What is this distance?

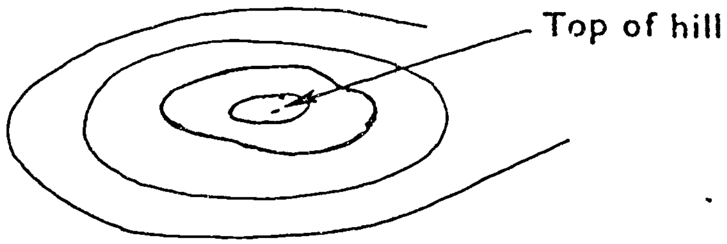
10. An area of the earth's surface is usually measured in units called square kilometers or in square miles. The area can be found by multiplying the length of a surface by the width of the surface. How many square miles are represented by this map?

11. Find the contour lines on the map. A magnifier may help you in observing these lines. You remember that the change in elevation from one contour line to the next is called the contour interval. Locate the contour interval in feet at the bottom of the map. What is the change in elevation from one contour line to the next?

12. The darker contour lines are marked in the number of feet of elevation above sea level. Find the dark contour line that runs closest to your school. Counting lighter contour lines up or down from the dark one, and using the contour interval, you can estimate the elevation of your school.

13. Find the contour line that runs closest to your home. What is the elevation of your home above sea level?

14. A hill can usually be located on a topographic map by looking for closed contour lines.



15. Find the hill nearest your school. What is the elevation of this hill?

16. How far is the top of the hill from your school?

When students have had an appropriate amount of time to complete the above tasks; hold a class discussion as to:

1. How would a topographic map be helpful to the Department of Highways in planning a new road through your area?

2. What other agencies might use a topographic map and for what purposes?

PURPOSE: To help students understand the need and necessity for sound water management for the health, safety and survival of the community.

LEVEL: Junior High School

SUBJECT(S): Science
Social Studies

REFERENCE: Mary Junglas, et al. Environmental Learning Experiences: Socio-Cultural, Junior High School Center for the Development of Environmental Curriculum, Willoughby - Eastlake City Schools, Willoughby, Ohio, 1974, Title III ESEA. ED 099 231.

ACTIVITY:

Discuss the fact that water is such a common and inexpensive product that we often fail to realize its importance. Like many things in society, we often take it for granted until it no longer exists or creates a problem.

Have the students investigate the source of the community water supply. Introduce the students to the concept of a watershed. Does the community depend upon aboveground or underground sources for their water? Is the supply of water adequate? What provisions are made for storage of water during drier months? What is the quality of the water received by the community prior to treatment? What are the sources and types of pollutants and contaminants present in the water? Are there other communities and industries upstream which discharge into the water source, and are thus partly responsible for the water quality? Are the present storage and treatment facilities sufficient to meet current and future water needs of the community? Will the present source of the community's water supply be adequate to meet future water demands?

Now have the students investigate the importance of having an adequate supply of quality water.

1. Have the students determine the impact of not having enough water on the present and future growth of the community. What would the economic impact be? Would industries who are high-volume water users have to cut back production, layoff workers, move to a community with an adequate water supply, restrict future expansion? Would water shortages and rationing slow down the development of new residential areas? Would shortages cause people to seek other communities in which to work and live?

2. Have the students investigate the potential health and safety hazards that might exist if the water quality standards of a community were below the allowed minimums.

Ask your students to determine the water usage of their own families. Collect the data and analyze it. They must learn to read a water meter. Why are there differences in water consumption among students' families? Have the students list as many possible reasons as they can for high water consumption. Possible reasons for higher usage might include the presence of the following:

-- larger family
-- automatic washing machine
-- garbage disposal
-- more bathrooms
-- showers instead of tubs
-- automatic lawn sprinklers
-- regular washing of family cars
-- etc.

Have the students determine if any correlations exist between the factors listed and the differences in water consumption. Generate a list of ways a family can conserve water. Posters could be drawn and displayed in the school to promote more efficient utilization of our water resources.

Take a field trip to the local water treatment plant. Have the students find out who works there and what their duties are. Students should, as a result of the field trip, be able to list or draw a schematic of the various stages of treatment carried out at the plant. (This is particularly appropriate for highly-motivated students.) A related activity would be for the students to diagram the movement of water from its source, through treatment, to the consumer. If local field trips are not possible, community resource people can be interviewed by the students or invited to speak to the class. As a last resort, the teacher can present the basic information.

PURPOSE: To trace the increases of prices of natural gas.

LEVEL: Junior High School

SUBJECTS: Science
Social Studies
Mathematics

REFERENCE: Energy Fact Sheet No. 24, November 1981 (DOE/EIA-0240/24), U.S. Department of Energy, Energy Information Administration, National Energy Information Center, 1F-048 Forrestal Building, Washington, DC 20585.

ACTIVITY:

Provide copies of the table below:

U.S. Average Value of Natural Gas Delivered to Consumers
(Current Dollars per Thousand Cubic Feet -- Taxes Included)

Category	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Residential	1.09	1.15	1.21	1.29	1.46	1.71	1.98	2.35	2.56	2.98
Commercial	0.82	0.87	0.92	0.98	1.12	1.40	1.69	2.10	2.30	2.77
Industrial	0.37	0.41	0.45	0.50	0.67	0.96	1.24	1.50	1.70	1.99
Electric Utilities	0.29	0.32	0.34	0.38	0.51	0.77	0.98	1.32	1.48	1.81
Other Consumers	0.47	0.52	0.57	0.70	0.70	0.91	1.21	1.46	1.75	2.36
All Categories	0.59	0.63	0.68	0.73	0.89	1.19	1.47	1.78	1.98	2.34

Have students prepare line graphs showing the changes in natural gas price during the ten-year period for which data are provided. The following questions, and related ones, may be researched and discussed:

1. What is meant by the term "current dollars"?

2. How are "current dollars" determined?

3. How might the pattern of the graph be changed if data were presented in terms of, for example, "1970 dollars"?

4. For what reasons do different types of users pay different prices for natural gas?

5. Has the pattern of difference in prices for different users been consistent, over the years? Why, or why not?

6. What factors have led to increases in prices of natural gas? List and explain as many as possible.

7. Based on the data available in this exercise, would one expect the rates of usage of natural gas to have increased, decreased, or remained relatively constant between 1970 and 1979? What additional information is needed to determine what actually occurred?*

*For more information, see _Natural Gas Production and Consumption 1979_, U.S. Government Printing Office (S/N 061-003-00[illegible]-9, $2.00), Washington, DC 20402.

PURPOSE: To investigate how choices are made between different resources which have similar uses.

LEVEL: Junior High School

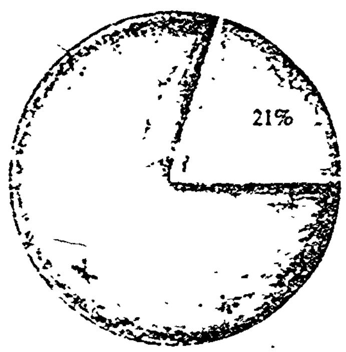
SUBJECTS: Science
Mathematics

REFERENCE: Energy in America: Progress and Potential, a 1981 publication of the American Petroleum Institute, Publications and Distribution Section. 2101 L Street NW, Washington, DC 20037. SE 036 092.

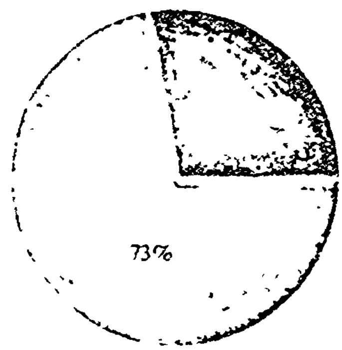
ACTIVITY:

In relation to these circle graphs, discuss the questions below:

U.S. Coal: Contribution and Potential



Coal's Share of 1980 U.S. Energy Consumption



Coal's Share of Recoverable U.S. Conventional Energy

Sources: U.S. Geological Survey and Department of Energy

1. How much of the energy consumed in the United States in 1980 came from coal?

2. What percentage of the total recoverable energy resources in the United States is coal?

3. List and explain as many reasons as you can why these percentages are not the same. (Responses should include differences in price, appropriateness of coal and other energy resources for specific uses, associated environmental problems, etc.)

4. Under what conditions or circumstances will the coal resources of the United States be further developed and used?

PURPOSE: To become aware of the products of the crude oil refinement process

LEVEL: Junior High School

SUBJECTS: Science
Mathematics

REFERENCE: Energy Fact Sheet No. 26, December 1981 (DOE/EIA-0240/26), U.S. Department of Energy, Energy Information Administration, National Energy Information Center, IF-048 Forrestal Building, Washington, DC 20585.

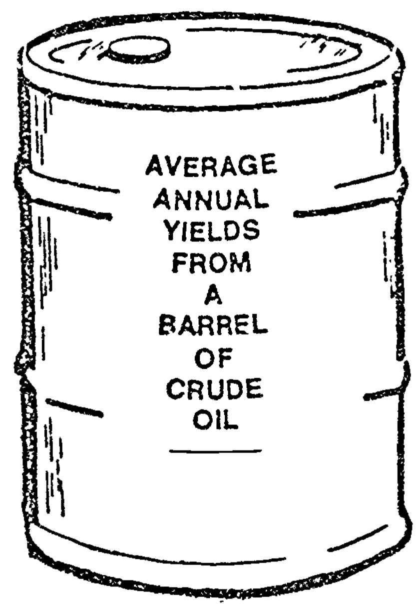
ACTIVITY:

Provide students with copies of the information and table below:

A BARREL OF CRUDE OIL

Most Americans know that motor gasoline is refined from crude oil. Yet many are unaware that a barrel of crude oil contains 42 gallons, and that gasoline is only one of a number of products refined from it. In 1979, one barrel of crude oil typically yielded:

Product	Gallons	Percent of Yield
Gasoline	18.06	43.0
Jet Fuel	2.90	6.9
Ethane (including Ethylene)[1]	0.04	0.1
Liquefied Gases	0.97	2.3
Kerosene	0.55	1.3
Distillate Fuel Oil	9.03	21.5
Residual Fuel Oil	4.83	11.5
Petrochemical Feedstocks	1.97	4.7
Special Naphthas	0.25	0.6
Lubricants	0.55	1.3
Wax	0.04	0.1
Coke	1.09	2.6
Asphalt	1.30	3.1
Still Gas[2]	1.60	3.8
Miscellaneous	0.34	.8
	43.52	103.6
Processing Gain[3]	-1.52	-3.6
Total	42.00	100.0



[1]Petrochemical feedstock (Ethane C_2H_6 and Ethylene C_2H_4)--used to make plastics and ethyl alcohol.

[2]By-product of the distillation process on the downstream side containing a variety of gases, normally methane, propane, and butane.

[3]The result of the addition of hydrogen during the refining process.

Not all commodities come in 42-gallon barrels. For example, whiskey, flour, and apples are each transported in barrels of different sizes. The sizes of each barrel type were determined by the barrel makers, of coopers, who originally constructed them. When oil was first brought to the market in commercial quantities, it was shipped in whatever barrels were available. Price was set by the barrel, no matter what volume of oil the barrel contained. In 1866 the container for oil was universally standardized as the herring barrel, containing 42 gallons. Legend has it that this number originated with King Edward IV of Norway, in the 15th century, when he decreed the standard volume of a herring barrel to be 42 gallons.

The following questions, and related ones, may be researched and discussed:

1. What uses, if any, do each of the refinement products have? Identify any that might be considered "waste."

2. Why was it necessary to standardize the volume of the oil barrel?

3. How many gallons of hydrogen are added per barrel of crude oil processed? Explain why.

PURPOSE: To consider the effects of conservation of natural resources on forecasts of future demand.

LEVEL: Junior High School

SUBJECTS: Science
Mathematics
Social Studies

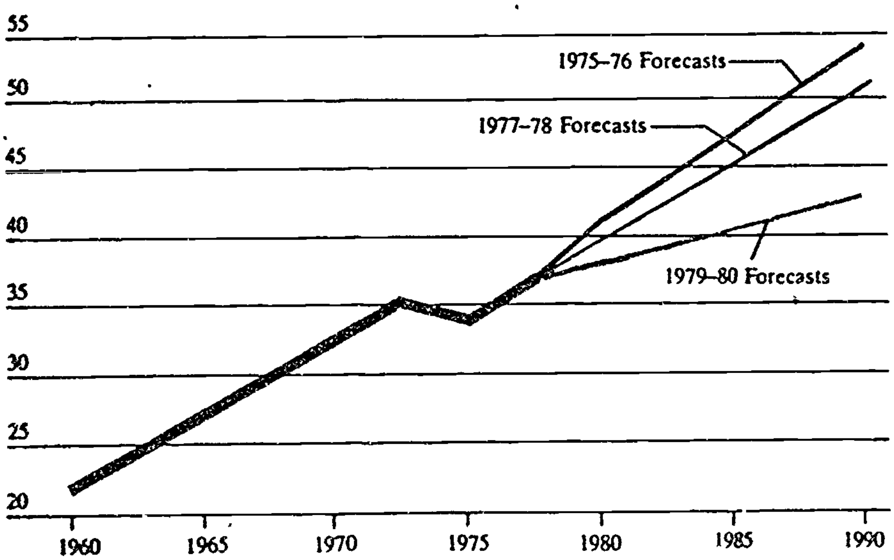
REFERENCE: Energy in America: Progress and Potential, a 1981 publication of the American Petroleum Institute, Publications and Distribution Section, 2101 L Street NW, Washington, DC 20037. SE 036 092.

ACTIVITY:

Those attempting to forecast future demand for natural resources must base their projections on historical patterns, current usage rates, and anticipated changes in need. Anticipated changes in need are difficult to forecast, because they include considerations for which actual data do not currently exist - for example, what numbers of people must be serviced by this resource in the future, what technological demands will there be in the future, etc? As a rule, conservation of natural resources has not been considered as a modifying factor in projecting future demand because conservation efforts have not demonstrated appreciable influence on usage rates.

However, some recent data indicate that attempts at conservation, in this case through decelerated rates of increase in energy demand, can play a significant role in modifying projections of future needs. The American Petroleum Institute reports that, since the mid-1970s, successive forecasts have projected decreased growth in demand in the area of energy use, as shown by the graph below:

Forecasts of Energy Use
(million barrels per day crude oil equivalent)



This chart—based on published forecasts from government, business, industry and other sources—shows how the trend toward energy conservation has caused forecasts to drop substantially over the last few years

Questions for discussion and further research:

1. What was the forecast of annual energy use, in million barrels per day of crude oil equivalent, made for 1980 in 1975-76? And the forecast for 1990, as made in 1975-76? What annual rate of increase, in million barrels per day, would this represent?

2. What was the forecast of annual energy use, in million barrels per day of crude oil equivalent, made for 1980 in 1977-78? And the forecast for 1990, as made in 1977-78? What annual rate of increase, in million barrels per day, would this represent?

3. What was the forecast of annual energy use, in million barrels per day of crude oil equivalent, made for 1980 in 1979-80? And the forecast for 1990, as made in 1979-80? What annual rate of increase, in million barrels per day, would this represent?

4. Is it reasonable to assume that 1981-82 forecasts would project similar decreasing rates of increase? Why, or why not?

5. What factor(s) may have contributed to changes in forecasts, over the period 1975-1980?

6. Is it reasonable to assume that America's problem of energy supplies is solved, on the basis of this evidence? Why, or why not?

7. Is it reasonable to project the patterns shown here to other non-renewable resources? Why, or why not?

PURPOSE: To compare production and consumption of energy in the United States.

LEVEL: Junior High School

SUBJECTS: Social Studies

REFERENCE: Energy Fact Sheet No. 25, November 1981 (DOE/EIA-0240/25), U.S. Department of Energy, Energy Information Administration, National Energy Information Center, 1F-048 Forrestal Building, Washington, DC 20585.

ACTIVITY:

Provide students with copies of the table below:

U.S. ENERGY REVIEW

1980 Consumption	Quadrillion Btu	Percent of Total	1980 Production	Quadrillion Btu	Percent of Total
Petroleum	34.2	44.9	Crude Oil	18.3	28.2
Coal	15.6	20.5	Coal	18.7	29.0
Natural Gas (Dry)	20.5	26.9	Natural Gas (Plant Liquids and Dry)	22.0	34.0

Have students prepare two circle graphs - one for 1980 U.S. energy consumption, the other for 1980 U.S. energy production. The following questions, and related ones, may be researched and discussed:

1. For both "production" and "consumption," determine what items might be included in the category "other."

2. If "consumption" of energy is greater than "production," in what ways was the difference made up?

3. In the case of coal, "production" exceeded "consumption" by 3.1 quad Btu's.* What might have happened to these Btu's?

4. The data summarized below provide additional information relative to 1980 U.S. energy production and consumption. They may be used for a number of discussion activities, particularly related to comparisons between and among raw materials needed for energy production and conversions involved.

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*1 quad Btu = 1,000,000,000,000,000 = 1 x 10^{15} Btu. A Btu is a British thermal unit, which is defined as the amount of energy required to raise the temperature of one pound of water one degree Fahrenheit. One Btu is equivalent to 252 calories, where a calorie is the amount of energy required to raise the temperature of one gram of water one degree centigrade, or Celsius.

PETROLEUM - 1980: The United State ....

- Produced a daily average of 8.6 million barrels of crude oil, about 64 percent of total average daily crude oil input to refineries.
- Consumed 17 million barrels of petroleum product per day.
- Imported 37 percent of the petroleum consumed, the lowest since 1975.
- Imported 68 percent of its net petroleum imports from OPEC, down from a 72 percent high in 1977.

COAL - 1980: The United States ....

- Produced a total of 829.7 million short tons of coal.
- Operated 6,425 coal mines, the majority located in Kentucky.
- Employed 255,000 coal miners (170,000 underground; 85,000 surface).
- Produced more coal by surface mining, 60 percent, than by underground mines, 40 percent.
- Consumed 702.7 million short tons of coal, 3.3 percent more than the record consumption in 1979; electric utilities, the largest consumer of coal, used 81 percent.
- Exported 91.7 million short tons of coal and imported '.2 million short tons.

NATURAL GAS - 1980: The United States ....

- Produced a total of 20.145 trillion cubic feet, or 55 billion cubic feet per day, down 1.9 percent from the daily rate of marketed production during 1979.
- Imported an estimated 985 billion cubic feet of natural gas. Natural gas imports represent 4.9 percent of the total natural gas comsumption.
- Had an average natural gas wellhead price of 149.6 cents per thousand cubic feet (the average residential heating price was 391.5 cents per thousand cubic feet).

ELECTRICITY - 1980: The United States ....

- Produced 2,286 billion kilowatt-hours, up 1.7 percent from 2,247 billion kilowatt-hours in 1979. In 1980, 92 percent of the net power generated was sold.
- Had a total of 3,067 electric powerplants, 2 fewer than in 1979--total capacity: 613,546 megawatts (1980) and 598,298 megawatts (1979).
- Had an average of 74 nuclear power reactors licensed for commercial operation, an increase of 18 over the 1975 level of 56.
- Generated a total of 251.1 billion kilowatt-hours of nuclear-based electricity, 46 percent above the 1975 level. Nuclear generation in 1980 represented 11 percent of total electricity generation.

SOLAR - The United States ....

- Produced about 0.008 quadrillion Btu of usable energy output from solar collectors in 1979, or between 0.01 and 0.02 percent of domestic energy consumption.
- Increased its total of solar collector manufacturers from 45 in 1974 to 364 in 1980.
- Produced 55 percent of its solar collectors (from July through December of 1979) for pool heating; the remainder was for domestic hot water, space heating, and space cooling.

PURPOSE: To be aware of the complexity that often exists in resource management, especially when intergovernmental and intercorporational cooperation is required.

LEVEL: Junior High School

SUBJECTS: Social Studies
English

REFERENCE: California Environmental Education Guide, Volume 3, pp. 104-105. Hayward, CA: Office of the Alameda County Superintendent of Schools, copyright 1981. Reprinted by permission. SE 036 095.

ACTIVITY:

Read the following account of the Great San Francisco Egg War to your class.

One spring day in 1850 a young prospector dragged himself into the best eating place in Placerville, California, then called Hangtown. As he walked in, tired from his long ride from Angel's Camp, all eyes followed him. In spite of his dusty and fatigued look, he had the air of a man who had just struck it rich in gold. He looked slowly around, then sat down. He said to the waiter, "Sir, I am very rich. I want you to prepare a meal for me consisting of only your most expensive and finest foods." "Yes sir!", replied the owner, delighted at such an order. All of the people in the restaurant waited breathlessly to see what the chef would prepare.

Finally, out it came! The chef uncovered the silver dish and there, sitting garnished and elegant was an oyster omelette. To this day an oyster omelette is called the "Hangtown Fry." Both the eggs and the oysters were gifts from the sea. In the early days of the Gold Rush, the only source of fresh eggs was from nests of sea birds on the Farallon Islands off the coast of San Francisco. Rival companies were formed which would sail to the Farallons to gather eggs from the slippery cliffs of the granite islands. Eggs were selling for several dollars each and the price was rising daily. Eventually, the high price and the diminishing supply of eggs, as well as the danger involved, led to violence. The Great San Francisco Egg War ended only when vigilantes hanged many of the most violent egg traders and when laying hens were finally imported from the East and the Orient.

1. Prepare a list of episodes similar in flavor to the Great San Francisco Egg War. Such a list might include:
   - The Exploits of Joaquin Murietta
   - The Journeys of Junipero Serra
   - The Mormons in the San Bernardino Valley
   - The History of Emperor Norton
   - The Naming of the Golden Gate by John C. Fremont

How the Big Euphemia was beached and became the City Jail of San Francisco
How the Steamboat Senator made $50,000 a week between San Francisco and Sacramento
Mail order brides from France in the Gold Rush

2. Have each student pick one such episode for further study. Reports, drawings, scrapbooks, poems, etc., should stress the resource management aspects of the happening. For example, a report on the Egg War should make the point that the bird eggs were a resource that could have been managed better. Because of poor management, people were killed. Prices soared and eventually there were no more eggs to be had from this source. The bird population was greatly reduced. To this day the Farallon Islands are protected by the government because of its early history of exploitation (eggsploitation).

3. Discuss the following questions with respect to the California episodes reported:
   a. What resources are involved in this story?
   b. What bad practices are shown?
   c. What good practices are shown?
   d. What was the involvement of government to this story? Of private enterprise? Of citizen's groups? Of media?
   e. If these groups had shown more of a spirit of cooperation, what outcomes would have been changed?

FOLLOW-UP:

There are some present-day issues which cry out for "sector cooperation" for what might be perceived as proper outcomes. Have your students research one or more of the following with emphasis on cooperation being the first step toward the best solutions:

The Drying of Mono Lake
The Overpopulation of Nonpredator Species in Our Parks
Land Use in the Tahoe Basin
The Peripheral Canal
Nuclear Power Plants (Sundesert, Canyon Diablo, Rancho Seco)
Distribution of Farmlands in Westlands Water District
Aspirations of Migrant Workers
Flight of Business from the Inner Cities
Splitting of California into Two or More States

PURPOSE: To be aware of the key factors in the world today that have contributed to the decreased availability and quality of all natural resources.

LEVEL: Junior High School

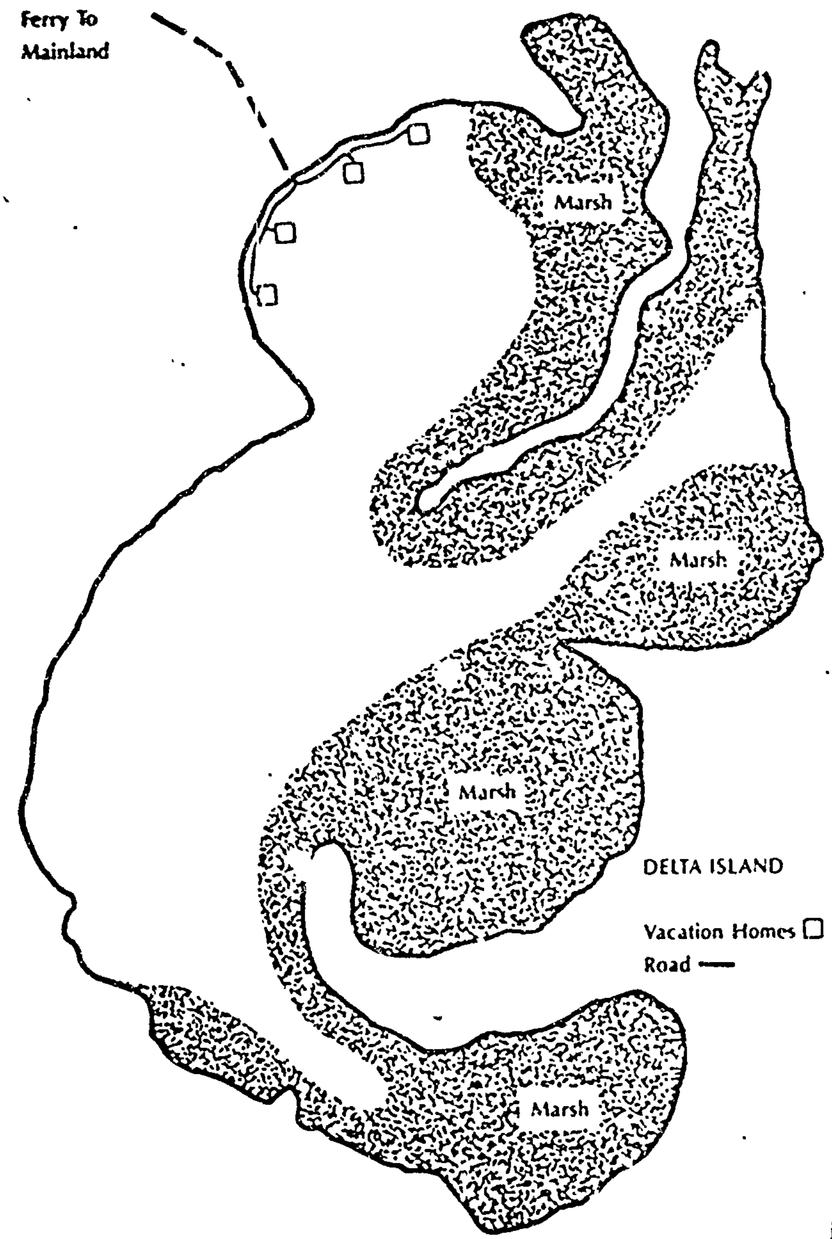
SUBJECTS: Science

REFERENCE: California Environmental Education Guide, 1981-84, Volume 3, pp. 95-98. Hayward, CA: Office of the Alameda County Superintendent of Schools, copyright 1981. Reprinted by permission. SE 036 095.

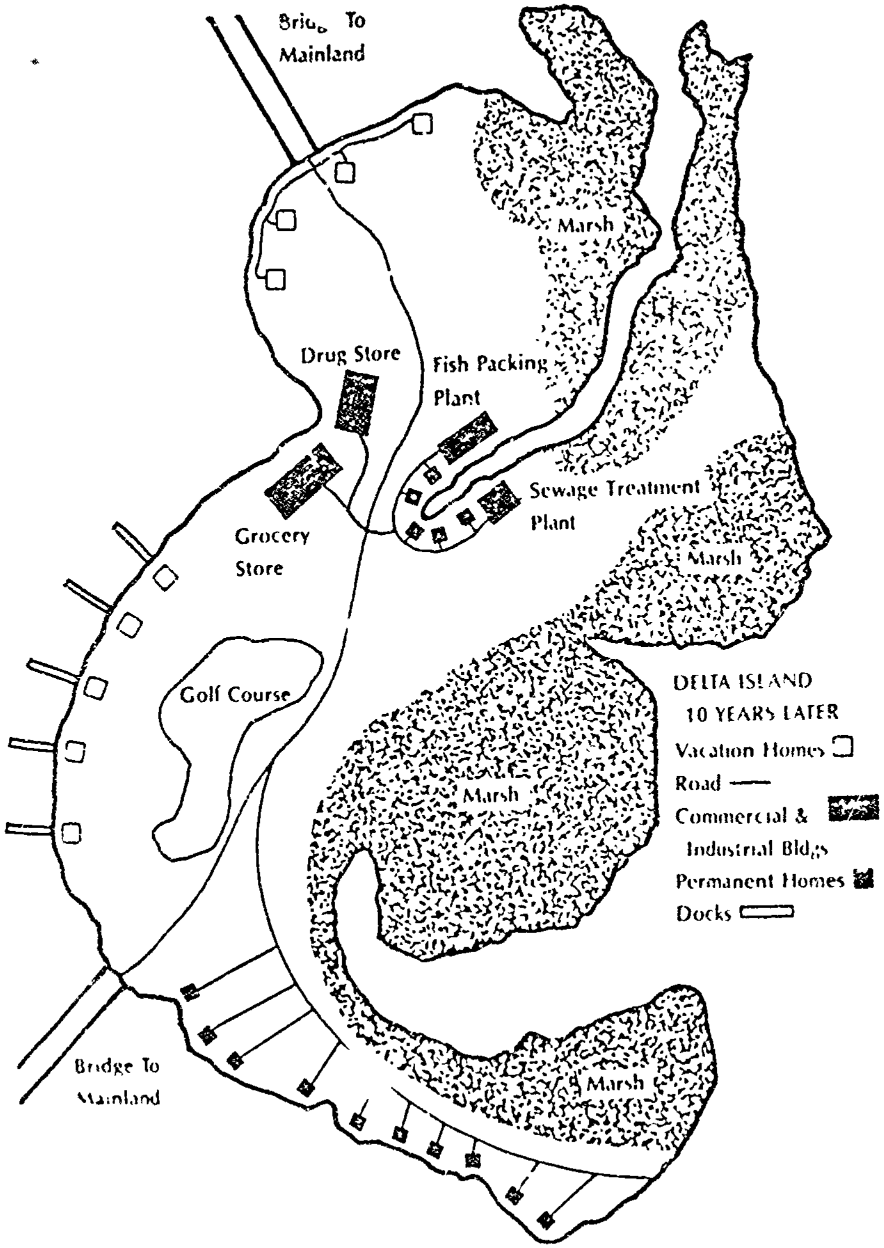
Prepare copies of the four maps of Delta Island (pp. 79-81) for each student.

1. Examine all four maps. Ask the questions below:
   a. Look at the first map. What percentage of Delta Island was covered by marsh?
   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?
   c. What percentage of the marsh was filled in at each ten year interval?
   d. Compare Map 1 with Map 4. What is the percentage of the original marsh that remains?
   e. What was built first that stimulated 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. How has the fishing been affected by the increase in development?
   h. In what ways could people use the marsh in its natural state for recreation? In what ways have people altered the marsh for recreational purposes? How have the recreational uses of the island changed over time?
   i. What immediate benefits are received by development of the wetlands? What are the long-term benefits of this development? Who has been adversely affected by the development of the wetlands?
   j. Where could development have taken place on this island without destroying the marsh vegetation?

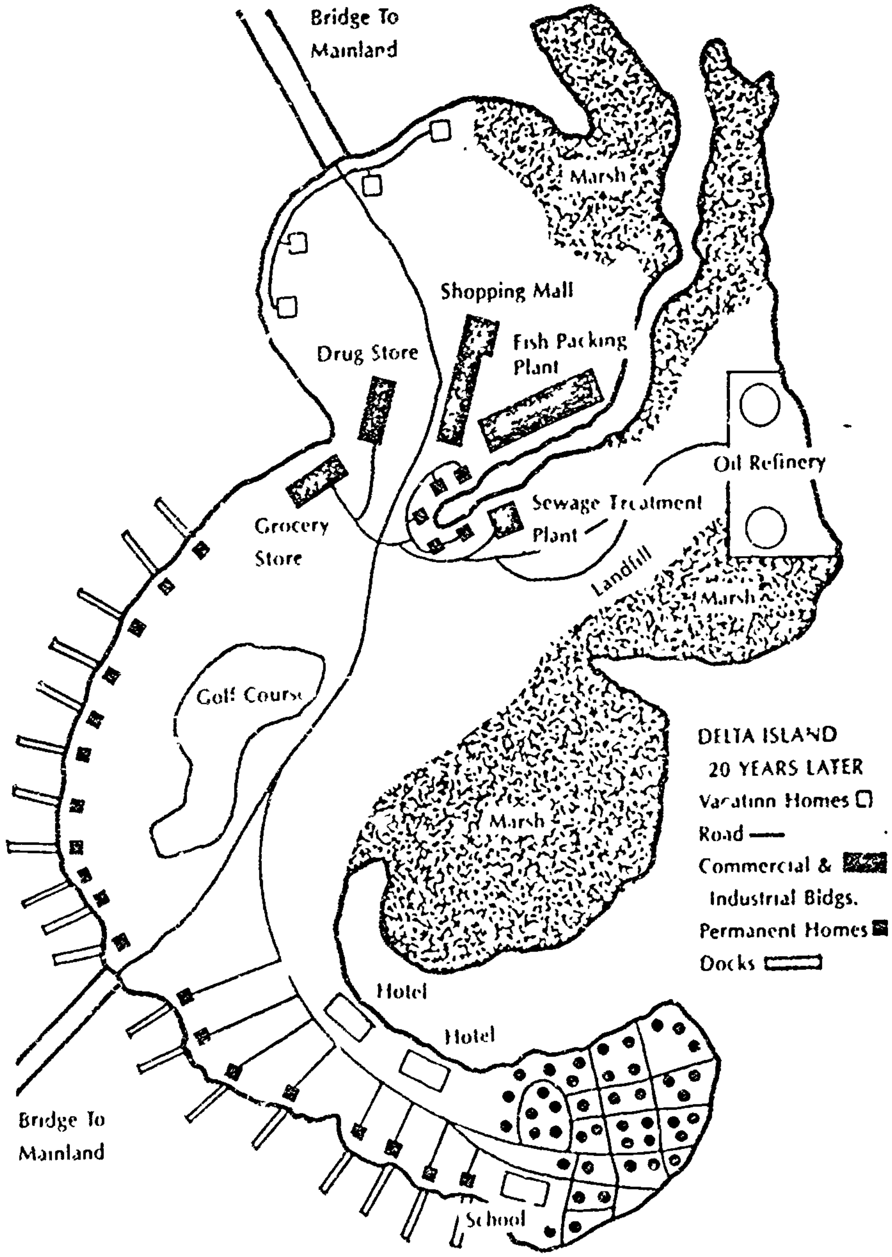
2. Now that your students have examined what human development can do, they are ready to develop their own plans for the island using the first map as a guide. The individual plans created by the students should provide


Ferry To
Mainland
Marsh
Marsh
Marsh
Marsh
DELTA ISLAND
Vacation Homes
Road

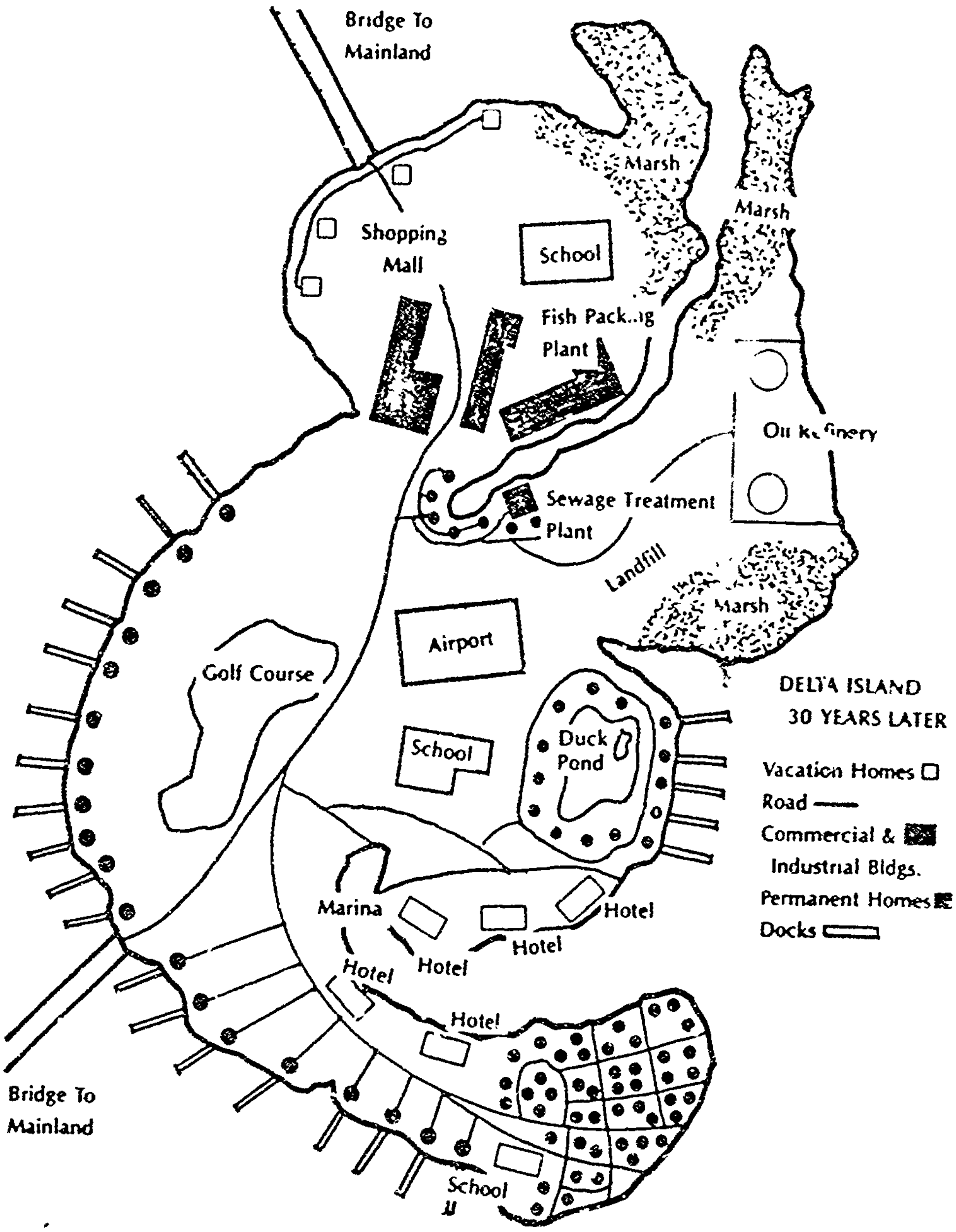
MAP 1


Bridge To Mainland
Marsh
Drug Store
Fish Packing Plant
Sewage Treatment Plant
Grocery Store
Marsh
Golf Course
Marsh
Bridge To Mainland
Marsh
DELTA ISLAND
10 YEARS LATER
Vacation Homes
Road
Commercial & Industrial Bldgs
Permanent Homes
Docks

MAP 2


Bridge To Mainland
Marsh
Shopping Mall
Drug Store
Fish Packing Plant
Oil Refinery
Sewage Treatment Plant
Grocery Store
Landfill
Marsh
Golf Course
Marsh
DELTA ISLAND
20 YEARS LATER
Vacation Homes
Road
Commercial & Industrial Bldgs.
Permanent Homes
Docks
Hotel
Hotel
Bridge To Mainland
School

MAP 3


Bridge To
Mainland
Marsh
Marsh
Shopping
Mall
School
Fish Pack..ng
Plant
Oil Refinery
Sewage Treatment
Plant
Landfill
Marsh
Airport
Golf Course
DELTA ISLAND
30 YEARS LATER
School
Duck
Pond
Vacation Homes
Road
Commercial &
Industrial Bldgs.
Permanent Homes
Docks
Marina
Hotel
Hotel
Hotel
Hotel
Hotel
School
Bridge To
Mainland

MAP 4

for human needs without completely destroying the marsh. They must consider the economic needs of the population and still provide the best balance between development and conservation of the marsh.

FOLLOW-UP:

1. Find a local wetland in danger of development. Will such a development be beneficial or harmful? To whom?
2. Plan a campaign to influence the outcome of a local wetlands issue.

Adapted from National Wildlife Federation materials.

JUNIOR - SENIOR HIGH SCHOOL

NATURAL RESOURCE MANAGEMENT ACTIVITIES

PURPOSE: To help students understand how competition for available nutrients influences plant growth.

LEVEL: Junior - Senior High School

SUBJECT(S): Science

REFERENCE: <u>Project Learning Tree Supplementary Curriculum Guide for Grades 7 through 12.</u> American Forest Institute, copyright 1977. Reprinted by permission.

MATERIALS NEEDED:

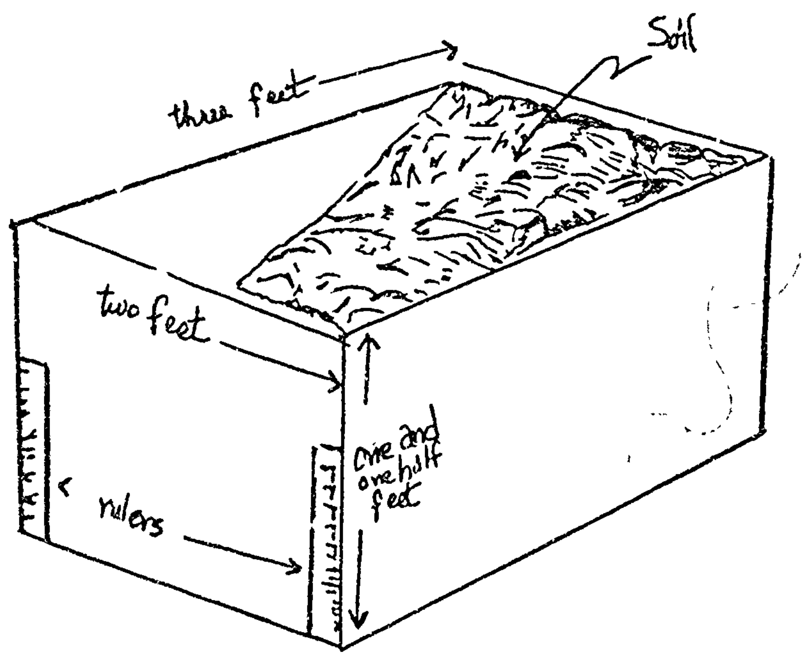
Sunny inside location.

Three identical or nearly identical soil boxes, each approximately 2 feet x 3 feet (65 x 100 centimeters) at the base and 1-1/2 feet to 2 feet in height (45 to 65 centimeters). (See illustration.) Fill each box with soil, forming a slope from one end of the box to the other. Be careful to make the slope and soil compactness the same in all three boxes.

Seeds. Marigold seeds germinate readily. Wheat grass or rice grass will thicken quickly and offer good root systems. Pick a local variety that will grow quickly. The county agricultural extension agent or a nursery that sells lawn and garden products can make suggestions. Six metric rulers, two for each box. Sprinkling can.

ACTIVITY:

Plant an equal number of seeds in each of the boxes. One side of the soil area in each box should be planted with seeds at one-inch (three centimeter) intervals and the other side with seeds every two inches (six centimeters). Water equally and place in the sun, being careful to provide each box with as nearly identical growing conditions as possible.



Plant one corn seed in container #1.
Plant 4 corn seeds in container #2.
Plant 8 corn seeds in container #3.
Plant 16 corn seeds in container #4.
Plant 16 corn seeds in container #5 and thin to 8 plants when 5 inches (12 centimeters) tall.
Plant 16 corn seeds in container #6 and thin to 4 plants when 5 inches (12 centimeters) tall.
Place all the containers in a sunny, inside location and keep moist with water. Measure and record (graph) the height of the plants at regular intervals. When the plants are sufficiently high that students can measure their circumferences or diameters, record these statistics also. A piece of string or sewing tape is a good tool for this task.

Af r a suitable "growing sea , use the students' observations and data to discuss:

1. Which container has the tallest plants; which the l gest in diameter; whether these containers are the same one; how density (the number of plants/unit area) influences height growth and diameter growth.

2. Whether any of the containers have plants which look less healthy than those in other countries. Whether there is a relationship between density and plant vigor. What you think would happen if you removed one-half of the plants from one of the containers holding 16 plants. If you removed three-fourths of the plants. Try it, using containers #5 and #6. Observe and record any plant responses.

3. Consider what other factors might affect the health and vigor of plants, for instance: soil conditions, nutrients, slope, exposure, climate, species.

4. Compare your removal of one-half and three-fourths of the plants with thinning trees in a forest. Why might foresters plant many small trees close together, knowing they must thin them when they grow larger?

5. To what extent it is possible to gene lize from this experiment to conditions and practices in forested areas.

As the seedlings develop, three different management modes should be followed:

1. Forester's Box A: Allow this box to grow untouched. Add water only.

2. Forester's Box B: Thin (remove) every other plant on one end of the box and three out of every four on the other end and add water. Thin twice, once two weeks after the seeds have germinated and a second time four weeks after germination.

3. Forester's Box C: Remove all of the plants from a one-foot (30 centimeter) square area on one side of the box beginning about 1/3 of the way down the slope. On the other side remove all of the plants from a two-foot (65 centimeter) square area beginning about 1/6 of the way down the slope.

Keep records on all of the boxes. Include data on:

- Amount of water supplied and when
- Germination date
- Seeds/square inch (or centimeter) at different intervals of time
- Growth rate - by recording height of plants on a regular basis
- Thinning dates
- Other data which students feel might be useful

The following are suggested for class discussion:

Discuss:

1. From this experiment, attempt to make a generalization about the effects of thinning on plant growth.
2. Hypothesize about the productivity of soil relative to nutrients.
3. Is it or is it not possible to generalize from this situation to forest conditions?
4. What are the differences between a forest thinning and this type of thinning?

You may wish to extend this activity through the following variation:

Prepare six potted-plant containers, each containing an equal amount of the same kind of soil. Bottom sections cut from half-gallon (two liter) paper milk cartons work quite well as containers. Number the containers.

PURPOSE: To provide the opportunity for students to assume the role of wildlife managers and investigate the characteristics of Lepidoptera (Butterflies, Skippers and Moths).

LEVEL: Junior - Senior High School

SUBJECT(S): Science

REFERENCE: Suggested by Susan Kains Ahern, Doctoral student in Science Education, The Ohio State University.

ACTIVITY I:

With your class, find a field where there are many wildflowers blooming. Observe until you locate a flower that seems to be attracting butterflies or moths. Refer to the following tables and drawings to determine whether the insects visiting your flower are butterflies, skippers or moths. Remember, the behavior of the insect is the determining factor.

Practice the above exercise with a variety of flowers and insects until students become somewhat skilled in differentiating among butterflies, skippers and moths. You may wish to have students refer to a field guide on butterflies to identify individual species.

ACTIVITY II:

Now select two meadows or empty urban lots. One should be carefully mowed and trimmed. The other should be overgrown with native wildflowers and grasses. Spend an equal amount of time observing and counting the number of butterflies and day-flying moths present in each field. Results should indicate a greater number of butterflies in the unmowed field. What does this suggest about man's influence on wildlife population and the preservation of habitat suitable for wildlife?

Now, suggest to students that they become wildlife managers by attempting to attract butterflies and moths to the well-mowed field. One obvious way would be to discontinue mowing; another would be to simulate native vegetation and provide necessary food. For the latter you will need the following materials:

a. brightly colored tissue paper, preferably purples, yellows and reds
b 10 - 15 stakes
c. 10 - 15 test tubes
d. twine
e. cotton
f. honey
g. water
h. food coloring
i. tape

COMPARATIVE CHARACTERISTICS OF LEPIDOPTERA

	BUTTERFLIES	SKIPPERS	MOTHS
TIME OF FLIGHT	Daytime; sometimes at lights	Daytime;	Some are day fliers; most at night
WING POSITION AT REST	held upright over body	Held upright over body	Held flat over body or at sides
WING COUPLING	Wings held together by expanded edge of hindwing	Expanded edge of hindwing (called humeral angle)	a bristle locking on to forewing (frenulum)
WING VEINATION	at least one vein of forewing is branched	all veins of forewing are branched	variable
WING SIZE	proportionately large to body	proportionately small to body	variable
LARVAE	with spines or bristles	dull colored, with few hairs, head patterns	with spines, bristles; colorful
PUPAE	brilliantly colored	fastened by silk thread in a cocoon	usually brown; if under-ground, no cocoon
ADULT COLORATION	usually brilliant	usually dull colored	night fliers are dull; day fliers brilliant
GENERAL SHAPE	slender	stout	variable
ANTENNAE	arise close together on head; clubbed part extends to tip	arise far apart on head and tip bends backwards; apiculus present	hairlike or comblike and feathery
FLIGHT	swift not darting	flight is swift, darting, erratic	some hover darting, erratic

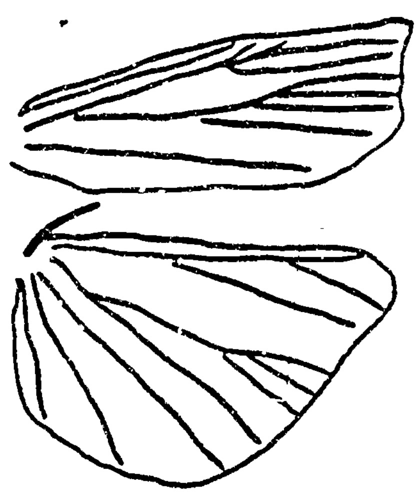
EXAMPLES OF COMPARATIVE CHARACTERISTICS OF LEPIDOPTERA

Antennae of Butterflies

Antennae of Skippers

Antennae of Moths

Expanded edge (the humeral angle) of the hind wing



A Frenulum

Have students place the stakes throughout the well mowed field. Fashion flowers out of the brightly colored tissue paper and attach to the top of each stake with tape. Secure a test tube directly below the flowers with twine and fill test tubes with a honey/water solution, colored with food coloring and stuffed with cotton. (Butterflies and moths are attracted to moist, sweet, brightly colored -- especially reds, yellows and purples -- liquid concoctions.)

Assign students to observe and record observations at each "feeding station" and also at the unmowed field during the same time span. (Sunny days should yield greater butterfly and day flying moth activity.) Compare observations. You may wish to experiment with different food colorings to determine color preferences of your butterfly visitors.

ACTIVITY III:

Although a complex of factors influences the distribution and abundance of butterflies, a limiting factor often is the availability of larval food plants; i.e., when food sources for caterpillars are in short supply, so are the butterflies that depend on them. Another aspect that influences population is that some species depend on a very few available plants for survival while other caterpillars feed on a wide variety of plants.

Acquire (either by collecting or ordering from a biological supply house) two or three different species of butterfly or moth caterpillars. Immediately place each in separate box with several fresh green leaves of the same species cut in small twig sizes and placed in a small container of water. The opening of the container should be covered with strips of tape so that the caterpillar will not fall in the water and drown. The water should keep the leaves fresh for a day or so thus allowing enough time to determine whether the caterpillers accept or reject that particular species of leaves. Record observations. If food source is rejected by any of the species, try other leaf species, one species at a time. Compare the number of different kinds of acceptable food for the different species of caterpillars. Which caterpillar accepted more different kinds of leaves? Are there any similarities in their preference? Hold a class discussion as to how this type experiment would be useful to a wildlife manager. What kinds of information does a wildlife manager need to know about any wildlife species in order to attract, maintain, and increase populations of specific species in specific habitats.

ACTIVITY IV:

One very important aspect of wildlife management in maintaining a high population of a given species involves planning and managing that species' food. To do this you must understand both the behavioral characteristics of your wildlife species and the characteristics of the type of food necessary for the survival of the species. To manage for butterfly larva it is important to determine the number of broods (times the adult butterflies lay eggs) per season and to make available sufficient food sources for the caterpillars at those peak brood times.

The following example is suggested as a way your students can participate in this type of wildlife management since the butterfly species is common to various parts of the United States. You may wish to consider other species more appropriate for your particular area.

Young and tender nettles are a good source of food for the Red Admiral caterpillar. The adult butterfly lay their eggs on the nettles and thus, when they hatch, the larvae have a ready made food source. In early spring when the Red Admirals lay their eggs, the nettles are young and tender and are excellent food for the caterpillars. However, the Red Admirals lay eggs at least twice; i.e. they have two broods per season. At the time of the second brood, many of the nettles are old and tough and the adult female butterfly will seek other areas to lay their eggs such as areas that have been mowed allowing new tender plants to begin to sprout. Thus, to manage an area for Red Admirals, first find a field that has a nettlebed. Mow one third of the bed the first week of June, one third in early July and one third in early August. This should encourage the butterflies to stay in your specific area.

You may wish to ask your students to pick a specific animal species and research its specific habitat needs. Students could then devise a management plan for a selected area to attract, maintain and increase the population of their chosen species.

ACTIVITY V:

Explain to students that adding or removing a species from a community can cause harmful reactions in the community. Some butterflies and moths, as well as other insects pollinate wildflowers. The Lepidoptera visit the flowers to sip the nectar. Several members of the same plant species may be visited within the vicinity. As the butterflies or moths visit the flowers, they transfer pollen from one plant to another or from one plant part to another part of the same plant. If a species of moth or butterfly is extirpated from an area where it is the pollinator of a particular plant, pollination may not occur and the flower very possibly will not reproduce.

With your students locate two separate areas that have similar plant species that are pollinated by Lepidoptera or other insects. Specify one area as a control area and the other as the experimental area; i.e. one area will not be manipulated by students. Observations should be recorded on each area simultaneously.

Devise sleeves made of thin netting or curtain material and place over plants before they flower in the experimental area. Fasten the sleeves with string at the base of the plants. The sleeves should limit access of all insects, regardless of size, to the plants. Observe the plants' perenology in both areas. Be sure to investigate your chosen plants' means of reproduction or sprouting before drawing conclusions. What effects did the lack of pollination have on plant reproduction in the experimental area? What does this imply about the long range effects insecticides could have on a given area?

PURPOSE: To investigate acid precipitation and some of its potential effects.

LEVEL: Junior - Senior High School

SUBJECT(S): Science
Social Studies

REFERENCE: Acid Precipitation Awareness Program (Draft Material), Freshwater Biological Research Foundation, Minnesota Environmental Education Board and Minnesota Department of Education, October, 1980, ESEA Title IV-C Grant, 1980-82.

BACKGROUND INFORMATION:

General

Acid rain. While the name itself evokes concern, the term is a misnomer of sorts because it excludes other means whereby acids fall to earth: there is acid snow, acid sleet and hail, even cases of acid fog. And there is another phenomenon: pollutants in dry form fall to earth awaiting some future precipitation or other moisture that may transform them into the same acids found in acid rain. Both of these phenomena, precipitation and dry deposition, are part of the same problem which - rightly named - is acid deposition. Nevertheless, acid rain is the name by which the problem is identified.

Rain tends to be naturally acidic because carbon dioxide in the atmosphere reacts with rain to produce carbonic acid. That amount of acidity is, however, sufficient to dissolve minerals in the Earth's crust, making them available to plant and animal life, yet not acidic enough to cause damage. Other atmospheric substances from volcanic eruptions, forest fires, and similar natural phenomena also contribute to the natural sources of acidity in rain. Still, even with the enormous amounts of acids created annually by nature, normal rainfall is able to assimilate them to the point where they cause little, if any, known damage. It is the human contribution, however, that is thought to throw off this acid balance and convert natural and mildly acidic rain into precipitation with far-reaching environmental effects.

"Pure" rain is defined as rain with a pH of between 5.6 and 5.7. These pH values take into consideration the amount of acidity created by the reaction of rainwater with normal levels of atmospheric carbon dioxide. But the acid precipitation that is of concern is that rain (or snow, sleet, or hail) with a pH of 5.6 or below.

This concern with acid rain is not without good reason. Recent research shows that the average precipitation in most states east of the Mississippi River lies between pH 4 and 5, with individual storms having pH values well below these averages. Furthermore, acid rains and snows have been observed in remote and wilderness areas in both the eastern and western United States testifying to the possible widespread dispersion of the phenomenon.

In the eastern United States, the major component of acid rain is sulfuric acid, comprising as much as 65 to 70% of the rain's acidity. The second major component is nitric acid with a presence of 25 to 30%; other acidity comes from other acids in trace amounts. In the western United States, the acids in acid rains are generally half nitric acid and half sulfuric acid, although in some western urban areas, a much as 80% of a rain's acidity can be comprised of nitric acid. In either case, west or east, the major components do not start in the atmosphere as acids. Rather, they generally begin as sulfur oxides (SO_x) and nitrogen oxides (NO_x) - gases emitted into the air primarily from fossil fuel combustion in power plants,industry, and cars and trucks. In the atmosphere, SO_x and NO_x - widely recognized as among the major human-made pollutants - are transformed into sulfates and nitrates, which then react with moisture in the air, forming acids. Thus when it rains, it rains a solution of water and sulfuric and nitric acid.

Once the SO_x and NO_x compounds are released into the atmosphere, two factors determine their geographic impact. First is their residence time -- the amount of time before the compounds either descend to the earth as dry deposition or react with moisture in the air to form acids or other concoctions. Second is the distance the sulfates and nitrates can travel in that time.

The residence time of sulfates and nitrates is generally up to about four days, although they may remain aloft longer. Their movement depends primarily on wind speeds. Under certain conditions sulfate and nitrate compounds can stay aloft long enough to cross continents, oceans, and international boundaries, creating a situation in which the acid rain in one country is caused by the emissions of another, but the recipient of this damaging rain receives little or no benefit from the source initiating the pollution.

For example, in 1892, the New York State Legislature established New York's scenic Adirondack Park as "forever wild." But in the 1950s, fishermen began to complain of fewer and fewer trout in the park's more than 200 high lakes and streams. It was then thought that predator yellow perch were responsible, but soon the perch died out, as well as did new species introduced experimentally to replace the native fish. For a while, beavers and the logging industry bore the blame. It was not until recently, however, that scientists discovered that the chief reason for the disappearance of fish from half of the park's high elevation lakes was acidification of the lake's water.

The acid rain condition in the "forever wild" Adirondacks underlines the problem posed by the transport of pollutants from the point of their creation to the point of their effect. Clearly this is a problem that cannot be dealt with on a local level, and in instances where the polluted atmosphere drifts across international borders, not even stringent national controls can stave off potentially severe damage.

It is the Adirondack's geographic misfortune that they lie downwind of many large industrial areas; it is similarly Sweden and Norway's misfortune to suffer the airborne pollution from England and Germany. In a few short days and often less, problems of local origins become ones of international scope.

pH

The acidity of any solution, including rain or snow, is measured on a scale known as a pH scale. This scale is numbered from 0 to 14. A pH value of 7 is neutral, neither acidic nor alkaline. Values lower than 7 are more acidic - vinegar, for instance, with a pH of between 2.4 and 3.4. Values above 7, such as ammonia or lye, represent alkalinity.

The pH scale is a logarithmic measure; that is, each change of one pH unit -- say from 6 to 5 -- represents a tenfold increase in acidity. Thus a drop from pH 6 to pH 4 represents a hundredfold increase and drop from pH 6 to pH 3 represents a thousandfold increase in acidity.

The pH ("potential hydrogen") scale is determined by a mathematical formula based on a solution's concentration of hydrogen ions (H+). Hydrogen ions have a positive electrical charge and are called cations; ions with a negative electrical charge are known as anions. A substance containing equal concentrations of cations and anions so that the electrical charges balance is neutral and has a pH of 7. However, a substance with more hydrogen ions than anions is acidic and has a pH less than 7; substances with more anions than cations are alkaline and have pH measures above 7. Remember: the <u>lower</u> the pH value, the <u>higher</u> the acid content.

Adapted from: "Acid Rain"
U.S. Environmental Protection Agency
July 1980

As a result of the combustion of tremendous quantities of fossil fuels such as coal and oil, the United States annually discharges approximately 50 million metric tons of sulfur and nitrogen oxides into the atmosphere. Through a series of complex chemical reactions these pollutants can be converted into acids, which may return to earth as components of either rain or snow. This acid precipitation, more commonly known as acid rain, may have severe ecological impacts on widespread areas of the environment.

Various sulfur compounds which may act as precursors to sulfuric acid are known to travel as far as several hundred kilometers per day while in the atmosphere. During transport these pollutants may easily cross geographical and political boundaries. This situation creates numerous national and international regulatory problems in that the air pollution standards of one state or country can have an indirect impact on the natural resources of another.

It is believed that other nitrogen-containing pollutants may be transported in a similar manner. Research is underway to clarify the transport processes associated with the major pollutants contributing to the acid deposition problem.

Hundreds of lakes in North America and Scandanavia have become so acidic that they can no longer support fish life. More than 90 lakes in the Adirondack mountains in New York State are fishless because acidic conditions have inhibited reproduction. Recent data indicate that other areas of the United States, such as northern Minnesota and Wisconsin, may be vulnerable to similar adverse impacts.

While many of the aquatic effects of acid precipitation have been well documented, data related to possible terresterial impacts are just beginning to be developed. Preliminary research indicates that the yield from agricultural crops can be reduced as a result of both the direct effects of acids on foliage, and the indirect effects resulting from the leaching of minerals from soils. The productivity of forests may be affected in a similar manner.

In addition, acid deposition is contributing to the destruction of stone monuments and statuary throughout the world. The 2500 year old Partheron and other classical buildings on the Acropolis in Athens, Greece, have shown much more rapid decay in this century as a result of the city's high air pollution levels. Research is underway to clarify the role of acid rain in the destruction.

In recognition of the potential seriousness of the acid rain problem, the President's Second Environmental Message to Congress in August of 1979 called for a minimum $10 million per year research program to be conducted over the next ten years. The Environmental Protection Agency and the Department of Agriculture co-chair the Acid Rain Coordination Committee established to plan and coordinate the Federal interagency program which is presently being developed.

Precipitation is defined as being acidic if the pH is less than 5.6, the pH of normal, unpolluted rain. The slight natural acidity of normal rain is due to the presence of carbonic acid (H_2CO_3), which is formed by the reaction of atmospheric carbon dioxide (CO_2) with water.

MATERIALS NEEDED:

- 600 ml .1M H_2SO_4
- pH paper
- 100 gm $CaCO_3$(marble)/student or student team
- 100 gm crushed granite/student or student team
- 1 (1 liter) beaker/student or student team
- 3 (400 ml) beakers/student or student team
- 1 stirring rod/student or student team
- 1 medicine dropper/student or student team
- 1 graduated cylinder/student or student team

ACTIVITY 1:

Hold a class discussion focusing on the fact that acid precipitation has had devastating effects on some lakes in various parts of the United States. Why is it that some lakes are more affected by acid precipitation than others? Tell students they will be involved in an experiment simulating three lake basins. Give students the following task list:

1. Fill a 1.0 liter beaker with 900 ml of tap water.
2. Add the H_2SO_4 acid drop by drop, stirring <u>until</u> the pH paper gives a value of 4.
3. Place 100 grams of marble in the first 400 ml beaker.
4. Place 100 grams of crushed granite in the second 400 ml beaker.

5. Add 300 ml of the "acid rain" solution to each of the three beakers. (One beaker has just 300 ml acid rain, one has 100 grams of marble as well, and one has 100 grams of granite.)
6. Record the pH in each of the three beakers.
7. Make a prediction (or hypothesis) about what you think will happen to the pH in each of the beakers.
8. Let the three beakers set over night and record the pH in each the following day. Design a table for recording the data.

As a class answer the following:

1. Which of the three simulated lake basins was least affected by the acid rain? Was most affected?
2. Based on what you know about earth science/chemistry, explain the results you observed.
3. How might your findings determine the way people in different areas of the country view acid rain?
4. What kind of lake basins appear to be especially susceptible to acid rain?
5. In what parts of the United States are these kinds of lakes located?
6. What are some possible reasons to help explain differences from student/teams to student/teams? How reliable are the data?
7. Which beaker shows the closest scattering of data points? The widest scattering? What accounts for these differences?

You may wish to continue this part of the activity as follows:

1. Use other kinds of rock basins and compare results.
2. Collect material from a lake, dry it and use it as basin lining.
3. Determine the amount of lime required to restore the "lake." Try the experiment again and see whether the treatment effect lasts.
4. Make pH measurements over several days.

Now, investigate with your class the effect of pH on regulative reproduction using duckweed as a representative plant. Duckweed is suggested for the experiment since it is a small aquatic flowering plant which floats on the surface of open fresh water bodies. The plant has leaflike structures called fronds, and usually a single rootlet. Vegetative reproduction occurs as a mature frond produces new fronds. One mature frond may give rise to two or three young fronds. As the young fronds mature and increase in number the plant separates into individual plants. If conditions are favorable a plant may reproduce within a day or two. The genetic make up of the young plant is the same as the parent plant.

MATERIALS NEEDED:

For each team of 4:

Duckweed plants (60)
Stereomicroscope
Tape or marking pencil

pH indicator paper - narrow page
pH 1-7
Petri dish

Concentrated HNO_3 or H_2SO_4	pH meter (optional)
Glenwood spring water (1 gallon)	Buffer solutions (optional)
Small culture dishes - 6	

pH STOCK SOLUTIONS

a. pH 1 = 6.5 ml conc. HNO_3 per liter of solution. Use Glenwood spring water. This solution may be used as a stock solution and is a 0.1 M solution.
b. pH 2 = 2 ml of 0.1 M solution (pH 1) + 198 ml spring water. 0.01 M solution.
c. pH 3 = 2 ml of 0.01 M solution (pH 2) + 198 ml spring water. 0.001 M solution.
d. pH 4 = 2 ml of 0.001 M solution (pH 3) + 198 ml spring water. 0.0001 M solution.
e. pH 5 = 2 ml of 0.0001 M solution (pH 4) + 198 ml spring water. 0.00001 M solution.
f. pH 6 = 2 ml of 0.00001 M solution (pH 5) + 198 ml spring water. 0.000001 M solution.
(Plain spring water, which is close to pH 6, may be substituted for above)

The following pH solutions of H_2SO_4 may be used in place of the HNO_3 solutions.

a.	500 ml of spring water	pH 6
b.	500 ml of spring water + 5 drops of 10% H_2SO_4	pH 5
c.	500 ml of spring water + 15 drops of 10% H_2SO_4	pH 4
d.	500 ml of spring water + 25 drops of 10% H_2SO_4	pH 3
e.	500 ml of spring water + 30 drops of 10% H_2SO_4	pH 2
f.	500 ml of spring water + 35 drops of 10% H_2SO_4	pH 1

g. Be sure that all the solutions are stirred well while adding the drops of H_2SO_4.

ACTIVITY II:

Give each group of four students the following instructions:

Procedure:

1. Observe a duckweed plant under the stereomicroscope.
   a. Locate fronds and rootlet.
   b. Make a sketch in your laboratory notebook.

2. Label six culture dishes 1 to 6 and fill them 3/4 full, or with 150 ml, of the following solution:
   a. dish 1 = 150 ml pH 1 solution
   b. dish 2 = 150 ml pH 2 solution
   c. dish 3 = 150 ml pH 3 solution
   d. dish 4 = 150 ml pH 4 solution
   e. dish 5 = 150 ml pH 5 solution
   f. dish 6 = 150 ml pH 6 solution, or plain spring water (150 ml)

3. Place 10 duckweed plants into each culture dish.

4. Cover each dish with a petri dish lid.

5. Place the dishes in a well lighted area.

6. Each day for the next two weeks, count the total number of plants in each of the culture dishes.

7. Record the numbers you observe in a table.

8. Construct a graph of your data. Your graph should show the data for each of the six dishes.

Answer These Questions:

1. Which of the culture dishes can be considered a "control"? What was the purpose of this dish?

2. Compare the growth/vegetative reproduction rate of the duckweed plants in each of the culture dishes with your "control".

3. What general effect did pH have on the vegetative reproduction of duckweed?

4. How would you determine the biomass of duckweed in each culture dish?

5. Based on these experiments, predict the effect of "acid rain" on duckweed populations in an open water area. What are the limitations, if any, of your prediction? What does your evidence mean? Briefly describe an experiment to test your prediction.

6. What effect would a change in duckweed population, due to acid rain, have on the food web in an open water area?

After students have had time to complete the above tasks:

Compare the class data with your students. Ask students to help determine the best way of depicting group findings for the entire class. Where appropriate, have students identify the mean, mode and range of the data. Which measurement best represents a collection of data -- mean, mode or range?

What pattern can students discern in the pooled class data? Can variety in the outcomes of equivalent experiments be avoided?

What are some of the sources of the variety of findings observed.

What is an acceptable level of variety in the outcomes of the class experiments? Are there any data that appear to fall outside the level of acceptability?

The following are suggested extensions of the activity:

1. Modify the procedure for this acid rain activity by using a nutrient solution such as Knop's solution. Prepare the nutrient

solution so that you have a pH range from 1 to about a pH of 6 or 7.

2. Try to propagate an "acid resistant" strain of duckweed.

3. Investigate what consumer organisms are dependent upon duckweed as their primary food source. Diagram a food web with and without duckweed as the primary producer organism.

Now to examine possible effects of acid precipitation to animal life, conduct an experiment using wild fruit flies (Drosophila).

MATERIALS NEEDED:

a. Drosophila media
b. 15 ml beaker
c. Six plastic shell vials
d. Six polyfoam plugs to fit vials
e. Labels/Tape
f. Drosophila flies
g. HNO_3 solutions: pH 1, 2, 3, 4, 5, and 6
h. pH indicator paper

ACTIVITY III:

The Drosophila media should be prepared on Monday so that students can make observations for the rest of the week. Be sure that they read the task list completely. The report requires that they make a prediction before they do the investigation.

Assign students the following task list:

Follow These Steps:

a. Place a 15 ml beaker of instant media into a vial. Add 15 ml of a pH 1 HNO_3 acid solution to this media. Test the pH with pH indicator paper. Label the vial appropriately.
b. Place 15 ml beaker of instant media into a vial. Add 15 ml of a pH 2 acid solution to this media. Test with pH indicator paper and label vial.
c. Place 15 ml of dry media into a vial. Add 15 ml of a pH 3 acid solution to this media. Test with a pH indicator and label the vial.
d. Place 15 ml of dry media into a vial. Add 15 ml of a pH 4 acid solution to this media. Test with a pH indicator paper and label the vial #4.
e. Place 15 ml of dry media into a vial. Add 15 ml of a pH 5 acid solution to this media. Test with a pH indicator paper and label the vial #5.
f. Place 15 ml of dry media into a vial. Add 15 ml of a pH 6 acid solution to the media. Test with a pH indicator paper and label vial #6.
g. Etherize at least 150 flies from a healthy stock culture of wild flies.
h. Place 25 flies into each of the vials prepared above.
i. Place the vials on their side until the flies become active.

j. Every day count the number of flies in each vial, and keep a record of the count.

k. Count until all the flies are dead or terminate the experiment after 3 weeks.

l. Make a table and a graph from your data that show the total number of survivors each day.

When you have completed your observations write a report which includes:

a. A prediction (hypothesis) made in advance of doing the experiments.
b. If your prediction (hypothesis) is true, then what kinds of evidence do you expect to find?
c. The procedures you used to determine the survivorship of Drosophila raised in media of various pH's.
d. A data table and graph of the number of daily survivors.
e. Statements of why you classified the evidence in the table and graph as you did.
f. A statement in which you describe the relationship between the evidence and your prediction (hypothesis).

After students have completed their tasks ask:

1. Why might a biologist be interested in the question asked of students?

2. How adaptable are Drosophila to differences in pH?

3. If organisms exhibit a narrow/wide range of pH tolerance would they be more/less likely to adapt successfully to environmental pressures? What are the arguments for and against your answer?

4. Compare the class data with your students. Ask students to help determine the best way of depicting individual/group for the entire class.

5. What patterns can students discern in the pooled class data?

Next discuss that most of us are not accustomed to thinking about animal life (or plant life) in the same way that we do about human life. As concern has grown over the biological and ecological effects of our complex industrial society a small but steadily increasing number of people are beginning to raise questions about our relationships to nonhuman life. Does nonhuman life have basic rights? What are they? Who speaks for nonhuman life?

Distribute copies of the following reading to each student:

The seriousness of the acid-rain problem is still neither fully appreciated nor universally accepted. It is also true that much of the damage acid rain is alleged to have caused is based on minimal evidence. Let's examine what we know for sure.

In many parts of Norway and Sweden, valuable trout and salmon runs have been wiped out. Canadian studies have revealed how the fish populations of so many streams and lakes have been destroyed: The acid seldom kills fish directly; it mainly affects their procreative capacity so that the next generation simply fails to be born.

High acidity in the water lowers calcium levels in a prospective-mother fish to a point where she cannot produce eggs. Even when she does, both the eggs and freshly hatched larvae are especially vulnerable to acid. Adult fish, too, are so stressed by it that their biochemistry is altered. In lakes where there is year-round acidity, the stress is chronic and debilitating. When the spring thaws set in, acids that have accumulated in the melting snow are released in sudden intensive bursts, causing the already-stressed fish to die in large numbers.

In some lakes, only the very young, the very old, and the very ill are left---and they are all particularly susceptible to further increments of acidity. Before long the fish population in the lake has fallen to zero. Though some species of fish succumb sooner than others, even the more resistant varieties are affected when the pH goes below 5. The Cornell group is actively working at developing strains of acid-resistant fish as one means of replenishing the depleted Adirondack lakes while waiting for the world beyond the Adirondacks to stop sending up pollutants for the rain to wash down.

After students have read the article engage them in a discussion about it. Be sure that you ask your students to circle/underline words which puzzle them. Clarify these words before you begin. Some examples of questions follow:

1. Do fish have rights? What are they? Develop a Bill of Rights for fish modeled after the U.S. Constitution.

2. Such qualities as emotion and feeling, along with the capacity to communicate and remember, are ordinarily thought to be found only in humans and higher animals. If it is true that fishes also have these characteristics, should that affect human treatment of fishes? If so, how?

3. Who is guilty of killing these fish? What would be a good argument for someone who disagrees with your position? Why would it be a good argument?

4. To what extent are the lives of fish equal in value to the lives of Americans?

5. Factual statements are descriptions of the way things are, have been, or will be. Statements do not have to be true to be considered factual statements, e.g.:
   a. Columbus landed in the West Indies in 1492.
   b. Slavery was the cause of the Civil War.

c. Visitors from outer space built Atlantis.
d. Water freezes when its temperature reaches 0°C.

- Value statements tell others what you think is good or bad, right or wrong, or what you think people should or shouldn't do, e.g.:
  a. Human life is more important than anything else.
  b. You should always tell the truth.
  c. It is better to give than receive.
  d. It is wrong to accept welfare.

Stop! Ask your class to identify factual and value statements found in the article.

6. Genocide, the killing of a whole race or ethnic group, is considered to be one of the worst crimes humans commit. Is the extinction of animal species an example of genocide? If you agree that practices resulting in the extinction of a species are a crime against nature, who should be punished and what should the punishment be? Why?

7. Is it wrong to kill trout by acid rain even if scientists supervise the process and develop acid resistant species so that there is no danger of the species becoming extinct? Why or why not?

8. Is it right for scientists to try to develop strains of acid-resistant fish? Why or why not? Is this a moral problem? Why or why not?

9. Some people oppose the killing of fish by fisherwomen/men. Does the method of killing the fish make any difference? Why or why not?

10. Some people might agree that killing trout in their lakes would be beneficial because we need the energy and the trout are not necessary to human survival. Do you agree that this makes the killing justifiable? Why or why not?

11. Some people might find comfort in hoping for solutions to the acid rain problem from American technology: the genetic engineering of an acid resistant species. Do you agree or disagree? Why or why not?

12. Do our economic needs justify the killing of the fish? Why or why not?

13. Do our economic needs justify the development of acid rain tolerant fishes in place of the acid rain intolerant fishes? Why or why not?

14. Sydney Harris, a newspaperman for Field Enterprises wrot "If we fail as a species, it will have nothing to do with energy or any other technological obstacle; it will have to do with the way we

regard ourselves and others, as threats, rivals and enemies, rather than as members of the same family. Until we know who we are, and what we are supposed to do, all our other knowledge cannot save us." Do you agree? Why or why not? What does it have to do with acid rain? The death of fish? The invention of an acid-resistant species? What does Harris mean "until we are" and "what we are supposed to do?" What are we "supposed" to do about acid rain?

15. There is much evidence in humans that it is not possible to have change without stress. Change, in other words, has been found to be injurious to health. The statement that every species is adapted to its environment is self-evident. Do you think that faster adaptation to changing environments, for example, of fishes is necessary if technology is to continue? Why or why not?

PURPOSE: To identify some values of wildlife to a community.

LEVEL: Junior - Senior High School

SUBJECT(S): Social Studies
Science

REFERENCE: Project Learning Tree Supplementary Curriculum Guide for Grades 7 through 12. American Forest Institute, copyright 1977. Reprinted by permission.

ACTIVITY:

Divide your class into two groups. Ask one group to investigate the amount of money spent in your community by hunters and fishermen and women; the second, the amount spent by nonconsuming "users" of wildlife, such as photographers, bird watchers, and artists.

Students can use the classified section (yellow pages) of the telephone book as a resource to compile two lists, one of local businesses which cater directly to outdoor activities (sporting goods stores, meat processing establishments, photography shops) and the other of businesses indirectly related to these "users" of wildlife (motels, service stations, bookstores).

Students can visit businesses on the list and interview the owners or employees to find out what percentage of their income derives from wildlife-related activities. (In smaller communities, particularly in the mountains, this figure may be substantial.)

After students have completed their interviews and tabulated their data, discuss these questions:

Which form of wildlife use, consuming or nonconsuming, contributes the most to the local economy? Will it continue to contribute the most? Why or why not?

Where does the money go which is generated by hunters and fishermen and women? By nonconsuming users?

Does the money spent by either of these groups of users of wildlife represent the real value of wildlife to you? To the community? To the biosphere?

How would you measure the value of an endangered species?

What values, other than economic, do wildlife represent? Design a way other than money to represent the value of wildlife to you; to the community; to the planet.

PURPOSE: To simulate a meeting of the Law of the Sea Conference in an effort to demonstrate problems associated with determining rights of countries to neutral resources in the sea.

LEVEL: Junior - Senior High School

SUBJECT(S): Social Studies

REFERENCE: Victor J. Mayer and Stephanie Ihle. It's Everyone's Sea: Or Is It? Ohio Sea Grant Program, The Ohio State University Research Foundation, 1981. ED 202 723.

ACTIVITY:

Discuss with your students that determining the rights of countries to parts of the sea and seabed has become a very important problem. In the seventeenth century two types of rights were commonly accepted by all countries; territorial seas and high seas. Territorial seas extended three to six miles out from the coastline of a country. The country had complete rule over this zone, except that any ship had the right of "innocent passage," that is, movement that did not threaten the safety of the country. Beyond this were the high seas in which any country had both free movement and fishing rights.

With the Industrial Revolution came greater use of fish from the oceans and recently the discovery of energy and mineral resources in the sea bed. Countries began to compete for these resources. In 1973 the United Nations held the third conference on the Law of the Sea to draw up rules and regulations for all countries to follow, to provide for a fair division of those resources.

Inform the students that they are going to participate in a simulation of a meeting of the Law of the Sea Conference and that the following four actions are being considered for adoption:

I. Establish a 12-mile Territorial Zone in which the customs, sanitary, and financial laws of the country would be enforced.

II. Establish an Exclusive Economic Zone, 200 miles wide, in which the nation would have wide control over living and mineral resources in the water and the sea bed. Other nations would keep the traditional freedoms of navigation, overflight and the rights of cable-laying and pipelaying.

III. Establish an International Seabed Authority which would develop and use the area of the sea beyond the 200 mile Exclusive Economic Zone in cooperation with the bordering states. Half of the resources would be controlled by the Authority and given to the countries that do not border the oceans.

IV. Establish a Pollution Tribunal which would act to control pollution from ships. Divide the class into eight groups which will represent the eight countries that will take part in this conference. United States, Russia, Bolivia, Nigeria, Spain, Iceland, Bermuda and Yugoslavia. These countries represent the different interests countries have in the sea, because of their location, industries and development. Each of the world's countries belongs to one or more of eight categories; straits, fishing, island, maritime, limited-shelf, land-locked, developing and developed.

Teacher Background Information:

1. Following are the eight categories of nations and descriptions of each of the categories:

   STRAITS STATES. These are countries that are located next to a strait, a narrow passage connecting water bodies having access to the sea. There are 100 straits less than 24 miles wide. A 12-mile territorial sea would limit the rights of innocent passage through these straits. Spain is one such state, sitting on the north side of the Straits of Gibraltar.

   FISHING STATES. This group includes those states with important coastal fisheries and also those with distant-water fishing fleets. The USSR, USA, Iceland, and Spain can all be considered fishing states. All but the USSR have extensive coastal areas for fishing. The USSR sends its fleet world wide.

   ISLAND STATES. If 200-mile Economic Zones are accepted then island states such as Bermuda would command extensive areas of the ocean basin, and the sole right to exploit such areas. Such potential wealth might be in great contrast to the relative size of the country in area and population.

   MARITIME STATES. These are states with large fleets of commerical and/or naval vessels, such as USSR, and USA. They have concern about the rights of free passage of their vessels, especially important through straits.

   LIMITED SHELF STATES. These are states with narrow and/or short shelves. Therefore, they have limited access to the resources found on shelves. They could consider themselves disadvantaged in access to the resources of the ocean especially under current law.

   DEVELOPED STATES. These are countries that have well developed economies and industrial bases. They are the ones, such as USSR, and USA, that have the greatest potential for developing the mineral resources of the sea. They also have a large share of the current wealth of the world.

   LANDLOCKED STATES. These are countries, such as Bolivia. Under current law they have no rights to any coastal resources. They would generally be in support of some type of Seabed Authority that would share ocean resources among all countries.

DEVELOPING STATES. These are countries of the "third world." They do not have a strong industrial base. Frequently, they are deficient in natural resources. These countries are concerned that there be a law of the sea that would not favor the developed countries. They may be more in need of the sea's mineral and food resources, yet they do not have the technological capability for obtaining them.

2. It would be very difficult to enforce a law of the sea unless all countries accepted it.

3. The basic interests of most countries in the sea are economic, using its resources, and for defense and transportation.

Inform the class that:

Each country is to take an official stand on the proposed actions of the conference. A country can also propose that an action be changed or a new one adopted, provided it can get the support of one other country.

Give each group the information sheet found on the following pages for its particular country and the following instructions:

1. Read the role card for your country and study its location on the map of the Atlantic Ocean. Determine why it belongs to the categories indicated on the role card.

2. Elect an ambassador.

3. Discuss the four actions being considered by the conference and decide which you as a country will support and which you will oppose. You can support or oppose as many as your group wishes.

4. Develop a position statement stating the reasons your group supports or opposes each action.

5. The ambassadors will then present the position statement of their country to the entire conference.

6. Countries meet individually to reconsider their position statements, revising them if necessary. They may meet with other groups to lobby for their positions on each action.

At this point countries may develop new actions to be presented to the conference. Any new ones must have the support of one other country.

7. Repeat Steps 3 and 4.

8. A vote is taken. Each country casts one vote either for or against each action.

9. For an action to pass, the vote must be unanimous.

THE UNITED STATES OF AMERICA

The United States of America has been nicknamed "the melting pot of the world" because of the wide variety of nationalities, religions, climates, natural resources, agricultural and manufacturing products. Education from age 6 to 16 is compulsory. Most Americans graduate from high school or vocational school and many attend colleges and universities. In 1976, the average per capita income was $7,890; one of the highest in the world.

AREA: 3,615,122 square miles (4th largest country in the world)

POPULATION: 220,806,000 (4th highest population in the world)

The current goals of the armed forces are: to deter an all-out strategic nuclear war and to be ready for limited nuclear or non-nuclear conflicts. To accomplish these goals about 2,000,000 people are enlisted in the Army, Navy, Air Force, Marine Corps, and Coast Guard and the defense budget is over $100,000,000,000 (about 7% of the Gross National Product). The Navy employs about 500,000 men and women at American naval bases and also at bases located in Newfoundland, Bermuda, Bahamas, Jamaica, St. Lucia, Trinidad, Antigua and British Guyana. Shore activities of the Navy include eight shipyards, 35 air stations and facilities, two amphibious bases, two submarine bases and 15 naval stations and facilities.

Seventy-five percent of the population lives in metropolitan areas situated along coastlines or major waterways. The United States is the world's leading manufacturing country. Machinery, food products, transportation equipment, chemicals, electric and electronic equipment, fabricated metal products, primary metals, printed publications, paper products and instruments are the leading products.

Twenty-five percent of the population lives in rural areas. There, farming is the leading occupation. The United States has fertile soils. The use of modern machines and technology has greatly improved the quantity and quality of farm products. Beef cattle, corn, dairy products, eggs, hogs, poultry, soy beans, tobacco and wheat are produced in great quantities.

The United States has many natural resources. Water supplies provide hydroelectric power, irrigation for agriculture, and transportation for industrial products. Leading minerals include coal, iron ore, lead, limestone, natural gas, oil phosphorus, potash, uranium and zinc. Due to low or absent supplies, antimony, asbestos, bauxite, chromite, cobalt, copper, diamonds, iron ore, magnesium, mica, nickel, oil, tin, titanium, and uranium must be imported. Because of its high rate of energy consumption, the United States must now import almost half of its oil, most of which comes from overseas.

The imported products come from many countries. The United States trades with every nation in the world. Over 800 vessels, carrying 1,000 gross tons or more make up the American merchant fleet, however, 90% of America's shipping is done with vessels that are registered with foreign governments.

The total fish catch along the Atlantic and Pacific Oceans amounts to $1,353 million. Two and one-half million tons of fish and other seafood are caught annually. The chief fishing states include Florida, Massachusetts, Maine, North Carolina and Oregon. Cod, haddock, herring and mackeral are caught along the New England Coast. Menhaden fish and shrimp are the major fish catches in the South Atlantic and Gulf Coast, and salmon and tuna are caught along the Pacific Coast.

The United States falls into several categories of states; it is next to several straits including the Bering Strait, it is a major fishing nation and maritime nation, and it is developed.

UNION OF SOVIET SOCIALIST REPUBLIC (USSR) "RUSSIA"

Russia is the largest country in the world. It borders three major oceans; Atlantic, Pacific and Artic Oceans. However, its only ports lie in high northern latitudes and are, therefore, closed by ice during part of the year.

Russia was the first country to develop a communist government and today has alliances with most other communist countries.

A governing council rules over the 15 republics that make up the USSR. Each is almost like a separate country, since languages, customs and traditions vary greatly among the republics.

AREA: 8,649,500 square miles (3 times larger than the United States, excluding Alaska)

POPULATION: 266,403,000 (Somewhat larger than the United States)

It has the largest armed forces in the world, employing 3,375,000 persons. The defense budget is $95,800,000,000--approximately 9% of the Gross National Product. Russia's navy is steadily expanding and progressively modernizing with over 500,000 officers and men. Naval ports are located in Nikolaiev and Sevastopol on the Black Sea, Molotovsk on the White Sea, Komsomolsk on the Amur River, and Leningrad.

Russia is a developed country with an excellent educational system enrolling 55 million full-time students. Sixty-four percent of the population lives in cities and is employed in business and industry. Thirty-six percent of the Russian people live in the country, most on farms. A few farms are privately owned and operated, while most are state owned and operated by 5 to 10 families. The per capita income is approximately $4,000 (U.S. dollars).

Russia produces the following agricultural products: barley, corn, flax, rye, cotton, oats, potatoes, sugar beets and livestock. Russia's leading natural resources are bauxite, coal, copper, gold, iron ore, lead, manganese, magnesium, nickel, salt, tungsten, zinc, platinum, natural gas and forestry products. Russia is the largest oil producing nation in the world. Besides oil, hydroelectric power and coal are the major energy sources. It also has one of the world's largest fishing fleets. Fish provide a major source of protein in the Russian diet.

Russia exports iron, steel, lumber, machinery, and petroleum. Since Russia is almost self-sufficient in most materials, only a few goods are imported--industrial equipment and consumer goods. Russia's leading trading partners are the European nations; primarily Czechoslovakia, Austria, Italy, East and West Germany, Poland, Bulgaria, Hungary and Romania. Over 7,000 vessels make up the Russian merchant fleet. The most important merchant sea ports are at Vostochny in far eastern Russia, Grigorevsky on the Black Sea, Ventspils at Lativa and Murmansk and Archangel, used for Arctic traffic.

Russia also is in several categories; it is next to several straits, including the Bering Strait; it is a fishing state with a world-wide fleet; a maritime state, and developed.

SPAIN

Spain shares 5/6 of the Iberian Peninsula with Portugal. It boasts 3,340 miles of coastlines bordering both the Mediterranean Sea to the south and the Atlantic Ocean to the north and west. The climate is sunny and dry. The high central plateau region has hot summers and cold winters. Along the coast, climatic conditions are not as severe.

AREA: 194,883 square miles (slightly larger than California)

POPULATION: 35.7 million (about 50% larger than California)

Spain has approximately 280,000 men in the armed forces. The Spanish fleet is undergoing modernization.

It has grown to become a modern, industrial country. Today, half of Spain's population lives in cities, dwelling mostly in apartments. The per capita income is $2,920 U.S. dollars. Most of the working force is employed in industry, farming, or fishing. Spain is one of the world's leading producers of automobiles and ships. In addition, cement, chemical products, clothing, shoes, cork products and steel are also major manufactured items. Most of the industrial and energy resources must be imported since Spain lacks raw materials. A few minerals such as coal, lignite, iron ore, zinc ore and lead are mined for industrial use or exported.

Farm production in most regions is low due to poor soil, dry climate and inferior farming techniques. Although livestock, cereals, vegetables, grapes, oranges, tobacco, honey and sugar cane are major farm products, much food must still be imported.

Spain is a leading fishing nation catching over 1.4 million metric tons of fish each year, chiefly anchovies, codfish, hake, sardines and tuna. The Spanish fishing fleet includes 16,853 vessels. The fish come primarily from the waters off the northern coast of Spain. The merchant shipping fleet includes 3,040 vessels carrying over 3 million passengers and 49 million tons of cargo to other parts of the world annually.

Because of its position at the mouth of the Mediterranean, Spain would be considered a "straits" state. It is also a fishing nation and is becoming a developed state.

YUGOSLAVIA

The Socialist Federal Republic of Yugoslavia borders the Adriatic Sea in southeastern Europe. A communist country, it is influenced by the USSR. Its population is a mixture of many nationality groups with different cultures, religions, and languages. Much of the area is mountainous. Along the coast, over 700 islands and the indented coastline provide many excellent natural harbors. In northcentral Yugoslavia, the Danube River runs through the Pannonian Plains region which is flat with rich soils, making this region the chief farming area. The climate along the coast is mild; however, more extreme climatic conditions occur inland.

AREA: 98,766 square miles (a little larger than Oregon)

POPULATION: 19,958,000 (ten times greater than Oregon)

The Yugoslavian armed forces consists of about 250,000 men, 27,000 of which are in the navy. The defense budget is $1,300,000,000 or 8.5% of the Gross National Product. This is a larger percentage than many other countries.

The Yugoslavian standard of living is high. Most families own a car, television set and other luxury items. They travel freely to other countries. In most cases, both the husband and wife hold full-time jobs. The per capita income is $1,680 (U.S. dollars).

Farmland covers 58% of the country providing high yields of corn, sugar beets, wheat, barley, oats, potatoes, tobacco, grapes, olives, plums, cattle and sheep. Forests cover 35% of the land and forest products are a major export.

Mineral resources include bauxite, chromite, coal, copper, iron, lead, mercury, natural gas, petroleum and zinc. Yugoslavia trades mostly with Italy, East and West Germany, the Soviet Union and the United States. The major exports are forest products, livestock, machinery, metals, plastics and textiles. The chief imports include coal, crude oil, machinery, motor vehicles and textiles. The Yugoslavian shipping fleet consists of 432 vessels. Half of Yugoslavia's energy comes from hydroelectric power. Coal is also widely used and a new nuclear power plant is near completion.

The principal product from the Adriatic Sea is fish. Yugoslavia owns more than 200 motor fishing vessels and over 1,700 sailing and rowing fishing vessels. Greater than 35,000 tons of saltwater fish are caught annually.

NIGERIA

Nigeria is located on the west coast of Africa, along the Gulf of Guinea, just north of the equator. Topography in Nigeria varies greatly. It has hot, rainy swamplands; dry, sandy deserts; grassy plains; tropical forests; high plateaus; and rocky mountains.

AREA: 356,669 square miles (the size of Texas and Colorado combined)

POPULATION: 69,667,000 (four times the combined population of Texas and Colorado)

Over 200,000 persons serve in the Nigerian Army. Nigeria also operates a small navy (4,500 persons), an air force and a federal police force.

Three-fourths of the Nigerian people live in rural areas earning their living in farming, fishing or herding. The per capita income is $380 (U.S. dollars). The people live in small villages in huts made of grass and dried mud. Over 250 languages are spoken.

Nigeria's economy is based on farming and mining. Nigeria ranks among the world's leading producers of cacao, palm oil and palm kernels, peanuts and rubber. Other important crops include beans, cassava, corn, millet, rice and yams. Farmers also raise goats, poultry, sheep and cattle.

The oil industry is the fastest growing industry in Nigeria. Most of the oil fields are operated by foreign companies. Many of the oil wells are located on the Nigerian continental shelf in the Gulf of Guinea. Nigeria is a member of OPEC (Organization of Petroleum Exporting Countries). Other minerals are coal, columbite, gold, iron ore, lead, limestone, natural gas, tin, and zinc.

The principal shipping ports include Lagos, Port Harcourt, Warri and Calabar. Ninety-three percent of what Nigeria exports is oil. It also exports cacao beans, palm products, peanuts, rubber, timber and tin. Important items that must be imported include cement, chemical products, food products, machinery, manufactured goods and textiles. Nigeria's most important trading partners are Great Britian, the Netherlands, West Germany and the United States.

Nigeria has a limited continental shelf and is a developing country.

ICELAND

Iceland is a republic located just below the Arctic Circle in the northern Atlantic Ocean. Because of its northern location, it has a relatively cool climate. A good part of the country is covered by an icecap. There is a great deal of volcanic and earthquake activity. Much of its energy comes from hot water that is found at and below the surface.

AREA: 103,000 square miles (about as big as Kentucky)

POPULATION: 210,000 (3/5 as many as Kentucky)

Iceland has no army or navy; however, the United States has troops stationed there. Iceland does have a small coast guard which patrols the fishing area surrounding the island. In 1975, Iceland announced an extension of its fishing rights to 200 miles to protect the fishing stocks and its fishing industry.

Most Icelanders live in coastal towns, making a living by fishing or working in fish processing plants. The per capita income is $6,000 (U.S. dollars). Fifteen percent of the Icelanders are farmers, making a living in the fertile lowlands along the southern and western coasts. The major agricultural products are hay, wool, meat, skins and dairy products.

The most important industry in Iceland is fishing and fish processing. In 1977, its total fish catch was 1,373,954 tons, primarily cod, haddock, and herring. Most of the fish are dried, salted or frozen and exported to other countries. Iceland trades mainly with Denmark, Great Britian, Norway, Russia, Spain, Sweden, Switzerland, East and West Germany and the United States. Fish and whale products are Iceland's greatest exports. A small merchant marine consists of six steam powered vessels and 987 smaller motor vessels.

Iceland is an island state, a fishing state, and developed.

BOLIVIA

The Republic of Bolivia located in South America, has been a landlocked country since 1879 when its western neighbor, Chile, seized the Bolivian coastal province, Atacama, in a dispute over nitrate deposits along the Pacific Coast. This isolated country lies between the Amazon jungle and the Andes mountains. It has high plains, plateaus, mountains, and lowlands. The average temperature varies from 45° to 75°F depending on the region of the country.

Bolivia is often called a "Beggar sitting on a throne of gold." This poor country has large mineral, forest and water resources, yet lacks the capability for using these resources.

AREA: 424,165 square miles (about the size of California and Texas together)

POPULATION: 6.5 million (one-half the population of Texas)

Bolivia employs 24,000 people in the armed forces.

Two main social classes exist in Bolivia; "those who have much" and "those who have little." Basically, the majority of Indians and some Mestizos (mixed Indian and White) are poor farmers, miners and industrial workers. They live in adobe houses and eat corn, cereal and potatoes as major portions of their diet. The minority Whites and Mestizos dwell in Spanish-style homes in the large cities and primarily operate the businesses. The per capita income is about $360 (U.S. dollars).

Farming employs over one-half of the Bolivian workers, although only 2% of the land is cultivated. Lack of funds to buy machinery, primitive farming methods and unwillingness to move to richer lowlands prevent larger crop yield. Beef, cocoa, coffee, corn, cotton, rice, hides, mutton and sugar are the chief products.

Although poor in many aspects, Bolivia is rich in minerals. Thirteen percent of the world's tin is mined in Bolivia. Other valuable minerals include antimony, bismuth, copper, gold, lead, tungsten, silver and zinc. Bolivia is also self-sufficient in oil production. Vast forests supply quebracho wood (used in tanning and drying) and rubber. Waterfalls and rapids are possible sources of hydroelectric power.

Since Bolivia is landlocked, trade with other countries is limited, however, surrounding countries allow Bolivia the use of some ports. Africa and Antofagasto, ports in Chile, Mollendo-Matarani in Peru and La Quiaca on the Amazon are the most-used import-export shipping centers for Bolivia. Of the revenue from exports, 55% comes from tin and other exported minerals, and 30% from gas and oil. Bolivia imports cotton, food, machinery, motor vehicles, timber and wool from the United States and other South American countries. Railroads connect harbors on the Pacific to major cities in Bolivia making foreign trade easier.

Bolivia is a landlocked state and one of the developing states.

BERMUDA

The British dependency, Bermuda, consists of more than 300 coral islands in the North Atlantic Ocean. This favorite resort country is known for its warm, sunny climate, winding roads, palm trees, colorful flowers and shining beaches. The only source of fresh water in Bermuda is rain water caught on roofs of buildings and stored in tank outside. Small fish are sometimes put in the tanks to keep them free of mosquito larvae.

AREA: 21 square miles (1/8th the size of Columbus, Ohio)

POPULATION: 60,000 people (1/9th the population of Columbus, Ohio)

For defense, Bermuda relies primarily on Britain; however, the Bermuda Regiment defense-force employs 350 men. Since Bermuda occupies a very strategic military location the United States, in 1941, leased 2.3 square miles of land for naval and air force bases.

Only 20 of the 300 Bermudan Islands are inhabited. On these islands, hotels, beaches, and recreational resources attract over 500,000 tourists each year. Tourism represents 44% of the Gross National Product. It has almost no natural resources and therefore must import all energy and minerals.

Farming and fishing employ 1.5% of the work force in Bermuda. Bananas, citrus fruits, lilies, potatoes, green vegetables, eggs and milk are the major farm products.

Bermuda imports three times more goods than it exports in its 200 vessel shipping fleet. Four-fifths of its food must be imported. Britain, the Netherlands and the United States are Bermuda's biggest customers. In addition, Bermuda re-exports many goods due to ships stopping in major harbors such as Hamilton and St. George for medical, fuel and other ship supplies.

Bermuda is a developing island state.

After students have completed this simulation, answer the following questions:

1. Briefly describe each of the eight different categories of countries.

2. Why do you think one requirement of the simulation was that actions had to be passed unanimously?

3. What are the basic interests that countries have in the sea?

PURPOSE: To identify some of the pros and cons for the use of pesticides and fungicides to manage plant health.

LEVEL: Junior - Senior High School

SUBJECT(S): Science
Social Studies

REFERENCE: C. Wendell Horne and Joe W. Doby. 4-H Teacher's Guide and Supplement to Plant Diseases. Texas Agricultural Extension Service. The Texas A&M University System.

ACTIVITY I:

Ask students if they have ever had the opportunity to observe plant diseases; i.e. organisms harmful to plant health. Have they ever noticed spots on apples, a rotten head of lettuce, a large brown patch on a lawn, black spot on roses, mold on a plant, gulls on leaves of trees or goldenrod? Explain that these diseases are caused by organisms which result in change of appearance, hinder the function and reduce the value of the plants. We are all affected either directly or indirectly by the occurrence of plant disease as follows:

-- Farmers suffer direct economic losses
-- Gardeners experience reduced production along with lower quality
-- Homeowners' lawns and ornamentals are less attractive
-- Damage to plants raises food prices
-- Starvation occurs in some places.

Explain to students that concern over plant health is not new; plant disease is even referenced in the Bible.

Genesis 41:6	And behold, after them sprouted seven ears, thin and blighted by the east wind.
Deuteronomy 28:22	The Lord will smite you with consumption, and with drought, and with blasting, and with mildew; they shall pursue you until you perish.
I Kings 8:37	If there is famine in the land, if there is pestilence or blight or mildew or locust or caterpillar; if their enemy besieges them in any of their cities; whatever plague, whatever sickness there is;

Provide students with the following supplemental information:

1. Historical Developments

Plant pathology, the study of plant disease, has evolved into its present state from recordings of blastings and mildews written in biblical times. Significant developments in the history of plant pathology include:

370–286 B.C.	Theophrastus, a Greek philosopher, recorded the first speculative (not experimental) study of plant diseases between 370-286 B.C.
1675	Leeuweenhoek invented the compound microscope in 1675.
1729	Micheli identified fungal spores in 1729 using the compound microscope. He demonstrated that spores spread on a food source would reproduce.
1743	In 1743 Needham observed plant parasitic nematodes in wheat galls (kernels).
1755	Twelve years later in 1755, Tillet showed by experimentation that stinking smut of wheat is a contagious disease, the occurrence of which can be reduced by seed treatment.
1801	Person published papers on fungi identification in 1801. He believed rust and smut fungi were products of diseased plants rather than distinct organisms.
1807	In 1807 Prevost proved that bunt of wheat is caused by a fungus. He used copper sulfate to control the disease. His contemporaries, who believed in spontaneous generation, rejected this method.
1821	Fries published papers on fungi identification in 1821. His beliefs were similar to Person's.
1845-1846	Late blight destroyed the 1845-1846 potato crop in Ireland.
1853	DeBary proved in 1853 that fungi cause, but are not the result of, plant disease.
1857	Speerschneider proved experimentally in 1857 that the fungus Phytophthora infestans causes late blight of potato.
1876	Pasteur and Koch in 1876 proved a bacterium causes anthrax, an animal disease.
1878	Two years later in 1878, Burrill, in a similar discovery, showed that a bacterium also causes fire blight of pear and apple; a plant disease.

1882 In 1882 Millardet sprayed a mixture of copper sulfate and lime on his grape vines to prevent anyone from stealing his fruit. This mixture controlled downy mildew on the plants. This fungicide, called Bordeauz mixture, is used today.

1898 In 1898, Beijerinck showed that tobacco mosaic was caused by a virus.

Thousands of professional plant pathologists today continue to develop plant disease descriptions and methods for the twentieth century.

2. How Plant Diseases Affect People

When plant disease strikes food crops, the human food supply decreases. History shows the possible devastating effect plant diseases can have on humans.

As recently as 1970 the United States suffered reduced corn production followed by increased corn prices as the result of plant disease. A new race of the Southern Corn Leaf Blight fungus developed which affected plants carrying a genetic factor called "male sterile cytoplasm". A technique of growing corn with this factor was widely in use because it reduced field labor costs and management problems unlike previous methods.. The only impact on the human food supply was increased corn prices resulting from reduced production. This occurrence can remind us how plant disease affects us materially. Growing extensive acreages of a narrow generic base crop leaves us susceptible to extensive food destruction by a new or mutated pathogen organism.

In 1845 and 1846 late blight, caused by a fungus destroyed the potato crop in Ireland, resulting in a loss of one-third of the Irish population. The impact of this disease was devastating because the Irish peasants had relied on the easily grown, nutritious potato as their main food. During the Irish potato famine, a million people died from disease caused by malnutrition or from starvation. A million and a half people emigrated to other countries. Those migrating to the United States became the nucleus of the Irish-American population. The famine affected subsequent social and economic policies. Its influence on British-Irish relations is still felt.

Two to three years before the famine, the potato blight first occurred; and in 1845 and 1846, weather conditions were ideal for its reoccurrence. The same disease damaged crops in Europe and the United States during that time with less severity because populations there had a varied food source.

Late blight destroyed approximately one-third of the German potato crop in 1917. Since potatoes were a large part of the

German wartime diet, the late blight possibly contributed to their defeat in the First World War.

3. Rust

Rust (probably leaf and stem rust) occurred in the wheat field of the ancient Romans. This plant disease frightened them because the rust was destructive and its origin was a mystery. They believed its appearance was evidence of the displeasure of the gods.

The Romans called the disease "robigo" because of the redness. Their corn god, Robigus, was named for the rust. This god, in their belief, possessed the power of inflicting or withholding the scourge of the disease. He was so important to them that every year they staged a festival, the Rubigalia, in his honor with ceremonial offerings and sacrifices to ward off his displeasure and seek his favor for the crops.

Discuss with students the fact that plant diseases can be identified, classified, and understood.

Plant disease can be classefied in various ways:
° By the type of organism that causes it; for example, fungal disease
° By the plant part the organisms strike; for example, leaf spot
° By the type of crop the organisms attack; for example, a cotton disease

Plant diseases can be identified on the basis of symptoms as well as by observation of the disease-causing organisms.

Plant disease specimens can be collected and preserved for future reference.

Assign students to independently make a collection of plants that have been attacked either by disease or insects. Ten collected specimens should be reasonable to expect from each student.

Ask students to record the following information about each specimen.
- Common name of plant
- Where and when collected
- Type of organism that is affecting plant health (fungus, bacteria, nematodes, insects, etc.)
- Name of collector.

Note: The following information extracted from 4-H Teacher's Guide and Supplement to Plant Diseases, cited previously, is included to aid students in preserving and explaining specimens:

1. Methods of Preserving and Displaying Plant Specimens

Persons wishing to study identification and control of plant diseases must collect specimens. Several methods are available.

Glass front boxes with cotton backing (Riker mounts) are used for dry mounting diseased plant tissue. They are available from biological supply companies. Clear plastic boxes also work well. Perhaps the most inexpensive mounting system would be plastic disposable petri dishes. Cotton can be placed in the bottom and the specimen positioned on top of the cotton.

Some specimens, like fresh fruit, do not lend themselves to dry mounting. These can be placed in preserving solutions such as a mixture of:

50% Alcohol	100 ml.
Formalin	6.5 ml.
Acetic acid, glacial	2.5 ml.

Many formulas for preserving tissues have been developed. A serious student may want to research several of these proposed formulas and conduct independent experiments.

2. Mounting Fungal Spores For Observation With Compound Microscope

Many fungi that cause leafspots or affect leaf tissue, like powdery mildew, are prolific spore producers. These spores can easily be collected and observed.

Place one drop of water in the middle of a glass slide. Cut a 2-inch strip of clear cellophane tape. Touch the gummed side of the tape of the leaf surface which contains the spores. Then use your thumb and forefinger to hold the tape at the ends and press the tape ends to the slide. The slide is ready for observation.

3. Separating Nematodes From Soil

Normal soil contains nematodes but not all soils contain plant parasitic nematodes. The importance of finding plant parasitic types will probably depend on the course level. The presence of the stylet is the diagnostic feature of a plant parasitic type.

Separate nematodes from the soil by using the following equipment and technique:

Necessary equipment:

- One 6-inch funnel
- One piece of tubing that will slip snugly over the tip end of the funnel. It should be about 4 to 6 inches long.
- One pinch clamp strong enough to pinch the tubing just described and prevent passage to water
- One piece of screen wire or hardware cloth cut in a circle 4-1/2 inches in diameter
- A stand to hold the funnel assembly in an upright position

Technique:

1. Collect soil from a lawn area. Take the soil from where the roots are growing. Put one heaping tablespoon of soil in the center of a tissue which has wet strength. Set aside until funnel system is operational.
2. Place the tubing over the stem of the funnel far enough to prevent its slipping off.
3. Place the pinch clamp on the tubing that extends past this stem. Be sure it is tight enough to hold water in the funnel.
4. Fill the funnel with water.
5. Place the screen in the funnel proper so it is below the water surface.
6. Fold the tissue over the soil and hold this.
7. Gently place the soil contained in the tissue on the screen.

Nematodes will move through the tissue and collect at the point where the clamp holds the water. After 24 to 48 hours collect about 5 cc's of water by carefully releasing the clamp to permit the flow of only this amount of water. Collecting the water containing the nematodes in a small dish or watch glass will permit observation of the sample with a dissecting microscope or the lower powers of a compound scope.

Have students share collections with the rest of the class. Classify (list) the various specimens collected by the entire class.

ACTIVITY II:

Discuss the ways the collected plants were attacked by the various organisms.

Organisms attack plants by:
° Direct penetration
° Enzymatic action
° Through wounds and natural openings
Organisms derive nourishment from plants by:
° Specialized feeding structures
° Osmotic intake
° Direct action

Discuss the importance of knowing how organisms attack plants. This knowledge can be used in developing control methods for human advantage. If, for example, we know the fungus-causing black spot on a rose produces spores that grow and penetrate plant tissue, we can use protectant fungicides. Furthermore, if we know bacteria enters through wounds and natural openings, we are more careful in handling fruits. By understanding the disease cycle, we can attack the organism at the weakest point in the cycle.

Explain that many plant diseases can be prevented or controlled by chemical and cultural methods. Chemical control includes:

° Fungicides used against fungi
° Bactericides used against bacteria
° Nematicides used to control nematodes

Cultural methods include:

° The use of resistant plant varieties
° Rotation with unrelated crops
° Wise use of irrigation, fertilizer and other management practices.

To demonstrate one form of chemical control of plant disease, specifically seed rotting, fill two boxes or pots with heavy soil; i.e. soil that contains a large amount of water. Obtain a package of vegetable seeds such as peas or beans. Check to make sure the seeds have not been previously treated with a fungicide. Divide the seeds equally into two groups and dust one group with a fungicide such as Captan (Captan is used to help control seed rot). Plant an equal number of seeds from each group in the containers of heavy soil. Label the container as to which contains the treated seeds. Observe and keep records of which is more productive.

ACTIVITY III:

Hold a class discussion involving the direct and indirect effects of pesticides and fungicides. Begin the discussion by reviewing methods employed by plant pathologists and entomologists to control plant health. Ask students why, if scientists have the chemicals to control diseases and insects, they don't eliminate these pests. The following are suggested points you may wish to consider:

1. Pesticide use can be very dangerous. Spraying large areas can do long term damage to the food chain. For example, the use of DDT in the late 1950's to control the gypsy moth proved to have serious side effects by also killing birds, fish and other animals that eat gypsy moths. What effects could this have on humans?

2. Sprays can filter into the soil and eventually find their way into water sources that could effect both human water supply and live stock (source of human food).

3. Fruits and vegetables that have been sprayed and not washed before they are eaten can be a health hazard.

4. Insects provide a very valuable service to our environment as recyclers. They decompose dead vegetable matter. If we eliminated insects, in one year's time six feet of vegetable matter such as leaves would accumulate on the ground.

ACTIVITY IV:

Explain to your class that although scientists have made much progress in the control of plant health there is still much we don't know --- particularly because of the direct and indirect effects of the use of pesticides and fungicides.

Share the following information extracted from Science, Vol. 213, August 28, 1981, pp. 991-993.

THE SUMMER OF THE GYPSY MOTH

Entomologists who made bets on its destructive power never guessed it would strip 10 million acres this year.

What th Mediterranean fruit fly tried and failed to do this summer near San Francisco, the gypsy moth did more than 100 years ago in Boston's harsher climate. It made its way across the ocean from Europe, established a colony, and spread through the New World. Unlike the Medfly, the gypsy moth has overcome every obstacle thrown in its path. It is well on its way to colonizing the entire eastern United States. This summer, in fact, has been a banner season for the moth. Every entomologist who spoke with Science said the insect (Lymantria dispar) has covered far more ground in 1981 than anyone could have predicted.

Some see in this a graphic warning of what can happen with insect pests if they are not dispatched quickly and thoroughly, as California is now trying to dispatch the Medfly. The difference between the gypsy moth and the Medfly, however, is that the moth does not attack cultivated crops. It prefers forests, and has never posed a direct threat to farming. But for people who live near infested woods, it is an overpowering nuisance, and it does kill trees. As one U.S. Department of Agriculture (USDA) official put it, living in territory overrun by the moth can be like "living in an Alfred Hitchcock movie."

According to Gary Moorehead, director of the gypsy moth quarantine program for the USDA's Animal and Plant Health Inspection Service (APHIS), scientists at an APHIS laboratory on Cape Cod organized a betting pool last year to see who could come closest to guessing the number of acres the moth would strip bare in 1981. The number in the previous season, a record breaker, was 5 million acreas. The results for 1981 are now coming in, and, according to Moorehead, even the highest guesses are short of the mark. It looks as though the total will be 9 to 10 million acres, maybe more. Next year is expected to be worse.

The number of defoliated areas rises and falls periodically, but the area held by the moth grows steadily larger. The USDA and state agricultural officials have had several massive confrontations with the insect, most notably in 1957, when 3 million acres were sprayed with DDT. The public reaction against this tactic was loud and effective. Shortly afterwards, following the publication in 1962 of Silent Spring, Rachel Carson's book on the dangers of pesticides, DDT spraying was stopped. USDA officials speak nostalgically of the weapon they have lost, but concede that DDT appeared to be doing long-term damage as it accumulated in the food chain. Chemical residues were found in birds and fish.

Since the 1960's, aerial spraying with less potent pesticides has been continued on a smaller scale. The pest fighters' ambitions are now reduced. All they really hope to do is slow the rate of spread and keep the moth out of backyards, parks, and campgrounds. The front line of the advancing colony is now said to be in Maryland and Virginia, moving west and south.

The federal government's forces are divided into two groups: APHIS, which enforces the quarantine on products and camping vehicles moving out of the Northeast, and the Forest Service, which runs a "cooperative suppression" program with state governments in the worst-hit areas. Moorehead essentially agrees that the insect has won the war. Holding the latest environmental impact statement for the gypsy moth program in his lap, Moorehead put his left thumb over one corner of the document. "This is what APHIS covers," he said. Then he put his right thumb over another corner: "And this is what the Forest Service covers." All the rest of the space belongs to the moth.

John Kegg, New Jersey's commander in the battle against the moth, says he has been on the losing side for 18 years. "We can keep a green island here and there, but by the end of May with the caterpillars hatching and blowing into new areas, we cannot prevent their spreading."

The moth's tactics are eccentric. After hatching in April or May, the tiny caterpillars weighing less than a milligram climb the nearest tree. Before feeding, or later in the season if food is scarce, they spin down and hang from the upper branches on silken threads. Winds carry them aloft quite easily and drop them up to half a mile from the hatching point. Strong winds carry them farther, and in the Appalachian Mountains, the insect can hop from ridge to ridge in this fashion. Since the female moth cannot fly, this is the way the population migrates. The moths also travel by laying eggs on logs, cars, trucks, and campers that move through an infested area at laying time. Their favorite food is oak leaves, although when desperate they devour almost any foliage. In recent tests, they have shown a keen interest in salads of manzanita leaves from the West Coast.

Containment has been abandoned as a credible policy. The gypsy moths, Kegg says, are "having a ball out there; it's like introducing houseflies into a house full of honey." He does not expect the exploding population to stabilize until all the eastern U.S. oak forests have been infested.

The moth was introduced by accident, to Medford, Massachusetts, and to the continent in 1869 by a French entomologist named Leopold Trouvelot. He had hoped to cross this European insect with oriental silkworms and produce a hybrid that would spin silk and thrive on American oaks. No doubt he hoped to make a lasting contribution to the silk industry, if not a fortune for himself. He failed in this, although he did make a name for himself. A windstorm one day in 1869 blew over a cage of his imported caterpillars, and they crawled out the window. The result, 20 years later, was recorded by Sylvester Lacy of Medford:

> I lived on Spring Street when the caterpillars were thickest there. The place simply teemed with them, and I used to fairly dread going down the street to the station. It was like running a gauntlet. I used to turn up my coat collar and run down the middle of the street. One morning, in particular, I remember that I was completely covered with caterpillars, inside my coat as well as out. The street trees were completely stripped down to the bark....The fronts of these houses were black with caterpillars, and the sidewalks were a sickening sight, covered as they were with the crushed bodies of the pest.

In the early days, pest fighters went after the insect with torches, creosote paint, scrapers, sticky paper, and sprays of lead arsenate and other general poisons. The chemical assault became the most frequently used, eventually reaching a crescendo in the aerial DDT spraying of the 1950's. Since that high point, the campaign has tapered off to a sporadic application of pesticides now considered safe: malathion, Sevin, Dylox, and Orthene.

At the same time, entomologists who believed in the efficacy of biological control--the use of "friendly" insects to fight pests--were importing the natural enemies of the gypsy moth from all over the world. Most of these are small wasps and flies that attack the eggs or larvae.

According to Roger Fuester, an entomologist at the USDA's Beneficial Insects Research Laboratory in Newark, Delaware, 47 species of natural enemies have been imported and released since the turn of the century, and about 10 have established themselves in this country. One of the latest arrivals, for example, is the Calosoma beetle from Japan, which has done well in New England but has not yet crossed the Delaware River into the front line area. Fuester thinks the friendly insects have done a valiant job, but he does not make any great boasts for them. At best, he says, they seem to have lengthened the time between peak outbreaks in the repeating cycle of infestations. He guesses that without the natural enemies, the worst outbreaks would come every 2nd or 3rd year, rather than every 5th or 6th. Biological control has worked well against some pests, notably the cereal leaf beetle in the Midwest and the alfalfa weevil in the Northeast, reducing farmers' use of chemicals. But the USDA has found nothing strong enough to stop the gypsy moth, even though an official of the Benefical Insects lab says, "We've scoured the world" for a superbug.*

Assign students the task of investigating projects that are current in your state in regard to plant health. First, students will need to obtain information as to the various state and federal agencies involved in control of plant disease. City, county or school libraries contain addresses of various agencies. The following list contains the names of some of the agencies your students may wish to contact for control information:

1. U.S. Department of Agriculture, Animal and Plant Health Inspection Service
2. American Society of Photogrammetry, Falls Church, Virginia
3. U.S. Forest Service
4. U.S. Environmental Protection Agency
5. USHEW PHS Center for Disease Control, Atlanta, GA
6. State Health Department
7. State Department of Natural Resources
8. County Cooperative Extension Service
9. State Cooperative Extension Service, Attention Plant Pathology

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*With permission of the editors of Science magazine.

PURPOSE: To help students understand the importance of conserving natural areas and the concepts involved in management of a natural area, and to develop a management plan for a specific area.

LEVEL: Junior - Senior High School

SUBJECT(S): Social Studies
Science
Mathematics

REFERENCE: Suggested by Steve Goodwin, Administrator of Staff Operations, and Chuck Olson, Intern, Division of Natural Areas and Preserves, Ohio Department of Natural Resources, Fountain Square, Columbus, Ohio.

ACTIVITY I: Discuss with your class the fact that since pioneer settlers arrived in our country over two hundred years ago, our land has undergone extreme change. The dense forests, vast prairies, lush wetlands and vital streams that greeted our forefathers have dwindled and given way to social and economic development, producing urban sprawl, industrial development, highways and cultivated farmlands. Many plants and animals that once thrived in our country have been extirpated or are endangered. However, concern for this trend of depleting natural areas is growing and action to stop environmental abuse is being demanded by the public. Ask students why they think government, industry and the public are becoming increasingly aware of their effects on the environment. Why are natural areas important?

The following are suggestions of some points you may wish to cover in class discussion:

1. Natural areas are living laboratories. We can study species and learn how they contribute to ecological balance. Though man is the dominant species, he remains so only as long as a certain degree of ecological balance is respected. To demonstrate the importance of how various organisms interacts and are interdependent with one another, conduct a food web exercise.

   Either assign or have each student select one organism from the following list. The students should search for information about the orgahism. Provide the students with a variety of reference material. Emphasize that every organism is part of the natural life pattern and serves some purpose within nature.

Coyote	Vulture	Fly	Spider
Mouse	Algae	Man	Dog
Rabbit	Oak Tree	Bacteria	Cow
Snake	Cattails	Mold	Tapeworm
Grass	Hawk	Earthworm	Corn
Owl	Grasshopper	Sparrow	Flea
Snail	Duck	Fish	Beaver
Deer	Beetle	Toadstool	Cat
Raccoon	Louse	Fox	Wildcat

Others may include: Bear, Wolf, Praying Mantis, Skunk, Frog, Woodpecker, and so on.

Students should arrange their desks in a circle, leaving enough room behind so that the teacher can walk on the outside. Tape a sign with the organism's name on the front of each student's desk where all others can see. Have a skein of yarn rolled into a ball before starting the exercise.

Start by asking one student representing a consumer (for example, the coyote) to select from the other organisms one he would eat in order to obtain food. Do not start with a producer. Connect the yarn between the "eater" and the "eaten". Continue connecting "eating" organisms to "eaten" organisms until all organisms are involved in at least one path. After discussing what some animals eat, select a green plant. If students do not realize green plants make food rather than eat other organisms, review briefly how plants use sunlight, water, carbon dioxide, and minerals to produce food and release oxygen. Emphasize that all the other organisms depend directly or indirectly on the producers. Connect the yarn from the plants to organisms that eat the plants.

Continue connecting yarn between organisms until several of the students have two or more strings. Be sure each student realizes he represents a population (all organisms of one type), thereby can be eaten by several others.

Once you have connected sufficient strings, depending on the number of relationships and concepts you wish to illustrate, have all students tape the strings to their desks. Students may want to sketch the food web they formed before leaving the circle.

When you finish your food web, hang the signs and strings from the ceiling or room lights. Next clip one or two strands of the web and discuss the long range effects when parts of an ecosystem are destroyed. How might such distribution of various components of any given ecosystem affect man?

2. Wonder drugs of today have been developed from nature. Have each student research a modern medicine drug and report on how it was discovered, by whom, where it comes from and what it is used for. How many of the drugs are related to something in the natural environment? You may wish to include reports of how pioneers used various plants and animals for medicinal purposes. Pharmacopoeias (books containing selected lists of drugs and their preparation) should prove useful for this exercise.

3. Many world citizens are fed today as a result of exploring nature and through extending nature's products. With your students make a list of the basic foods we eat. Almost every domesticated animal and cultivated plant crop has been developed from a natural or wild species. Check to find the original source of selected products. Trace the history of agriculture as it developed from a society of hunters and gatherers.

4. We cannot speculate on the future importance of any given species to mankind; i.e. what may seem like a worthless weed today may be the only source of a certain chemical to prevent or find a cure for a specific disease in the future. Furthermore, the greater the diversity of organisms that live on our planet the safer it is for human life. With every extinction, man himself becomes one step closer to extinction.

   Mold was once considered to be worthless and even undesirable. Yet it is the source of penicillin today. Foxglove, a common wild plant, is the main source of digitalas, used extensively in treatment for heart disease. The bark of a cinchona tree is the source of quinine, a treatment for malaria. Ask students to watch in the news media for new medical breakthroughs relating to the development of some natural product. Check sources of vitamin tablets.

5. Natural areas provide havens for city dwellers. Research shows that people contained in crowded areas tend to suffer a much higher rate of both mental and physical disease. With your class, visit a natural area. Place students at a distance of at least twenty feet apart and ask them to write down things that come to mind (such as things they see, hear, smell etc.) After a period of

twenty minutes, rearrange students to a distance of about five feet apart. Repeat the exercise. Now, take class to a crowded area such as a picnic area, playground or busy street corner. Have them sit in the total group (side-by-side) and repeat the exercise. Compare and discuss students feelings in each setting.

ACTIVITY II:

Now that you have established a need for preserving unique natural areas, identify agencies in your state that are responsible for the selection and management of natural areas. Metropolitan Park Systems, State Departments of Natural Resources, Nature Conservancies, U.S. Forest Service would all be concerned with natural areas. Obtain a listing of all of the natural areas in your state and indicate the agency responsible for each area. How are the areas acquired by each agency? Where do they acquire the funding?

How students participate in the following Nature Preserve Simulation to demonstrate some potential conflicts in the selection of natural areas. It should be noted that although this simulation is specific to the State of Ohio, similar issues would occur in the selection of natural areas in any given state.

Potential Nature Preserves

(Suggested by Richard Moseley, chief, Natural Areas and Preserves, The Ohio Department of Natural Resources, Fountain Square, Columbus, Ohio.) Review as a class the following information consisting of six potential sites for designated nature preserves:

Site A

Name: Gray's Gorge

Location: Licking County

Size: 800 Acres

Cost: $240,000 ($300/acre)

Significance: Geological - Botanical - Historical

Comments: The prime feature of the site is a narrow east-west gorge cut by the Hanover River through the Blackhand sandstone which creates rugged topography. The hilltops are dominated by oak, hickory, Virginia pine, and mountain laurel. Mixed hardwoods and lush spring flora abound on the wooded slopes and ravines. Remnants of the Ohio-Erie Canal are present on the area. The area has been somewhat misused and abused in the past -- motorcycle paths, trash and litter from beer parties, etc., are present on property.

Site B

Name: Pleasant Prairie

Location: Lucas County

Size: 40 Acres

Cost: $120,000 ($3,000/acre)

Significance: Botanical - Zoological

Comments: Site is considered to be the finest wet prairie in the state and last remaining natural area in this section of the state. It has several distinctly different plant communities on the site. The area is well known for its prairie plants including blazing stars, Riddell's and Ohio goldenrod, prairie coneflower, and several prairie grasses. Several species of orchids, gentians, cardinal flower, and turtlehead are also found on the site. In addition to the plantlife, the area is important habitat for the Blandings and spotted turtle, the rare Buck Moth, and several species of rare or unusual birds. Numerous scientific studies have been conducted on the area. The site is close to an urban center (within city limits) and is adjacent to property on which a proposed housing development is to be initiated within the near future.

Site C

Name: Morton Marsh

Location: Lake County

Size: 100 Acres

Cost: $200,000 ($2,000/acre)

Significance: Botanical - Zoological

Comments: The area has several plant communities with the cattail - phragmites and swamp forest communities being the largest and most important. Due to the diversity of habitats, the site exhibits a remarkable profusion of trees, shrubs, ferns and wildflowers. The site is equally known for its variety of birds, mammals, reptiles and amphibians. It is utilized by many birds during the spring and fall migrations and is a known nesting site for the prothonotary warbler. The site is adjacent to a housing development and is close to a major urban center. Some problems with mosquitoes and pollution from septic systems.

Site D

Name: Pickaway Pond

Location: Hocking County

Size: 500 Acres

Cost: $100,000 ($200/acre)

Significance: Geological - Botanical

Comments: The prime feature of the site is the 40-acre "kettle" lake created by the Wisconsin glacier, the last of its type in this section of the state. The site is best known as a prime observation area for bird life. The pond and marshy areas attract a wide range of migratory waterfowl, great blue heron, green heron, and other shorebirds. Much of the site adjacent to the pond is old farm land and pastured woods. It has little or no botanical significance. There is interest in this project expressed by a local conservation club with a possibility of some local financial support for the project.

Site E

Name: Hemlock Hollow

Location: Hocking County

Size: 500 Acres

Cost: $100,000 ($200/acre)

Significance: Geological - Botanical

Comments: The chief feature of this site is a narrow, steep-walled gorge which terminates headward forming a large cove with beautiful waterfalls which cascade over vertical cliffs of sandstone. Glacial relic vegetation of hemlock, Canada yew and birch are abundant in the cool, moist canyons and ravines, while forests of oak, hickory, and pine inhabit the cliff tops and ridges. Three other similar preserves exist in the vicinity but none are as large or are in virgin condition. The site is 60 miles from an urban center and has poor access which explains its present state of preservation.

Site F

Name: Ben's Bog

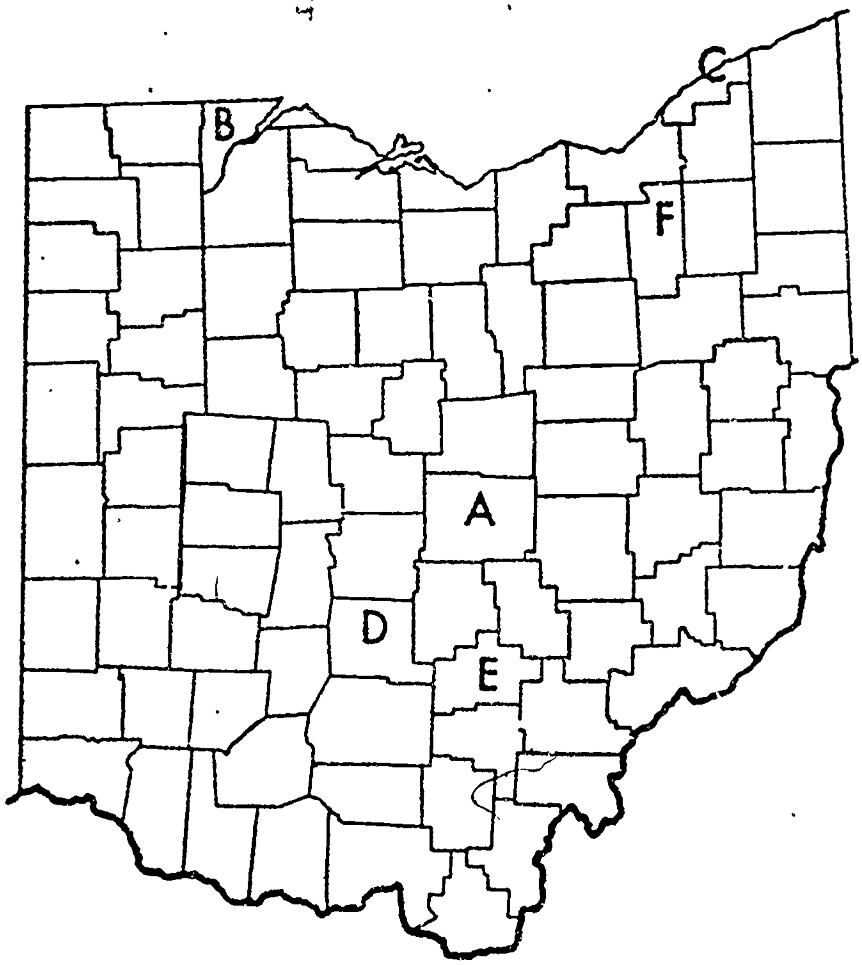
Location: Summit County

Size: 50 Acres

Cost: $[illegible]0,000 ($400/acre)

Significance: Geological - Botanical

Comments: The site is perhaps the finest remaining glacial bog lake in this portion of the state. The bog lake exhibits excellent zonation and has a floating margin of Cranberry, sphagnum moss, pitcher plant and sundew. Tamarack, poison sumac, yellow birch, and red maple are prime features of the bog forest surrounding the floating mat. Several scientific studies have been completed on the site. The area is close to a major urban area and is adjacent to land recently rezoned for industrial development. The proposed development will require a great deal of ground water for its processing.



Check site locations with a map of Ohio to determine whether the locations are in populated areas and whether they have public acc:ss.

Next, divide your class into groups of five. Each group represents the Nature Area Council which makes decisions regarding what areas in the state will be purchased as natural preserve. Inform your students that each will assume the one of the following roles:

Group I: You are a professor of zoology and director of a museum of natural history. You are particularly interested in the rare and endangered vertebrates and invertebrates of Ohio. You feel that the preservation of habitats of those species is an important function of the state nature preserve system. You would like to see preserves established as living museums for the general public, but would also like to see areas set aside away from heavily populated areas as undisturbed laboratories for serious research.

Group II: You are a plant ecologist. Your doctoral thesis was devoted to an investigation of the natural vegetation of the state in pioneer days. You are currently involved in locating remnants of these communities which still exist in an undisturbed state. You feel that the primary emphasis of the state nature preserve program should be to preserve the best example of each of these communities and that special attention be given to locating preserves in areas of the state where the representative natural communities are not yet protected.

Group III: You are a professional geologist. You support the active preservation of botanical and zoological communities but feel that a stronger emphasis could be put on the preservation of the state's geological features. While many of these features are in areas where the surrounding natural communities have been degraded by human activity, the geological features themselves are undamaged and retain their full value as representative elements of the state's natural histor From this standpoint you feel they too should be permanently set aside within a state nature preserve.

Group IV: You are in the field of environmental education and are currently working as chief naturalist for a major metropolitan park system. You have seen many metropolitan parks put under heavy recreational use, often at the expense of the natural environment. Since the use of state nature preserves is restricted by law to education and passive, non-consumptive recreation, i.e. hiking, nature observation, etc., you would like to see more preserves in the vicinity of urban areas. You feel these areas would then serve as important outdoor classrooms to educate more citizens to the value and importance of preserving our natural heritage.

Group V: You are a member of the Division of Natural Areas and Preserves staff. You must consider the different aspects involving the purchase, planning and management of state nature preserves. It is your responsibility to be aware of any potential problems involving proposed preserves and to inform the council of these. This involves questions of the preservation value of an area versus its cost, possible threats to the integrity of an area by existing or forseeable environmental conditions and changes, management problems from present and possibly continuing misuse of areas, etc.

Remind students that it is imperative that they represent the interests of the role they are assuming and not their personal interests.

Now inform all of the councils that the state has been given $500,000 to purchase available natural areas that will be designated as nature preserves. Explain that the $500,000 will not satisfy the specific interests of each council member; however, each council must reach a decision as to which areas should be purchased and justify its decision. Councils do not need to spend all of the $500,000, but should be aware that cost of land may increase significantly in a year's time and that the decision not to spend a portion of the money must also be justified. Allow councils approximately forty-five minutes to complete this task.

After the designated time allotment, ask each council to report its decisions and state its reasoning. Compare and contrast the various councils' decisions. Discuss problems that occurred with each council as they reached its decision. At this time, you may wish to allow councils to change their decisions as a result of a report(s) of another council.

ACTIVITY III:

As a class, check with the manager of a local park or nature preserve to determine management concerns such as what decisions must be considered when an area is planned for public use and how park managers plan an area. After students have some understanding of the various concerns in planning and managing a public area, assign the following project:

REFERENCE: Fox, Charles E. Activities for Teaching Forest Conservation: Grades 10-2nd Year College, Forest Service, U.S. Department of Agriculture, June, 1958.

This project is a constructive activity in that recreation policy must be formulated and problems of objectives, population growth, etc., considered in practical terms. The idea is to "start from scratch" with an hypothetical area, make a simple map, and develop a plan for use. Begin with a discussion of recreation objectives, different types of developments, needs of the future, and analysis of specific areas known to the class, either locally or encountered on vacation trips.

a. Select an area in the vicinity that has potential for development as a public picnic ground and campground, and--if suitable water is present--for bathing, boating, and fishing. Assume that funds are available for purchase, or that the land can be obtained by donation. One area can be selected as a project for the whole group, or individuals or "committees" can select their own.

b. It might be well for the "planner" first to ask himself certain orientation questions: Who will use the area? When? Will timber be cut, and if so, how much, where, and with what protection of recreation and scenic values? How much road construction? What structures? Of the many uses to which the area may be put, which shall receive priority? Swimming? Picnicking? Baseball? Shall any portions be left undisturbed? Where? As such questions are considered, the planner will develop the general feeling that he believes should be caught and preserved in the development. He is then ready to make the preliminary map and writeup.

c. Map. A map on the scale of at least 8 inches to the mile will be necessary in order to show the necessary detail. Some of the students will understand the use of plane table or compass and pacing, and if it is decided to use one area for the whole class, perhaps these "mappers" could lead the group in making a map which could be used as a base by the entire class; as a substitute, a sketch map approximately to scale, with distance estimated, will have to do.

Prepare a rough working copy of a map on which changes can be freely made. A simple legend for topographic and cultural features is a necessity. Probably the best source for a legend is the sheet "Topographic Map Symbols," free on application to the Director, U.S. Geological Survey, Washington, D.C. 20025. One copy will do for the class. For area development such as tent sites, float, campfire circle, not found in conventional legends, use original symbols that suggest the subject. The accompanying map of a recreation area should be helpful (Figure 1).

Improvements that might be shown on the map and in the plan: roads (main, secondary, and service); bridges; trails; camp areas; picnic areas; beaches; trailer sites; summer home sites; organization campsites; store, other concessions; observation tower; docks; playground area; sanitary facilities; water supply facilities; fences; entrance signs; bulletin boards; shower and wash houses. (There may be a tendency to include too much.)

After the final draft of the following written section ("d") is prepared, the final map can be drawn.

d. Written section of plan. This will consist of 2 parts: (1) General policy; (2) Discussion of individual units or improvements. A preliminary draft should be made first.

(1) General Policy

Purpose of area; objectives; policy regarding timber cutting, livestock grazing, signs, road construction; priority of types of use; fire protection; cooperation with other agencies; hunting and fishing; open fires; length of stay; fees charged; others not listed.

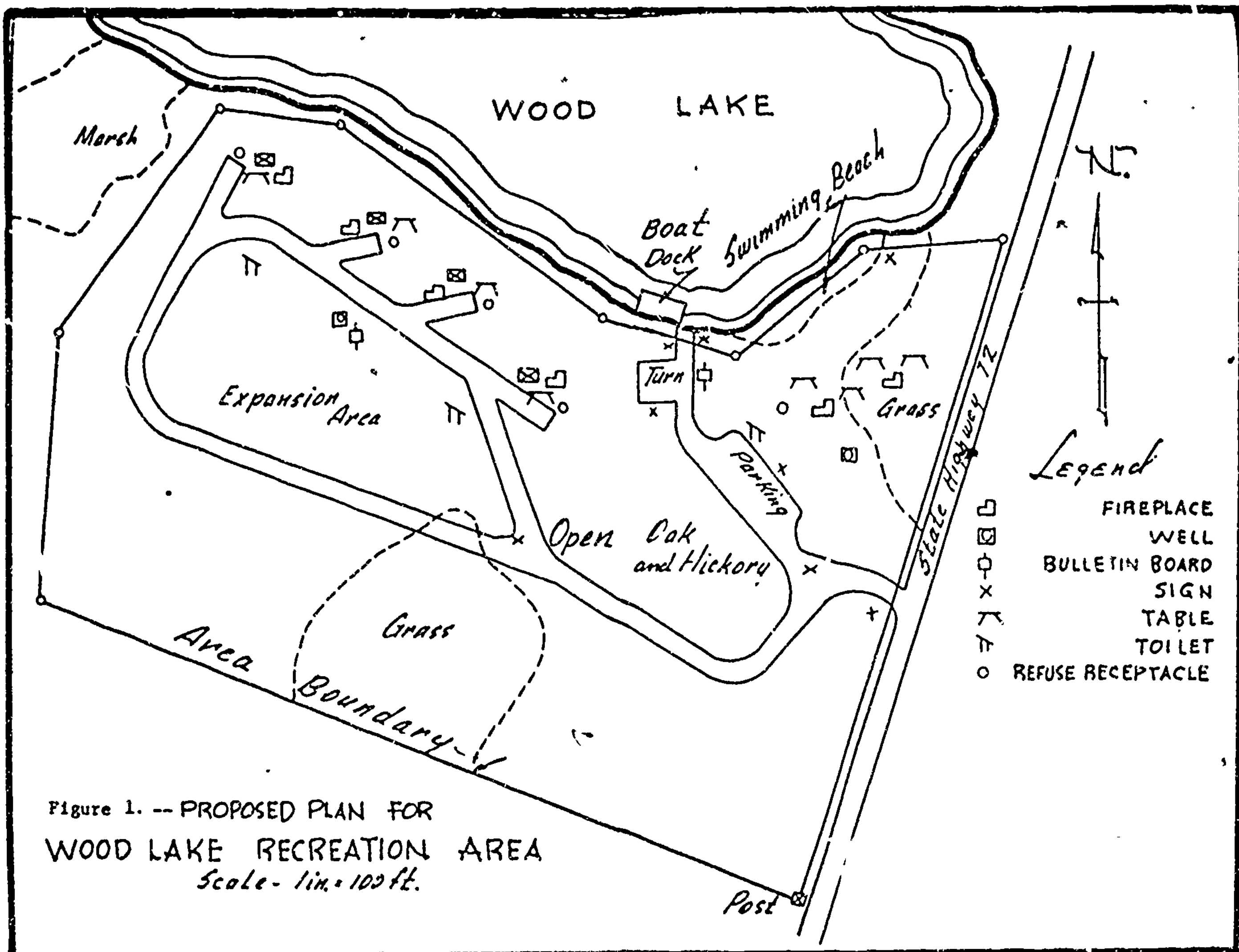


Figure 1. -- PROPOSED PLAN FOR
WOOD LAKE RECREATION AREA
Scale - 1in. = 100 ft.

(2) Individual units or improvements

For each type of improvement, separately and briefly discuss standards of construction; number of units and capacity, if applicable; sanitary precautions; restrictions; plans for maintenance, garbage removal, etc.; patrolman or supervisory guard. If initial construction is only for a portion of the total planned, indicate which units will be completed first, and which later, assigning appropriate years.

e. Discussion and evaluation. Compare the different plans as to practicality, effectiveness in meeting the needs, innovations in approach. Let the planners defend their proposals. Summarize by bringing together the best features introduced. Are there any opportunities for new recreation areas, or for improving existing areas in your community?

PURPOSE: To identify the environmental impacts of development of a mineral resource.

LEVEL: Junior - Senior High School

SUBJECTS: Science
Social Studies

REFERENCE: Environmental Quality 1980. The Eleventh Annual Report of the Council on Environmental Quality. Washington, D.C.: U.S. Government Printing Office, 1981. S/N 335-801/7090, $7.50.

ACTIVITY:

As demand for a given resource increases, intensified effort must be expended both to find it and to develop it. These efforts often are in the areas of exploration for new reserves and in the development of new production technologies, along with increases in prices of the raw resource itself (see pp. 159-162). An additional area of concern relates to the environmental impacts resulting from exploration, extraction, and development. The following case study, from Environmental Quality 1980, pp. 331-332, provides an example of the conflicts generated between need for development of a natural resource and desire to minimize negative environmental impacts:

"World phosphate rock demand is projected by the Bureau of Mines to rise from its 1978 level of 125 million tons to 365.3 million tons per year by 2000. The United States is currently one of the world's leading suppliers of phosphate rock. If U.S. production is stepped up to meet increased world demand, environmental problems associated with the mining and processing of phosphates will increase unless resource management policies are improved. Mining and processing of phosphate require vast quantities of water, can scar the landscape, and release radioactive radium and radon gas into water and the air.

"Because many of the U.S. phosphate reserves are on public lands administered by the Forest Service or the Bureau of Land Management, the federal government has the opportunity to consider how this resource is to be developed and to what extent the environmental costs are controlled.

"Florida's Osceola National Forest contains substantial phosphate reserves. The federal government acquired most of this land under the Weeks Act of 1911 for timber production and wetlands protection. The BLM is responsible for issuing mineral leases on the land, although the Forest Service must first approve the leasing terms.

Between 1963 and 1968, the Department of the Interior, with the approval of the Secretary of Agriculture, issued 92 permits to prospect for phosphate on the Osceola National Forest. By 1969, four companies had filed 41 applications for preference right leases based on their prospecting efforts. These applications cover 52,000 acres--34 percent of Osceola--the majority of the land in the western half of the Forest.

"Whether to grant leases is a decision to be made by the Department of the Interior. EPA and the State of Florida have opposed issuance of the leases on environmental grounds, stating that the leases would not be in the public interest because phosphate mining in the Osceola Forest might well result in the permanent loss of 28,000 acres of wetlands and productive forest. Such a loss would be contrary to purposes for which the land was initially acquired.

"Phosphate mining could have other adverse effects, including drawdown of the artesian Floridian aquifer system, increased levels of radon and radium, and increased sediments in surface waters, including the Suwannee River. In addition, large bermed "slime ponds" would be constructed either within or adjacent to the Forest and would contain thousands of acre-feet of phosphate clay slurry produced during extraction. EPA referred this controversy to CEQ, stating that the proposed leasing alternatives being considered by Interior were environmentally unsatisfactory.

"After discussions among representatives of CEQ, Interior, EPA, and the Forest Service, the Secretary of Interior announced that the Department would support legislation which:

- Precludes phosphate development in the Osceola National Forest
- Directs the Secretary of Interior to determine whether any lease applicants are legally entitled to phosphate mining leases; if so, the lease rights would be exchanged for leases covering minerals on other public lands, or, if no exchange were possible, compensation would be paid."

Discussion questions relative to this case study might include:

1. How is the decision to "go ahead" for the development of such a mineral resource made? Is this the best way? What other methods might be used?

2. Is it possible that there might be a case where environmental considerations preclude the development of a mineral resource? If not, why not? If so, what might be the rationale, or rationales?

Cases involving similar development-environmental tradeoffs abound. Students may wish to investigate other examples, such as the development of oil shale, strip mining, etc. The teacher should ascertain that "prodevėlopment" arguments, by themselves, or "pro-environmental" arguments, by themselves, are not presented as definitive arguments "f r" or "against" development, but that students are required to investigate, c ument, and present both sides of each case. A debate presenting "for" and "against" arguments may be a useful device.

PURPOSE: To understand that through technology, we expand the range of resources which we use in meeting our needs and desires

LEVEL: Junior - Senior High School

SUBJECTS: Social Studies
Science

REFERENCE: California Environmental Education Guide, 1981-84, Volume 4, p. 95. Hayward, CA: Office of the Alameda County Superintendent of Schools, copyright 1981. Reprinted by permission. SE 036 096.

Technology is often viewed as either the good guy or the bad guy; the solution or the problem. Can you make a list of some of the results of modern technology which are all bad or all good? Mostly bad or mostly good? Share your results and discuss.

Following is a list of tasks. They are game descriptions or problems to be solved. They are technological in nature inasmuch as they require a technological approach: assessment of the problem, suggested solutions, trial and error, redesign, etc. Do as many as you think the class would enjoy. They may be assigned to your class as individual, small group, or whole class assignments. They may be set up as competitions or cooperations. They may be used as simulations of corporate, agency, or group processes. (The SEEPCO Corporation has been offered a contract to . . . etc.)

TASKS:

1. Design a container which will keep an ice cube from melting completely for three hours while sitting on the teacher's desk.
2. Design a container or method to keep an egg from breaking when dropped from the roof of the school to the pavement below.
3. Design a paper airplane which will stay airborne for 30 seconds.
4. Figure out a way to get the entire class to stand in an area just four feet by four feet (120 cm x 120 cm.)
5. Figure out a way to lift a student's chair four feet (120 cm) in the air without anyone touching it. (The gloved hand and similar solutions are not permitted.)
6. Figure out a way to soundproof your classroom.
7. Have students think up more tasks.

FOLLOW-UP:

Do any of the technologies you invented have practical applications?

PURPOSE: To be aware of economic, legislative, social, and other means that can be used in promoting the conservation of resources.

LEVEL: Junior - Senior High School

SUBJECTS: Science
Social Studies

REFERENCE: California Environmental Education Guide, 1981-84, Volume 4, pp. 91-92. Hayward, CA: Office of the Alameda County Superintendent of Schools, copyright 1981. Reprinted by permission. SE 036 096.

ACTIVITY:

Discuss: "Trees are renewable resources inasmuch as they can be grown at a reasonable rate to replace those which have been harvested. It seems that people, even though they use forest products every day in ever increasing amounts, have an emotional attachment to trees. They often want to, as the bumper sticker says, save a tree. We're going to look into ways of saving trees and are going to rank them according to their effectiveness and desirability."

Present the following list of ways to save trees to the class:

1. Recycle paper.
2. Recycle wood.
3. Repair wood products that break.
4. Refuse to buy wood.
5. Share your newspapers and books with friends.
6. Don't use varnish and other wood resin products.
7. Actively lobby to cut lumber companies' profits.
8. Start a campaign to end defoliant spraying of forests.
9. Campaign to close National Forests to logging.
10. Create more National Parks.
11. Declare the redwood off-limits to logging.
12. Chain yourself to a tree.
13. Use more plastics and less wood.
14. Substitute cotton and other fiber products for wood products (cotton diapers vs. disposable diapers, for example).
15. Write threatening letters.

Rank these according to which are the most effective in saving a tree, and which are the most desirable.

Go through each of the ways with the class. Discuss the trade-offs of each of the ways. For example, using more plastic is often unaesthetic and promotes the use of petrochemicals, not necessarily a desirable outcome. Writing threatening letters is illegal in some cases. Recycling paper is good, but perhaps it would put some lumberperson or truck driver out of work (even though the recycling industry is creating jobs). Some of the jobs that spraying does could be done by laborers, but it would take longer and be more expensive. The price of lumber could go up as a result of banning spraying.

Also outline the following facts about paper for the class.

1. Over 75 percent of the paper made in the Western U.S. is from sawmill and plywood waste that formerly was burned.
2. Many by-products of paper making are used in consumer products, often as substitutes for petrochemicals.
3. Packaging allows for foods to be kept longer and for a greater variety of products to be marked. "Overpackaging" has not really been defined.

Have the class again rank the list of ways according to which are the most <u>desirable</u>. How have the rankings changed since the first time? What major contentions still remain?

FOLLOW-UP:

1. The lumber companies refer to what they do in terms that a farmer might use. They speak of tree farms and crop management and harvesting. How much like farming is the lumber industry?
2. Invite a representative of a lumber company to visit your school. Remember, like many other segments of our society, the forest industry has a point of view and a message they want to get across to the public.
3. Invite a representative from an environmental group, perhaps one that is engaged in curtailing the actions of the forest industries. Remember, like many other segments of our society, an environmental organization has a point of view and a message it wants to get across to the public.

PURPOSE: To identify advantages and disadvantages related to different methods of land allocation.

LEVEL: Junior - Senior High School

SUBJECT(S): Social Studies

REFERENCE: Project Learning Tree Supplementary Curriculum Guide for Grades 7 through 12. American Forest Institute, copyright 1977. Reprinted by permission.

ACTIVITY:

Ask your students to make a large-scale map of a publicly owned forest which contains 120 acres (approximately 50 hectares) and these features: a scenic area such as a canyon or meadow; a two-lane highway; a prominent stream with a smaller, tributary creek; a stand of old-growth timber.

Ask each student to assume the role of one of the following individuals or groups who wish to lease a portion of the land:

° Timber company executive (40 acres; 15 hectares)
° Seven owners of summer cabins (2-1/2 to 3 acres each; 1 hectare each)
° Private campground developer (12 acres; 5 hectares)
° Mining company executive (20 acres; 10 hectares)
° General store and service station owner (2 acres; 1 hectare)
° Railroad company executive (a 100-foot-wide right-of-way; 30 meter right-of-way)
° Ski resort owner (30 acres; 15 hectares)
° Dude ranch operator (15 acres; 5 hectares)
° Scenic preservation society (amount of land to be decided by the class after the map is drawn)

Each student, either in a predetermined or random pick-a number order, chooses a site and marks off the area on the map.

As the land is claimed for each use, students with later choices will find the remaining area insufficient or inappropriate for their needs. Some forest users may be left out entirely.

Ask the class to talk about how the land might be allocated in a better way among those who wish to use it. Attempting to use consensus processes, the class may work out a land-use plan to meet the needs of everyone involved. They might also consider whether there is a need to look beyond the people directly involved in this issue. Are there other possible uses and users not yet represented? What seems to be the most just long-term solution? Have some people given up more than others? What does each person or group give up? What does each gain individually or collectively?

Discuss the merits and drawbacks of the two methods of land allocation: "first come, first serve" or consensus.

A variation of this activity is to assume that the forest land is privately owned and each potential user must buy the land he or she requires. (In the first exercise, the land was publicly owned and leased.) Follow the procedures described in the first activity, except when the land "runs out" ask the students to try to reallocate the amount using a free market system. Land can be exchanged or sold. Some users may decide to sell out and locate elsewhere.

Compare the two methods of allocation, identifying the advantages and disadvantages of each. Discuss such ideas as:

Which method seems to create the most controversy, the planning system whereby the land is allocated on the basis of the consensus of the majority or the voluntary system whereby land is allocated on the basis of the individual's ability to pay?

Which system appears to leave the individual owner most satisfied? Explain your response.

Which system appears to be the best for society as a whole? Explain your response.

PURPOSE: To measure the trees in a selected woodlot area, and to calculate the volume and value of wood.

LEVEL: Junior - Senior High School

SUBJECT(S): Science
Social Studies
Mathematics

REFERENCE: Suggested by William F. Cowen Jr., Professor, Forestry, The Ohio State University

MATERIALS NEEDED:

Tape measure, biltmore sticks, marker tapes, recording sheets, clipboard and writing material

ACTIVITY I:

Explain to your class that forest resource managers can calculate the number of board feet for any given standing tree in an effort to estimate the retail value of the tree. To do this they must be able to determine the diameter of a tree at breast height or 4-1/2 feet above the ground and the number of 8' (or 16') lengths of usable timber. They must also be able to identify the type of tree since different values are placed on different kinds of trees.

With your class, visit forest land (preferably hardwoods) consisting of at least 1/2 acre of good sized trees (approximately 12" or more in diameter) and inventory the kinds of trees as to species. Develop a list of the various species. Next appoint a student to call a local sawmill and ask the relative value and uses of the species on your list.

Now that you know the value of the various species, you are ready to determine the value of the trees on your selected forest area. To do this you must obtain the diameter and height. Use the following procedures to find the volume of each tree:

1. Use a measuring tape and measure the circumference of a tree at 4-1/2' above ground level. (You may wish to practice this in the classroom with a waste basket or any such cylindrical object.)

2. Divide the circumference by 3.14 to determine the diameter.

3. You now need to know the useable height of the tree. Sight along the base of a biltmore stick at a point of 12" above ground level at the base of a tree. (Trees are severed about 12" above the ground and up to the first heavy branching, or to a 10" diameter top if there is no heavy branching when they are

used for saw logs). Pace 66' away from the tree you are investigating at the same level or on the contour. Measure the number of 16' logs (or half logs--8').

4. When you have determined the number of logs, refer to Volume Table I on the following page.

Example: A tree with a diameter of 18" with two 16' sawlogs contains about 240 board feet of lumber when it is processed at a sawmill into 1" thick boards. Four trees of this size will yield about 1,000 board feet of lumber. Make a chart as follows to list the trees on your area:

	Diameter	No. of logs	Board feet	Kind of tree
Example:	12"	!-1/2	80	White oak
Tree 1				
Tree 2				

With the information regarding the value of different trees you obtained from the sawmill operation, determine the potential value of trees on your area.

ACTIVITY II:

Now suppose you wish to build a two-story home with approximately 2,000 square feet of living area. This house might utilize about 10,000 board feet of wood products. Approximately how many half acres of your area would you need to build the house?

ACTIVITY III:

Next, suppose you wish to use an air tight wood burning stove to heat your new home in which you have installed good insulation. Such a stove would require between six to ten cords of air dried wood; i.e., wood that has been seasoned for a year. For the purpose of this activity, assume you will need eight cords of wood.

In the standing trees, it takes about 80 cubic feet to equal one cord of wood after the wood is cut, stacked and air dried. Take the diameter measure of the trees in your plot and record all over 6 in diameter at breast height (4-1/2').

Firewood is measured to a 4" diameter usable length. (It should also be noted that any stem of the tree that is 4" in diameter can be used for firewood.) Refer to Table 2 to estimate the number of cords of usable firewood on your 1/2 acre. For how long can you heat your home with the trees on your area?

Volume Table 1 TREE SCALE (International ¼ Inch)

DBH	Number of 16-Foot Logs							
	1/2	1	1-1/2	2	2-1/2	3	3-1/2	4
	Contents in Board Feet							
12"	30	60	80	100	120			
14"	40	80	110	140	160	180		
16"	60	100	150	180	210	250	280	310
18"	70	140	190	240	280	320	360	400
20"	90	170	240	300	350	400	450	500
22"	110	210	290	360	430	490	560	610
24"	130	250	350	430	510	590	660	740
26"	160	300	410	510	600	700	790	880
28"	190	350	480	600	700	810	920	1020
30"	220	410	550	690	810	930	1060	1180
32"	260	470	640	790	940	1080	1220	1360
34"	290	530	730	900	1060	1220	1380	1540
36"	330	600	820	1010	1200	1380	1560	1740
38"	370	670	910	1130	1340	1540	1740	1940
40"	420	740	1010	1250	1480	1700	1920	2160
42"	460	820	1100	1360	1610	1870	2120	2360

Table 2 - Gross volume in cubic feet

Dbh (inches)	*Merchantable height in feet														
	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64
5	0.9	1.2	1.5	1.8	2.1	--	--	--	--	--	--	--	--	--	--
6	1.3	1.8	2.2	2.7	3.1	3.5	3.8	--	--	--	--	--	--	--	--
7	1.8	2.4	3.1	3.6	4.2	4.8	5.3	5.7	6.2	--	--	--	--	--	--
8	2.4	3.2	4.0	4.8	5.5	6.2	6.9	7.5	8.1	8.6	9.1	--	--	--	--
9	3.1	4.1	5.1	6.1	7.0	7.9	8.8	9.6	10.3	10.9	11.5	12.1	12.6	--	--
10	3.8	5.0	6.3	7.6	8.7	9.9	10.9	11.9	12.8	13.6	14.3	15.0	15.6	--	--
11	4.6	6.1	7.7	9.2	10.6	12.0	13.3	14.4	15.5	16.5	17.4	18.2	18.9	19.6	20.1
12	5.5	7.3	9.2	11.0	12.7	14.3	15.9	17.3	18.6	19.8	20.8	21.8	22.7	23.4	24.0
13	6.5	8.7	10.8	13.0	15.0	16.9	18.7	20.4	21.9	23.3	24.6	25.7	26.7	27.6	28.3
14	7.6	10.1	12.6	15.1	17.5	19.7	21.8	23.7	25.5	27.2	28.6	30.0	31.1	32.2	33.0
15	8.7	11.6	14.6	17.4	20.2	22.7	25.1	27.4	29.4	31.3	33.0	34.6	35.9	37.1	38.1
16	10.0	13.3	16.7	19.9	23.1	26.0	28.7	31.3	33.7	35.8	37.8	39.5	41.1	42.4	43.5
17	11.3	15.1	18.9	22.6	26.2	29.5	32.6	35.5	38.2	40.6	42.8	44.8	46.6	48.1	49.4
18	12.8	17.0	21.3	25.5	29.5	33.2	36.7	40.0	43.0	45.8	48.3	50.5	52.5	54.2	55.6
19	14.3	19.0	23.8	28.5	33.0	37.2	41.1	44.8	48.2	51.2	54.0	56.5	58.8	60.7	62.3
20	15.9	21.2	26.5	31.8	36.7	41.4	45.8	49.9	53.6	57.1	60.2	63.0	65.4	67.5	69.3
21	17.6	23.5	29.4	35.2	40.7	45.9	50.7	55.2	59.4	63.2	66.6	69.7	72.5	74.8	76.8
22	19.5	25.9	32.4	38.8	44.9	50.6	55.9	60.9	65.5	69.7	73.5	76.9	79.9	82.5	84.7
23	21.4	28.4	35.6	42.6	49.3	55.5	61.4	66.9	71.9	76.5	80.7	84.4	87.7	90.6	93.0
24	23.4	31.1	39.0	46.6	53.9	60.8	67.2	73.2	78.7	83.7	88.3	92.4	96.0	99.1	101.8

*To a 4" diameter top

ACTIVITY IV:

Various woods have different weights per cubic foot due to different densities. Heavier wood will produce more BTU's per cubic foot than will wood with less density; i.e., you might have two pieces of wood the same size from different kinds of trees and one will weigh more. The heavier piece would be more fuel efficient and produce more heat (B.T.U.'s). Thus in order to more accurately predict your wood needs for your wood burning stove, you should figure the weights of the different trees on your area.

Find two different kinds of trees with similar diameters and usable heights--trees measuring to a 4" minimum top of stem diameter. Assume the trees are going to be cut, split and air dried for a year. Figure the number of B.T.U.'s produced by each.

For example: suppose you have a shagbark hickory that is 14" in diameter and has 48' of usable length. Nearby is a tulip tree (yellow-poplar) with the same dimensions. Referring back to Table 2, this size tree contains about 28.6 cubic feet.

Now use Table 3 to find the weight density of each tree. Shagbark Hickory (5th listing) weighs 50.9 pounds per cubic foot at 20% moisture content (air dried). Tulip tree (9th listing on second column of Table 2) weighs 30.7 pounds per cubic foot under the same conditions.

Shagbark - 28.6 x 50.9 = 1,456 lbs.
Tulip - 28.6 x 30.7 = 878 lbs.

Hardwoods at 20% MC (air-dried) will yield about 7000 BTU per pound of wood. Thus:

Shagbark 1456 pounds x 7000 = 10,192,000 BTU's
Tulip 878 pounds x 7000 = 6,146,000 BTU's

Which trees on your area are the most fuel efficient?

ACTIVITY V.

Now, discuss with your class the fact that each person in our country uses approximately 800 lbs. of paper products per year. (You may wish to ask each student to make a list of paper products they use daily to reinforce the concept of our dependence on paper.) Ninety-five percent of all paper products in the U. S. come from wood. If hardwoods weigh about 2-1/2 tons per 80 cubic feet of stacked wood, how many people's yearly paper product needs would your woods support?

Table 3

HARDWOODS

Listed in Decreasing Order of Weight Densities at 20% Moisture Content (MC)

Tree	LB/Cu. Ft. (20% MC)
Osage-orange	56.9
Pignut hickory	53.2
Persimmon	52.4
Flowering dogwood	51.7
Mockernut hickory, shagbark hickory, swamp white oak	50.9
Eastern hophornbeam (ironwood), American hornbeam (muscle-wood, blue beech)	50.2
Black (yellow) locust, shell-bark hickory, apple	49.4
White oak	48.7
Honeylocust, scarlet oak, post oak	47.9
Bitternut hickory, chestnut oak, pecan	47.2
Red mulberry, black (sweet) birch	46.4
American beech, bur oak	45.7
Rock (cork) elm, sugar maple, northern red oak, pin oak	44.9
Yellow birch	44.2
Black oak, white ash	43.4
Blue ash	41.9
American holly, black maple	41.2
Green ash	40.4
White (paper) birch, black walnut, sourwood, Kentucky coffeetree	39.7
Red maple, gray birch	38.9
Slippery (red) elm, hackberry	38.2
Sweetgum (redgum)	37.4
American (white) elm, southern magnolia, black tupelo (sour-gum, blackgum), black cherry	35.9
Black ash, American sycamore	35.2
Cucumber magnolia (cucumber-tree	34.4
Silver maple, sassafras	33.7
American chestnut	31.4
Yellow-poplar (tuliptree, tulip-poplar)	30.7
Red alder, northern catalpa	30.0
Eastern cottonwood	29.2
Bigtooth (largetooth) aspen, black willow	28.5
Butternut (white walnut), quaking (trembling) aspen	27.7
American basswood	27.0
Yellow buckeye	26.2
Balsam poplar	24.7

NOTES: Wood to be air-dried to 20% M.C.
1 pound of wood at 20% M.C. produces about 7000 BTU
Apply stove efficiency factor to 7000 BTU/lb.

SENIOR HIGH SCHOOL

NATURAL RESOURCE MANAGEMENT ACTIVITIES

PURPOSE: To understand how supplies of natural resources change with changes in scientific knowledge and economic considerations.

LEVEL: Senior High School

SUBJECT: Social Studies

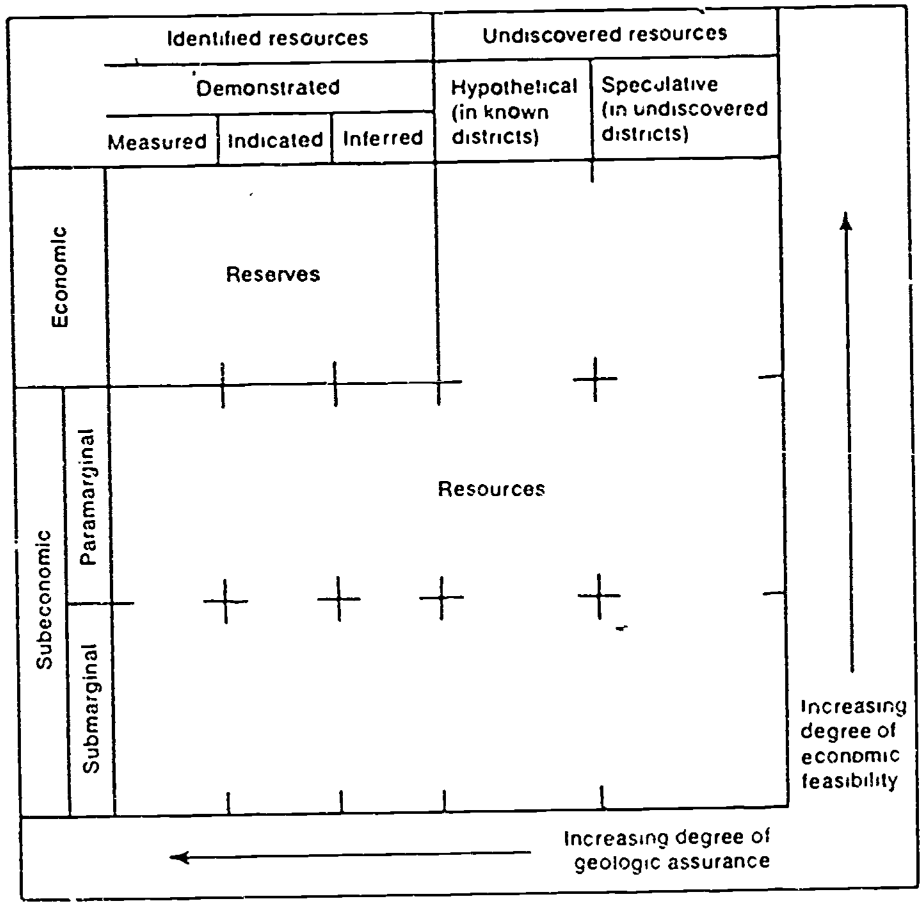
REFERENCES: Committee on Mineral Resources and the Environment, Mineral Resources and the Environment. Washington, DC: Commission on Natural Resources, National Academy of Sciences, 1975. Vincent E. McKelvey, "Approaches to the Mineral Supply Problem," Technology Review 76:5 (March/April 1974). 13-23. Vincent E. McKelvey, "Mineral Potential of the United States." In The Mineral Position of the United States, 1975-2000, the Proceedings of a Symposium sponsored by the Society of American Geologists, November 1972, edited by Eugene N. Cameron. Madison: University of Wisconsin Press, 1973. Vincent E. McKelvey, "Mineral Resource Estimates and Public Policy," American Scientist 60(1972): 32-40.

ACTIVITY:

It is obvious that, in the cases of non-renewable natural resources, finite supplies exist in, on, and under the surface of the earth. A number of methods of "extending" these supplies exist -- conservation, recycling, and the like. But short of non-use and/or 100 per cent recycling, eventually all of these resources will be depleted.

However, the process of establishing clearly how much longer any given non-renewable resource will last is complex. A number of assumptions must be made if one is to project any such time line. It is often assumed that current or recent-historical use patterns will continue into the future, and that currently-known reserves represent the total amount of any given resource ever likely to be available for use. Such assumptions are at best simplistic, and at worst misleading to the point that they develop completely erroneous conclusions, upon which faulty resource management decisions may be based.

The U. S. Bureau of Mines and U. S. Geological Survey in assessing total mineral resources of the United States currently use a classification scheme which considers two prime elements of information - the degree of certainty about the existence and magnitude of supplies of these materials and the economic feasibility of recovering them. The diagram on the following page, along with accompanying definitions of terms, summarizes this scheme.



In this system, "reserves" (upper left) are those resources known to exist and to be recoverable. At the opposite extreme (lower right) are poor-grade deposits that may exist in unexplored areas. The following definitions provide additional information:

Resource

A concentration of naturally occurring solid, liquid, or gaseous materials in or on the earth's crust in such form that economic extraction of a commodity is currently or potentially feasible.

Identified Resources

Specific bodies of mineral-bearing material whose location, quality, and quantity are known from geologic evidence supported by engineering measurements with respect to the demonstrated category.

Undiscovered Resources

Unspecified bodies of mineral-bearing material surmised to exist on the basis of broad geologic knowledge and theory.

Reserve

That portion of the identified resource from which a usable mineral and energy commodity can be economically and legally extracted at the time of determination. The term ore is used for reserves of some minerals.

The following definitions for measured, indicated, and inferred are applicable to both the Reserve and Identified-Subeconomic resource components.

Measured

Material for which estimates of quality and quantity have been computed partly from sample analyses and measurements and partly from reasonable geologic projections.

Indicated

Material for which estimates of the quality and quantity have been computed partly from sample analyses and measurements and partly from reasonable geologic projections.

Demonstrated

A collective term for the sum of materials in both measured and indicated resources.

Inferred

Material in unexplored extensions of Demonstrated resources for which estimates of the quality and size are based on geologic evidence and projection.

Identified-Subeconomic Resources

Materials that are not Reserves, but may become so as a result of changes in economic and legal conditions.

Paramarginal

The portion of Subeconomic Resources that (a) borders on being economically producible or (b) is not commerically available solely because of legal or political circumstances.

Submarginal

The portion of Subeconomic Resources which would require a substantially higher price (more than 1.5 times the price at the time of determination) or a major cost-reducing advance in technology.

Hypothetical Resources

Undiscovered materials that may reasonably be expected to exist in a known mining district under known geologic conditions. Exploration that confirms their existence and reveals quantity and quality will permit their reclassification as a Reserve or Identified-Subeconomic resource.

Speculative Resources

Undiscovered materials that may occur either in known types of deposits in a favorable geologic setting where no discoveries have been made, or in as yet unknown types of deposits that remain to be recognized. Exploration that confirms their existence and reveals quantity and quality will permit their reclassification as Reserves or Identified-Subeconomic resources.

Based on the information provided above, the following questions may be addressed:

1. What role is played by mineral exploration in the identification of "new" mineral reserves?

2. What role is played by improvements in the technologies of mineral extraction and/or processing in the identification of "new" mineral reserves?

3. What role is played by changing economic conditions in the identification of "new" mineral reserves?

4. What role is played by the substitution of one substance for another in the production of desirable products in the distinction between "resource" and "reserve" for each substance?

NOTE: This activity can, depending on the objectives of the course or teacher, the abilities of the students, and the interest generated, become the basis of extensive research and understanding. The creative teacher will be able to relate it to many of the other activities in this volume, and to any number of specific cases.

PURPOSE: To investigate the implications of global and regional production of and demand for food resources, as related to their availability.

LEVEL: Senior High School

SUBJECTS: Social Studies

REFERENCE: Gerald O. Barney, study director, The Global 2000 Report to the President: Entering the Twenty-First Century, Volume 1. Washington, DC: U.S. Government Printing Office, 1980. S/N 041-011-00037-8. ED 188 935.

ACTIVITY:

Tables A and B provide current information and projected situations for the year 2000 with respect to regional and global food resources. Table A deals with regional and governmental levels. Table B brings the information to the individual - per capita - level.

Table A presents world totals, and Table B world per capita averages, for both production and consumption of grain. Both are organized into groups - industrialized countries, centrally planned economies, and less developed countries (LDC's). In further sub-groupings, certain nations are considered individually - the United States, Japan, U.S.S.R., People's Republic of China - while others are grouped regionally.

In each grouping and sub-grouping, the difference between production and consumption figures is reported. A positive difference indicates a surplus, which is available for export to other nations. A negative difference indicates a deficit which indicates the necessity of importing needed supplies.

These data may be treated in many ways, in terms of student activity. Line graphs may be developed from either or both tables. A particularly interesting graph is one which allows the comparison of per capita consumption among various regions, current and projected. Bar graphs comparing per capita consumption, now and in the year 2000, among various regions or sub-regions indicate striking contrasts.

Questions for further discussion, some involving additional research, might include:

1. Figures for 1969-71 and 1973-75 may be considered factual, but figures for the year 2000 are protections. What factors must be considered in developing projections of this nature? (Responses must include production capabilities, projections of population growth, and the like).

TABLE A

Grain Production, Consumption, and Trade, Actual and Projected, and Percent Increase in Total Food Production and Consumption

	Grain (million metric tons)			Food (Percent increase over the 1970-2000 period)
	1969-71	1973-75	2000	
Industrialized countries				
Production	*401.7*	*434.7*	*679.1*	*43.7*
Consumption	*374.3*	*374.6*	*610.8*	*47.4*
Trade	*+32.1*	*+61.6*	*+68.3*	
United States				
Production	208.7	228.7	402.0	78.5
Consumption	169.0	158.5	272.4	51.3
Trade	+39.9	+72.9	+129.6	
Other developed exporters				
Production	58.6	61.2	106.1	55.6
Consumption	33.2	34.3	65.2	66.8
Trade	+28.4	+27.7	+40.9	
Western Europe				
Production	121.7	132.9	153.0	14.6
Consumption	144.2	151.7	213.1	31.6
Trade	-21.8	-19.7	-60.1	
Japan				
Production	12.7	11.9	18.0	31.5
Consumption	27.9	30.1	60.1	92.8
Trade	-14.4	-19.3	-42.1	
Centrally planned countries				
Production	*401.0*	*439.4*	*722.0*	*74.0*
Consumption	*406.6*	*472.4*	*758.5*	*79.9*
Trade	*-5.2*	*-24.0*	*-36.5*	
Eastern Europe				
Production	72.1	89.4	140.0	83.2
Consumption	78.7	97.7	151.5	81.7
Trade	-6.1	-7.8	-11.5	
U.S.S.R				
Production	165.0	179.3	290.0	72.7
Consumption	161.0	200.7	305.0	85.9
Trade	+3.9	-10.6	-15.0	

TABLE A (Cont.)

	Grain (million metric tons)			Food (Percent increase over the 1970-2000 period)
	1969-71	1973-75	2000	
People's Republic of China				
Production	163.9	176.9	292.0	69.0
Consumption	166.9	180.8	302.0	71.4
Trade	-3.0	-3.9	-10.0	
Less developed countries				
Production	*306.5*	*328.7*	*740.6*	*147.7*
Consumption	*326.6*	*355.0*	*772.4*	*142.8*
Trade	*-18.5*	*-29.5*	*-31.8*	
Exporters[a]				
Production	30.1	34.5	84.0	125.0
Consumption	18.4	21.5	36.0	58.0
Trade	+11.3	+13.1	+48.0	
Importers[b]				
Production	276.4	294.2	656.6	149.3
Consumption	308.2	333.5	736.4	148.9
Trade	-29.8	-42.6	-79.8	
Latin America				
Production	63.8	72.0	185.9	184.4
Consumption	61.2	71.2	166.0	165.3
Trade	+3.2	+0.2	+19.9	
North Africa/Middle East				
Production	38.9	42.4	89.0	157.8
Consumption	49.5	54.1	123.7	167.3
Trade	-9.1	-13.8	-29.7	
Other African LDCs				
Production	32.0	31.3	63.7	104.9
Consumption	33.0	33.8	63.0	96.4
Trade	-1.0	-2.4	+0.7	
South Asia				
Production	119.1	127.7	259.0	116.8
Consumption	125.3	135.1	275.7	119.4
Trade	-6.2	-9.3	-16.7	

Note: In trade figures, plus sign indicates export, minus sign indicates import.
[a]Argentina and Thailand.
[b]All others, including several countries that export in some scenarios (e.g., Brazil, Indonesia, and Colombia).

TABLE A (Cont.)

	Grain million metric tons)			Food (Percent increase over the
	1969-71	1973-75	2000	1970-2000 period)
Southeast Asia				
Production	22.8	21.4	65.0	210.0
Consumption	19.3	17.9	47.0	163.6
Trade	+3.4	+3.7	+18.0	
East Asia				
Production	29.9	34.0	73.0	155.3
Consumption	38.3	42.9	97.0	164.9
Trade	-8.8	-9.7	-24.0	
World				
Production/Consumption	*1,108.0*	*1,202.0*	*2,141.7*	*91.0*

Source: Global 2000 Technical Report, Table 6-5.

TABLE B

Per Capita Grain Production, Consumption, and Trade, Actual and Projected, and Percent increase in Per Capita Total Food Production and Consumption

	Grain (kilograms per capita)			Food (Percent increase over the 1970-2000 period)
	1969-71	1973-75	2000	
Industrialized countries				
Production	*573.6*	*592.6*	*769.8*	*18.4*
Consumption	*534.4*	*510.7*	*692.4*	*21.2*
Trade	*+45.8*	*+84.0*	*+77.4*	
United States				
Production	1,018.6	1,079.3	1,640.3	51.1
Consumption	824.9	748.0	1,111.5	28.3
Trade	+194.7	+344.0	+528.8	
Other developed exporters				
Production	1,015.6	917.0	915.6	-11.3
Consumption	575.4	514.0	562.6	-5.7
Trade	+492.2	+415.0	+353.0	
Western Europe				
Production	364.9	388.4	394.0	1.0
Consumption	432.4	443.3	548.8	15.5
Trade	-65.4	-57.6	-154.8	
Japan				
Production	121.7	108.5	135.4	6.1
Consumption	267.5	274.4	452.3	54.2
Trade	-138.1	-175.9	-316.7	
Centrally planned countries				
Production	*356.1*	*368.0*	*451.1*	*29.6*
Consumption	*361.0*	*395.6*	*473.9*	*35.8*
Trade	*-4.6*	*-20.1*	*-22.8*	
Eastern Europe				
Production	574.0	693.0	921.9	53.3
Consumption	626.6	757.4	997.6	52.1
Trade	-48.6	-60.5	-75.8	
U.S.S.R				
Production	697.6	711.2	903.2	28.1
Consumption	663.1	796.1	949.9	41.4
Trade	+16.1	-42.0	-46.7	

TABLE B (Cont.)

	Grain (million metric tons)			Food (Percent increase over the 1970-2000 period)
	1969-71	1973-75	2000	
People's Republic of China				
Production	216.3	217.6	259.0	17.4
Consumption	220.2	222.4	267.8	19.1
Trade	-4.0	-4.8	-8.8	
Less developed countries				
Production	*176.7*	*168.7*	*197.1*	*10.8*
Consumption	*188.3*	*182.2*	*205.5*	*8.6*
Trade	*-10.7*	*-15.1*	*-8.4*	
Exporters[a]				
Production	491.0	521.9	671.7	10.4
Consumption	300.1	325.3	287.8	-22.6
Trade	+184.3	+198.2	+383.9	
Importers[b]				
Production	159.4	173.8	180.7	10.8
Consumption	177.7	193.6	202.7	10.8
Trade	-17.2	-24.1	-21.9	
Latin America				
Production	236.1	241.0	311.4	33.7
Consumption	226.5	238.3	278.1	25.1
Trade	+11.8	-2.7	-33.3	
North Africa/Middle East				
Production	217.1	214.6	222.5	-1.8
Consumption	276.2	273.8	292.8	2.2
Trade	-50.8	-69.8	-70.3	
Other African LDCs				
Production	139.9	118.3	113.2	-15.5
Consumption	139.1	127.7	112.0	-19.1
Trade	-4.2	-9.1	+1.2	
South Asia				
Production	161.6	162.4	170.0	4.6
Consumption	170.0	171.8	181.0	5.8
Trade	-8.4	-11.8	-11.0	

Note: In trade figures, plus sign indicates export, minus sign indicates import.
[a]Argentina and Thailand.
[b]All others, including several countries that export in some scenarios (e.g., Brazil, Indonesia, and Colombia).

TABLE B (Cont.)

	Grain (million metric tons)			Food (percent increase over the 1970-2000 period)
	1969-71	1973-75	2000	
Southeast Asia				
Production	244.7	214.5	316.5	35.9
Consumption	207.2	182.6	228.5	14.6
Trade	+37.5	+31.9	+87.5	
East Asia				
Production	137.3	136.0	163.5	22.8
Consumption	176.2	171.5	217.3	27.3
Trade	-40.4	-38.8	-53.8	
World				
Production/Consumption	*311.5*	*313.6*	*343.2*	*14.5*

Source: Global 2000 Technical Report, Table 6-6.

2. Why are world total production and consumption figures reported as being the same, in each instance (1969-71, 1973-75, 2000)? Is this realistic? Why, or why not?

3. Make comparisons between and among current and projected consumption figures, particularly with respect to industrialized nations, centrally planned economies, and LDC's. What implications do these comparisons suggest with respect to international relationships both presently and in the future? For example, how do nations showing present or future deficits have to operate in order to overcome them?

4. The data indicate that U.S. production of grain will increase from 228.7 metric tons in 1973-75 to 402.0 metric tons in 2000. What are the implications of this for U.S. agriculture, for land use in the United States, and for U.S. relationships with other nations, particularly LDC's?

5. Might it be possible for LDC's to cooperate only with one another with respect to grain trade in 2000? Why, or why not?

PURPOSE: To investigate lifetime expectancies of non-renewable resources.

LEVEL: Senior High School

SUBJECTS: Social Studies

REFERENCE: Gerald O. Barney, study director, The Global 2000 Report to the President: Entering the Twenty-First Century, Volume I. Washington, DC: U.S. Government Printing Office, 1980. S/N 041-001-00037-8. ED 188 935.

ACTIVITY:

Projections of the supplies of non-renewable natural resources on both local and global bases are continually being made by natural resource managers. In making such projections, many factors must be kept in mind:

1. What is the history of demand for this resource?

2. What is current demand for this resource?

3. What are probable future demand patterns for this resource?

History and current demand data are commonly available, but determination of probable future demand patterns is difficult. A number of factors must be taken into account, including absolute need for the resource, probable increases or decreases in need, changes in technologies, availabilities of supplies, etc.

The table below summarizes life expectancies of 1976 world reserves of certain mineral commodities, as projected in the Global 2000 report commissioned by President Carter and conducted cooperatively by the Council on Environmental Quality and the U.S. Department of State, with the assistance of other federal agencies. The first two columns, "1976 Reserves" and "1976 Primary Demand" represent factual information. The third column, "Projected Demand Growth Rate," assumes that demand for each will increase by the given percentage annually. This projection is based on historical demand growth patterns, current demand patterns as they are known, and anticipated increases in demand.

The final two columns indicate life expectancies in years. They are different because they are based on two different assumptions. The column labelled "Static at 1976 Level" assumes that the 1976 primary demand pattern will continue until the resource is exhausted. The column labelled "Growing at Projected Rates" assumes that the "Projected Demand Growth Rate" percentage is compounded annually.

For investigation and discussion:

1. Develop a line graph for one or more of these minerals, plotting remaining reserves as a function of time (year). On the graph, include lines for both static demand life expectancy and life expectancy if growth in demand occurs at projected rates. Different students may plot graphs for different minerals.

2. Which of the minerals will have its reserves completely depleted first, assuming static demand? In what year? Which of the minerals will have its reserves completely depleted first, assuming growth in demand at projected rates? Is this pattern the same for all minerals? Explain why, or why not?

3. Making reference to the activity distinguishing between "resources" and "reserves," (pp. 159-162) how might additional "reserves" be added to remaining supplies?

4. What alternatives are available at the point when supplies of any resource are depleted? Explain them carefully.

5. What alternatives are available in the period between now and the point in time when supplies of any resource are depleted? Explain them carefully.

A similar activity related to world forest resources appears on pp. 181-183. It may be appropriate to complete the activities together, with the additional question:

6. How are projections of use patterns of non-renewable resources similar to those of renewable resources, and how different?

Life Expectancies of 1976 World Reserves of Selected Mineral Commodities at Two Different Rates of Demand

	1976 Reserves	1976 Primary Demand	Projected Demand Growth Rate	Life Expectancy in Years[a]	
				Static at 1976 Level	Growing at Projected Rates
			percent		
Fluorine (million short tons)	37	2.1	4.58	18	13
Silver (million troy ounces)	6,100	305	2.33	20	17
Zinc (million short tons)	166	6.4	3.05	26	19
Mercury (thousand flasks)	5,210	239	0.50	22	21
Sulfur (million long tons)	1,700	50	3.16	34	23
Lead (million short tons)	136	3.7	3.14	37	25
Tungsten (million pounds)	4,200	81	3.26	52	31
Tin (thousand metric tons)	10,000	241	2.05	41	31
Copper (million short tons)	503	8.0	2.94	63	36
Nickel (million short tons)	60	0.7	2.94	86	43
Platinum (million troy ounces)	297	2.7	3.75	110	44
Phosphate rock (million metric tons)	25,732	107	5.17	240	51
Manganese (million short tons)	1,800	11.0	3.36	164	56
Iron in ore (billion short tons)	103	0.6	2.95	172	62
Aluminum in bauxite (million short tons)	5,610	18	4.29	312	63
Chromium (million short tons)	829	2.2	3.27	377	80
Potash (million short tons)	12,230	26	3.27	470	86

Note: Corresponding data for helium and industrial diamonds not available.

[a]Assumes no increase to 1976 reserves.

Source: After Global 2000 Technical Report, Table 12-4, but with updated and corrected entries. Updated reserves and demand data from U.S. Bureau of Mines, Mineral Trends and Forecasts, 1979. Projected demand growth rates are from Global 2000 Technical Report, Table 12-2.

PURPOSE: To investigate interrelationships between the natural resource base and demands on it in the framework of long-range resource management planning.

LEVEL: Senior High School

SUBJECTS: Social Studies

ACTIVITY:

Much of the "business" of the natural resources manager is in forecasting future demand for specific resources. Accurate forecasts facilitate the development of resources so that they will be available at the points in time when they are needed.

Historically, these projections have been short-term (one to five years). They have generally been cast in economic terms, with economic benefits and costs as primary considerations. Particularly in nations like the United States, an implicit assumption has been that, if accurate forecasts of future needs for specific resources are known, the resources themselves will be located and/or developed without undue difficulty. This attitude is often referred to as the cornucopian philosophy, which basically assumes that there is a neverending supply of resources the development of which is dependent only upon the ingenuity of those developing them.

Another school of thought points to the increasing complexity of resource supply and demand, in large part triggered by rapid population growth both locally and worldwide. Those espousing this philosophy are more pessimistic in their long-range forecasts; they generally forecast the time when the resource base will no longer be able to support the earth's population.

Students may wish to investigate the forecasts of "futurists" who have paid particular attention to the impacts of modern conditions and trends on the resource base. Among them have been:

1. Thomas Malthus, the various versions of whose essay "A Summary View of the Principle of Population" in the 1800s considered relationships between exponential population growth and arithmetic growth in availability of food;

2. Jay Forrester, whose book World Dynamics (Cambridge, Massachusetts, Wright-Allen Press, 1971) reported computer studies of the global interrelationships among population growth, natural resource depletion, economic patterns, agricultural development, and increasing pollution;

3. D. H. Meadows, D. L. Meadows, J. Randers, and W. Behrens, whose report, The Limits to Growth (New York, Universe Books, 1972), explored further the work of Forrester;

4. Mihajlo Mesarovic and Eduard Pestel, whose Mankind at the Turning Point (New York, Dutton, 1974), followed the Forrester-Meadows models but disaggregated the single global model into a model of ten interacting and interdependent regions; and

5. Gerald O. Barney and others, whose Global 2000 Report to the President: Entering the Twenty-First Century (U. S. Government Printing Office, 1980, in three volumes) represents the first "official" U. S. Government projection in these areas.

It should be noted that this is a "one-sided" list: all five of these references project an intolerable depletion of the global resource base over the next 20-50 years. Students should also investigate the reports of those who take a more optimistic view, and attempt an impartial assessment of both "sides."

Because of the complexities of the situation, it is unrealistic to attempt to achieve resolution of the issue in the classroom, but it is appropriate to point out that those supporting either viewpoint agree that sound natural resource management policies are required, so that needs can be forecast and met to the extent possible.

PURPOSE: To investigate ramifications of the development of substitutes for needed resources.

LEVEL: Senior High School

SUBJECTS: Social Studies

REFERENCE: R. Neil Sampson, "Energy: New Kinds of Competition for Land," in Economics, Ethics, Ecology - Roots of Productive Conservation, edited by Walter E. Jeske. Ankeny, IA: Soil Conservation Society of America, copyright 1981, pp. 326-352. Reprinted by permission. SE 036 369.

ACTIVITY:

Dependence of the United States on other nations for necessary natural resources is a fact of life, but it is not necessarily true that our nation cannot develop self-sufficiency in at least some of them. Political instability in many nations on which we depend for various resources has created increased interest in the potential for domestic production.

For example, many of the products manufactured from petro-chemicals, most of which are imported, might be grown agriculturally in the United States. Several examples are provided in the table below.

Products that might be grown agriculturally in the United States to replace current imports.*

Product Imported or Manufactured from Petro-chemicals	Percent Imported	Plant Species Used to Replace Imports	Year Full Production Could Be Achieved	For Full Production (million/a)
Natural rubber	100	Guayule	1995	1.2
Synthetic rubber	50	Guayule and milkweed	2000	12.0
Plastics	50	Many oilseed crops	1990	50.0
Rubber and plastic additives	50	Same as above	1990	(with above)
Coating and printing inks	60	Flax, caster, soybean, cottonseed, safflower	1985	4.0
Adhesives	50	Stokes' aster	1995	1.0
Lubricants	60	Jojoba, crambe	1995	20.0
Detergents, etc.	60	Cuphea	2000	1.0
Newsprint, paper	?	Kenaf	1998	0.9
Synthetic and natural fibers	50	Cellulose from trees, cotton, flax	1990	1.0
Waxes	50-100	Jojoba, crambe	1990	0.2

*Table prepared from data developed by Dr. L. H. Princen and staff scientists at the USDA/SEA North Central Regional Research Laboratory, Peoria, Illinois, March 1980.

According to Howard Tankersley, director of the Soil Conservation Service, U.S. Department of Agriculture:

"Sufficient technological research has been done that we could commercialize the agricultural commodities that produce the substitutes for these imports within 5 to 20 years, if that were to become a national goal. However, achievement of total domestic production of these products would require the use of about 55 million acres of land. This acreage is equal to about 22 percent of our current cropland base or about 17 percent of our crop and pasture land base (SCS figures). While it is technologically possible to produce all these essential materials domestically, studies need to be undertaken to determine the optimum level of production to meet the objectives of this program, given the constraints of our land base and foreign trade commitments."

For further investigation and discussion:

1. Most of the plants species indicated in the table are uncommon. Students may wish to investigate background information concerning them, including the conditions under which they grow, etc.

2. What impacts would development of these products in the United States have on continued production of the current and projected agricultural products? Is it likely to be realistic to add production of these products to the output of the U.S. agricultural industry?

3. What are the international ramifications of developing full-scale production of these species?

4. What decisions must be made in resolving whether or not to work toward full-scale, or partial, production of these products?

PURPOSE: To investigate the implications of dependence on foreign nations for non-renewable resources.

LEVEL: Senior High School

SUBJECTS: Social Studies

REFERENCE: Paul Sarnoff, "Exploring Strategic Metals." Moneymaker, April/May 1981, pp. 41-45.

ACTIVITY:

Currently, the United States is self-sufficient in only five of 30 metals considered by the federal government to be "strategic." "Strategic materials" are defined as those which must be stockpiled in sufficient quantity to assure availability to industry for at least three years' supply. Each of the major industrial nations maintains a stockpile of various metals and minerals needed for industrial and military purposes, primarily to insure against disruptions in supply.

Clearly, the United States has come a long way since earlier days during which it was essentially self-sufficient in terms of non-renewable resources. Much of its increasing dependence on foreign sources has been created by technological advances which have provided the goods and services needed and/or desired by an increasingly complex society, while necessitating securing them from other nations.

The problem has two aspects: (1) world-wide supplies of many non-renewable resources are being depleted (see pp. 171-173) and (2) international politics has a strong bearing on the extent to which resources in which the nation is not self-sufficient can continue to be available.

For example, a present-day jet engine contains:

5366 pounds of titanium, for which the U.S. is 96% dependent on other nations;

5204 pounds of nickel, for which the U.S. is 77% dependent on other nations;

1656 pounds of chrome, for which the U.S. is 92% dependent on other nations;

920 pounds of cobalt, for which the U.S. is 97% dependent on other nations;

720 pounds of aluminum, for which the U.S. is 93% dependent on other nations;

717 pounds of columbium, for which the U.S. is 100% dependent on other nations; and

3 pounds of tantalum, for which the U.S. is 97% dependent on other nations.

The table on p. 180 provides brief descriptive information concerning several of the "strategic metals" on which the United States has heavy import dependence. It represents only a series of examples; more complete information can be located in current editions of Mineral Facts and Problems, a yearbook of the U. S. Bureau of Mines (Office of Mineral Information, 2401 E Street NW, Washington, DC 20241).

Students may investigate to find out, with respect to a comprehensive list of minerals, for which the U. S. is self-sufficient and for which the U. S. is dependent on other nations, perhaps as an expansion of the list on page 180.

Questions for further research and discussion may include:

1. What would happen if the U. S. were to have no access to one or more of the strategic metals? Teachers should not accept the simplistic response that "A substitute will be found," unless students can document what the substitutes might be. Such substitutes may, of course, also be "strategic." Other simplistic responses, such as "Do without," must also be pursued to the point where their implications are made clear.

2. In a social studies context, this discussion may be placed in a "balance of payments" context for foreign trade. In such a framework, what trade-offs might become necessary?

3. Historically, what has been the pattern of U. S. dependence on foreign nations for strategic metals, or other substances? In addition to those for which data are provided here, other examples may be chosen. Petroleum is, of course, a good example.

U. S. IMPORT DEPENDENCE FOR SOME STRATEGIC METALS*

Metal	Principal Industrial Uses	1980-81 Price Range	Import Dependence	Major Source(s)
Antimony	Constituent in alloys for type metals and metal bearings	$1.50-$1.70/lb	53%	China, South Africa, Bolivia
Chromium	Alloyed with nickel in heat-resistant metals; alloyed with iron and nickel in stainless steel; also used in corrosion-resistant plating	$3.25-$4.50/lb	91%	Soviet bloc, South Africa, Phillipines
Cobalt	Alloyed with iron in ferroalloys; alloyed with chromium and iron in cobalt-chromium steel, which is used for valves for internal combustion engines	$13.50-$50.00/lb	93%	Zaire, Zambia
Germanium	Component in manufacture of solid rectifiers or diodes in microwave detectors; used pure in transistors	$522.00-$1450.00/kg	11%	U.S., Soviet bloc, Belgium, Zaire
Indium	Ingredient in plating of lead-coated silver airplane bearings	$7.00-$20.00/troy oz.	NA	Soviet bloc, Canada, Japan
Manganese	Component of high-grade steel alloys and alloys of other metals	$0.65-$0.75/lb	97%	U.S.S.R., South Africa, Gabon, Brazil
Rhodium	Component in silver plating and in thermocouples	$550.00-$900.00/troy oz.	87%	South Africa, U.S.S.R.
Tantalum	Component in manufacture of corrosion-resistant apparatus for laboratories and in electronic equipment	$80.00-$120.00/lb	97%	Canada, Brazil, Australia
Titanium	Alloying metal used extensively in aircraft construction	$16.00-$19.00/kg	'4%	U.S.S.R., China, U.S., Australia

*Date from Bache, Halsey Stuart Shields, Sinclair Group, and "Exploring Strategic Metals," by Paul Sarnoff, in Moneymaker, April/May 1981, pp. 41-45.

NA = information not available

PURPOSE: To investigate the implications of the depletion of renewable resources.

LEVEL: Senior High School

SUBJECTS: Social Studies

REFERENCE: Gerald O. Barney, study director, The Global 2000 Report to the President: Entering the Twenty-First Century, Volume I. Washington, DC: U.S. Government Printing Office, 1980. S/N 041-011-00037-8. ED 188 935.

ACTIVITY:

The Global 2000 Report presents this summary statement (pp. 23, 26) concerning projections of availability of global forest resources in the year 2000:

If present trends continue, both forest cover and growing stocks of commercial-size wood in the less developed regions (Latin America, Africa, Asia, and Oceania) will decline 40 percent by 2000. In the industrialized regions (Europe, the U.S.S.R., North America, Japan, Australia, New Zealand) forests will decline only 0.5 percent and growing stock about 5 percent. Growing stock per capita is expected to decline 47 percent worldwide and 63 percent in LDCs. The table (p. 182) shows projected forest cover and growing stocks by region for 1978 and 2000.

Deforestation is projected to continue until about 2020, when the total world forest area will stabilize at about 1.8 billion hectares. Most of the loss will occur in the tropical forests of the developing world. About 1.45 billion hectares of forest in the industrialized nations has already stabilized and about 0.37 billion hectares of forest in the LDCs is physically or economically inaccessible. By 2020, virtually all of the physically accessible forest in the LDCs is expected to have been cut.

The real prices of wood products--fuelwood, sawn lumber, wood panels, paper, wood-based chemicals, and so on--are expected to rise considerably as GNP (and thus also demand) rises and world supplies tighten. In the industrialized nations, the effects may be disruptive, but not catastrophic. In the less developed countries, however, 90 percent of wood consumption goes for cooking and heating, and wood is a necessity of life. Loss of woodlands will force people in many LDCs to pay steeply rising prices for fuelwood and charcoal or to spend much more effort collecting wood--or else to do without.

Updated forest projections would present much the same picture as the Global 2000 Study projections. The rapid increase in the price of crude oil will probably limit the penetration of kerosene sales into areas now depending on fuelwood and dung and, as a result, demand for fuelwood may be somewhat higher than expected. Some replanting of cut tropical areas is occurring, but only at low rates similar to those

Estimates of World Forest Resources, 1978 and 2000

	Closed Forest[a] (millions of hectares)		Growing Stock (billions cu m overback)	
	1978	2000	1978	2000
U.S.S.R.	785	775	79	77
Europe	140	150	15	13
North American	470	464	58	13
Japan, Australia, New Zealand	69	68	4	4
Subtotal	1,464	1,457	156	149
Latin America	550	329	94	54
Africa	188	150	39	31
Asia and Pacific LDCs	361	181	38	19
Subtotal (LDCs)	1,099	660	171	104
Total (world)	2,563	2,117	327	253
			Growing Stock per Capita (cu m biomass)	
Industrial countries			142	114
LDCs			57	21
Global			76	40

[a]Closed forests are relatively dense and productive forests. They are defined variously in different parts of the world. For further details, see Global 2000 Technical Report, footnote, p. 117.

Source: Global 2000 Technical Report, Table 13-29.

assumed in the Global 2000 Study projections. Perhaps the most encouraging developments are those associated with heightened international awareness of the seriousness of current trends in world forests.

Natural resources management problems are often compounded because they are inter-connected with one another. In addition to the problems discussed above, deforestation has potential negative impacts in at least three other areas: desertification, availability of water, and species extinctions.

1. In summary, what are the problems of desertification, availability of water, and species extinctions? How are they related to the problem of deforestation?

2. In what ways may the problem of deforestation be solved, or at least mitigated? Consider such methods as decreased usage and reforestation. What problems are inherent in such measures?

A similar activity related to non-renewable mineral resources appears on pp. 171-173. It may be appropriate to complete the activities together, with the additional question:

3. How are projections of use patterns of non-renewable resources similar to those of renewable resources, and how different?

PURPOSE: To participate in a simulation to demonstrate that special interest groups can have conflicting values.

LEVEL: Sen'ᵔr High School

SUBJECTS: Science
Social Studies

REFERENCE: Modeled on "Hunter's Choice", by Paul Mehne, as printed in Mary Lynne Bowman, Values Activities in Environmental Educatio". ERIC/SMEAC, 1979. ED 182 118.

ACTIVITY:

Inform your students that they are going to participate in a simulation which deals specifically with strip mining.

The Situation

Over the past sixty or so years, large tracts of land in the dissected plateau region of the state have been surface-mined for coal. Because many of these areas were mined prior to the enactment of stringent strip mine reclamation laws, little reclamation was either required or done. More recent laws are somewhat more rigorous, such that current operators in the area face both penalties and suspension of licenses for violations. However, little has been done to reclaim those areas stripped before enactment of current law. Thus, much of the land of the area is currently unused, and essentially unsuitable for agriculture or other traditional uses. The stripped land is characterized by rugged topography, spoil banks, acid streams, and heavy siltation. Some land, stripped and unstripped, is currently in national and state forests, and some is being managed for timber. Much of the stripped land is in private hands, and might be available at relatively low cost should some demand for it emerge.

In this simulation, several possible uses for the stripped, unreclaimed land are under consideration. These possible uses are essentially summarized by the policies listed on the "Influence Allocation Form." Inform students that each will play the role of a member of one of eight interest groups, and each will attempt to use its "influence" to establish policy regarding the management and use of tens of thousands of acres of this land. The interest groups are: Chamber of Commerce, Local Government, Campers, Sportmen, Legislature, Aldo Leopold Society, State Department of Resources and Development, and State Energy and Environmental Protection Commission.

Give each student a packet which includes a copy of the simulation instructions, the goals of the eight interest groups, the six policies and the influence allocation form (see following pages for this material).

Go over the following instructions with the entire class:

This simulation will be conducted in three 45-minute simulation sessions. During these periods you may talk with members of your own group, communicate with members of any other group willing to communicate with you, and conduct conferences with members of other groups. It is suggested that each group first determine its own priorities and strategies, then consult with other interest groups to seek support, identify conflicts, and/or negotiate. Each group has 100 "influence units" at its disposal during each simulation period; they may be used in any combinations of positive and negative allocations, in support of or opposed to any one or combination of the six listed policies. Any policies totaling net allocations (positive-negative) of 500 "influence units" at the end of the third session will be considered to be adopted. At the end of each simulation session, each group will submit an Influence Allocation Form to the Game Director. No announcement of any group's allocations will be made until all have been submitted at the end of each simulation period, but any group not submitting its form promptly will lose its allocation for that period. Units not used during the first session are lost, but units not allocated during the second session may be retained for the third session.

Divide the class into eight groups and assign each group to represent a specific interest group. Make sure each group represents a different interest group and that all seven groups are represented. Give the groups a chance to read through the materials and formulate strategies.

You are now ready to proceed.

INTEREST GROUPS

Chamber of Commerce: This group is made up of businesspersons, including members of the State Strip Mine Operators Association and representatives of other local business and industry. It may be characterized as concerned about the current economic status of the area, which is poor, and desirous of promoting economic development. Part of its concern is directed toward the improvement of the "image" of the area throughout the rest of the state, and perhaps throughout the nation.

Local Government: This group may be considered equivalent to the County Commissioners. They also are interested in promoting the economic well-being of the area, but have major concern with provision of services to local residents--something that they have had difficulty in doing in the recent past, primarily due to their poor tax base and the additional problems faced because of poor water quality, stream flooding due to siltation, and the like.

Campers: This group includes those who have camped, or might wish to camp, at developed and undeveloped camp sites throughout the area. They are interested in trail and jeep-road accessibility to interior areas, making the area "safe" for hikers and campers, elimination of hunting adjacent to trail and camp areas, elimination of predator species, and promotion of environmental clean-up programs.

Sportsmen: Members of this group are interested in increased access to remote areas, increased populations of game species, establishment of bounties on all predators of game animals, promotion of reintroduction of any extirpated species which offers promise of becoming an additional game animal, and promotion of local control of game laws. Members of the State Federation of Sportsmen's Clubs would likely be members of this group.

Legislature: The legislative branch of the state government. Among goals of this group are satisfaction of their constituents, increasing of revenues, and decreasing of appropriations for programs which do not "pay their own way," unless such programs have massive popular support.

Aldo Leopold Society: Members of this Society include citizens who favor promotion of "Forever Wild" designations of undeveloped areas; they might desire management policies which foster a "forest primeval" atmosphere, retention of large tracts of remote, forested areas, promotion of re-establishment of extirpated species, promotion of programs which foster low level human usage of the area, and prohibition of the use of any types of motorized vehicles in remote forested areas.

State Department of Resources and Development: This administrative group favors increased legislative appropriations for its programs in wildlife management, minimization of exploitation of non-renewable natural resources, minimization of program interference by the legislature, keeping the sportmen and the Aldo Leopold Society happy, and providing maximum benefits to all resource users in a fashion compatible with sound resource management programs.

State Energy and Environmental Protection Commission: This group is charged with the protection of environmental quality in the state, as well as the development of programs to make the State "energy independent" by 1990.

INFLUENCE ALLOCATION FORM

Interest Group: ______________________________

Policies	Allocations
1. The right for each county to determine its own hunting regulations should be mandated by the legislature.	______
2. Steps should be taken to increase the populations of game animals in the area, including the re-introduction of the black bear and the bobcat.	______
3. Remaining forested areas, which collectively comprise 40 per cent of the area, should be designated as "Wilderness;" travel by vehicles in these areas should be prohibited.	______
4. A "power park," using the best possible combinations of available energy sources, should be developed to supply electrical energy for the entire state, so that no new power plants will be needed elsewhere in the state in the foreseeable future.	______
5. A large state park, with lodges, swimming pools, hiking trails, recreational areas, rugged (but accessible) scenery, and the like, to be called "Badlands East," should be established.	______
6. Immediate legal action should be brought against all business and industry which is polluting the environment; the construction of new enterprises, and the continued operation of extant ones, should be prohibited until they can provide assurance of 100 per cent pollution-free operation.	______
TOTAL INFLUENCE UNITS ALLOCATED	______

REFERENCES

REFERENCES

Acid Precipitation Awareness Program (Draft Material) Freshwater Biological Research Foundation, Minnesota Environmental Education Board and Minnesota Department of Education, October, 1980, ESEA Title IV-C Grant, 1980-82.

Ahern, Susan K. Doctoral student in Science Education, The Ohio State University.

Barney, Gerald O., study director. The Global 2000 Report to the President: Entering the Twenty-First Century, Volume 1. Washington, DC: U.S. Government Printing Office, 1980 S/N 041-001-00037-8. ED 188 935.

California Environmental Education Guide, 1981-1984, Volume 1. Hayward, CA: Office of the Alameda County Superintendent of Schools, 1981. SE 036 093.

California Environmental Education Guide, 1981-1984, Volume 2. Hayward, CA: Office of the Alameda County Superintendent of Schools, 1981. SE 036 094.

California Environmental Education Guide, 1981-1984, Volume 3. Hayward, CA: Office of the Alameda County Superintendent of Schools, 1981. SE 036 095.

California Environmental Education Guide, 1981-1984, Volume 4. Hayward, CA: Office of the Alameda County Superintendent of Schools, 1981. SE 036 096.

Changing World (The): The Surface of the Earth, Student Manual for Junior High School Science, Board of Education of Baltimore County, Towson, Maryland, 1970. SE 011 298. ED 064 036.

Committee on Mineral Resources and the Environment, Mineral Resources and the Environment. Washington, DC: Commission on Natural Resources, National Academy of Sciences, 1975.

Cowen, William F. Jr., Professor, Forestry, The Ohio State University.

Energy Fact Sheet No. 24, November, 1981 (DOE/EIA - 0240/24), U.S. Department of Energy, Energy Information Administration, National Energy Information Center, IF-048 Forrestal Building, Washington, DC 20585.

Energy Fact Sheet No. 25, November 1981 (DOE/EIA - 0240/25), U.S. Department of Energy, Energy Information Administration, National Energy Information Center, IF-048 Forrestal Building, Washington, DC 20585.

Energy Fact Sheet No. 26, November 1981 (DOE/EIA - 0240/25), U.S. Department of Energy, Energy Information Administration, National Energy Information Center, IF-048 Forrestal Building, Washington, DC 20585.

Energy in America: Progress and Potential, A 1981 publication of the American Petroleum Institute, Publications and Distribution Section, 2101 L Street NW, Washington, DC 20037. SE 036 092.

Energy We Use (The): Grade 1. National Science Teachers Association and U.S. Department of Energy, Technical Information Office, P.O. Box 62, Oak Ridge, Tennessee 37830. ED 153 846.

Environmental Quality 1980. The Eleventh Annual Report of the Council on Environmental Quality. Washington, DC: U.S. Governmental Printing Office, 1981. S/N 335-801/7090, $7.50.

Foster, Albert B. and Fox, Adrian C. Teaching Soil and Water Conservation: A Classroom and Field Guide. U.S. Department of Agriculture, Soil Conservation Service, August, 1970. ED 067 218.

Fox, Charles E. Activities for Teaching Forest Conservation; Grades 5 through 9. Forest Service, U.S. Department of Agriculture, January, 1958.

Goodwin, Linda L. Training Officer, Division of Oil and Gas, Ohio Department of Natural Resources, Fountain Square, Columbus, Ohio.

Goodwin, Steve. Administrator of Staff Operations and Olson, Chuck, Intern Division of Natural Areas and Preserves, Ohio Department of Natural Resources, Fountain Square, Columbus, Ohio.

Horne, Wendell C. and Doby, Joe W. 4-H Teacher's Guide and Supplement to Plant Diseases. Texas Agricultural Extension Service. The Texas A & M University System.

Junglas, Mary, et al. Environmental Learning Experiences: Socio-Cultural, Junior High School Center for the Development of Environmental Curriculum, Willoughby - Eastlake City Schools, Willoughby, Ohio, 1974, Title III ESEA. ED 099 231.

Kennedy, Beth A. and Fortner, Rosanne. Coastal Processes and Erosion. Ohio Sea Grant Program, The Ohio State University Research Foundation, 1980. ED 179 356.

Mayer, Victor J. and Ihle, Stephanie. It's Everyone's Sea: Or Is It? Ohio Sea Grant Program, The Ohio State University Research Foundation, 1981. ED 202 723.

McKelvey, Vincent E. "Approaches to the Mineral Supply Problem," Technology Review 76:5 (March/April 1974).

McKelvey, Vincent E. "Mineral Potential of the United States." In The Mineral Position of the United States, 1975-2000, the proceedings of a Symposium sponsored by the Society of American Geologists, November, 1972; edited by Eugene N. Cameron. Madison: University of Wisconsin Press, 1973.

McKelvey, Vincent E. "Mineral Resource Estimates and Public Policy," American Scientist 60 (1972).

National Commission on Materials Policy, Final Report. Material Needs and the Environment, Today and Tomorrow. Washington, DC, June 1973.

Project Learning Tree Supplementary Curriculum Guide for Grades 7 through 12. Washington, DC: American Forest Institute, 1977.

Sampson, R. Neil. "Energy: New Kinds of Competition for Land," in Economics, Ethics, Ecology - Roots of Productive Conservation, edited by Walter E. Jeske. Ankeny, IA: Soil Conservation Society of America, 1981.

Sarnoff, Paul. "Exploring Strategic Metals," Moneymaker, April/May 1981.

ENVIRONMENTAL EDUCATION PUBLICATIONS

Unless otherwise noted, these publications are available in both microfiche and hard (paper) copy from Educational Document Reproduction Service (EDRS), and may be located in ERIC microfiche collections. Most are also available in printed form from:

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TEACHING ACTIVITES

ED 091 172
John H. Wheatley and Herbert L. Coon, One Hundred Teaching Activities in Environmental Education. 1973; 204 pages. IRC price: $4.50.

ED 102 031
John H. Wheatley and Herbert L. Coon, Teaching Activities in Environmental Education, Volume II. 1974; 200 pages. IRC price: $5.15.

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ED 152 541

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Mary Lynne Bowman and Herbert L. Coon, Recycling: Activities for the Classroom. 1978; 154 pages. IRC price: $4.95.

ED 1[illegible]2 897

William R. Hernbrode, Multidisciplinary Wildlife Teaching Activities. 1978; 96 pages. IRC price: $3.30.

ED 162 895

Richard L. Sagness and Rebecca L. Sagness, Selected Science Activities in Consumer Decision Making. 1976; 167 pages. IRC price: $3.30.

ED 173 072

Herbert L. Coon and Mary Lynne Bowman, Energy Activities for the Classroom--Vol. 11. 1978; 164 pages. IRC price: $3.00.

ED 182 118

Mary Lynne Bowman, Values Activities in Environmental Education. 1979; 142 pages. IRC price: $3.75.

ED 194 349

Charles E. Roth and Linda G. Lockwood, Strategies and Activities for Using Local Communities as Environmental Education Sites. 1979; 207 pages. IRC price: $5.50.

ED 196 704

Mary Lynne Bowman, Teaching Basic Skills Through Environmental Education Activities. 1979; 128 pages. IRC price: $4.00.