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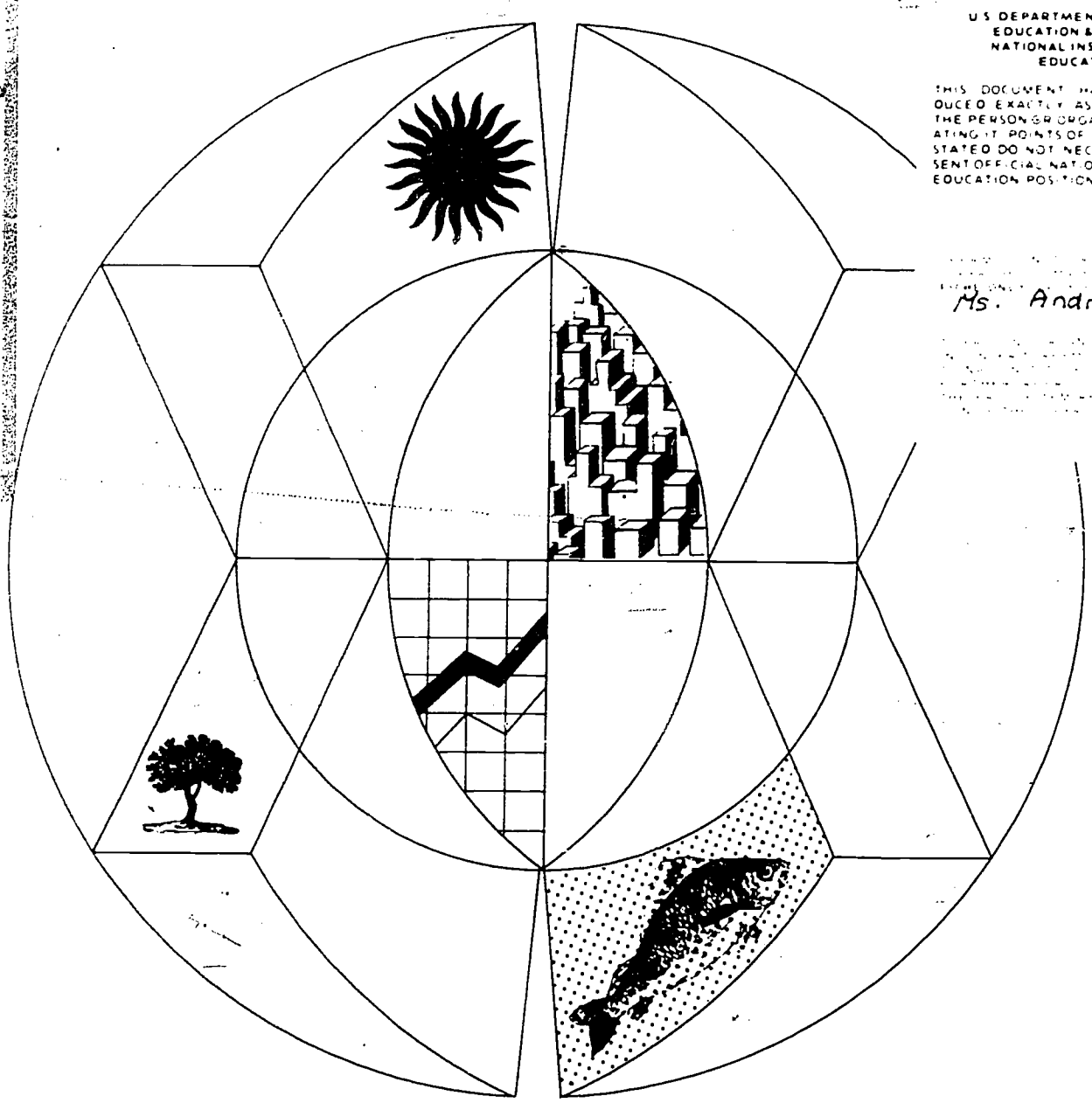
ABSTRACT

Two booklets comprise the grades 4-6 component of a series of guides for incorporating environmental education into the existing curriculum. Both the guide and handbook emphasize a multidisciplinary approach, use the concept of interdependence as an organizing theme, and offer suggestions for using the local community as a resource to study the individual's relationship to the total environment. Among eight objectives are understanding the meaning of systems and interdependence, recognizing that people use and shape their environments, and appreciating relationships between one's immediate surroundings and the natural systems of the planet. In the guide, activities and related readings are suggested for achieving the objectives in specific subject areas: social studies, art, science, mathematics, U.S. and state history, reading, and writing. For example, students use a globe to calculate how much of the planet is land and how much land is habitable. The handbook contains 11 lessons, many based on readings which emphasize comparison of human and environmental systems, the role of microbes, and environment-dependent communities such as a river town. Some activities involve the exploration of students' familiar surroundings; others focus on global issues. Each lesson contains goals, objectives, activities, and follow-up activities. (AV)

Part B
4-6 Guide



Environmental Education
Interdependence: A Concept Approach

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CENTER FOR GLOBAL PERSPECTIVES

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ENVIRONMENTAL EDUCATION

INTERDEPENDENCE: A CONCEPT APPROACH

SUGGESTIONS FOR CURRICULUM DEVELOPMENT

PART B, 4-6

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INTRODUCTION TO THE SERIES

PURPOSE

The purpose of this series of guides is to provide:

- strategies for incorporating environmental education into the existing curriculum (it is not a blueprint for a new course);
- a variety of ideas, questions to explore, and suggestions for lessons and activities which will allow teachers and curriculum developers to select those portions which best meet their particular needs;
- exemplary lessons -- which should prove useful in themselves and also offer ideas for your own curriculum development;
- an emphasis on multi-disciplinary approaches, since study of the environment is not limited to any single discipline or subject area;
- suggestions for using the local community as a resource for learning about population and other environmental concerns;
- an organizing theme around the concept of interdependence -- a conceptual lens which will provide students with a new way of organizing information and of looking at the world around them.

> Environmental education is not a new class to teach. Rather it is a fresh way to approach, consider and apply what you are already teaching in the classroom.[1]

> When we move into the areas of the social sciences, arts, and humanities, which once were considered unrelated, the outlines of a curriculum begin to emerge that not only will help children understand their interdependence with the natural world, but will help them develop the skills, attitudes, and knowledge necessary to understand and solve environmental problems.[2]

These two quotations stress the same point: environmental education is an integral part of the existing curriculum rather than a separate area of study. Perhaps that needs to be explained a little more fully.

Environmental education involves more than concern for the protection of wildlife or awareness that humans are poisoning the environment. Conservation and awareness are important, but they are only parts of a larger whole. In its fullest sense, environmental education involves *the individual's relationship to his or her total environment* -- and that includes the built environment as well as the natural. Every course we teach has something to do with how people relate to each other and to their world.

From every corner of the curriculum, then, there can emerge the skills, attitudes and information young people need for a creative approach to their environment. The major goal of environmental education is not to persuade students to launch or participate in anti-pollution campaigns. Much more basic is the objective of helping them learn to use all their senses to "reconnect" them with their natural and human-made surroundings. Each of us shapes and is shaped by the environment. The challenge to educators is to provide an education that will enable people to recognize areas of individual and

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[1] The American Institute of Architects, *Built Environment; a Teacher Introduction to Environmental Education*, 1975, p. 7.

[2] *Ekistics*, A Guide for the Development of an Interdisciplinary Environmental Education Curriculum, California State Department of Education, Sacramento, 1973, p. v.

group responsibility for their surroundings. They can then work intelligently toward structuring a healthy environment, instead of passively accepting whatever they find around them. Such a goal becomes increasingly vital as our world becomes more crowded and more urbanized.

INTERDEPENDENCE: THE ORGANIZING THEME

The idea of *interdependence* is deceptively simple. It means *mutual dependence* -- parts of the whole depending on each other. The term has become popular in the past few years as a key means of describing the nature of life on our planet. Such terms as Spaceship Earth or Global Village are more dramatic ways of stating the fact that we live in an increasingly interdependent world where the parts of the whole depend more and more on each other.

We constantly encounter interdependence in our daily lives and in the subjects we teach. When children learn about families or communities, they are learning about interdependent relationships. Similarly, the study of life in the ecosystem of a pond is a study of systems -- or interdependence -- as is the study or analysis of the functions of different aspects of government, the workings of an economy, or the interaction of characters in a play.

Although much of what we teach deals with interdependence, we have not really tried to help students understand the concept itself. Events are too often treated as isolated phenomena. Children are not trained to see a similarity between, say, what's involved in a unit on buying and selling and what happens in the microscopic life of a pond. One similarity is that both involve systems (interdependence).

This set of guides uses examples of systemness or interdependence to help students understand the concept. There is an underlying assumption: as young people become more familiar with the concept, they become better equipped to understand and cope with interdependence -- whether it involves their relations with others, with their environment, or with a subject being studied in school. Here is a simple example:

Without any major changes in curriculum, the child begins to see his or her world as being made up of an endless series of systems and subsystems. A tree is a system; so is the human body. A road map describes a road system; an equation describes a numbers system. A house is a system, so is the neighborhood, and the community is an even larger system composed of hundreds of subsystems. Through experience, the child becomes able to see the world through a systems lens; where appropriate, he or she puts on the systems spectacles and can then see how parts of a whole relate to each other, how the system

functions, what variables might interfere with its smooth operation, how it is similar to and different from other systems.

The concept thus becomes a tool to use for organizing information. With increased experience it can be applied to ever-more complex and sophisticated subject matter. An increase in population can be analyzed in terms of the many systems and subsystems involved. The student automatically knows what questions to ask about the consequences of this population change on space, food, light, other species, and so on. Students will develop the skills needed to minimize the negative results of systems change on their own lives. Finally, understanding of the concept enables the person to recognize the interactions between self and immediate surroundings and between immediate surroundings and the total environment of the planet itself.

This conceptual lens is not magic, nor does it provide everything people need to know to understand their relationship to their environment. But it does provide part of the equipment people need to attain that understanding and to respond to it in creative ways.

We said earlier that the idea of interdependence is deceptively simple. Obviously younger children will deal with it on less complicated levels, applying it to their familiar surroundings. However, when high school students explore the intricacies of global interdependence, they will be aware of the complexities, pressures, and tensions involved.

Robert G. Hanvey describes the complex nature of the subject:

> How does the world work? As a system. What does that mean? It means put aside simple notions of cause and effect. Things interact, in complex and surprising ways. "Effects" loop back and become "causes" which have "effects" which loop back...It means simply that events ramify -- unbelievably.[3]

Consider an example: The Organization of Petroleum Exporting Countries (OPEC) quadrupled the price of oil. This caused an increase in the price of petroleum-based fertilizers (effect), which in turn made it difficult (cause) for a farmer in India to produce a good crop yield (effect) since the new strains of grain developed by the Green Revolution, created (cause) to increase world food supply (effect),

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[3] Robert G. Hanvey, *An Attainable Global Perspective*, Center for War/Peace Studies, 1975.

rely heavily on those fertilizers. At the same time the oil price increase set off other chains -- increased inflation, the decision to build the Alaska Pipeline, lessening of aid to poor countries, and so on. A student with a solid background knowledge of interdependence has the tools to analyze and understand such a maze of interrelated events.

USING THE GUIDES

The curriculum guides are divided into grade clusters (K-3, 4-6, 7-9, 10-12). In each, we have presented a framework or outline describing ideas, suggestions, and activities for topics normally taught at these grade levels. The suggestions listed under each topic will indicate ways you can use your existing course work to develop better understandings of population and other environmental concerns through the concept of interdependence.

When you are planning a unit of study, refer to the relevant portions of the guide. Incorporate some of the activities or exploratory questions into your lesson plans. The guide, then, becomes something like a transparency that you place over your unit plans in order to see where you can add important elements of environmental education. You will also find that the sample lessons can be used for certain key topics, and as models for developing your own lessons.

While many of the topics listed in the guide emerge from social studies, we will frequently be crossing over into art, literature, science, and mathematics. This interdisciplinary approach will probably be easy for elementary-grade teachers to handle. In middle and upper grades, combining courses is more difficult, since there is often little coordination among teachers of different subject areas. We strongly urge team-teaching wherever possible, or at least a close working relationship among teachers. The students will gain tremendous benefits if there is a meshing of subject areas in dealing with environmental education. Faculty or inter-departmental meetings can be used to work out broad areas of coordination among the various subjects.

RESOURCES AND BIBLIOGRAPHIES

Even though most teachers are familiar with the basics of curriculum planning and development, they may find it desirable to review some of the current literature. Two extremely helpful reference books are *Education Index* and *Books in Print*. Look under subject areas such as "curriculum," "environmental education," or "conservation education." In addition, Educational Resources Information Center (ERIC) publishes a monthly index, *Research in Education* (RIE) which has an excellent collection of environmental education documents, including many produced by some interesting programs supported by HEW under Title III and the Environmental Education Act of 1970. All three publications are found in most major libraries.

If you wish to develop materials especially for your local needs and resources, you should get in touch with the directors of model programs throughout the country. Their names, addresses, and telephone numbers are listed in *A Directory of Projects and Programs in Environmental Education for Secondary Schools* by John F. Desinger and Beverly Lee (ERIC, The Ohio State University Press, 400 Lincoln Tower, Columbus, Ohio 43210). Also see *Environment U.S.A.: A Guide to Agencies, People and Resources* (R.R. Bowker, P.O. Box 1807, Ann Arbor, Michigan 48106, 1974).

At the end of each unit in this Guide, you will find additional resources. They are by no means complete or comprehensive, but are intended to serve as general and supplemental readings. You may also discover that readings listed in one unit will be helpful in expanding material found in another unit of the Guide. We hope that the Guide, and the references, will provide you and your students with additional ideas for developing the curricula.

SUGGESTIONS FOR CURRICULUM DEVELOPMENT

ENVIRONMENTAL EDUCATION

UPPER ELEMENTARY GRADES (4-6)

INTRODUCTION

All the materials in this outline will suggest ways you can examine the interaction between humans and their environment. Choose those ideas and activities which fit best into your own patterns of teaching and your existing courses. We have tried to follow current 4-6 curriculum as much as possible. You will probably find that the major adjustment you will have to make is to combine courses to provide a multi-disciplinary approach.

The concept of interdependence is frequently *implied* in your materials, rather than stated directly. The teacher can tell best when it is most appropriate to use the words *systems* or *interdependence* to reinforce concept learning -- or when to compare a specific topic to some other examples of interdependence for the same purpose of reinforcement.

For most topics or subtopics, art, music, and literature are included as well as purely ecological concerns. For when people face decisions regarding the use of our environment, aesthetics and cultural values are also involved. For example, a controversy over preserving or consuming the redwood forests of California is a choice involving more than economics and conservation; it also reflects our ideas about the quality of life, our sense of what is beautiful, and our ideals about how to shape our present and future.

Children at these grade levels can begin to understand the interactions between population changes and other environmental factors. Migrations, as well as population growth or decline, are vital factors in determining environmental health or balance. A decline in numbers of one life form will alter the ecosystem of a pond; a change in human population will influence local conditions and can also affect worldwide systems. At this point in their learning careers, your students will probably gain most by considering population dynamics in limited settings -- an aquarium, a pond, the local community -- with only limited consideration of a population change on a global scale.

OBJECTIVES

(We state below a series of broad objectives. The teacher should select at least one of these to be the focus of every lesson developed from the guide. The specific knowledge, skills, and attitude objectives can best be developed by the teacher in preparing individual units and lessons.)

1. To use knowledge and skills from all subject areas to explore and understand the student's total environment.

   Example: Mathematics, science, literature, and art can be combined in the examination of the environment of the school playground.

2. To distinguish between built and natural environment, and to recognize functional and aesthetic elements in each.

   Example: A forest is a potential resource for wood, needed to create the built environment (paper, houses, carvings, etc.). It is also the home of many living things which depend on its preservation. And it has cultural significance in terms of our sense of beauty and need for recreation.

3. To understand the meaning of *systems* and *interdependence*, and to be able to apply this knowledge to newly encountered material.

   Example: Given a picture of a natural or built environment, the student can describe the systems present and explain how the parts of the system interact.

4. To recognize that people both use and shape their environments.

   Example: Students feel a sense of responsibility for their immediate surroundings.

5. To know that there is interdependence in the interactions between humans and their environment.

   Example: Humans need water for survival, but also use it for a variety of other needs. They must therefore guard against the dangers of damaging water systems.

6. To understand that population is a major factor in determining the health of the environment.

   Example: Changes in the population of one species in an ecosystem create changes in the entire system.

7. To recognize relationships between one's immediate surroundings and the natural systems of the planet.

   Example: Water pollution in local communities affects the total world water system.

8. To better understand and appreciate the local environment.

   Example: Students discover how their lives affect and are affected by the systems around them.

TOPIC AND IDEA OUTLINE

I. THE IDEA OF SYSTEMS

If the students have not had previous work with the concept of *systems*, use the sample lessons introducing the idea in the accompanying Handbook, Part I.

Complete this beginning work with systems before dealing with any of the topics which follow.

ADDITIONAL RESOURCES:

Patterns for Teaching Interdependence. David C. King and Cathryn J. Long, eds. Center for Global Perspectives, 218 E. 18th St., New York, New York. 10003, 1975.

Interdependence K-3, 4-6. David C. King, Center for Global Perspectives, 1975.

I. EXPLORING THE ENVIRONMENT

A. Systems in Nature

GOALS

- To observe systems in nature.
- To infer what might happen when parts of the natural system are changed.

Systems knowledge becomes a valuable lens with which students can explore their natural environment. When children are familiar with the concept, a diagram of the carbon-oxygen cycle becomes more meaningful to them -- it fits their mental image of how systems work. Margaret Stimmann Branson, author of the text *The Environments We Live In* (Follett Publishing Co., 1973) explains:

> Once students understand the concept of a system, they have a basic structure which they can apply to interacting life everywhere, whether it be insects within a sack of flour, the total complex of a large lake, or the immensity of the entire biosphere.
>
> (p. T81)

Here are some examples from science lessons which can be used to apply or expand systems understanding:

SCIENCE

1. The nature of energy

   a. The air, water, and land systems of the planet all help to hold or "trap" some of the sun's energy.

   b. The essential role of green plants is to convert the sun's energy into food.

2. The study of photosynthesis or the carbon-oxygen cycle are good examples of how parts of natural systems work together.

   Use microscopes or magnifying glasses so that learners can explore the minute parts of the systems, like veins in leaves and variations among different kinds of leaves.

3. *Food chains* and *food webs* are also ideal examples of systems in nature:*

   a. Outdoor studies and films can be very important for making such aspects as food producers or consumers vital and observable parts of life, rather than merely portions of a diagram.

   b. Knowledge of the workings of food chains is basic background for understanding environmental problems.

      - Provide examples of changes in a food chain or food web and challenge students to tell how the entire system will be affected.

      - Examples: The deer population in a forest increases; changes in a pond cause a rapid increase in algae growth. Two good resources are: Carol and Donald Carrick, *The Pond* (Macmillan, 1970); and Julian May, *Why Plants Are Green Instead of Pink* (Creative Education, 1970).

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* See sample lessons in the Handbook, Part II, "Microbes in the Garbage."

4. *Ecosystems* --Studies of ecosystems might provide a good opportunity to enlarge the concept of systems, by introducing the term *interdependence*.

   a. Ecosystems can also be described in terms of *models* -- and, of course, children can have great fun building their own miniature ecosystems in an aquarium or terrarium.

   b. Show paintings of natural settings from different parts of the world.

ART

   - Have the class pick out parts of ecosystems or food webs.

   - What parts of the environment does the artist seem to be most interested in? Why? (Seeing natural systems in terms of beauty.)

   - How are they different? Can the children find any variations in the way the artists portray their surroundings?

   c. Provide readings about different environmental settings (biomes)-- some texts will provide descriptions; others can be found in stories.

READING

WRITING

   d. Have some children write about what it might be like to live in one of these settings. For example, if your students live in Arizona or New Mexico, what do they think it would be like to live in Switzerland, or Greece, or Central Canada?

B. Humans and Natural System

GOALS

- To observe how farming has altered the interaction between humans and the environment.
- To evaluate some of the changes caused by technology.
- To investigate ways in which people change with the environment and how they can protect it.

SOCIAL STUDIES

1. Pre-history: in learning about humans' interactions with natural systems, learners should understand that even when they were hunters and gatherers, people changed the environment in some ways --but not much more than other animals.

Farming should be seen as a giant step in the degree in which people changed the natural environment.

a. Show the class a picture of a field (wild grasses, bushes, flowers). Ask them to guess what changes will occur if the field is used for growing crops.

(The children should see that some living things will be removed and replaced with others, selected by humans.)

b. Some questions to consider:

- What will happen if people don't farm carefully? (Soil will become worn out if nutrients aren't replaced; top-soil can be lost through erosion.)

- How would farming have changed human populations? (Farmed land can support more people; and people can live in more settled communities.)

c. Conclusion: With the introduction of farming, humans of course remain interdependent with the environment, but the nature of that *interaction changes.*

2. Pre-history to modern history: the use of tools. Tools and technology should be studied in terms of how humans gained increasing ability to change the natural environment. They learned to use the *raw materials* supplied by nature to make new things that improved their life or made it more comfortable.

a. The things that are made by people we call our *built* environment.

b. What are the advantages of this growing power to change natural systems? What are some of the disadvantages?

(Pollution, overuse of resources, towns becoming overcrowded, epidemics.)*

3. To reinforce social studies learning, science classes can be used to explore:

SCIENCE

a. How do humans change ecosystems?

Show a picture of an ecosystem -- a pond, field, lake, etc. Suppose people moved there --

- What would they do that would change the ecosystem? (Use parts of the natural environment to meet their needs.)

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* For lesson ideas focusing on ecological problems, see Section VI of this Topic and Idea Outline.

- What changes could you predict if the people moving there were (1) a farm family; (2) twenty families starting a business; (3) people starting a factory or mine; (4) thousands of people building a city?

b. How can humans perserve or protect an ecosystem?

Example: A good research assignment would be to have a student (or task group) find out how and why the lumbering industry today is active in reforestation. (A major lumber company or the U.S. Forest Service can provide lots of information, sometimes including films.)

C. Exploring Built Environment and Natural Environment**

GOALS

- To identify aspects of the natural and built environments in the classroom.
- To construct models of built and natural environments.
- To review art and literature for examples of the built environment.

SCIENCE Both science and mathematics are more meaningful to children when they can see how these are involved in their own lives. Both subjects provide

MATHEMATICS tools for exploring the environment from a variety of perspectives.

1. Consider the classroom as part of your environment. There are endless questions to be explored through science and math projects:

   a. How do you get water, air, heat, light in the room?

   b. What are the objects in the room made of? What are the origins of these materials?

      - Individuals or groups could provide case studies of interaction with the natural environment by discovering and explaining (or demonstrating) the origins of wood items, steel, aluminum, paint, plastic, etc. List on the board the variety of systems involved in providing the built environment of the classroom.

      - How was the natural environment changed in creating this built environment?

   c. The care of classroom plants or pets can be used to measure amounts of water and food needed, and to work out averages for certain periods of time.

** Some of the ideas in this section are adapted from: Humanities Framework Committee, *Proposed Humanities Framework for California Public Schools,* Sacramento 1975.

- A variety of plants can be used to study germination and growth under different conditions, measuring and charting the variations.

SOCIAL STUDIES

ART

- An interesting addition to plant study can be provided by exploring the history and cultural significance of any number of plants. The California *Proposed Humanities Framework* points out:

> Ornamental plants are ornamental by human decision. What makes us decide that one plant is beautiful and another is not? What differences are there among pupils' opinions of which plants are beautiful and which are not? Plants have profoundly influenced art in every culture, serving either as motifs or materials. Pupils should be aware of this influence and of other cultural attributions to plants as well. Rice, lilies, wheat, corn, roses, the lotus, garlic -- all reverberate with cultural symbolism, and all have been eaten at some time somewhere on earth.
>
> (p.250)

d. Establish a classroom weather station to gather and record data about local weather patterns (barometric changes, precipitation, wind, temperature).

Occasionally ask how these factors interact with our daily lives.

e. Reinforcement: Have each child write a story of what he or she did during one particular day. Then, using a few of the stories, list on the board things that involved the *natural environment* (e.g., "it was raining") and those that involved *built environment* ("but I forgot my raincoat").

> Notice that some things might go under both headings e.g., breakfast: cereal (natural) in a bowl (built).

SCIENCE MATHEMATICS

2. A scale model of some aspect of environment -- the school or something associated with work in another subject (a mountain range; an adobe house; a frontier town) -- can be used to apply mathematical knowledge and scientific principles. It can also provide experience in how parts of a whole depend on each other. Examples:

a. A model of a baseball field, built to scale. The class could then measure actual distances and understand the logic of the pattern by using a stop watch to measure running and throwing times. Students interested in baseball could go further and explain, for example, the mathematical calculations a third-base coach must make (e.g., if a flyball is hit to an outfielder, what determines whether he will signal a runner on second or third to try to advance?)

b. Build scale models of structures like a bridge or an arch. Assign research to find out about different designs; students might read about how people devised improved structures.

3. Photographs, paintings, literary or poetic accounts of famous buildings, bridges, or towers would add an important element. The class might consider:

   a. What materials are used and why?

   b. Why is a bridge (or other structure) important to the particular community?

   c. Why are some structures famous? Can the children think of local examples that combine beauty and strength?

D. Discovering Your Surroundings

GOALS

- To investigate the influence of the natural environment on the development of the local community.
- To identify special features of the built and natural environments through mapping.
- To identify environmental problems in the local community.
- To observe ways in which people express their feelings for their surroundings.

COMBINING SUBJECT AREAS

Building on activities involving the classroom as part of the environment, you can use all subject areas to help children become more familiar with the shapes, sounds, colors, and uses of their immediate surroundings. Since we usually pass through our neighborhood or community without really seeing or sensing the environment, you can combine many of the subjects you teach to create a new awareness.

1. History: Find out how your city or town was started.* How were the origins influenced by elements of the natural environment -- climate, terrain, water, easy routes for travel and trade, raw materials?

HISTORY

   a. Use old photographs (from the local historical society or public library) to show how the community has changed over time.

   b. Find statistics on population change -- where did people come from and why?

2. Mapping: Divide the class into groups, each to design and explain a map. Each group should have a different location -- school, neighborhood, or even an entire town. Use the maps to talk about such things as --

MAPPING

   - routes people take to school -- how and why these particular routes are used;

* See Handbook, Part III, Lesson 2.

- play or recreation areas -- where and why;
- buildings the group feels are important -- either to themselves or the community;
- places where new construction is taking place;
- areas in need of repair or rebuilding;
- any features the group finds useful or enjoyable and why.

3. Collecting data: Population and housing patterns. A guidebook for teachers called *Built Environment* (American Institute of Architects, 1975) describes this activity:

> A class of 4th grade students asked each other "how big is an acre?" Then each walked out a 208-foot square somewhere in the town and compared what was found in each acre through short reports, diagrams and numerical data (such as the number of dwelling units, stores, trees) in the area.

This activity will give the class a sense of the varying densities and functions of different parts of the community.

4. Measuring environmental problems in a variety of ways:*

   a. Establish air-pollution "measuring stations" at various points in the community (such as near each student's house or apartment) by spreading a thin coat of vaseline on a clean glass plate or slide. Attach these to strings and let them hang outside for 24 hours.

      Then bring the plates in and examine them under a microscope. Show on maps or charts the length of exposure, location of each slide, and any variation in pollution discovered.

MAPPING

   b. Identify on a map the possible sources of pollution -- traffic areas, factories, incinerators, etc. This should help determine why some plates show more pollution than others.

INTERVIEWING

   c. You might also try a survey activity, with students asking people if they think air pollution is a serious problem in the community. (Additional questions: What do you think the sources are? Is it getting better or worse? Are people doing enough to clean up the air?)

      Tabulate the results; compare these to the pupils' own feelings on the subject.

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* Additional ideas for lessons on environmental pollution are in Section VI of this outline.

d. *Photography* could be used to create a bulletin board display or a slide show of "The Air in Our City."

e. *Imaginative stories or poems* should be encouraged -- a bird stopping here on the way north or south; why the snow turns color; why the spaceship didn't land here, etc.

5. How do people feel about their surroundings?

ART

a. Art classes can be used to discover ways people express their feelings about their surroundings -- natural and built -- providing children with another dimension of the interdependence between humans and environment.

- Local art museums, galleries, or public libraries are likely to have paintings by area residents -- how do they see the community or region? What did they choose to emphasize?

- After a field trip, have children draw or paint something from memory -- some object or scene that struck them as unusual or beautiful.

MUSIC

b. Music classes: Music teachers can readily supply records which will indicate clearly a composer's feelings about a natural setting. Beethoven's *Pastoral* (6th Symphony) is a good example; others are Respighi's tone poems ("Pines of Rome," etc.) and even Prokofiev's "Peter and the Wolf." Modern "folk" songs (John Denver, etc.) and some country/western music will also be fun.

You can use a tape recorder to capture natural sounds. A trip to a wooded area or park (at dawn when birds are most active) will be rewarded by a wide variety of bird and animal sounds.

READING

c. *Stories and poems* also provide a variety of personal viewpoints about the author's surroundings. Again, you may find examples from local writers -- contact the English or folklore department of the nearest university.

ADDITIONAL RESOURCES:

Fiction

Cedars of Charlo. Virginia W. Johnson. New York: William Morrow and Co., 1961. A girl, a horse, the beauty of Montana's mountains and the threat of logging.

Action at Paradise Marsh. Ester Wier. Harrisburg, Pa.: Stackpole Books (Window Books), 1968. A boy helps save Paradise Marsh from being drained and there by preserves the marsh creatures.

Non-Fiction

City Lots: Living Things in Vacant Lots. Phyllis S. Busch. Cleveland: Collins, Williams, and World Pub. Co., 1970. The environment of a vacant lot and the interdependence of life on it.

Balance of Nature. B.M. Parker. Row, 1961. Man is constantly trying to suit his surroundings to himself instead of learning about the balance necessary in nature and adapting to it.

Because of a Tree. Louis J. Milne. New York: Atheneum, 1963. The interdependence of trees, insects, plants, and animals.

Why We Live Where We Live. Eva K. Evans. Boston: Little, Brown and Co., 1953. The tale of America and how the shape of hills, harbors and waterways affects the way we live.

Teacher References

Our Man-Made Environment. Group for Environmental Education, Inc. (GEE). Cambridge, Mass.: MIT Press, 1971. A collection of experiences, resources, and suggested activities.

How Do They Cope With It. Suzanne Hilton. Philadelphia: Westminster Press, 1970. Describes the technological discoveries that help people cope with nature but still preserve an ecological balance.

III. EXPLORING SPACESHIP EARTH

Once students have an understanding of such concepts as the basic needs of life (air, water, space, food, light), systems in nature, and the interactions between humans and environment, they are ready to extend these understandings to the planet. Perhaps the best way to achieve this is to think of the planet in terms of Spaceship Earth. The spaceship model contains the basic elements of planet-wide systems -- human passengers all depending on each other and on the same life-support systems -- air, water, food, space, light.

Many teachers use the entire classroom as the spaceship, providing opportunities for physical activities and emphasizing the notion of limited space. A set of lessons developing this classroom spaceship are contained in *Intercom #71*, November, 1972, Center for War/Peace Studies (now the Center for Global Perspectives).

A. Measuring the Systems of Spaceship Earth*

GOALS

- To identify the habitable areas of earth.
- To construct a model of a closed environment (e.g., Spaceship Earth).
- To investigate the effects of population increase on earth's life support systems.

1. Use a large globe, showing physical features, to explore the question: where can people live on Spaceship Earth?

MAPPING

a. Is most of the planet land or water? (Oceans cover about 70 percent of the surface -- if percentages have not been introduced, fractions can be used -- or even rough estimates.)

SCIENCE

GEOGRAPHY

b. What kinds of land would *not* be good places to grow food? (Mountains, deserts, tundra, or frozen regions.) Have volunteers point out these areas, which make up about 20 percent of the surface.

MATHEMATICS (Statistics) (Percentages)

c. How much of the earth's surface provides suitable places for humans to live? (Roughly 10 percent of the total surface.)

d. To give a better idea of the shapes and relationships of land masses, use a variety of different map projections. See for example, "Novel Map Projections," *Scientific American,* November, 1975.

2. Build a model of a spaceship -- on a table top or using the entire room. Using the globe figures, how much space can be allowed for the living quarters of passengers?

   Are the other areas important? Why? (Air, water, and land are all part of the essential support systems.)

3. The population of the spaceship -- are we becoming crowded?

SOCIAL STUDIES

a. Provide charts of human population growth, such as the one on the top of the next page.

MATHEMATICS

b. Measure doubling time -- when did world population reach 1 billion?

   - How long did it take to reach 2 billion? 4 billion?
   - If it keeps growing, what is it expected to be by the year 2000?

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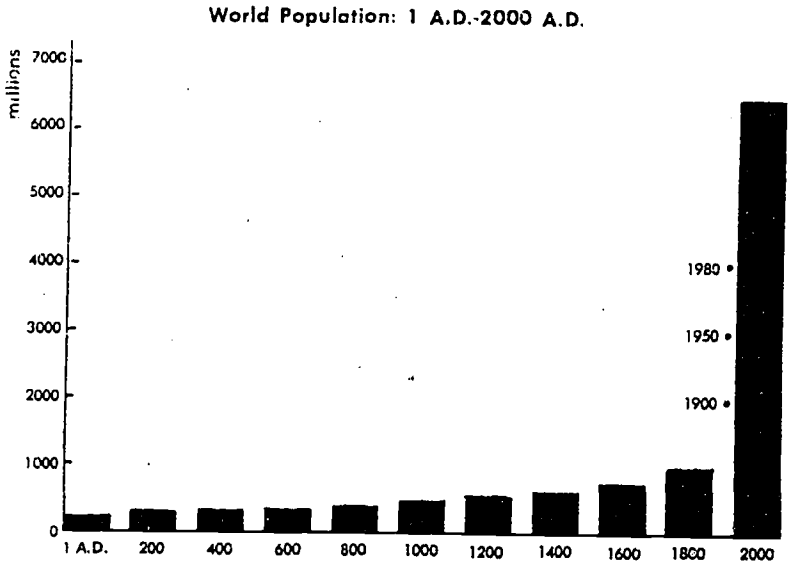
* For more detailed lesson plans, see Handbook, Part IV, "Looking at the Environment With New Eyes."



Source: United Nations

c. What do these figures mean for the spaceship? What questions does it raise about the life-support systems (space, food, water)?

Does this suggest that we need agreements about food supply, resources, air, space?

In some compartments there is little or no change in population, in others substantial increase. Do you think slower population growth is needed? In some school districts, this question might be considered inappropriate for the age level; increasingly, however, standard social studies texts encourage children to consider the question. If this question is raised, students may find it more relevant when related to their school. Invite one of the school district's maintenance personnel to discuss the school's carrying capacity. What problems will occur when the school's population goes beyond this capacity? How can these problems be remedied? In what ways will it interfere with regular school functioning?

B. Global Interdependence

GOALS

- To identify ways in which the world is becoming a "global village."
- To discuss both the positive and negative effects of modern technology on the natural environment.
- To model and correct, in the classroom, problems of Spaceship Earth.

What do we mean when we say the "earth is shrinking" or that the planet is becoming a "global village"? At certain points in your social studies course, you will deal with such topics as:

SOCIAL STUDIES

- the Industrial Revolution;
- modern technology;
- high-speed communication and travel.

1. Use these topics to create understanding of such changes as:
   a. increased ability to alter natural systems;
   b. increased food production and a lower death rate;
   c. the growth of cities and their connections to each other by trade, travel, business;
   d. increased competition for scarce resources;
   e. increased interactions between cultures;
   f. the ability to move anywhere in the world in a short time;
   g. almost instant communications.

   Taken together, these changes mean that parts of the world depend more and more on each other.

2. Individual or group assignments can demonstrate this global interdependence. Examples:
   a. One group could bring in newspaper clippings which describe events in other parts of the world.

SCIENCE

b. A science project with two or three students could demonstrate communications satellites and show how they bring parts of the planet into closer contact.

ECONOMICS

c. A local research project could show how business depends on other parts of the world for materials and markets.

3. What have been some results of these modern abilities to change the natural environment?

   a. Students should find such positive results as: making life more comfortable; controlling floods; irrigating arid lands; easy travel, etc.

   b. And such negative results as: damaging the vital envelope of air; polluting the water system; destroying species and whole ecosystems, etc.

4. Build all the above ideas into your spaceship model. One technique is to use a tape recorder to announce a special danger on the spaceship. The "crew" must respond by considering the possible consequences of the threat, and trying to decide what should be done. Examples:

   a. Certain areas of the spaceship might be poisoning the oxygen supply system.

      - Can this pollution be limited to one part of the spaceship?

      - What should be done about it?

   b. Dangerous chemicals might be found in parts of the water supply.

      (Again, the children should see that the whole system will be affected. They should decide that it is necessary to find the sources of pollution and correct them.)

   c. Some passengers might have more than enough food, others are starving.

      (You may have to draw out parallels to the real world, divided between rich and poor societies.)

C. Other Explorations of the Planet

GOALS

- To observe how earth's different systems interact.
- To discuss ways in which pollution interacts with the natural environment.

1. The planet's systems *interact* with each other. Use photographs or filmstrips to have children find examples of interaction --

   - sand dunes formed by the wind;

GEOGRAPHY

   - rock formations eroded by water;

   - streams changing direction because of rock formations.

   How do plants and animals interact with the natural environment? (breathe air, etc.) What about people? Are there interactions between people and plants/animals?

2. *SCIENCE* You can explore how plants and animals have been changed by humans -- e.g., compare wild with domesticated species. (Corn was originally a grass; animals have been changed by domestication.)

   How do built things interact with the environment? (Pictures of highway systems and cities provide vivid examples.)

3. Pollution --

   a. *SCIENCE* *SOCIAL STUDIES* How do natural systems interact with pollution? (The pollution doesn't stay in one place.) Use studies of air or ocean currents, or the flow of streams, to demonstrate how pollution can spread throughout the globe.

   b. Refer to studies of how to control pollution in your own community. How does this help globewide systems?

      - Will protecting the environment in just one place do any good? For example, many Americans are opposed to the building of a huge jet plane -- the SST -- they say it will damage the air envelope. The U.S. decided not to build the plane. But such a plane is being built by England and France, and by the Soviet Union.

      - Can we protect the air by preventing SST's from flying over the U.S.?

      - If the SST is dangerous, how can the danger be removed?

4. Use science fiction or stories of space travel to draw out parallels with the idea of earth as a spaceship.

READING

For example -- what kinds of problems are encountered that are like those of Spaceship Earth?

Poetry, too, can be used to give examples of how some poets use the spaceship image.

(For example, see the song, "The Spaceship Earth," in Edith King, *Worldmindedness; The World: Context for Teaching in the Elementary School,* Wm. C. Brown Co., 1971, pp. 44-45.)

ADDITIONAL RESOURCES

Teacher References

One Earth, Many People: The Challenge of Human Population Growth. Laurence P. Pringle. New York: Macmillan, 1971. The population crisis, its pros and cons as presented by biologists, economists, ecologists, etc.

The Earth Book. Gary Jennings. Philadelphia: J.B. Lippincott Co., 1974. A look at our troubled planet.

Mice, Moose and Man: How Their Populations Rise and Fall. Robert M. McClung. New York: William Morrow and Co., 1973.

IV. ACTIVITIES IN U.S. (OR STATE) HISTORY

A. The Early Period -- From Pre-history to the Nation

GOALS

- To determine the ways in which American Indians and white settlers interacted with the natural environment.
- To investigate the confrontation between settlers and Indians as it related to land issues.
- To develop an awareness that our interactions with the natural environment are endangering certain animal species.

As with studies of other cultures, a major objective should be to help children understand the variety of ways people have developed for adapting to their natural environment, creating built environment, coping with special problems, and expressing ideas and feelings about themselves and their surroundings.

1. American Indians

HISTORY

a. Use studies of Indian culture to point out their interactions with their environment, their technology, the feeling of closeness with nature.

(You might point out that some practices were not ecologically sound: a tribe might stampede a buffalo herd over a cliff, killing more than they needed; they also overfarmed and then moved on. But since their numbers were small and the tribes were scattered, the impact was slight. Besides, they never lost sight of their dependence for survival on the natural environment.)

- How did tribes use their technology to change the natural environment and to adapt to it?

- What kind of rules did they have? Why are rules important when people are interdependent?

ART

b. Artifacts and art objects are excellent items for demonstrating human ingenuity in transforming natural resources into useful or decorative items.

- A good source of designs and objects is Charles Miles, *Indian and Eskimo Artifacts of North America* (Henry Regnery Co., 1963).

- Many art classes encourage children to experiment with Indian designs and crafts.

READING

c. Indian song-poems and legends describe people's feelings toward their surroundings.

2. The colonial period and early national years

READING

a. Stories of, or journals by, some early frontiersman (e.g., Daniel Boone) can be compared to Indian folklore to demonstrate a shared feeling of closeness with nature -- a sense of awe and wonder about the wilderness. These, in turn, could be compared with later stories of the builders of great industry (Carnegie, etc.) to show changes in the way Americans thought about the natural environment.

HISTORY

b. The confrontation between settlers and Indians should be placed into context as a conflict over land and how land should be used.

Role-playing of specific encounters, described in texts or readings, will help students gain a better sense of colliding needs and values.

c. Settlers and animals

HISTORY

SCIENCE

Settlers tried to control or eliminate some animal species (wolf, bison, fox, weasel, etc.). Individual students could research the fate of specific animals, and what steps are now being taken to protect some endangered species.

- Why did settlers want to get rid of the animals?
- How did animals also suffer from unintentional human actions? (e.g., railroads, cities, lumbering)
- Why do many people now feel it's important to preserve and protect these species? (A practical reason is that this helps restore ecological balance -- "pests" can even help in pest control.)
- The class might want to "adopt" an endangered species. (Contact conservation groups to find out the kind of support needed; find out more about the animal, decorate the room with pictures, posters, etc.) Money from a bake sale, for instance, would help the class feel a sense of involvement.

d. An episode: The Fur Trade and Ecology

- Through text and outside readings have the class explore the fur trade in relation to: opening wilderness areas; contacts with Indians; conflict between French and English colonies; conflict over territory.
- As a science project, have some students prepare a report on beavers, their life and influence on an ecosystem, and the impact of intensive trapping over long periods.

B. The Growing Nation

GOALS

- To discern the changing attitudes of Americans as they relate to the environment.
- To understand that the combined impact of many instances of careless acts can lead to environmental problems.
- To recognize that a growing population creates problems which are not always anticipated.
- To realize that a greater interdependence between the natural and built environments arises from population growth.

1. Attitudes toward growth and the natural environment

READING

Stories of folk heroes, legendary figures, explorers, and frontier settlers are very appealing. You can use such stories to talk about attitudes toward the natural environment -- like the idea that there was this seemingly endless stretch of territory to be opened up for its treasures of farm land, minerals, timber, furs, etc.

Ask the class why Americans in the 19th century didn't worry much about such things as where they dumped garbage.

2. Attitudes and population

HISTORY

a. Children should have a sense of a rather small population spreading over a vast area. A farm family in a sod house wouldn't worry much about how they farmed their land.

b. As numbers grew, the *combined* impact of thousands of careless farmers is what made the difference. The Dust Bowl provides an excellent case study.

3. Population changes and new problems

Develop lessons that stress the idea that immigration and an urban explosion changed people's relationship to the environment and created new problems.

a. Select a town -- your own or even a mythical one. Have the class list goods and services people depend on when this town has 200 people:

- nearby farms produce most of the food;
- water comes from wells;
- local craftsmen and tradesmen supply much of what is needed -- harnesses, tools, etc.

b. Then between 1870 and 1900 the town suddenly has tremendous growth. The population leaps from 200 to 120,000. What new problems will this create? (Consider sanitation, water supply, food, law enforcement, fire protection.)

c. Notice that as population increases, so does interdependence with places farther away.

- Where will fresh water come from?
- Can local farms supply enough food for all these people?
- How will they come to rely on: railroads (or canals); factories in other parts of the country; farms in other parts of the country?

d. How will the environment be changed by this growth?

(There will be huge increases in the built environment; great changes in natural environment - wildlife, forests, water, etc.)

e. If this happened in only one place in the country, its impact would be slight. But, again, stress the idea that it is the cumulative effect of many people doing the same thing.

Charts, maps and photographs of 19th century city growth will reinforce this idea.

4. The unexpected pains of growth

Recall to the class the attitudes people had toward the endless frontiers of America. They were not prepared for the changes created by industrialization and urban growth?

a. The problems of city government provide good case studies -- why weren't city governments working?

b. Descriptions of the lives of factory workers, pictures of children in mines or slums, etc., also reveal a sudden change in people's relationship to their environment. For many people the built environment had replaced the natural.

c. Ask the class to suggest ways people could have planned better.

d. The rapid development of the automobile also excellently illustrates the unplanned results of change.

Ask volunteers to suggest effects that early vehicle builders couldn't predict (traffic laws, safety, highway construction, air pollution, etc.) A picture of an early automobile next to one of a crowded freeway will enable them to find most of these answers.

5. Trying to change attitudes

a. Read biographies of people like John Muir, who tried to warn people about the need to protect the natural environment.

READING

b. Stories of reformers (including Theodore Roosevelt) will develop the idea that some people were trying to create a better balance between the growth of human-made things and the health of the environment.

C. The Modern Nation

GOALS

- To recognize that there are many levels of responsibility involved in environmental decisions.
- To discuss the ways in which environmental improvement depends on the interdependence of many systems.
- To discover some of the ways people are establishing new (or old) relationships with their environment.

How do we make decisions about the environment today?

Environmental decisions are *interdependent* concerns -- students should that their own actions are involved as well as decisions of huge government agencies.

1. Who makes decisions about changing the environment?

SOCIAL STUDIES

Show pictures of such things as: a person burning leaves in a garden; a person driving a car; an automobile factory; a building under construction; a hydro-electric dam.

Ask the class how each act will change the environment. What are the possible dangers to the natural environment? *Who* is making the decision in each case? (individuals, companies, government)

2. How is interdependence involved in the attempt to improve the environment?

Use specific examples of environmental action to show that:

- people have to know about the problem and care;
- scientists can provide information about harmful chemicals or manufacturing processes;
- businessmen must be willing to correct harmful practices;
- consumers might have to pay more for things they want;
- governments have to make and enforce laws where needed.

Notice that our chances of creating a healthier environment depend on all these elements working. For reinforcement, ask the class how each of the following might help correct an environmental problem:

- a newspaper writer
- a mayor
- a children's club
- a poet or song writer
- a voter
- a scientist

3. Rediscovery: The crafts movement of recent years is a striking example of how people are trying to re-establish a healthier relationship to their environment. In dealing with this topic, be sure to point out that this does not mean the end of manufacturing or that everyone is returning to hand-made production. Rather the emphasis should be that we've rediscovered parts of traditional ways that had almost disappeared -- now more and more people are learning about these traditional ways.

ART

a. Group projects: Film libraries or the *Reader's Guide* can provide you with interesting stories about the renewed vitality of handcraft industries -- in the Ozarks, among various Indian tribes, Eskimos.

Supply pictures or objects. Ask the class how this rediscovery makes our life richer.

Notice, too, that there is new interest in the handcrafts of other countries -- you might have the children try the paper cut-out designs of Poland, or the origami of Japan.

b. Local resources: Find people in the local community who can demonstrate handcrafts to the class (and have the students try projects where appropriate). Quilting, pottery, jewelry, leathercrafts, hand-made toys, embroidery, candle-making. These are among the many projects that will be exciting to the children and provide an illustration of how some people are establishing new (or old) relationships with their environment.

SCIENCE

c. Home gardening is another example of a widespread return to tradition. Again, stress that this is not a move to replace the highly mechanized and superbly efficient modern farms.

Provide stories (or visitors) that will tell the class why people are gardening. If it can be worked out, plan your own small garden (an urban school in Daly City, California has operated a highly successful city garden for nearly 10 years). This will provide the class with experiential learning in such matters as soil, fertilizer, moisture, spacing, and so on.

ADDITIONAL RESOURCES

Fiction

Ahmeek. Jane and Paul Annixter. New York: Holiday House, 1970. A young beaver banished from an over-populated beaver pond finds a mate, starts a new colony, and protects the colony from everything but man.

Letters from Foxy. David Ross. New York: Pantheon Books, 1966. When the fox family's home is threatened by bulldozers, they move to London. Humorous account of their adjustment to city life.

Teacher References

Wildlife in Danger. James Fisher, et al. New York: Viking Press, 1969.

The Foxfire Book. Eliot Wigginton, ed. Garden City, N.Y.: Doubleday, 1972. Log cabin building, mountain crafts and foods, snake lore, hunting tales, and other affairs of plain living.

Citizens Make the Difference. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, 1973.

Population and the American Future. Commission on Population and the American Future, U.S. Government Printing Office, Washington, D.C. 20402

V. STUDYING OTHER CULTURES OR WORLD REGIONS

A major purpose of studying other societies should be to gain understanding and appreciation of cultural diversity. The interdependence of humans and environment provides a common theme, enabling students to draw comparisons with their own culture and experience. Material in social studies texts provides important information about other cultures, but much of this is necessarily descriptive. Art, music, literature, and language will provide the class with much richer experience in gaining a sense of the interaction between other peoples and their total environments.

A. The Setting

GOAL

- To become aware of the diversified ways cultures interact with their environment.

Background information on climate, terrain, settlement patterns, and so on, can be supplied by texts. To make this introduction more interesting, have groups of students work on such projects as:

1. Creating a picture study from as many sources as possible of landforms, biomes, ecosystems, human communities.

SOCIAL STUDIES
- Consulates and tourist bureaus can help supply pictures.

PHOTOGRAPHY
- Students interested in photography can learn to make color slides from magazine pictures.

The variety of the display will help create visual impressions of the people and their land -- more than can be supplied by text pictures. At the same time, student involvement in the activity is often superior to merely showing a commercial filmstrip.

2. Using outside sources, some students could write newspaper-style stories about the country --

WRITING
- Special features of the environment that are favorable for life in this culture -- climate, resources, foods, etc.
- Special environmental features which create problems: weather extremes; too many people for the food supply; pollution, etc.
- Any projects currently underway to improve food production or ties to the rest of the world; or programs to combat a disease or other environmentally related problem.

3. *COOKING* Cooking -- recipes from lands being studied offer a tasty and fun activity to learn about others' environments. Have the students try -- with your help -- to prepare a meal typical of the culture. You can use this as a lead-in to studies of kinds of food, proper nutrition, etc. (See Frances Moore Lappe, *Diet for a Small Planet*, Ballantine Books, 1971.)

4. *REPORTS* To demonstrate cultural variations, one group could report on how another society has used the same or similar environment in different ways.

This project would be useful in emphasizing that natural environment provides possibilities and limits for how people live -- but it does not *determine* how a culture will make use of those possibilities.

B. People and Environment

GOALS

- To explore other cultures through their art and literature.
- To experience cooperation as one aspect of interdependence.
- To increase one's awareness of the common hopes, interests, and needs shared by all humans.

ART 1. Provide examples of art objects -- or plan a trip to an art museum.

Bring objects to class whenever possible -- an Eskimo carving, a Japanese silk screen, a Nigerian mask, etc. Ask the class --

- Why do you think the artist (or craftsperson) did this? What is he or she trying to say?
- In paintings, how do land features look?
- Can you tell what parts of the environment are important to this person?

Comparisons can be made with examples of European and American art -- past and present. From this will emerge the idea that people in all cultures learn certain ways of "seeing" their environment. Art in all cultures is concerned with giving messages about how people see their surroundings.

ART 2. Choose student examples of art or writing on any number of subjects -- storms, space travel, animals, winter -- for a bulletin board display.

WRITING For comparisons, use the art and writing of children in other lands. An excellent source with large color prints is the UNICEF collection, *Have You Seen a Comet?* (U.S. Committee for UNICEF, John Day Co., 1971). This is likely to be available from your local Council on World Affairs or United Nations Association bookstore.

LANGUAGE 3. Notice that many of the stories are written in English as a second language. If any of your students are bilingual or happen to be studying a language, they would have fun writing a story in a language other than English. Questions to talk about --

What kinds of things do children in other lands write about or draw? Are these the same as or different from things we're interested in? (The class should see that children throughout the world have many things in common.)

MUSIC 4. Records of music from areas being studied also can add an important dimension to understanding and appreciation. School or local musicians might be able to provide "live" performances. Music activities could be combined with preparing a class version of a festival or holiday. Check local colleges and high schools for exchange students from countries involved; they might be willing to help you plan the activity.

(Resources like Eunice Boardman and Beth Landis, *Exploring Music* [Holt, Rinehart and Winston, 1971] can suggest ways of helping children understand non-American music and make comparisons with more familiar sources.)

DRAMA

5. The study of other cultures also is a "natural" for experience with drama -- and even the writing of plays (individually or in groups) built around themes developed in their study. If this seems too difficult a task, the students can act out stories or provide new twists to stories they have read. Performing the play in the classroom is as valuable as using a stage.

   The very act of putting together a play provides concrete experience in group cooperation -- one aspect of interdependence. The play itself will dramatize the interrelationships depicted in another cultural setting.

   In talking about the experience, help the class see that one of the things that ties all humans together is that we share common interests, hopes and needs.

C. Culture and Change

GOALS

- To discern ways by which societies are changing.
- To discuss the advantages and disadvantages of urban migration.
- To explore the effects of population pressures on life.
- To realize that consequences must be considered before decisions are made.

In our contemporary world, your studies of other cultures will often deal with the phenomenon of change -- particularly with respect to developing countries striving to modernize their economies. Here are some ideas and questions to incorporate:

1. How is the society changing?

SOCIAL STUDIES

   a. In what ways is the government trying to modernize?

   b. How do these changes affect the way people live?

   c. Do *all* the people want a modern society? If some prefer traditional ways, what are their reasons?

   d. Does the class think it would be possible, or wise, to preserve traditional ways of life?

2. Industry and cities

   a. People move from rural areas to cities looking for jobs. What success do they have? What problems do they encounter?

b. Compare the reasons for moving and the problems of adjustment in:

- 19th century America -- immigrants and farmers moving to cities;
- people today who move from rural areas or other countries to American cities.

c. Talk about the advantages and disadvantages of these urban migrations.

- What do people give up in moving to cities? (Being closer to nature, fresh air, traditions, etc.)
- What do they gain? (Some, at least, find better jobs, a more exciting life, etc.)

3. How do population changes affect life in the culture being studied?

a. Largely because of a lower death rate, populations are growing too fast. The land doesn't provide enough food.

- This is one reason for trying to build up industry.
- It also helps explain the difficulty of creating a modern economy.

b. Provide case studies, using outside sources if possible. Children should see that population pressures and lack of capital make it hard for a village population to improve its living standards.

Comparisons can be made with rural and urban poverty in this country. Once caught in poverty, it is very hard for a group to get out.

c. Some case studies should provide examples of success stories -- people in a rural village developing a water system; the Aswan Dam in Egypt providing electricity and more farm land.

4. Unexpected results of change

a. Your text material may provide you with examples of the surprise effects of environmental change --

e.g., removal of hippopotamuses from the Congo river unexpectedly took away their ability to provide natural irrigation ditches; the Aswan High Dam contributed to the increase of disease-causing snails.

Use such examples to draw comparisons with similar surprise effects in this country and elsewhere -- for example, DDT performed miracles -- then we discovered it was extremely dangerous to health.

b. Develop the idea that: when we alter natural systems, we often can't predict the consequences. This means we have to be cautious as we decide to make future changes. Suppose a new dam was going to be built in your region, what kinds of questions would the students want to ask before they voted for or against it?

5. Modernization and the Spaceship Earth view

a. Recall what the students have learned about the planet's life-support systems and the dangers to them.

- What might happen if every country in the world developed and depended on its own modern industry?

- America, with only 6 percent of the world population, consumes nearly 40 percent of the resources. Should the U.S. use less? Who makes such a decision?

b. Even with their limited information, students can consider the questions:

- Do you think we can arrange our spaceship so everyone lives well?

- How can we do this? (Slow population growth, produce enough food, plan more carefully.)

- What kinds of things do we have to be careful about? (Over-using resources, ruining the natural environment, becoming too crowded.)

ADDITIONAL RESOURCES

Teacher References

People in Twilight: Vanishing and Changing Cultures. Adrien Stoutenberg. Garden City, N.Y.: Doubleday, 1971. The effects of modern technology on the culture of primitive peoples around the world.

Moment of Wonder. Richard Lewis, ed. New York: Dial, 1964. A collection of Chinese and Japanese poetry celebrating the small, fleeting wonders of life.

Seasons of Time. V.V. Baron. New York: Dial, 1968. Tanka poetry celebrating the marvels of nature.

Trees Stand Shining. H: Jones, ed. New York: Dial, 1971. Poetry of the North American Indian celebrating nature.

Cultures in Process. Alan R. Beals. New York: Holt, Rinehart and Winston, Inc., 1967.

The Study of Anthropology. Pertti J. Pelto. Columbus, Ohio: Charles E. Merrill Pub. Co., 1965.

VI. ENVIRONMENTAL POLLUTION: THE LOCAL COMMUNITY AND THE GLOBAL COMMUNITY

Perhaps the best approach to issues of environmental pollution is to deal with real examples in the local community. This will help the children see how problems -- and solutions -- are related to their own lives.

At the same time, it's equally important to draw comparisons with other communities, both in the U.S. and other countries. These comparisons will stress a point we've developed before -- that it is the collection of individual and local decisions which transform pollution problems into global concerns. The goal, then, is for students to see environmental health as a personal and local responsibility, but also -- because we live in an interdependent world -- to see how our actions affect the environmental health of Spaceship Earth.

A. Why Are We Polluters?

GOALS

- To become familiar with the concept: paradox of the aggregate.
- To trace some of the consequences of America's desire to "consume".
- To relate population changes to pollution.

In general terms, threats to environmental health do not stem from a wanton disregard for our own health or that of our surroundings. Rather, our *combined* decisions are what create problems. (This is called the *paradox of the aggregate:* what the individual does has only minor impact, but the aggregate of individual actions has widespread impact.) To put this idea across, try the following:

SOCIAL STUDIES

1. Ask the class to list the different kinds of pollution on the board. They should mention air, water, and land. If not mentioned before, ask if they think *noise* also pollutes the environment.

   a. Ask who creates the pollution --

      Students will mention things like people driving cars, factories polluting air and water, etc.

   b. Now have them consider their own role -- and that of their families -- in creating pollution.

- Make a list of household appliances used, automobiles, goods purchased over the past year, the number of garbage cans the family fills in a week.

- Trace some of these items in terms of how their manufacture, transport, and sale involves pollution: mining and lumbering for resources; factories producing goods; railroads and trucks for shipping; electricity for power; gasoline for vehicles.

- Compare an American family to a family studied in a Third World culture -- which contributes most to pollution?

- Suppose *one* American family decided to consume less, would it make much difference? What if people in a whole state decided to change patterns, would this make a difference? (You might mention decisions made by the people of Oregon -- banning aerosol cans and disposable beverage bottles as a means of reducing waste and pollution.)

c. Conclusions: Americans create more waste and pollution than others because they consume more. Yet it is our desire to consume that leads our industries to produce goods full-speed at low cost.

2. How are population changes related to pollution?

a. Remind the class of population changes in this country: millions of immigrants; people moving westward; cities growing too fast for anyone to plan.

> When Los Angeles was a town of 25,000 (not so long ago) its contribution to environmental dangers was small compared to today.

b. Use maps and census charts to show shifts in population over the past few years. Which areas are likely to have the largest increases in pollution problems? (There are some surprises -- the state with the fastest rate of growth between 1970 and 1975 is Arizona.)

c. Refer to the population growth charts for the entire planet. As numbers grow, we place a greater strain on natural systems.

B. What's Happening in Our Community?

GOALS

- To investigate examples of pollution in the local community.
- To find out how pollution problems are dealt with.
- To compare the effectiveness of anti-pollution measures taken by different communities.

SOCIAL STUDIES

1. Your previous class work may have uncovered cases of pollution in the neighborhood or community. Explore these. Find out what is being done, by whom, and what more needs to be done.

2. Choose local examples to show each of the different kinds of pollution. In finding out about action being taken, try to find cases where --

   a. an individual makes a difference -- one person has launched a campaign to recycle waste, or clean up a slum, etc. (Local newspaper files and environmental groups will help you find sources.)

   b. group action has achieved results -- a neighborhood group or a youth club.

   c. voting has created change -- perhaps the voters have rejected a new construction project.

   d. local, state and national governments are involved.

      - Find out about the work of the Environmental Protection Agency -- what has been achieved.

      - Find out about state laws on such matters as air or water quality.

      - Invite a member of local government to talk about action taken and what remains to be done.

3. Compare your community with others.

   Your text will provide examples of other cases of environmental problems and actions taken to correct them.

   a. How are the problems similar to those in your community? How are they different (some localities will have special problems, like mining)?

   b. How do actions to create a healthier environment compare?

   c. Does your text material offer any ideas people in your community could try?

The Problem of Making Decisions

GOAL

To consider issues involved in making value judgments of environmental importance.

The class should begin to see by now that it is possible to make decisions which reduce environmental damage. But it's hard for the individual to see a personal relationship to the problem. To demonstrate, provide the class with a series of decision-making dilemmas and see how they would decide them:

SOCIAL STUDIES

1. A farmer wants good crops, to earn a decent living and also increase the food supply. He has learned that the pesticides and fertilizers he uses are dangerous. What should he do?

2. A family has a lovely garden. They, too, have learned that their pesticides and fertilizers are harmful. But, they say, this is just one small garden, so it doesn't have much effect. What should they do?

3. Mr. Carter and Mrs. Brown are neighbors in a suburb. They both drive to work in the city, 20 miles away. Mrs. Brown suggest that they take turns driving -- form a car pool. But, Mr. Carter says, I often have errands to run or have to work late. It wouldn't work out. What would you do if you were Mrs. Brown?

4. A freeway is proposed through your town. People in the suburbs say it will make it easier for commuters and may bring new business. An environmental group says we should spend the money in creating a better bus service. Whose side are you on? Why?

5. You are a group of lumber workers. The state has just stopped the cutting of redwood trees in order to preserve them. Now you can't find work. Someone suggests you stage a protest march to the state capitol. What will you do?

6. You want to buy a particular motorcycle. But your father complains that the model you want is too noisy and asks you to get another that won't make the neighbors complain so much. What will you do?

7. You own a factory. A letter from the federal government has come saying that you are violating air pollution standards. If you put in pollution control devices, you might go broke. Your lawyer advises you to take the issue to court -- that way it will be a long time before the order can be enforced. What will you do?

D. Learning More About Environmental Pollution

GOAL

- To investigate different forms of environmental pollution.

1. With the help of science texts -- or a high school science teacher -- develop projects around such topics as:

SCIENCE

a. *Pesticides* -- What benefits do we gain from them? How do they work? How do they affect lakes and streams, animals, people? What more do we need to know about pesticides?

b. *Air pollution* -- Choose an anti-pollution device (like a catalytic converter for automobiles), find out how it works, what the results (good and bad) have been.

c. *Noise pollution* -- Find out how noise levels are measured. Make a chart of the decibels of various objects -- jet planes, motorcycles, rock music, wind, jack hammers, trucks, etc. How does noise affect environmental health?

d. *Land pollution* -- Prepare a report on strip mining for coal. Present arguments for and against strip mining. Does the class favor or oppose the activity?

E. Exploring Attitudes About Environmental Health

GOALS

- To examine how different people feel about and protect the environment.
- To predict what environmental direction your community will follow.
- To design a "master plan" for your community.

1. Use stories, poems and songs that reveal how people today feel about the need to protect our environment and to establish a closer relationship to the natural environment.

READING

MUSIC

Try to avoid the "protest" kind of materials -- e.g., those that simply point fingers of blame -- and look instead for a positive or hopeful message. The point to stress is that we do shape our environment -- we simply have to develop the will to make better decisions.

2. Planning

a. Invite community planners or architects to the class. Learn about plans to improve the community. Visits to architects or city offices will often enable the class to see scale models of planned projects. Note the kind of built environment being planned; what is the relationship between built and natural environment?

SOCIAL STUDIES

ART

b. You might also want to study plans or photographs of model cities or ways older cities have been redesigned. (Samples: Reston, Va., a planned city; Philadelphia, San Antonio, with their blend of old and new.) Check back issues of *The Smithsonian* magazine for picture stories.

c. An ambitious -- but worthwhile -- art project would be to create a model of how the class would like the neighborhood to look 20 years from now.

- What would the students choose to preserve and why?
- What combination of built and natural environment would they like?
- How would they plan for future changes in population?
- How would their plan create a healthier environment?

ADDITIONAL RESOURCES

Fiction

Insect Summer. James Kirkup. Knopf, 1971. The closeness of the older Japanese to things of nature: insects, fish, frogs, birds. A plea against smog.

Little Prince. A. de Saint-Exupery. London: W. Heinemann, 1962. The prince loves his own natural habitat and cares for it lovingly.

Teacher References

Science of Life. L. Darling. World, 1961. An attempt to explain life and its adaptations and the responsibility of humans to use nature wisely and well.

Shadows Over the Land. Joseph J. McCoy. Seabury Press, 1970. A study of the pollution of air and water and what can be done about it.

Ecology: The City. Beverly Hills, Calif.: Benziger, Bruce, and Glencoe, Inc., Web of Life series, 1971.

City Planning. Environmental Education Center, 13 Veterans Drive, Oteen, NC 28805.

Learning to Make Environmental Decisions. Jones Junior High School, Environmental Science Study Curriculum, Washington, NC 27889.

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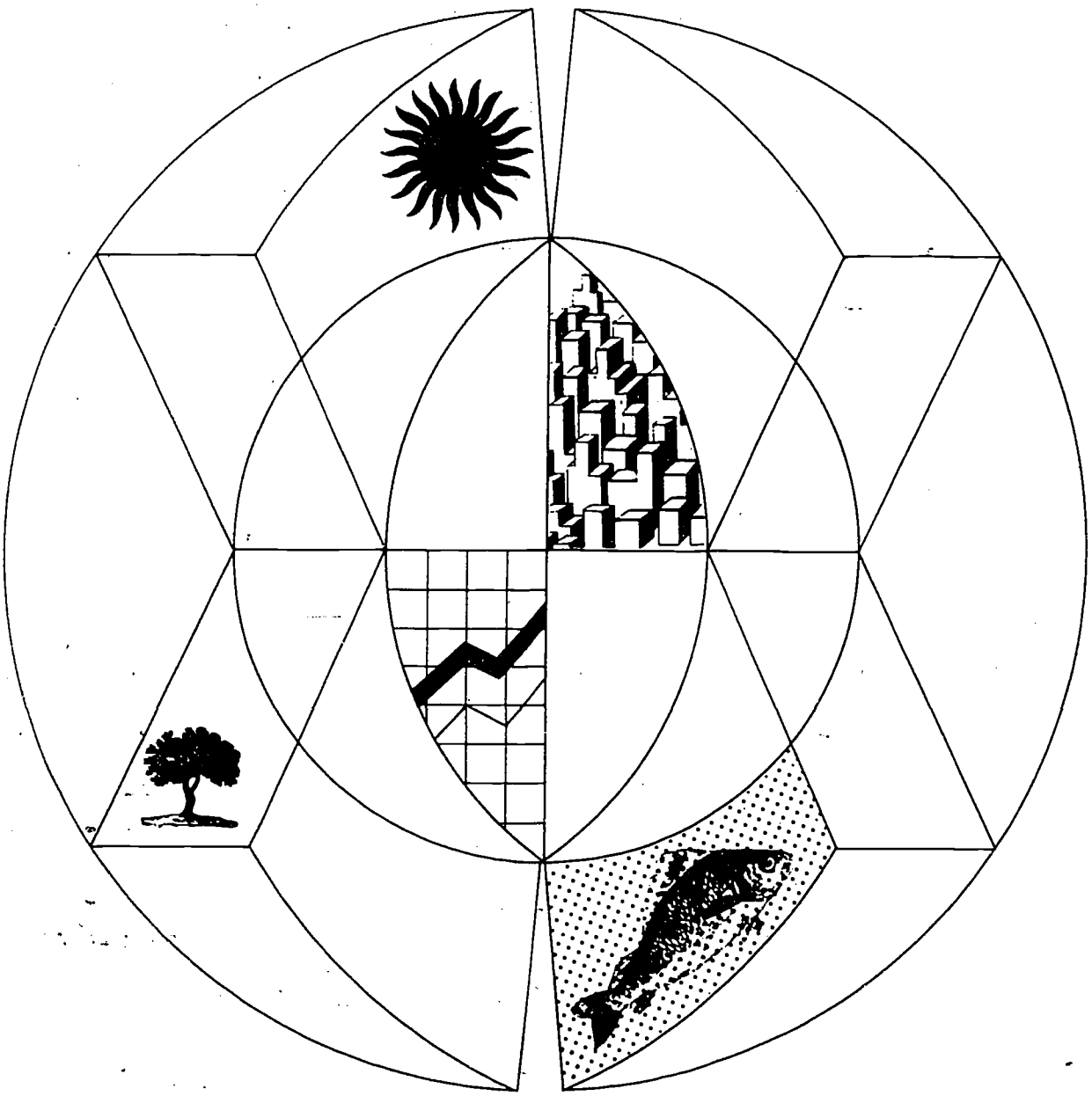
Part B
4-6 Handbook



Environmental Education
Interdependence: A Concept Approach

CENTER FOR GLOBAL PERSPECTIVES

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ENVIRONMENTAL EDUCATION

INTERDEPENDENCE: A CONCEPT APPROACH

HANDBOOK UPPER ELEMENTARY GRADES 4-6

TABLE OF CONTENTS

PART I: INTRODUCTION TO SYSTEMS

This first section can be used as a review of the "systems" idea introduced in the handbook and teacher's guide for grades K-3 in this series. It also serves as an introduction to environmental systems at the 4-6 level. The goals for students are to understand the meaning of systems and to apply this knowledge to newly encountered material.

LESSON 1: WHAT IS A SYSTEM?

GOAL

To introduce or review the properties of a system by using a set of familiar small toys and games.

OBJECTIVES

Students will

1. be able to name the parts of a whole or an incomplete toy;
2. be able to state why each part is needed in a system;
3. understand why the more complicated a system is, the more need there is for care and work to keep the system functioning.

MATERIALS

Enough small toys or puzzles with definable parts so that there is one toy for every two students. Examples: Wooden Chinese puzzles; metal ring or key puzzles; plastic covered bead games (where you tip the puzzle to make the beads go into the proper spots); water pistols (*without* water); a set of jacks. Leave half the toys complete, but remove some part of each remaining toy. You also will need two large paper bags in which to collect the toys, labelled "whole systems" and "not whole systems," respectively.

PROCEDURE

1. Divide the class into pairs of students. Give each pair a whole or partial toy. The toys should arouse interest by themselves; let the

students manipulate them for a couple of minutes, but move on to the next step before trading or loud play sets in.

2. Call on different pairs of students to tell what their toy is, what parts it has, and whether any part is missing. Work in the following questions when appropriate:

   a. What parts does your toy need in order to work? How does each part help?

   b. What if we took away (name some part of the toy: one jack, the decoration, a puzzle part, etc.), could it still work somehow? Are all the parts equally important?

   c. How does taking away this part affect another part (name a specific part)?

3. When students have begun to think about how parts work together, introduce the term *system* for a whole made up of parts that work together. Ask the students to help you list some facts about systems that they have been discovering. Your list might look like this:

   a. Systems have parts.

   b. The parts work together in a way different from the way they work apart.

   c. Parts of systems are not necessarily of equal importance.

   d. Taking away one part can keep other parts from working properly.

   When your list is started, or during class discussion, give students the term "interdependence." It's helpful to break up the word and talk about what "inter" means and what "dependence" means. Ask the class if they can see ways to apply the term to the list of systems' characteristics.

4. Ask a pair of students with a more complex toy to trade with a pair that has a simpler toy. Ask each pair: If you owned the Chinese puzzle *and* the bead toy (for instance), which one do you think might get broken or lose a part first? (The more complex toy is the usual answer.) Ask the class as a whole: What is the most complicated toy you ever saw or heard of? (They may name jigsaw puzzles, train sets, erector sets, etc.) Are those toys harder to take care of than these simple toys? What sometimes happens to hurt those complicated toys? (Parts get lost, delicate electric or mechanical parts are smashed, etc.) Is it fair to say that usually, the more complicated the system, the more care or work it takes to keep it going? (Add to your board list.)

5. Finally, have the pairs of students drop their toys in one of two bags labelled "whole systems" and "not whole systems."

Follow-up Activity 1

As part of language study, ask students to look for uses of the word "system" in books, newspapers, and magazines. You might start a bulletin board collection of phrases using the term. Discuss with the class why "system" is the appropriate word in the phrases they find. The key question to ask is: Are the parts of this "system" interdependent? In what ways?

Follow-up Activity 2

At a learning center, or as part of an individualized instruction program, set up a display or picture set of a wide variety of systems. Include natural systems (a potted plant, a goldfish in a bowl) as well as mechanical ones (a flashlight, a pair of scissors). Each child's task will be to name the parts of each system and tell how any two parts depend on one another to do their job in the system. You might include some "puzzlers" as food for later class discussion, such as a bowl of pond or sea water; a twig; a feather.

LESSON 2: FINDING ENVIRONMENTAL SYSTEMS

GOAL

To show how natural, built, and human systems work together in a playground environment.

OBJECTIVES

Students will

1. identify and list the parts of various systems they see on the playground;
2. describe how the playground systems are related;
3. infer what happens when one part of a playground system breaks down.

MATERIALS

Paper and pencils; clipboards or stiff cardboard to allow for easier writing out of doors.

PROCEDURE

1. Tell the students they are going to act as reporters or detectives to find as many systems as they can on the school playground. Ask a few volunteers to name possible systems they might list (fencing, light system, a tree) to give everyone the idea. If the notion of *human* systems (such as a group of children playing a game) has not yet come up in your classroom, ask -- Is a kickball game a system?

2. Inform students that they are simply to list as many systems as they can find on the playground. Each system named must include a list of its parts. Students may work in teams of two or three on this project. Give them a specific length of time, such as recess or lunch period, in which to work.

3. When teams have reassembled in the classroom, ask each team to go over its list of systems and consider which ones are closely related. Use an example, such as the lighting system or a kickball game, to introduce the idea of *subsystems*. That is, the kickball game includes the human system of players, the built system of asphalt, painted lines and bases, and the system of the kickball itself. Ask each team to try to make a shorter list of big systems which include subsystems they have found.

4. On the board, begin a list of playground systems and subsystems taken from students' lists. As you go, continue discussion of what makes a system and how systems are related. If there are clear gaps in the students' investigation of the playground environment, ask about them. Did anyone think about the air, or weather?

5. Use the word *environment* to describe the set of systems on the playground. If you haven't studied the word in natural science lessons, explain that it means "everything around us" -- not just natural things, but man-made objects and fellow people as well.

6. As a clincher, make a class comic book of "playground systems breakdowns." Assign teams of two or three to consider what might happen to *all* playground systems if one part of one system breaks down. Given such catastrophes as a hole in the fence, a flat kickball, a diseased tree, or a group of children who refuse to play with anyone else, the teams write and illustrate cartoons showing as many effects as they can think of on the other systems. Have students label their cartoons "What happens to the kickball system -- What happens to other play systems -- What happens to the plant system," etc. The set of cartoons can then be posted around the room or bound as a set.

LESSON 3: HOW HUMAN SYSTEMS WORK

GOAL

To emphasize the difference between mechanical and human systems by raising questions of how human systems can be directed and how interdependence makes us feel.

OBJECTIVES

Working in a variety of groups, students will

1. create systems coloring books for younger children;
2. review the systems idea themselves;
3. recognize the difference in personal feelings and efficiency among three diffrently conducted work groups (two of them systems).

MATERIALS

A set of felt pens or crayons in dark colors; heavy white paper; tracing paper.

PROCEDURE

1. Divide the class into three groups, explaining that each group is going to make systems coloring books for primary grade children.
2. Group I will work individually. Distribute paper and a pen to each student; tell them they should each think of a simple system (no more than five parts) to draw in outline. Their drawings should help a younger person see how a system goes together. They may draw the parts separately, then together; leave out a part and ask what it is; mix in other parts (not related) and tell the child to color them a different color. Suggested systems: A chest of drawers, a flashlight, a toy car. Students in this group must not talk or share work.
3. Group II will work as an assembly line. Assign them a system subject -- such as a lamp. Line up their desks in a long row. The first student in line is given a stack of paper. He draws one part just the same way on each sheet, then hands it to the next student, who adds his assigned part and passes it to the next. When each sheet leaves the last student, it should have a completed lamp drawing on it. Tell each student to make several single copies of

his part in addition, so that the coloring books will have both single parts and assembled systems. Give this group full directions and allow them to make no decisions. Encourage them to work quickly.

4. Group III also will work together to create systems coloring books, but they are to decide on the subject and method of work they want to use. Give them materials and suggestions such as you gave Group II, but tell them they must pick one system and work on the book together. Leave them on their own, even if they get into arguments or move slowly.

5. As work progresses, offer tracing paper for the purpose of making good copies of drawings that may be messy. Simple, clear outline drawings are the ideal. Traced drawings may be xeroxed or put on multilith for large scale reproduction.

6. When the work is done (an hour or two), come together for a discussion of work methods. Ask: Which groups were working as *systems?* Which group made the best looking books? The most books? Which group enjoyed the work more? What problems came up in the assembly line system (pile-ups, monotony of work, non-cooperation, no chance for creative work)? What problems came up in the self-directed group (inefficiency, leadership problems)? In the group of individuals (no one to share ideas with, can't make many drawings very fast)? For this task, what sort of system seems best? How do we balance the importance of how people feel, what individuals want, and the requirements of the task? Are different kinds of human systems fitted to different kinds of tasks or situation? Should our government (for instance) be organized like a football team?

7. Distribute the coloring books to primary teachers and ask for some return of colored samples to show your class.

PART II: MICROBES IN THE GARBAGE

The lessons in this section introduce children to one of the most important parts of the natural system of life: the microbe. These tiny living things (bacteria, microfungi, yeasts) play a primary role in converting organic material into the basic elements needed for new life: water, minerals, and gases. They have been called the "natural garbage men" of the earth.

In the past, microbes have been considered more as enemies than as friends. Molds and bacteria were thought of as "dirty" or "germs" and we preferred to burn our garbage and dump chemicals in our water rather than let the natural processes take care of waste. Now people are beginning to see that not only can scientifically handled microbes be a big help in waste treatment (and other areas), but they help us avoid making pollution worse. The idea is that we can and should work *with* the natural system for the benefit of ourselves and our environment.

The exercises in Lesson 1 introduce the microbe through classroom experiments and a story. Lesson 2 touches briefly on the idea that *pollution* is an upset of the environmental system in which microbes play an important part. Lesson 3 involves field work as students explore how well waste treatment in their school and community fits in with other parts of natural and man-made environmental systems.

LESSON 1: WHAT IS A MICROBE?

GOALS

1. To recognize relationships between one's immediate surroundings and the natural systems of the planet.

2. To observe interdependence in human-environment interactions.

OBJECTIVES

Students will

1. conduct experiments with yeasts and observe that living things we cannot always see, called microbes, can markedly transform material and can produce gas;

2. understand that microbes decompose dead plants and animals, in soil and in water;

3. discover that the products of the microbes' work help plants grow;

4. learn that while some microbes are harmful, they can often be controlled by other living things.

Activity A: Making Sourdough Starter

In this activity, children see how wild yeasts floating in the air can be captured to help make good food. You may want to conduct this exercise as part of a study of the American frontier. Explain that when settlers and miners were far away from civilization, they couldn't obtain cultivated yeast to use for making bread. So they captured their own leavening agents in this way.

MATERIALS

A stone crock or bowl, or a stainless steel bowl, sterilized just before use by pouring boiling water over it

A measuring cup sterilized by boiling

1 cup flour

1/2 cup evaporated milk

Boiling water

Cheesecloth and rubber bands

You may want to make just one "demonstration" batch of starter, or allow a batch to every student or pair of students.

PROCEDURE

In the measuring cup, pour 1/2 cup newly opened evaporated milk. Add 1/2 cup boiling water. Combine the diluted milk with 1 cup flour in the mixing bowl and beat until smooth. Cover the bowl with two thicknesses of cheesecloth held on by a rubber band (to keep out unwanted materials). Place the bowl outside for 12 to 24 hours. If it is warm weather, the starter will begin to bubble while still outdoors. If cool, the starter may have to sit in a warm room for a short time before it begins to bubble. While it continues to bubble, stir it every day. When the bubbling stops, refrigerate the starter and cover with an airtight lid (such as plastic film secured with a rubber band).

As students work with the bubbling starter, ask them what they think makes it bubble. List suggestions on the board and invite objections to any item listed. If no one knows about wild yeast, ask them what makes ordinary bread rise. How is baked bread different on the inside from bread dough? Children should see that bubbling fills the bread with little

holes and makes it less heavy. Explain that the bubbling is caused by a kind of microbe (tiny living thing) called *yeast*. As the yeast eats small amounts of organic food (such as flour and milk), it produces a gas that comes up through the dough. These are the bubbles. Invite speculation on other questions.

- Why does the starter stop bubbling? (The yeast has consumed as much food as is available to it chemically.) Does the yeast die then? (No.)

- Why do we refrigerate the starter? (Try leaving a batch of starter on a shelf instead for comparison.) Does the yeast die in the refrigerator? (No, it is inactive then, but becomes active again when it is warmed.)

- What happens to the yeast in baked bread? (As the bread bakes, the yeast is killed by the heat.)

Optional Follow-up Activities

1. Dissolve 1 package of commercial dry yeast in 1/4 cup of warm water in each of two dishes. To one dish, add 2 tablespoons of sugar. Ask the children to observe both dishes. Which bubbles up more? Why? Children may ask why the one without sugar bubbles at all. Explain that packaged yeast contains some food with the yeast organisms. Remember -- the wild yeasts can't be seen at all!

2. You can make an edible product with your starter from recipes in many commercially available cookbooks, such as *Sourdough Jack's Cookery* and *The Sunset Cookbook of Breads*.

Caution: Any starter may be invaded by unwanted yeasts, molds, or other ogranisms which produce off-tastes. If this happens, you may have to start over again with fresh ingredients. Ordinary starter produces baked goods with a slightly sour taste.

Here is a recipe for sourdough pancakes, a favorite California Gold Rush food:

> The night before you plan to use the starter, remove it from the refrigerator and divide it in half. To each half, add 1/2 cup of flour and 1/2 cup of fresh whole milk. Stir both mixtures until smooth, cover both with plastic film secured by a rubber band, and set in a warm place overnight. Next morning, return one batch to refrigerator and use the other. This way, you always have some starter. Other ingredients:
>
> 2 eggs
>
> 1 tablespoon sugar

1/2 teaspoon salt

1/4 to 1/2 cup melted butter or margarine

1/4 teaspoon baking soda dissolved in a little water

Mix the ingredients together, beginning with the starter. Adjust, with a little extra milk or flour, to make a pour batter. Makes 8-10 pancakes. (Adapted from directions by Home Economists, Consumers Cooperative of Berkeley, Inc.)

Activity B: Burying the Dead

In this activity, children observe partial decomposition of animals and plants, and explore the relation between the action of decomposers and the health of living plants.

MATERIALS

1. At least three small jars with lids, or enough for each pair of students to have one set of three jars.
2. Small dead plants and animals (preferably insects). If possible, use organisms from the classroom. You may use parts if the organisms seem too large. Aquatic and land organisms may be used.
3. Clean sand, moistened with water.
4. Ordinary soil.
5. Pond or stream water, or tap water aged 24 hours to reduce effect of chlorine.

PROCEDURE

1. Place the damp sand and several insects and plant parts in Jar 1 so that the organic materials are pressed against the glass for better visibility.
2. Repeat with damp soil and more organic bits in Jar 2. Use about the same number of plants and animals as in Jar 1.
3. Place some dead plants and animals, comparable to the amount in the other jars, in the pond water of Jar 3. Place lids on all jars, but leave them loose enough so that gas from decomposition can escape.
4. Have the children write down their observations of the jars every two weeks for 4-6 weeks. They should observe *mold*, which you can identify

as a kind of microbe, and a smell which you can explain comes from the invisible work of microbes called *bacteria*. As time goes by, children will see the organic material change as microbes eat and transform it.

5. Questions to be considered as children note down what happens:

   a) Which jar shows the quickest change? Why do you think it changes most?

   b) Do the decomposers (mold and bacteria) give off gas? How do you know?

   c) In what ways are the decomposer microbes like the yeast microbes of Activity A?

   Caution: Keep the students from closely smelling the jars' contents; explain that the microbe spores (like seeds) may not be good for humans.

6. When enough decomposition has taken place so that a kind of brown water can be poured from the soil and sand jars, ask students if they think the brown water might have any use. They may think it is "dirty" or "polluted." Some may suggest that it might make a fertilizer.

7. Experiment by "watering" a small plant potted only in sand, with some of the brown water (keep a similar small plant on a strict water diet as a control).

8. As an equivalent aquatic experiment, fill a goldfish bowl with pond or aquarium water and aquatic plants and algae (no fish). Add a little of the water from Jar 3. Children should see some plant growth.

For more information and alternative activities in the area of decomposition, see *Ecosystems* Teacher's Guide of the Science Curriculum Improvement Study, published by Rand McNally, 1971.

Activity C: Microbes and Health

Students often know about "germs" but are unaware that they are part of a large microbe family. If you can obtain microscope slides of disease microbes from a school nurse or local health department, have students look at them. (See E. Morholt, P. Brandwein, and A. Joseph, *A Sourcebook for the Biological Sciences*, Harcourt, Brace & World, 1958, pp. 380-381, for more information.) Invite a school doctor or nurse to talk to the class about disease bacteria and viruses, how they travel and how they work in the body.

The following story of the discovery of penicillin introduces the idea that certain microbes work to balance other microbes. This idea is

especially important for us in the area of disease control. Read the story aloud to the class, or have the students read it individually. (The story has been typed separately in larger type to facilitate reproduction and students' reading.)

THE DISCOVERY OF PENICILLIN

A cold December wind is blowing through an army tent. This is a medical tent, and the time is the First World War (1918). All around, wounded soldiers lie on cots. The only warmth comes from a small coal fire in a bucket. The soldiers are shivering and muttering in French and English.

Suddenly, a young British doctor comes in. He works quickly and carefully, changing bandages and talking with the sick. He is alone today; his usual attendant has caught the Spanish flu. Doctor Alexander Fleming fears that the attendant may die, as have so many others. Between the flu and the infected wounds, the village cemetary nearby has been overloaded with the dead.

In the evening, Dr. Fleming studies microscope slides by the light of a candle. He is examining bacteria that he thinks may cause the flu. But he finds that this bacteria is not the same in all flu victims -- so the cause of the flu remains a mystery. Moving between his books and microscope, he looks next at the microbes that cause gangrene (a terrible death of the flesh around an infected wound). He knows that keeping a wound clean with antiseptics before it is infected is good. But once infection begins, antiseptics only harm the victim.

Finally, late at night, the doctor pushes his books aside and turns to his journal. "I am surrounded by all these infected wounds," he writes. "Men are suffering and dying without our being able to do anything to help them. I only wish I could discover, after all this struggling and waiting, something which would kill those microbes."

Years later, Dr. Fleming was still working with antiseptics in a London research hospital. At one time, he almost thought he had hit on the miracle "bullet" that could kill harmful microbes without hurting people. He had discovered that a

little mucus from his own nose killed certain microbes. Experimenting further, he had found that fingernail parings, hair and other bits from the body surface had the same ability. Dr. Fleming traced the microbe-killing ability to a particular substance. But, he found that the substance killed only what we think of as "harmless" bacteria. The disease microbes remained very alive. Dr. Fleming realized he had simply seen the body's natural defense at work. Many bacteria never get inside us to do harm because they are stopped at the body surface. The microbes we think of as disease causers are just those strong enough to pass through that first defense line.

Dr. Fleming put his discovery on the shelf and went on with his antiseptics studies. He was still after something that would work against infection and disease.

One day in 1928, Dr. Fleming was hard at work in his laboratory, going back and forth among his dishes of bacteria and his microscopes. A tea kettle bubbled on a burner. The door of the laboratory was left open as always. When the air grew stuffy, the doctor would make his way past the piled-up dishes and equipment to open the window.

A younger researcher dropped in to see Dr. Fleming and as they talked, the doctor picked up a few old dishes and removed the lids. Some of them had grown moldy. "As soon as you uncover a culture dish," said Dr. Fleming, "something tiresome is sure to happen. Things fall out of the air." What do you think he meant by that?

As he looked over each old bacteria culture (that is, a group of bacteria grown in liquid "food"), he stopped at one dish. The mold on the old culture was well grown. And all around it the bacteria seemed to be dead or dying. "That's funny," said Dr. Fleming. Was something in the mold killing the strong disease microbes in the bacteria dish?

Dr. Fleming didn't let his guess lie. Quickly, he took parts of the mold and put them in new dishes with fresh "food." He tested the mold against many disease microbes, which it killed. And when put with human blood, it did no harm! For a time, Dr. Fleming collected as many molds as he could to see if they all would kill microbes. An artist friend of the doctor's remembers him coming to the Chelsea Arts Club and suddenly saying, "If any of you chaps has got a pair of moldy old shoes, I should very much like to have 'em." The artists were surprised, but they helped out.

Dr. Fleming soon found out that the first mold was the only one that worked to kill the harmful microbes. But the question of how to make the mold into a medicine remained to be answered. Dr. Fleming always had faith that the active ingredient in the mold -- he named it "penicillin" -- would one day cut down human disease. When penicillin finally did appear as a useful medicine, it had the work of many other scientists from England, France, Germany, and the United States behind it.

After he won the Nobel Prize in medicine for his discoveries, Dr. Fleming said: "I have been accused of having invented penicillin. No man could *invent* penicillin, for it has been produced from time immemorial by a certain mold. No, I did not invent the substance penicillin, but I drew people's attention to it, and gave it its name."

QUESTIONS FOR DISCUSSION

1. Disease microbes work by eating parts of the flesh. How are they like yeast? Like decomposer microbes?
2. What do you think Dr. Fleming meant about "not inventing" penicillin?
3. Many people were surprised to find that disease microbes had a "natural control" in a common mold. Similarly, birds control certain insects that would be very harmful if they could multiply without hindrance. Can you think of other "natural controls"?

LESSON 2: MICROBES IN THE SYSTEM

This brief transition lesson is meant to establish the fact that pollution involves some upset of the environmental system. Microbes are an important part of that system.

GOALS

1. To observe interdependence in human-environment interactions.
2. To better understand and appreciate the local environment.

OBJECTIVES

Students will

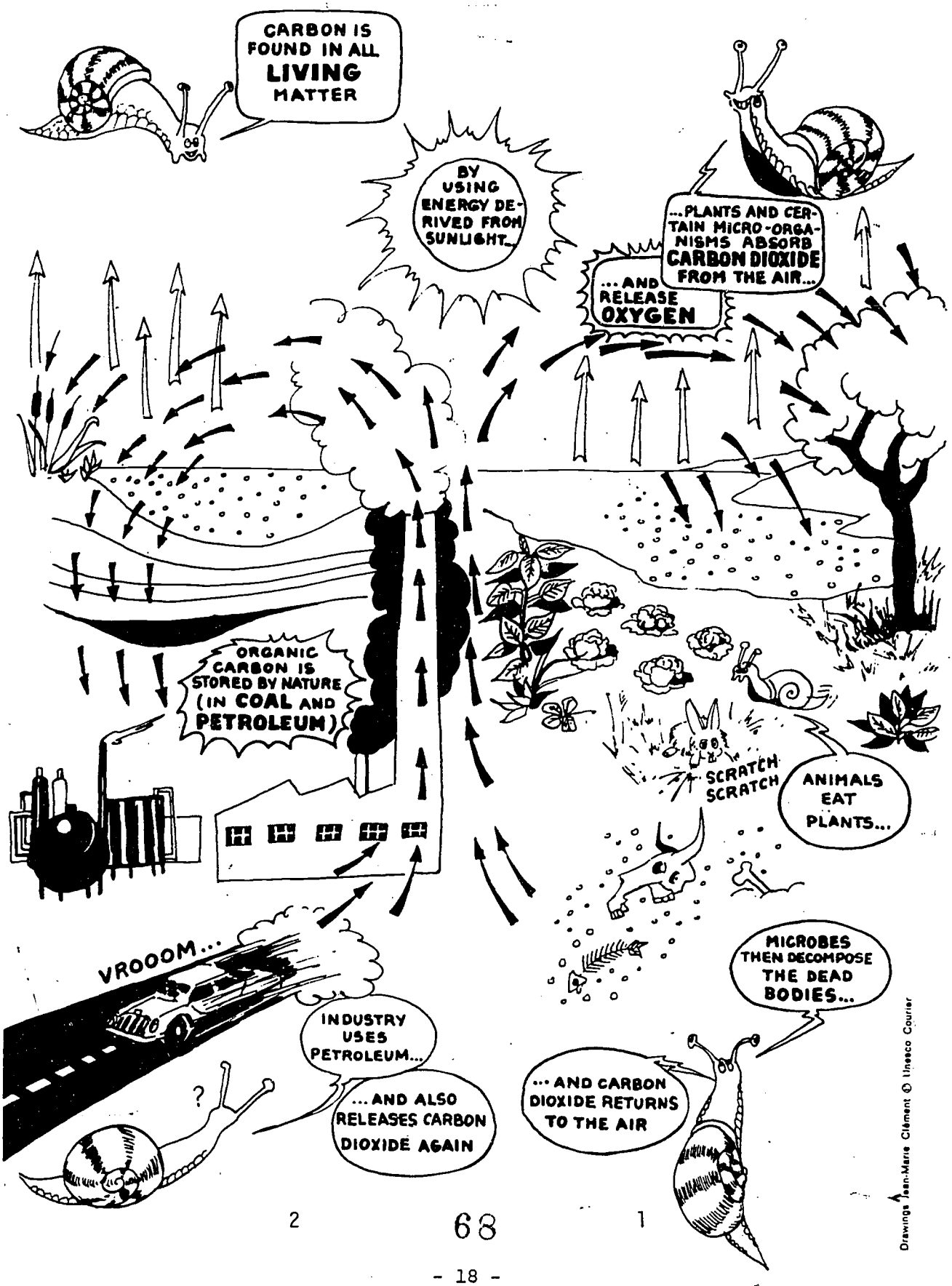
1. list known examples of pollution;
2. define pollution incorporating the term "environmental system;"
3. make generalizations about the need to work as close as possible with natural systems.

MATERIALS

1. Pictures of polluted areas -- algae-covered lake; brown trees hurt by smog; trashy picnic area; strip mined area; etc. Include some "natural disaster" pictures -- flood and fire damaged areas.
2. Simple cartoon chart (see next page) showing two cycles side by side. *Cycle 1* should show: using energy from sunlight, plants absorb carbon dioxide from the air and release oxygen. Animals eat the plants. Microbes decompose dead animals and return carbon dioxide to the air. *Cycle 2* should show: organic "food" is stored by nature in coal and oil. Industry uses these fuels and releases carbon dioxide to the air.

PROCEDURE

1. Begin by asking students for examples of pollution they know about. (You might list their answers on the chalkboard.) Most will probably name man-made pollutants such as oil in the water or trash left in public places. Ask whether the pollutant hurts different parts of the environmental system in each case (that is, do you think the oil spill hurts plants in the water? Fish? Birds? People who want to swim? How?). Go through your pollution pictures and ask similar


CARBON IS FOUND IN ALL LIVING MATTER
BY USING ENERGY DERIVED FROM SUNLIGHT...
...PLANTS AND CERTAIN MICRO-ORGANISMS ABSORB CARBON DIOXIDE FROM THE AIR...
...AND RELEASE OXYGEN
ORGANIC CARBON IS STORED BY NATURE (IN COAL AND PETROLEUM)
SCRATCH SCRATCH
ANIMALS EAT PLANTS...
VROOOM...
INDUSTRY USES PETROLEUM...
...AND ALSO RELEASES CARBON DIOXIDE AGAIN
?
MICROBES THEN DECOMPOSE THE DEAD BODIES...
...AND CARBON DIOXIDE RETURNS TO THE AIR
Drawings Jean-Marie Clément © Unesco Courier

questions. When you come to a picture of a flood or fire, ask: Is this pollution, too? Why or why not? As a class, try writing a definition of pollution using the term "environmental system." (You may want to refer back to work done on systems in Part I of these lessons.)

2. Turn to your chart. Ask: What if there were too many plants in Cycle 1? What would happen to other parts of the system? What if there were too many animals? Too many hungry microbes? What problems would occur if there were too few of these? Would they be similar problems for the system?

3. Turn briefly to Cycle 2. Ask: Which do you think will last longer, Cycle 1 or Cycle 2? Which cycle has an unlimited "food" supply? When microbes are at work, they actually produce, besides carbon dioxide, water and minerals that help the soil. What does industry produce besides carbon dioxide? (Consider, for example, an automobile or a coal furnace.) How well does Cycle 2 fit in with Cycle 1, in general? Most of us live in environments that include both systems. Why is it an advantage to try to work with the natural systems as much as possible, while we build the man-made items we want?

Optional Follow-up Activity

If you have a bare spot of ground in the school area where you can dig holes, try an experiment in garbage treatment. Have half the class bring in a small item of organic garbage -- such as a banana peel or bread loaf-end. The rest of the students should bring non-organic garbage items, such as plastic bags and tin cans. Discuss first any questionable items -- remind students paper and cardboard are organic because they come originally from living things. Bury the organic and inorganic garbage in separate holes; cover well with earth. After a couple of months, dig them up again and examine. What evidence to do you have of microbes at work? What (if anything) happened to the inorganic garbage?

LESSON 3: MICROBES IN THE GARBAGE: FIELD WORK

By the time students have completed the exercises of Lesson 1, they should have some idea of the place of microbes in the recycling of organic material. In this section, a variety of field trips and investigations into garbage in the local community are suggested. Children should observe how garbage and water treatment fit into the natural system.

GOALS

1. To observe interdependence in human-environment interactions.
2. To better understand and appreciate the local environment.
3. To recognize relationships between one's immediate surroundings and the natural systems of the planet.

OBJECTIVES

Students will

1. examine the amount and cause of "pollution" in their own school, and suggest remedies;
2. make a study of the local garbage dump and show, with a chart or mural, its degree of efficiency as a waste treatment system;
3. compare "natural" water purification with methods used in a local plant;
4. make conclusions about how well local waste treatment fits into the environmental system.

Activity A: School Garbage

A good place to begin investigating what happens to garbage is in your own school. Try:

1. Inviting a school janitor and a cafeteria person to your classroom. Have students prepare questions to ask them about garbage problems in the school. Sample questions: How much (in weight or number of cans) does the school produce each day? Where does it go? Is there any recycling of papers, cans, or bottles? Can students do anything to reduce the amount of trash?
2. Mapping the school and grounds, showing location of the trash receptacles and areas where litter is worst. Can trash cans be better placed? Can ugly cans be hidden or decorated?

3. Surveying the school grounds for kinds of pollution. This may include a list of all waste items left around buildings and grounds; notation of any air pollution (are buildings dirty? trees looking rusty?); and damage to lawns or plants by trampling or misuse. Invite students to suggest ways to stop the pollution, keeping in mind the possible consequences of any action. For instance, someone may suggest that throw-away paper forks or plates be replaced by washable plates and cutlery. But the class will have to keep in mind the detergent that will then regularly be sent down the drains. The most realistic approach to environmental problems includes economic and human consequences, too. Will the labor cost of hiring people to wash dishes outweigh the savings from not buying paper plates?

   While these points should come out, at the same time, you won't want students to feel that every effort at improvement is bound to get stuck in a mire of additional problems. Even a small improvement students suggest, and see carried out, will give them a sense that they make a difference.

Activity B: The Garbage Dump

If you are unable to make a field trip to the local garbage dump, try making slides of it to show students, and invite the dump manager or some other knowledgeable person to talk to the class.

Many American garbage dumps are simply that -- assigned spots where garbage is deposited, remaining unsorted and untreated. Some dumps have provisions for burning. If burnt at a very high temperature, garbage can be disposed of with very little pollution. But low-temperature burners simply spread pollutants through the air and leave a mass of charred remains still to be dealt with. Some dumps use garbage in "sanitary land fill" -- a layer of dirt over every layer of garbage. If enough soil is used this works well. Microbes from the soil easily decompose the garbage. But if there is not enough soil, garbage remains "undigested" and there is a danger of cave-in.

As students observe the dump and talk with the person in charge, have them fill out a checklist:

1. How does the garbage smell?

2. Possible cause of smell:

3. Any burners at the dump?

4. Pollution observed from burners:

5. Garbage used for any purpose?

6. Method (if any) of garbage sorting:

7. Amount of land taken up per year by garbage:

8. How long before 1 cubic meter of garbage is absorbed and transformed into soil:

9. Observation of molds or fungus:

10. Other plants:

11. Animals observed at the dump:

Back in the classroom, use the collected information from the checklists to make a large chart or mural of "the garbage dump system." Begin by listing on the board the decomposers students observed at work on the dump. Are they doing a good enough job? (See checklist answers #7 and #8.) Do they affect other systems in helpful or harmful ways? Your board list may look a little like this:

1. Bacteria at work (smell of gas released)

   - Probably helping garbage to decompose slowly

   - Smell is bad for miles around

2. Animals digesting garbage (flies, rats, cats seen)

   - Eat some garbage

   - Number of animals keeps increasing -- they spread around the community.

3. Incinerators burn garbage

   - Much garbage burnt

   - Piles of ashes still left and smoke pours into the air

4. Crushers break up garbage

   - Smaller pieces decompose faster

   - People given jobs on roller tractors, etc.; some noise and exhaust comes out

Students can then draw these activities and effects in a mural. Unless your community is unusual, what they will picture is a poorly working, or incomplete system. Students should begin to recognize this

as they work through the activity. Encourage their thinking with such questions as:

- If garbage takes up more and more land space each year, what other parts of the natural system will it hurt?
- Is our garbage handled so that microbes have the best chance to decompose it?
- How much of our garbage is *outside* the natural system -- that is, can't be easily decomposed? What are we doing with it?

The Spaceship Earth image should help students see how vital it is that our wastes be part of a system. If trash were simply allowed to pile up in a spaceship, the consequences for life would be disastrous. And earth is only a large spaceship traveling through the cosmos.

Finally, work as a class toward better ways of integrating garbage into the natural system. Make a list and keep it next to the garbage mural. You may title it, "Ways to Make Garbage Part of Our System." Students will probably immediately suggest recycling. Another approach is to provide ways for microbes to do their work better (for example, in proper sanitary land fill). In some areas, people are starting to use the methane gas produced by garbage decomposition for fuel. For example, the Palos Verdes sanitary landfill near Los Angeles supplies 3500 homes with methane gas. Here microbes are really used: they both "eat" the garbage and provide usable fuel.

Optional Follow-up Activity

Visit a farm, nursery, or garden where compost is being made. Ask those in charge to explain the process to your students. This will give them some understanding of where the *heat* in the compost comes from, and why proper moisture is important. They will see, quite graphically, how ideal conditions for microbes can make good food for plants.

Activity C: Water Treatment

A water treatment plant is often popular as an elementary school field trip. The trip will be more meaningful if incorporated with this sort of natural systems approach.

PROCEDURE

1. In-class preparation: Ask students where they think their drinking water comes from, and ask them to list things they think may need to

be cleaned out of it before it is drinkable. They can compare these pre-trip lists to what they find out on-side.

2. Make a brief study of ways in which water is purified. Many books for children are available on this subject; one with good pictures (but a sophisticated text) is the Time-Life series book on "Water." Briefly, water may be boiled or chlorinated to kill harmful bacteria; filtered and allowed to "settle"; aerated; or cleared with alum.

3. Prepare a checklist for your students on which they may note (a) the major "pollutants" that have to be cleaned out of the water, and (b) the means used.

4. Compare your water treatment plant's methods with those of "nature." Does the water plant use microbes to help with the job of cleaning? Explain that many modern water plants select and grow special microbes to help. These microbes are grown in a thin slime on pebbles; as the water filters through, the microbes eat up the "trash," just as they do in ordinary streams. A very good, simple book that explains this process is *Who Will Wash the River?* by Wallace Orlowsky and Thomas Biddle Perera (New York: Coward, McCann, and Geoghegan, Inc., 1970).

5. Prepare a chart or mural similar to that in Activity B, showing "Our Water System." Be sure students include the sources of water in your area (river, lake, reservoir); sources of pollution; the water treatment plant itself; and where the water goes after it is "used." How efficient is this "system"? Where do "hangups" lie? Can we learn anything from the "natural" water purification system to help us out?

Optional Follow-up Activity

Visit a local pond, stream, or lake -- preferably with a naturalist. Ask students to look carefully for signs of pollution and signs of health.

- Is there some algae? Too much?

- Do fish and insects live here? Birds?

- Does the water run through rocks or gravel?

PART III: THE COMMUNITY ENVIRONMENT

The lessons in this part are designed to explore how different peoples at different times may function in the same environment. One emphasis is on the difference various degrees of technology have on how a community interacts with its environment. More technology means more interdependence with other people and places around the globe. It provides the chance to make the most of our environmental blessings. But without proper control it can bring problems of crowding, pollution, and a loss of closeness with the earth.

A second emphasis is on ways of living in our built environment. Children are encouraged to compare modern life styles in homes and public buildings with the past. They consider why these styles are different and how various built environments make people feel.

LESSON 1: STORY OF A RIVER TOWN

GOALS

1. To distinguish between built and natural environments, and to recognize functional and aesthetic elements in each.

2. To recognize that people both use and shape their environments.

3. To observe interdependence in human-environment interactions.

OBJECTIVES

Students will

1. compare the lifestyles of different people in the same environment;

2. generalize about the effects of technology on both the natural and built environments.

Following are stories of life in a town on the same location at three different historical periods. St. Charles, Missouri lies on the Missouri River just above St. Louis. It was founded by French settlers who called it "Les Petites Cotes" -- "The Little Hills." (When the Spanish took over the Louisiana territory they renamed the town "San Carlos" -- whence the modern "St. Charles.") Even before the French, Osage and other Indian tribes had permanent villages along the river. Discussion questions and activities follow the stories, which begins on the next page for easy duplication.

STORY OF A RIVER TOWN

TO THE STUDENT

This story has three parts. As you read each part, try to imagine what it would be like to live in that time and place. How are these people like you? How do they live differently?

PART I: THE NATIVE VILLAGE

The Natives' village sits on a high bank, well above the wide and sluggish Missouri River. To the people of the village, the river is a powerful god. They know it is best to keep away from the river's anger when it comes into flood. And many times in every year the river becomes angry. Then around the village for miles the flood waters make a silvery lake, broken only here and there by a little hill of land or the top of a tree.

On such a flood day, most of the people stay inside their lodges. In each warm, roomy lodge there is a good stew of fish and squash, with corn pones to be toasted over the fire. The women meet together to sew or weave mats and talk. They feel glad that their last year's harvest of squash, pumpkins, beans and corn was so good. When the flood waters go down, they plan to go out to the river's edge to plant their seeds once more. Along the river the soil is rich -- blessed by the river god. And it is fitting that women only should plant and reap the harvest. Women give birth to all new life for the people.

Meanwhile some of the village men are gathering in the center of the settlement to talk. That space is open, the earth beaten down like a floor from the steps of many feet over the years. Around the open space the rectangular lodges

are ranged. The men outside can see smoke from the lodge fires pouring cheerfully from the roof-holes. This outdoor meeting in the cold and damp will have to be short, but of course the open village center is the proper place for councils and ceremonies. Meetings here have kept village order and pleased the spirits for many generations.

The men meet on this day to plan for the next long hunting trip. Twice a year, the 150 people living in the village leave the river and head for the prairie. They load their belongings on long drag-sleds to be pulled by dogs. Families hike along next to their dogs with much singing and joking. When they come to good hunting country, skin tents are set up and women and children get ready to skin and prepare the animals as they are brought in. Then the men face their hardest job of the year: to somehow trap and kill a few wild buffalo.

Thinking of the hunt, the men in the council area speak of their last trip out in the winter time. The trip was made mostly to get buffalo hide. Long buffalo robes keep the tribe warm in winter. And strips of hide are used for everything from attaching a blade to an axe handle to stringing a baby's cradle. Last winter's hunt brought in the hide, but at a great cost. First, they had tried to frighten the buffalo into running off a cliff -- but that did not work. Then a young volunteer had dressed in a wolf-costume to sneak into the herd and try to shoot one buffalo with his bow and arrow. But this brave hunter had been trampled to death by the herd. Finally, the men had separated two animals from the herd and killed them.

Now the men plan new ways to kill buffalo in the coming summer hunt. They could set fire to part of the prairie, to push the herd in one direction. Perhaps they could dig a great pit and try to lure some buffalo into it. Any way

they look at it, the job is hard. They are glad to have the easier game of the river at hand -- fish, birds, and beaver. When large deer or elk come down to drink, they can sometimes be killed for food as well. The river is always the staff of life.

Their meeting over, the men stroll back to their lodges. In most lodges, several families live, sharing the central cooking fire. Each lodge is built according to a common pattern. A framework of bent saplings meets at a central ridgepost. Mats woven from river rushes cover the roof and walls. Between the lodges there are broad pathways, but no straight streets. Tall racks outside hold drying corn and meat up out of the reach of the dogs, who wander loose through the village.

In one lodge an important visitor is being entertained. He has come from down-river in a canoe, bringing news and trade items from the south. A crowd of Natives gather around him as he tells of a strange new animal that his tribe has gotten by trade with yet another tribe. The animal is taller than a man, and can carry a man or a burden on its back. It is strong, and a great help in work and hunting because it can be trained. "What do you call this beast?" some of the Natives ask. "We call it the Mystery Dog," answers the visitor, and he smiles. "One day we may all ride these Dogs, to travel far and hunt more game." Some of the Natives agree. But others answer, "With the river to feed us and carry our canoes we need no new animals. Life here in the village is good. We live at peace with the river god."

QUESTIONS FOR DISCUSSION

1. Horses were brought to the New World by the Spanish, and reached Indians all over North America by trade, before white men started to explore the interior. Why do you

think the Indians called horses "mystery dogs"? What difference do you think "mystery dogs" might make to the way of life of the village people?

2. The village population was about 150. Why do you think the Natives in that area lived in such small villages? The present population of St. Charles, Missouri (a town near the old village site) is 30,000. Could that number of people live as the Natives lived in that place? What problems would they have?

3. How are the villagers interdependent? How do men and women depend on each other's work for the good of the village? Do they depend much on people outside their village? Do they depend much on the environment right around them? On places far away?

PART II: THE FRENCH OUTPOST

In 1769 a French Canadian trader named Louis Blanchette was moving by canoe up the Missouri River from St. Louis. His eyes followed the bank closely as he searched for the spot where he had stopped before, to camp and meet with other traders, trappers, and Indians. This time, he meant to build a house and start a real town. The Indians spoke of a village that had long since disappeared, near the same site. It certainly was a good dry place for a town, where the banks rose a bit from the river. Blanchette would call his new outpost "Les Petites Cotes" -- The Little Hills.

Blanchette and other French-speaking settlers soon made the outpost into a village a little like those they had known in France. True, their town was not as refined as some. Indians, trappers, and explorers argued with merchants and boatmen on the docks. The houses were often full of rowdy visiting frontiersmen, shouting and drinking at all hours of the night. Yet, the settlers of Les Petites Cotes went into

St. Louis to hear the opera. And they sent their daughters to finishing school at the older village of Sainte Genevieve down the Mississippi.

But in many ways, this village suited the Frenchmen's old habits. Homes often doubled as places of business. And around each house lay its own gardens, orchards, barns, stables and sheds, all neatly fenced in. These groups of buildings were separated by narrow, turning dirt lanes. You were as likely to meet a sheep or pig in those lanes as a person, for much of the livestock wandered about loose.

The houses were of many kinds -- from the tiny huts of the poor to the mansions of the rich. But most were built of upright logs, in the French manner, and each had some kind of porch. The porch kept the house cool and made a pleasant meeting place for neighbors.

Around the village lay farm and grass land. A few villagers tilled their own fields, and a few kept slaves. But most shared in the communal fields, which were owned by the whole village. Each citizen was given a strip of land to farm. Every spring, the people turned out with horsedrawn carts and wooden plows pulled by oxen. When their seeds had been planted, they let nature take her way. At harvest time, there always seemed to be enough. And what could not be grown, could be gotten by trade.

The biggest traders in St. Charles kept steady contact with French merchants in Canada, St. Louis, and New Orleans. A brisk trade floated in and out of the St. Charles harbor on bateaux (pronounced "bat-ohz"). These were large, flat-bottomed boats which could be paddled or poled along the river. They carried furs from the wilderness, grains and salted meats from villages. They brought to Les Petites Cotes goods from around the world -- metal tools from New England, china from France, spices from the Indies. Many men in the village prided themselves on their knowledge of the river -- for they

depended on it to keep the town alive. A good boatman knew how to watch for snags under the water, and how to find the rght channel in a flood. Winter ice jams often stopped trade and sometimes cost lives.

When trade was slow and the harvest was in, the villagers gathered in one another's homes to gossip and play cards. The host would offer his friends wine made from his own grapes. (The first grape plants had come from France.) Late into the evening they would shuffle the cards and tell stories, for they were at ease in rich America. Everyone felt that the future was bound to be good.

QUESTIONS FOR DISCUSSION

1. What does the village use the river for? How does this compare with the way the Indians used the river?
2. When a home and a store are the same place, how does that change going to the store? Or life at home? Do you like the idea of filling many needs close to home -- with barn, orchard, etc. right next door? Is that much like the way you live now?
3. How much do the French villagers depend on each other? On people far away? Do they depend as much as the Indians on their environment? Do they depend more on places far away?

PART III: THE MODERN PORT

It is nearly midnight when Jim Bradley comes on deck to take his turn steering the riverboat. The Missouri is calm and quiet, only a few lights showing along the bank. Jim glances at the radar screen as he sips his coffee. It shows the shape of the river bottom, although the dangers are few since the river was dredged some years ago. Suddenly a small machine overhead crackles. Jim picks up a receiver, and

speaks to the captain of a boat coming upriver. "Hello, Mac -- going to pass you soon," he says. "You take the outside and I'll stay close in the St. Charles side." A few moments pass, then a ghostly boat shows up, coming on through the foggy night. Jim runs out to the open deck and waves wildly. He can barely see the man on the other boat jumping and waving. It's nice to meet a friend on the river.

Back in the pilot house, Jim's thoughts turn to the state of the river. The Missouri always was muddy. But since they dammed it and started using it for power and watering crops, the river had gotten plain dirty. Part of it came from the meat packers along the river. Part came from fertilizer washed out of the land. And of course, part came from industry and gasoline-powered boats like his own. Of late, though, the river looked a little cleaner. Maybe the new clean water laws were starting to work.

Jim's boat is loaded with South American coffee he picked up in New Orleans. He is due to leave it in St. Charles. His boat will be loaded with electronic devices from the St. Charles factory to take back down the river.

Even though the river control project seems to have brought more people and pollution, Jim still feels grateful for it. Without the project, he and all the others wouldn't be on the river at all. When the railroad came at the turn of the century, people stopped shipping by the slow river. And fast modern boats couldn't get through the silt and floods. When the government agreed to help after World War II, they finally tamed the Missouri.

Jim's boat comes into St. Charles just at dawn. With a few hours to kill, he wanders downtown. There are still some signs of the old French village. He notices French names on shop signs and mail boxes. Mostly, though, this looks like a modern American town. The streets are lined with parked cars. Downtown he notes a post office, several national

banks and chain stores. The county courthouse has a dignified look in the early light.

Jim slips into a small cafe for breakfast. A TV set, over the counter, is showing the latest news from Israel. With the state of the world on his mind, Jim heads back to the dock. The electronic parts are being loaded on his boat, and a group of kids are watching. "Are you the pilot?" one of them asks of Jim. "Yes," he answers. "Do you kids often come down here so early?" They say they sometimes stop at the docks early on Saturdays. They all want to be river pilots.

Jim looks around the dock as he talks with the children. Men and machines are hard at work loading and unloading every sort of cargo. Jim thinks about all the people who have come up and down this river -- Indians, blacks, whites, traders, explorers, artists, engineers. The port of St. Charles might share similar looks and problems with many other American towns, but it is special in its own way. It's still a real river town.

QUESTIONS FOR DISCUSSION

1. Would you like to have Jim's job? How has technology made his work different from the work of the French river boatmen?

2. St. Charles today is a shipping point for farms all around the region. People of St. Charles also work at making dresses, beer, dairy products, aluminum products, and electronic devices. What work in St. Charles is connected to the environment there? What work depends on places far away? Do St. Charles people depend on others far away more than the Indian or French villagers did?

3. Most American towns have a "downtown" for shopping and a "residential area" where people live, one family to a house or apartment. How is this different from the French or Indian way? How does tech help make it possible? What do you like about it, ar don't you like about it?

ACTIVITY A

TO THE STUDI

The first of the following poems was a traditional chant of Indians from the central part of North America. The second is by the American poet, Carl Sandburg. What different attitudes do they show toward the land and time? Read the poems carefully. Then pretend you are a French settler in the old village. Write a short poem that tells how you feel about the land and passing time.

1. I shall vanish and be no more,
But the land over which I now roam
Shall remain
And change not.

2. I speak of new cities and new people.
I tell you the past is a bucket of ashes.
I tell you yesterday is a wind gone down,
a sun dropped in the west.
I tell you there is nothing in the world
only an ocean of tomorrows,
a sky of tomorrows.

I am a brother of the cornhuskers who say
at sundown:
Tomorrow is a day.

ACTIVITY B

Role play an imaginery meeting of the new and former residents of St. Charles to decide about the future of the town. Include Indians, French settlers, and modern citizens. Each culture group should meet first to decide what their goals are for the future. Then all can meet together to try and reach a decision. Allow time for each group to explain its values to the others. That is, the Indians for instance will need to talk about why they think the river is sacred and the moderns will have to explain why they think the latest technology is important.

LESSON 2: HISTORY AT HOME

GOALS

1. To use knowledge and skills from many subject areas to explore and understand the student's total environment.

2. To better understand and appreciate the local environment.

OBJECTIVES

Students will

1. make a study of their area's history through literature searchers, interviews and field trips;

2. generalize in class reports, panel discussions, and story-writing about the future of their area and how it relates to the environment.

Through the next group of activities, students explore the uses of the environment in their own home town. A few of these activities take place in class, but most of them take students out to use the resources of the community. The process of finding out is as important as the information students uncover here. If you live in a large city, you may want to select a single neighborhood for study.

Activity A: A Topographical Map

Begin your study of the community environment by making a topographical map as a class. Use a large sheet of butcher paper and a few different colors to represent elevations. Include bodies of water. You can get help from the county surveyor or road department. It's best to keep your map simple; you will want to refer to it as you explore community history. A paper-mache modeled relief map is an alternative.

Activity B: Early History

Try to find out what your area was like before European settlers arrived. This may have to be a library research project, but try other sources first such as: the natural history museum; the city or county public works department; any archives the city or a local college may have with first-hand accounts by the earliest settlers; the ranger or naturalist at a local park; local native Americans who are informed about their tribal history. Phone ahead to arrange for people to guide and speak to your class, so that students won't just be looking at objects. Information students may hope to collect:

1. - How the land or water forms may have been different before.
2. - What animals lived here.
3. - What plants lived here.
4. - How Indian people lived here.

Activity C: A Time Line

Make a time line for your town. It may extend on butcher paper all around the room. On it will go dates of importance to community life. At the most modern end students should put the fact that their class made a study of the community, with the date. At the starting end, put the date when Indians first came to your area and the date when settlers first came. In between will go everything else you can find out about the town's history.

Activity D: Interviews

Interview older residents of the town to begin finding out about the past. These may be relatives or firends of your students, or people in rest homes, etc. Have students write or phone first to ask for an interview. Working in groups of two or three, the students can encourage each other to ask questions. A question list should be prepared ahead of time. Some suggested questions are:

- When and how did you first come to town?
- What did it look like then?
- What did most people do for work?
- What did you do for fun?

Some of the older people may prefer to be interviewed in their homes. Others can be invited to your classroom. If each group interviews one old person, you will have a good collection of notes to begin with. Add important dates to your time line (The Shoe Factory opened in December, 1919; those cherry trees in the park were planted on Washington's birthday in 1935).

Have students write up an interview book from their notes. It can be organized by topics such as "Work in town before the War," "Fun at the lake then and now." Be sure to give each old person credit for what he or she said.

Activity E: Picture-taking

Ask students who have simple Brownie-type cameras to help with this activity. Send students in groups to different parts of the community to take pictures of buildings. They should include as much variety as possible -- old and new buildings, public and private. When the pictures come in, have everyone help sort them by how old the buildings may be and what district they are in. Make a bulletin board display, then invite a local architect or town planner to come and talk about kinds of buildings in the community. He may be able to give you hints about the age and purpose of any "mystery" buildings.

Finally, assign one older building to each student. The student's job will be to prepare a caption for the photo of the building, giving its age and what it has been used for. Some students may want to go talk to workers or others in "their" buildings. Check carefully first for permission and safety.

Activity F: A Tour of Historical Sites

Make class visits to any historical sites or sources to town history that may exist in your community. In some cases, this may simply amount to sitting down with a few local history books and pictures in a corner of the county library. But after their interviews and picture-taking, children should be more eager to learn from books. As you tour or read together, look for answers to these questions:

- How did the community begin?
- What natural features of the town have been important in the past?
- What built features have been important?
- Can our town history be divided into periods? What are they?

Back in class, make a list of the main natural and/or built features of your community. Discuss with students reasons for including or rejecting any suggestion they may make. Next to your list of features on the board, put the reasons why those features are important. A city community's list might look like this:

IMPORTANT ENVIRONMENTAL FEATURES

1. The Big Hill -- Richer people live there -- many fancy homes. Site of the water tower.
2. The subway station -- provides rides in and out of neighborhood.
3. The church square -- An important meeting place for old and young. Wildlife around trees and grass.

4. The box factory -- Many city people work there.

Discuss whether your list would be the same today as 100 years ago -- 200 years ago. How much has the environment shaped the town? In St. Charles, for instance, the river always was a big influence on the life of the people. Is your town something like that? Or has the culture of the people had a bigger effect on the environment? (An example here is the Los Angeles community that has "made the desert flower" and also developed its own smog atmosphere.)

Activity G: Story-writing

Visit the features you decided were most important to your town in the past and present. Have students write stories, from the point of view of the feature itself, about the changes that have taken place. That is, the student will pretend to be a hill or lake or factory. What might the hill have seen 100 years ago? What does it see now?

Activity H: A Panel Discussion

As a finale, have a panel discussion about the future of the town. The question to be addressed is: How should we treat our environment here in the future? Invite a few of the most helpful people you encountered in your town history researches, to act as resources. You may want to narrow the topic to one or two issues, if they seem urgent. Should we allow a shopping mall to be built here? Should we stop pouring raw sewage into the lake? Remind students to "think systems": consider how any change might affect the rest of the community, and people or places elsewhere.

Further Activities

1. Try to locate, on maps or the globe, a community the size of yours in a similar geographic and climatic situation. Write letters as a class to a school in that community asking what life is like there. You may find some interesting comparisons.

2. For more local history investigation ideas, see two excellent paperbacks:

   Old Glory, edited by James Robertson. An America the Beautiful Fund book published by Warner, 1973. Available from Warner Books, Inc., 315 Park Avenue South, New York, New York 10010.

   By Backyard History Book by David Weitzman, 1975. Published by Little, Brown and Company. Boston; printed at the Yolla Bolly Press, Covelo, California.

PART IV: LOOKING AT THE ENVIRONMENT WITH NEW EYES

These lessons are designed to sensitize students to the environment immediately around them. They are invited to investigate like detectives and to explore like men from outer space. It is all too easy to take our day-to-day environment for granted. And if we don't take environmental concerns seriously at home, it will be difficult to take them seriously when presented in the form of global statistics.

LESSON 1: INVESTIGATING THE CLASSROOM

GOALS

1. To observe interdependence in human-environment interactions.
2. To better understand and appreciate the immediate environment.

OBJECTIVES

Students will

1. make an inventory of everything in the classroom;
2. decide together on a set of class needs;
3. determine by measuring, judging, and experimenting how well the classrcom meets those needs.

PROCEDURE

Tell your students they are about to take a good look at their classroom environment in order to decide how fit it is for human habitation. A completely thorough inventory could, of course, take forever (What is the ceiling made of? What watt number are the light bulbs?). Divide your class into teams and assign each team some part of the classroom to inventory. Don't forget less obvious things like the state of the atmosphere (smoggy? smelly?) and any plant or animal life that may not strictly belong in the room. Allow each team a specific amount of time to complete their counting and descriptions. Encourage the children to use *all* their senses in taking the inventory. Pass out yardsticks and rulers for measurement. Tell them not to forget themselves -- to each student, the others are part of the environment. If students complain that they have "run out of things," tell them to look closer and describe each item in more detail. Precisely what color is the floor? How does that drawer full of paint brushes smell?

When the inventory is over, make a class list of the things you are in the room to do. Encourage students to be specific -- do they "learn geography" or study wall maps and examine photographs? Include the fun things, too, that are part of a healthy classroom experience.

When you have a list on the board, start going through the students' inventory, to compare the environment with the human needs it is supposed to serve. This will take several sessions, and may require some rearrangement. Some need-environment comparisons you may want to make are: Do the desks and chairs fit the size of the students? (Measure both to see.) Does stale air, heat or cold distract students from work? Is the teacher at the front too far away to help out students at the back of the class? And so on.

Experiment to find out how important different aspects of the environment are. How well can you see if the lights are not on? Are desks really necessary? Can you do without the chalkboard? The class may discover some surprising things about what they need and don't need.

Next, experiment to test improvements in the environment. Rearrange seating to suit different activities. Try reading a story by candle light. Move materials to higher or lower shelves as your discussions suggest. For more detailed suggestions on this sort of activity, see Mark Terry: *Teaching for Survival*, Ballantine, 1971. Available for $1.35 from Dept. CS, Ballantine Books, Inc., 36 West 20th Street, New York, New York 10003.

Follow-up Activity

Invite the school architect or buildings supervisor to talk to your class. Have students prepare questions to ask him about their classroom environment. Examples: What needs were most important in the building of the school? Cost? Comfort? Use of limited space? If the school were built today, how might it be different?

LESSON 2: YOUR OWN PLACE

GOALS

1. To observe interdependence in human-environment interactions.

2. To recognize that people both use and shape their environments.

OBJECTIVES

Students will

1. determine by classroom experiment, some of the characteristics of personal space in a community;

2. survey their personal spaces at home to determine how they fit their own needs and how they are affected by the needs of others in the family group.

MATERIALS

Use whatever large "building blocks" you can find for the construction of a mini-community in the classroom: big cardboard boxes, sheets, string, pillows, foam rubber. If you have movable desks, chairs and tables, they can be used.

PROCEDURE

Clear the room of all non-building furniture and have the students build their own little places. Each "dwelling" should have an entrance and adjoin another "dwelling." Each student should evaluate his or her own space, by asking:

- Is it comfortable for me?

- Would another person be comfortable here?

- Do I have enough privacy?

- Are my neighbors satisfied with my space?

Discuss any conflicts or special kinds of cooperation that went on in building the "community." Ask: 'Do you think builders of your own community had similar problems and good times?

Next, send students to survey personal space in their own homes Most students will have several personal spaces at home -- a room or a bed, a corner of the living room, a place at the table for meals. They may map or simply describe their spaces. Ask them to consider:

- What are my spaces especially good for?

- How might I change them to please myself better?

- What sort of space is my "dream-space"?

- How do my spaces fit in with those of others who live with me? How do we depend on each other at home to keep our environment the way we like it to be?

For more lessons along these lines, see *Built Environment: A Teacher Introduction to Environmental Education* by the American Institute of Architects. Available from the Department of Education and Research, American Institute of Architects, 1735 New York Avenue N.W., Washington, D.C. 20006.

LESSON 3: EA .I INVESTIGATIONS

The "puzzles" in this lesson are not meant to provide a comprehensive picture of how the global environment is being used. Rather, they are meant to spur students' curiosity and give them practice in manipulating data and analyzing situations in this general area. Use them as introductions to more elaborate units, or keep them for individual work. Most of these were constructed from data in INTERCOM #78 (published by the Center for War/Peace Studies, now, the Center for Global Perspectives) and the book, *The Environment: A Human Crisis* by M. Piburn, Hayden American Values Series, Hayden Book Co., Rochelle Park, NJ, 1974. You can create your own puzzles from these and similar sources.

GOALS

1. To understand that population is a major factor in determining the health of the environment.
2. To recognize relationships between one's immediate surroundings and the natural systems of the planet.

OBJECTIVES

Students will

1. interpret data to make general conclusions and value judgments;
2. use the system model in analyzing individual data puzzles;
3. seek further information in reference books and in the community.

SOME ANSWERS TO THE PUZZLES

Puzzle 1:

More bottles are used today because very few bottles are recycled. Twenty years ago most were.

Puzzle 2:

Asia's population is growing rapidly requiring increasing quantities of food. North America's population growth is less and productivity higher. Also farm land in North America that used to be held idle when there was less demand for food has now been put back into production.

There is a debate over the consequences and desirability of sending grain to Asia. In the short run, this would save lives. In the longer run, unless population growth is checked, North America's capability to feed all the needy would soon be surpassed.

Puzzle 3:

The concentration of cattle in feed lots has created waste disposal problems and threatens water systems for miles around the lots. Range land doesn't get the natural fertilizer it used to.

EARTH INVESTIGATIONS

TO THE STUDENT

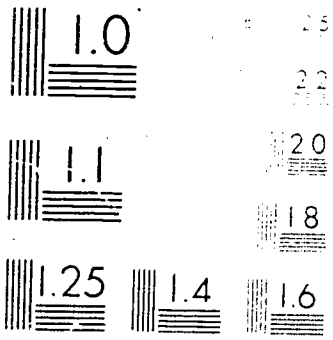
Pretend you are in charge of an exploratory visit to Planet Earth. Your own home is far off near another star in the Milky Way. Your spaceship came as far as Earth's moon, and docked on the far dark side. You don't want to scare the earthlings -- you just want to find out what you can about how they use their planet's resources. You sent out spies, and now they have returned. The only trouble is that they brought you a crazy jumble of facts. You have arranged the facts in a series of "puzzles" and now, with your knowledge of systems, you are going to try to figure them out. You begin with the knowledge that the resources of the earth are limited. Nothing can be added to the materials on earth. You know that all living things on earth use its resources and return material to the earth when they die. But if too many people use up resources too fast, the whole system is hurt.

If some puzzles make you more curious, try the "More Investigation" sections. And if you really get stuck, ask a friend or the teacher for help.

PUZZLE 1

In the country called U.S.A., some people drink beer. Those who drink it drink only a very little more now than they did 20 years ago. But 40% more bottles are used for every gallon.

- Why do you think more bottles are being used?
- Are all these bottles helpful to the earth system or not?


1.0
1.1
1.25
1.4
1.6
2.0
1.8

MORE INVESTIGATION: Look in your phone book to see if there is an ecology center or recycling place in your community. Call and ask them what's being done about beer bottles. Or write to the State of Oregon, in Salem, Oregon. Ask them what they think of the bottle problem.

PUZZLE 2

Here are some facts about grain trade in North America and Asia. Numbers with a *plus* in front mean the region had this much more grain than they needed for themselves and the grain was *exported*. Numbers with a *minus* in front mean the region was short of grain and had to *import* this much more.

	1934-38	1948-52	1960	1966	1973
N. America	+5	+23	+39	+59	+91
Asia	+2	- 6	-17	-34	-43

(in millions of metric tons)

- Why do you think Asia imports more and more, while North America exports more and more? (Hint: North Americans have more tractors and use much more mechanical and electrical energy per person than Asians do. Looking at two countries, note that U.S. population is growing at .9% per year, while the population of India grows at 2.4% per year.)
- Will it help for America to send grain to Asia? Why or why not? Will sending tractors solve the problem completely?

MORE INVESTIGATION: Look up "Asia" in an atlas. What countries are in Asia? Which is the biggest? Right now, hardly anybody trades with China. What difference do you suppose that makes to the world food supply?

- Why do you think carbon dioxide has increased so much? (Hint: Turn to the cartoon on p. 20 of these lessons.)
- Could extra carbon dioxide hurt the system of life on earth?

MORE INVESTIGATION: Ask a gas station mechanic what gases are in auto exhaust. (Ask him when he isn't busy.) Write to the Environmental Protection Agency, Washington, D.C. Ask for pamphlets about the dangers of air pollution.

PUZZLE 3

Some spies entered American supermarkets. There they found beef for sale and found out how it is produced. In the 1940's, the U.S. had a lot of extra grain. Someone suggested they get rid of it by feeding it to cattle. Cattle used to eat grass on the range; now they eat grain in closed stalls.

- Do you think this was a bright idea? Why or why not?
- Cattle used to drop manure on the range. Now they drop it in the stalls. What problems does this cause for the farmer and for the health of the range land?

MORE INVESTIGATION: Ask your local butcher what the grades of meat are and how they decide on the grade for each cut of meat. Ask him too if he carries grass-fed beef. Some shops have started to sell it again. Look in your family cookbook for information about cuts and grades of beef.

PUZZLE 4

Spies in China discovered many people working at tiny "back-yard" steel furnaces. China is badly in need of steel for tools and modern building. These little places turned out hardly any steel, while not too far away a big modern

steelmaking plant worked at full steam. Still, the workers at the small furnaces seemed happy. With the work of their own hands, they supplied local commune needs for steel. They didn't seem to care that it was inefficient.

- Why do you think the workers wanted to make their "own" steel? Do other people in the modern world sometimes feel like that, too?

MORE INVESTIGATION: Find someone who raises his or her own vegetables, and talk about why he/she does it. Is it always cheaper? Are there other rewards? Look up "steel making" in your school encyclopedia. Could your family do it in the backyard? How strongly do you think those Chinese must feel about being self-sufficient (not depending on others far away)?

SOURCES USED

(where not mentioned in text of lessons)

Part II: Microbes in the Garbage

Cartoon from *UNESCO Courier*, July, 1975, p. 28. By Jean-Marie Clement and Safoura Assia. © *UNESCO Courier*. Reprinted with permission.

Luna B. Leopold and Kenneth S. Davis, *Water*. New York: Time-Life Books, 1968.

Tom Nicholson, James Bishop, Jr., and Peter S. Greenberg, "The Methane Method," *Newsweek*, Oct. 20, 1975, pp. 85-87.

Peter Gwynne and James Bishop, Jr., "Bring on the Bugs," *Newsweek*, Dec. 1, 1975, p. 116.

Clare Jones, Steve J. Gradler, and Paul H. Engstrom, *Pollution: The Land We Live On*. Minneapolis, Minn.: Lerner Publications Co., 1971.

Andre Maurois, *The Life of Sir Alexander Fleming* (trans. Gerard Hopkins). New York: E.P. Dutton, 1959.

Part III, Lesson 1: Story of a River Town

Ruth M. Underhill, *Red Man's America*. Chicago: University of Chicago Press, Revised Edition 1971.

William E. Foley, *A History of Missouri* (Vol I: 1673 to 1820). Columbia, Mo.: University of Missouri Press, 1971.

Frederick Simpich, "Taming the Outlaw Missouri River," *National Geographic Magazine*, November, 1945.

G. Young, "That Dammed Missouri River," *National Geographic Magazine*, September, 1971, p. 374f.

B. Roueche, "Reporter at Large: Passenger on Barge Towboats," *New Yorker*, Feb. 26, 1972, p. 40f.

Indian poem from Alice Fletcher and Francis La Flesche, *The Omaha Tribe*. 27th Report of the Bureau of American Ethnology, Washington, 1911, reprinted in *American Indian Prose and Poetry*, ed. Margot Astrov. New York: Capricorn Books, 1962, p. 133.

Sources Used -- cont'd.

Sandburg poem excerpted from "Prairie" in *Cornhuskers* by Carl Sandburg, copyright,1918, by Holt, Rinehart and Winston, Inc.; copyright, 1946, by Carl Sandburg. Reprinted by permission of Harcourt Brace Jovanovich, Inc.

Part IV, Lesson 3: Earth Investigations

North America - Asia grain trade figures from U.S. Department of Agriculture.

RESOURCES

Ekistics: A Guide for the Development of an Interdisciplinary Environmental Education Curriculum. California State Department of Education. Sacramento, California, 1973.

Built Environment: A Teacher Introduction to Environmental Education. American Institute of Architects, Department of Education and Research, 1735 New York Avenue N.W., Washington, D.C. 20006, 1975.

Worldmindedness: The World: Context for Teaching in the Elementary School. Edith King. Dubuque, Iowa: William C. Brown Co., 1971.

Proposed Humanities Framework for California Public Schools. Humanities Framework Committee, Sacramento, California, 1975.

You Are an Environment. Noel McInnis. Evanston, Illinois: The Center For Curriculum Design, 1972.

Teaching for Survival: A Handbook for Environmental Education. Mark Terry. New York: Ballantine Books, 1971.

Man's Impact on the Global Environment. Colin Wilson. Cambridge, Massachusetts: MIT Press, 1970.

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