DOCUMENT RESUME

ED 093 673 SE 017 818

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TITLE Living Within Our Means: Energy and Scarcity. Environmental Education Instructional Activities K-6.
INSTITUTION New York State Education Dept., Albany. Office of Instructional Services.
PUB DATE [74]
NOTE 83p.

EDRS PRICE MF-$0.75 HC-$4.20 PLUS POSTAGE
DESCRIPTORS Activity Learning; *Elementary Grades; *Environmental Education; *Instructional Materials; Language Arts; Mathematics; *Objectives; Sciences; Social Studies; *Teaching Guides

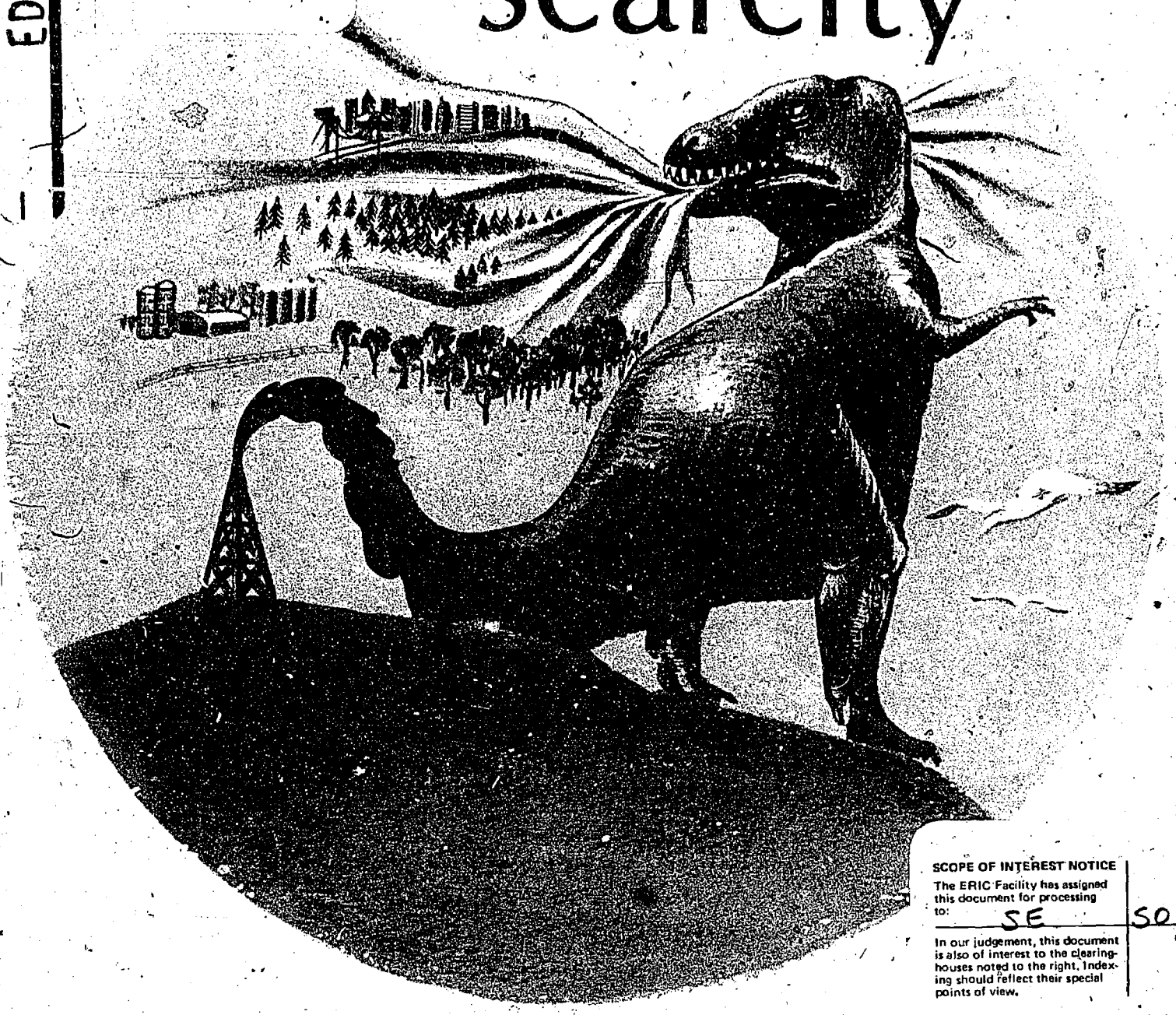
ABSTRACT

This booklet is a source of activities and instructional materials for teaching environmental education concepts in grades K-6. Contents are organized into the areas of language arts, mathematics, science, and social studies and are subdivided by suggested grade level. A listing of basic environmental understandings is referenced with the various activities. (LS)

# Living within our means:

# energy and scarcity







## Environmental Education Instructional Activities

## K-6

THE UNIVERSITY OF THE STATE OF NEW YORK

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# Foreword

Will the energy emergency and other related crises and shortages prove to be boon or bane for environmentalists and environmentally concerned citizens? Will society see some of the current conflicts between prevailing priorities and environmental limitations as a warning signal or merely as an economic problem requiring solution? Never before have these issues been so prominent in the public consciousness.

This publication, *Living Within Our Means: Energy and Scarcity*, has been prompted both by the currency of these issues and by the Department's continuing responsibility to provide instructional materials which will enhance our understanding of the all-pervasive nature of environmental considerations. This responsibility began with the release of *Isn't It Time We Learned* and the Regents' Position Paper No. 10, *Environmental Education*. The former was designed to alert school personnel to the problems posed by society's apparent disregard or disrespect for its natural surroundings and the scope of the school community's responsibility for addressing these problems. The Position Paper described the Department's responsibilities and objectives for environmental education.

*Environmental Education Instructional Activities, K-6* and *7-12* were compendia of classroom exercises which supported numerous basic environmental understandings and concepts. The booklets were designed as supplements which would aid teachers in creating an environmental awareness and conscience among their students when appropriate to their regular subject matter objectives.

The *Handbook of Environmental Education Strategies* suggested ways in which teachers could use conventional instructional strategies in a manner that would support environmental education objectives. More importantly though, a major purpose of this bulletin was to illustrate the relationship of environmental concepts and understandings to the specific objectives and understandings of the various subject matter syllabuses.

*Living Within Our Means: Energy and Scarcity* develops that relationship to useful proportions by providing environmental activities which are keyed both to broad environmental understandings and to most of the disciplines at all grade levels. Within are provided enough activities for each grade and subject area to define and illustrate the place of environmental education in these areas of the curriculum.

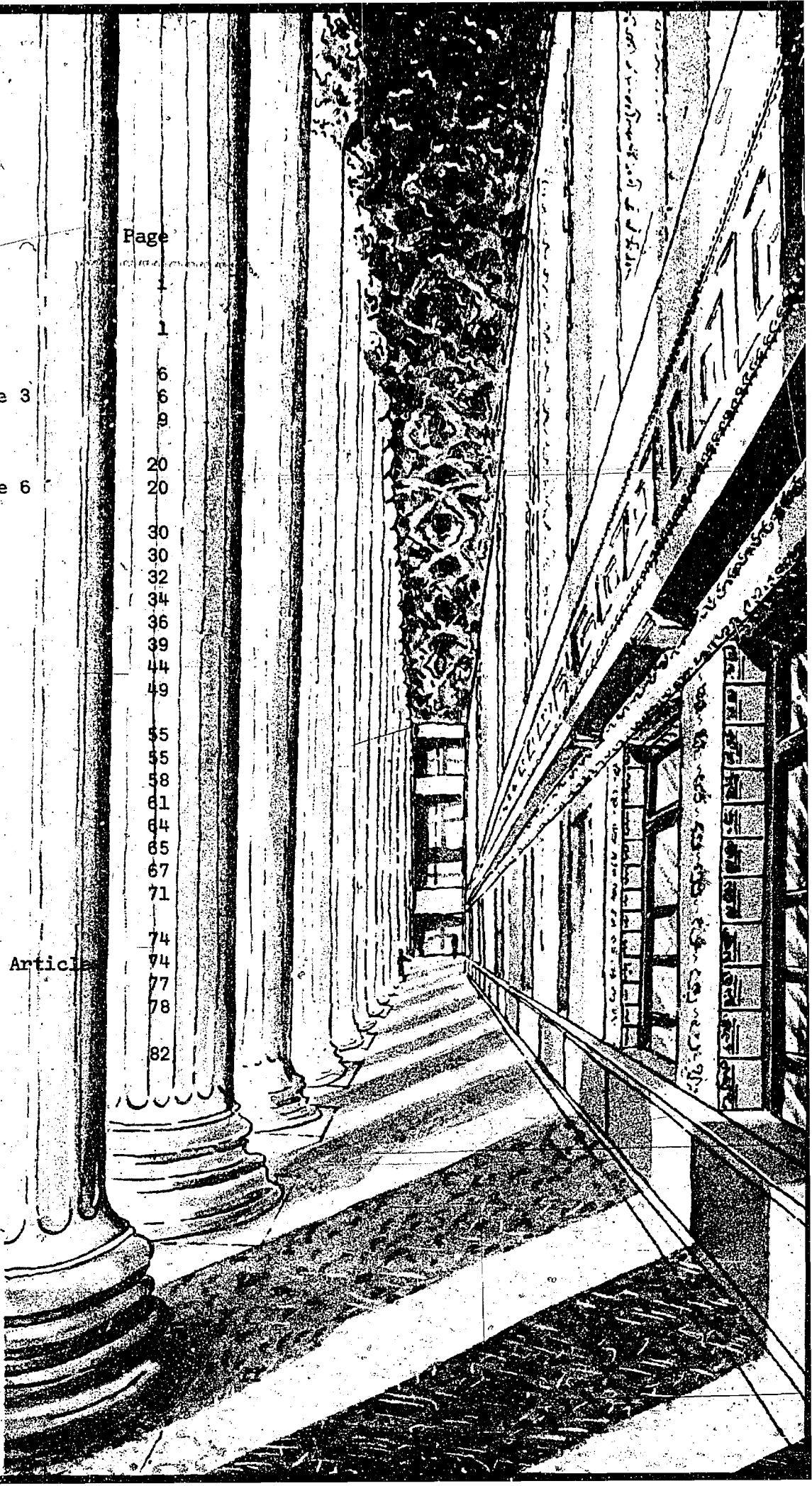
Barry W. Jamason has planned and developed all of these environmental education publications.

*VIVIENNE N. ANDERSON*
*Assistant Commissioner*
*for General Education*
*and Curriculum Services*

*WILLIAM L. BITNER III*
*Associate Commissioner*
*for Instructional Services*

# Contents





# Introduction

RATIONALE

The purpose of this instructional manual is twofold. First, the urgency of the current spate of shortages, dominated by a shortfall of petroleum supplies and the concomitant energy emergency, needs to be examined reasonably and logically within the instructional program. These problems should be viewed as symptoms of a basic shortsightedness which characterizes our treatment of our natural surroundings and, as such, must be attended to in the educational process.

Second, the publication illustrates the most appropriate and efficacious manner in which environmental concerns may be integrated into classroom instruction. Thus, the environmental education activities herein are grouped in accordance with their relationship to the subject matter of the various disciplines. These relationships are reinforced by references to the pertinent skill, objective, or understanding in the subject matter curriculum bulletins. In this way, the syllabus references justify the placement of the environmental activities within the regular instructional framework.

As with the previous environmental education activity manuals, the understandings are suppositions about the relationship of man and his environemnt which have serious implications for the manner in which we should live. Ideally, pupil participation in the activity will enhance understanding of these suppositions and the questions should serve as guides to the direction or objective of the activity. The curriculum bulletin references indicate how regular instructional objectives are served at the same time.

DEVELOPMENT

A practical way to proceed in using this manual would be to review cursorily the activities provided for your subject area and grade level.† Then, refer to the syllabus understandings (or objectives, or skills) indicated as appropriate to the activities and determine at what point in your instructional program you will be dealing with these subject understandings. Thus, when that point is reached, you will have ready-made activities which will enhance both your subject matter understandings

† Where activities are grouped by K-3 or 4-6 rather than by individual grade levels, you will have to judge at which level use of the activity will be most appropriate. The complexity, skill expectation, and conceptual sophistication of the activity will help you make this determination. Then too, with minor modifications many activities can be adapted for use at several grade levels.

In the English Language Arts section, asterisks (*) are used to indicate that the identified phrase in the activity instructions is the applicable learning objective in the syllabus reference found at the end of the activity.

and environmental education understandings. On the other hand, if the understandings for your subject area and grade level do not require sequential treatment, you may wish to choose activities in a more random fashion.

ENVIRONMENTAL UNDERSTANDINGS

The environmental understandings used as references for the activities and as a general group of learning expectations for the publication are provided below with a page index for the activities with which each is used.

Man must acknowledge that the interdependence of all living things dictates the manner in which and the extent to which resources may be used. [6, 21, 38, 61, 70]

- The rate of resource consumption increases in direct proportion to the expansion of our wants, needs, and markets. [27, 35, 47, 58, 66]

The waste of natural resources can limit the options available to future generations. [7, 17, 35, 39, 58]

- Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities. [9, 12, 26, 31, 46, 52]

The material welfare and aspirations of a culture largely determine the use and management of natural resources. [13, 17, 22, 47, 65, 71]

- Individuals tend to select short term economic gains, often at the expense of greater long term environmental benefits. [13, 50]

Water is a reusable and transient resource, but the usable quantity may be reduced by impaired quality. [38, 43]

- Natural resources are unequally distributed with respect to land areas and political boundaries, thus creating conflicts over priorities in the use, management, and conservation of these resources. [49, 51, 60, 64, 70]

Energy is initially supplied to an ecosystem by the activities of green plants. [44]

- Historically, cultures with high technological development have used disproportionately more natural resources than those with lower levels of technological development. [11, 40, 71]

Ethically, we are stewards rather than owners of the resource base. [6, 15]

- Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes. [50, 66, 67, 69]

Earth's resources and recycling system can support only a limited number of people; therefore as populations increase and as resource supplies decrease, the freedom of the individual to use the resources as he wishes diminishes. [55]

The demands of population growth coupled with man's tremendous waste of energy are responsible for some of our more serious environmental problems. [72]

Trade will be mutually beneficial if trading partners specialize in those products in which they have the greatest productive efficiency. [51, 64, 65]

Social, economic, and technological changes affect the interrelationships, quality, availability, and use of natural resources. [59]

Man must develop the technical and sociological knowledge needed to control population growth, modify environments, and alter resource use patterns. [26, 46, 52, 68]

In a democracy, people must consent to, or insist upon restrictions on resource allocation and use. [40, 68, 69]

The limited nature of productive resources makes it imperative that a society define its economic objectives in terms of environmental reality. [14, 45, 51, 63]

As natural resources become scarcer, the inexhaustible supply of human energy, resolve, determination, and ingenuity must be fully utilized. [15, 52]

Living things are interdependent with one another and with their environment. [35, 61, 73]

# ENGLISH LANGUAGE ARTS

## Kindergarten - Grade 3

Activity 1 - Read the story, *Noah's Ark* by Gail E. Haley, to (or with) your class. Discuss with the children the setting* Noah envisioned in his dream and how, when he awoke, he found evidence that such a setting was in fact a real likelihood in the future. Further, recognizing that the story has obvious parallels with our present concern for the natural environment, have the children prepare a pictorial display of one of, or a combination of, the topics below:

-extinct animals
-endangered species
-man's activities which threaten wildlife habitats
-the importance of wildlife
-how wildlife can be protected

The need for a greater degree of responsibility on the part of man with regard to the importance of wildlife as a resource can be emphasized through the following questions:

- How do animals help man?
- Choose a common wild bird or other animal and try to describe the effect of its extinction upon other animals and upon man.
- Why should man protect animals?
- What caused many animals to become extinct?
- In what ways has man caused the disappearance or endangering of many species of animals?

(*Environmental Understandings:* [Natural resources, e.g., animal populations, are interdependent and the use or misuse of one will affect others.] [Man must acknowledge that the interdependence of all living things dictates the manner in which and the extent to which resources may be used.])

(*Syllabus References:* English Language Arts: Literature K-12, *Characterization K-3, pp. 2-4; Plot K-3, pp. 11-13; Setting K-3, pp. 21-22; Theme K-3, pp. 38-39)**

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Activity 2 - To begin with, reading lessons should incorporate as many stories or books dealing with the environment as is practical. Stories about animals and plants, or with themes relating to our natural surroundings, or relating to man's actions which endanger these surroundings are replete with drama, mystery, and fascination for children.

As an example, through your using the natural history-ecology narrative, *The Dead Tree* by Alvin Tresselt, children can be entertained and fascinated while they (and you) develop vocabulary skills.

(Use Pictures or Objects as Clues to Word Meanings)*

-"... brown leathery leaves..." Show the picture of autumn leaves in the book. Compare with some samples collected in the school yard, and compare with an actual leather object such as a handbag or a loafer.

(Check Word Identification through Context)*

-"... Termites ate out passageways in wondrous patterns." Termites become more than merely another type of insect to the children through the contextual description afforded.

- How are animals and plants interrelated or interdependent?
- Do the relationships between animals and plants shown in the story sound like any of the ways people depend upon one another?

(*Environmental Understandings:* [Natural resources, e.g., animal populations, are interdependent and the use or misuse of one will affect others.] [Ethically, we are stewards rather than owners of the resource base.])

(*Syllabus Reference:* English Language Arts: Reading Section K-12, *Vocabulary Acquisition Skills K-3, pp. 18-21)**

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Activity 3 - Read the story, *The Wump World* by Bill Peet, or a similar story about survival, to the children and then provide time for general discussion. Have them provide a concise sentence which describes the *main idea of the story**. Then, discuss with them the order in which things happened (Understand and Organize by Time Order)*. They might reinforce this understanding of sequential order by drawing picture strips of story events so that the class as a whole could arrange them in their proper sequence.

- Were the Wumps like the animals in our world? How?
- Do we do some of the same things that the people in the story did which make life dangerous for animals?
- How can we take care of animals and at the same time provide for the things people need?
- Why do people need animals?
- What animals do you know of which we will never see again on earth? Why are they gone?

(*Environmental Understandings:* [As population expands and becomes more mobile, man's demands for natural resources increase.] [The waste of natural resources can limit the options available to future generations.])

*(Syllabus Reference:* English Language Arts: Reading Section K-12, *Comprehension Skills, pp. 34-36;* English Language Arts: Composition K-12, *Organization and Development, p. 48)**

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Activity 4 - When employing grammar exercises in the development of language skills, use every opportunity to use words with environmental significance when substituting in pattern sentences (Substitute Appropriate Words in Pattern Sentences; Expand Basic Pattern Sentences by Adding Single-word Adjectives and Adverbs)*. Then discuss the meaning of the sentence in terms of the environment while working with the children on structure.

-The (dead) leaves fell.[1]
-The air in the city is (dirty).[2]
-Cars are too (big).[3]

- When? What happened to the leaves after that?[1]
- Why? Is anything being done about it?[2]
- How do we know this? Is your family car too big? Could you be just as comfortable in a smaller car which uses less gas and causes less air pollution?[3]

(*Environmental Understandings:* [Individuals should become well-informed about the best ways to manage and conserve our energy supplies.] [Any one of an environment's components, such as space, water, air, food, or energy, may become a limiting factor.])

*(Syllabus Reference:* English Language Arts: Language Section K-12 - Experimental Edition, *Grammar K-3, pp. 5-12)**

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Activity 5 - Develop a surprise drawer by setting aside a special place for keeping objects and pictures which the children bring to school. Sometime during the course of the year, request that objects and pictures relating to our environment, our shortages, and our crises be brought to school to be placed in the drawer (objects: a piece of wood, a sample of trash, a mineral-bearing rock, a gas tank cap, a vial of dirty river water, a vial of motor oil; pictures of: deserts, oil refineries, forests, paper mills, "power" plants).

Invite the children to go to this drawer in small groups during free time. Encourage them to talk together (Recognize and Utilize the Various Forms of Speaking - Discussion)* about the items they find in this "environmental" surprise drawer.

- Did their parents or friends ask them why this particular type of object or picture was being brought to school?
- What were the children's responses to this curiosity?

- Did the objects and pictures relate to environmental problems? Explain.

(*Environmental Understandings:* [Individuals should become well informed about the best ways to manage and conserve our energy supplies.] [The prevailing condition of scarcity which underlies all economic considerations forces changes in the lifestyles of individuals and societies.])

(*Syllabus Reference:* English Language Arts: Listening and Speaking K-12, *Participation in Speaking, K-6, p. 66)**

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Grade 4 - Grade 6

Activity 6 - As a means of improving the children's listening skills (Listening for Specific Information)*, play the following game in conjunction with a social studies lesson. Have the children prepare written directions for traveling from one city to another by bus, train, auto, or airplane. Background would include some general knowledge about public transportation routes. Thus the intercity distance should be a modest one (probably not more than 100 miles, if that far). The public transportation routes should include directions to terminals. The class should listen carefully as one child reads his directions. Than, ask a pupil to trace on a wall map the route he has just heard described. If he is unsuccessful, he returns to his seat and another pupil attempts to trace the route. If he is successful, he reads the directions he has prepared, and so the game continues.

- Which method of travel offers the easiest set of directions?
- Estimate the time needed for the trip. Which method do you think would be the fastest? The slowest?
- What is a new restriction which makes the time of automobile travel longer than it used to be? (55 mile per hour speed limit)
- What is the reason for this restriction on auto travel?
- What benefits have come from this restriction?
- Are the public transportation facilities as good as they should be? Explain.
- How could they be improved?
- How has railroad travel been affected by the "energy crisis?"
- Do we need more, or straighter, or better roads?
- Which method of travel is the most expensive? Why?

- Is the expense of automobile travel likely to increase more rapidly than other means of transportation or not? Explain.

(*Environmental Understanding:* [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.])

(*Syllabus Reference:* English Language Arts: Listening and Speaking K-12, *Aural Comprehension, K-6, p. 3*)*

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Activity 7 - Environmental problems are timely, vital subjects which can be capitalized upon in developing the reportorial skills of children (Recognize the Importance of Reporting Accurately)*. First, reproduce the list below for the class. Then ask them, preparatory to making a report on the energy shortage, to select the items most relevant to the report and to discard the unrelated items.

- The world's population is doubling every 35 years.
- The United States has increased its energy consumption by 4 or 5 percent for each of the past several years.
- Advertising encourages the sale of products which are not necessary or even desirable, but which will make money for the company.
- Oil painting on canvas is an art that is gaining in popularity as a hobby.
- The United States throws away 74 billion cans and bottles each year.
- Harnessing the tides and winds is being considered as an additional source of energy.
- The state of Connecticut is building a plant which will reclaim metals and other usable materials from garbage and trash, and turn most of the remaining trash into fuel.
- Unemployment has been on the rise in the United States, and is increasing again this year.
- Most of our beverages are packaged in nonreturnable bottles.
- Whales are on the endangered species list.
- Home air conditioners use approximately 2,000 kilowatt hours per year.
- National parks may find it necessary to require people to make applications for camping dates in order to prevent congestion and overuse.

- The United States has been manufacturing only two-thirds of the energy it uses, and has been importing the rest.
- Cities do not want power plants built near them because of thermal pollution, visual pollution, and the danger of radiation.

(*Environmental Understanding:* [The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures.])

(*Syllabus Reference:* English Language Arts: Listening and Speaking K-12, *Participation in Speaking, pp. 63-65)**

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Activity 8 - Present the following list of developments, or a similar list of your own making, to the children. Have each child assign numbers to the events by way of placing them in chronological order (Recognize and Utilize Patterns of Organization - Time Order)*.

- (1) Henry Ford applied the assembly line technique to the manufacture of automobiles.
- (2) Oil producing countries refused to sell oil to the United States (and others) for political reasons.
- (3) The Wright Brothers successfully flew a machine-propelled glider at Kitty Hawk.
- (4) Machine-produced goods began to replace handmade articles.
- (5) Colonel Drake developed a practical way of pumping oil from the depths of the earth, and this fossil fuel began to replace coal in importance.
- (6) The use of home heating oil and gasoline was curtailed in order to conserve energy.
- (7) Earth Day was inaugurated to awaken us to the alarming facts of what we have been doing to our environment.
- (8) By government edict, only automobiles which travel at least 16 miles on a gallon of gasoline may be sold in the United States.
- (9) The earth's population jumped from 1 billion (1830) to 3 billion (1960).
- (10) Gasoline was rationed in order to divert this vital fuel to our war effort.

(*KEY - The correct sequence is: 4, 5, 3, 1, 10, 9, 7, 2, 6, 8 [not yet, 1980]*)

When the class has finished the exercise, discuss with them the ways in which each event is related to the present energy problem.

(*Environmental Understandings:* [As a population expands and becomes more mobile, man's demands for natural resources increase.] [Historically, cultures with high technological development have used disproportionately more natural resources than those with lower levels of technological development.])

(*Syllabus Reference:* English Language Arts: Listening and Speaking K-12, *Content in Speaking, p. 104)**

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Activity 9 - The sentences below are provided to suggest an exercise with which you may develop good reporting techniques and organization skills on the part of the children (Recognize the Importance of Reporting Accurately; Recognize and Utilize Patterns of Organization)*. Have them revise the order of these scrambled sentences so that they constitute a coherent paragraph (Understand Unit and Coherence)*. Many of the sentences give a clue as to what goes before them. The one sentence that does not seem to refer to an earlier sentence begins the paragraph.

- (1) The reason for this is the fact that garbage burned in the landfill since 1967 has undergone decomposition.
- (2) Up to the present time natural gas has been considered, for all practical purposes, a nonrenewable fossil fuel.
- (3) Fortunately, this newly formed methane is suitable for commercial and home use.
- (4) The company found that methane, a form of natural gas, can be obtained from one of their landfills in Los Angeles.
- (5) However, the Southern California Gas Company has evidence to the contrary.
- (6) The fact that there are numerous such landfills in the United States suggests the possibility of a supplementary source of energy.
- (7) One of the byproducts of this process of decomposition is methane (natural gas).

(*KEY - The correct sequence is: 2, 5, 4, 1, 7, 3, 6*)

(*Environmental Understandings:* [The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures.] [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.])

*(Syllabus References:* English Language Arts: Listening and Speaking, K-12 *Participation in Speaking K-6, pp. 64-65; Content in Speaking, K-6, p. 104-105;* English Language Arts: Composition Section K-12, *Organization and Development 4-6, p. 55)**

Activity 10--Read the delightful children's ecology mystery, Who Killed Cock Robin? by Jean George, to the children over a period of days. Each day, review with them what has already happened in the story and have them guess what might be going to happen (Anticipate Events)*. Then, at the end of the day's reading, have the children compare what actually happened to what they had expected. At the end of the story, encourage children to tell about experiences of their own which are similar to some of those in the book. Have them recall parts of the story which they found sad, joyous, exciting, and suspenseful (Relate What Is Read to Past Experiences; Relate What Is Read to Self)*. Use the story to discuss *characterization, plot, and setting** with the class.

Discuss with the class the details about the industries which affected the town's environment and about the various webs of life that were affected. Have the children list the actions taken by the townspeople to restore the environment. Have the children list the things that destroyed the animal habitats.

- What industries were in the town?
- What positive actions were taken by the townspeople?
- What characters in the story were always passing the buck?
- Could the various natural (plant and animal) communities around the town be saved?
- Who really killed Cock Robin?

Then, possibly in conjunction with a science lesson on wildlife populations and habitats, discuss with the children details about how man alters the composition and abundance of a wildlife population by changing, managing, or destroying its habitat.

(*Environmental Understandings:* [The material welfare and aspirations of a culture largely determine the use and management of natural resources.] [Individuals tend to select short term economic gains, often at the expense of greater long term environmental benefits.])

*(Syllabus References:* English Language Arts: Reading Section K-12, *Critical and Interpretive Reading, pp. 46-47;* English Language Arts: Literature K-12, *Characterization p. 7; Plot, pp. 16-18; Setting, pp. 25-26;* Science for Children, 4-6, *Summary Question 7, p. 66; Understandings 1, 10, & 11, pp. 66-67; Understanding 5, p. 114)**

Activity 11 - The following three paragraphs constitute a summary of the information presented in a recent magazine article. Note that details given in the paragraphs develop the *topic sentence* or *main idea** which begins each paragraph.

The present energy shortage is basically a problem of meeting an increasing demand for energy at a time when the supply of energy resources is decreasing. By 1990 the United States will probably have about doubled its present energy consumption. Domestic oil and natural gas, which account for two-thirds of the nation's energy, will be able to meet only 40 percent of demand. Nuclear, hydro, solar, and geothermal, and other nonfossil sources will take care of another 20 percent.

To fill the remaining 40 percent gap the nation faces two possible choices. It can import much more oil and gas, and incur more political dependence on foreign countries. Or it can turn to coal, which now provides 20 percent of U.S. energy.

Coal is a rich resource, but it presents many problems. It is dirty to burn and thus a great source of pollution. It is also difficult and dangerous to mine. For this reason, Congress passed the National Coal Health and Safety Act which has sharply increased operating costs. Strip mining, a process of peeling back the earth and gouging out the underlying coal, is less costly than working underground in deep shafts. But stripping has left scarred and torn land in vast areas. If Congress passes a law, as it should, compelling strip miners to repair the ravaged earth after mining, additional expense and difficulties of reclaiming some of the land will arise.

Have the children copy the topic sentence in each of the paragraphs. Point out that it is a good idea to vary the beginning words when writing paragraphs. Call attention to the fact that in this article the writer begins each paragraph in various ways. The youngsters should circle the first word or two in each paragraph and then answer the questions below as they pertain to each paragraph.

- How does the writer suggest that our requirements for energy will increase in the future?
- Does the writer imply that oil and gas production will become greater or less in 1990?
- In line 6, the word "domestic" means:
  (not wild) (of the family or household) (found in the United States)

- In lines 12-14, what word means "to bring down upon oneself?"
- Why would importing more oil and gas make us increasingly dependent upon foreign countries?
- What are the problems of coal as a resource?
- What are some drawbacks to strip mining?
- In lines 26-28, what word means "damaged or destroyed by violent action?"
- What is meant by "reclaiming land?"

(*Environmental Understandings:* [The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures.] [The limited nature of productive resources makes it imperative that a society define its economic objectives in terms of environmental reality.])

(*Syllabus Reference:* English Language Arts: Reading Section K-12, *Comprehension Skills, pp. 37-39)**

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Activity 12 - Read the essay found below to the class, or reproduce and distribute it to them. Have the children develop their vocabulary acquisition skills and reading comprehension skills (Increase Listening and Speaking Vocabulary; Find the Main Idea & Read For Detail)* by answering the questions for each paragraph which follow.

[1]Walter Lippmann, editorial writer for the *New York Herald Tribune*, once wrote that the great issues of life and politics in a prosperous nation are not material but spiritual. "Those in high places," he [5]said, "are more than administrators of government bureaus. They are the custodians of the nation's ideals."

One of our greatest renewable resources is our own spiritual strength, a quality that is often [10]overlooked. Its possession gives a sense of conviction and dedication that in turn yields a boundless source of energy. Often it is found to compensate for the lack of other resources.

The historic case of untrained, poorly equipped, [15]colonial farmers who called themselves "Minutemen" is a good example. Their spiritual strength provided them with enough dogged determination to outsmart and outfight the professionally drilled British soldiers, even though the British far [20]surpassed them in numbers and supplies.

The great Americans you have studied also depended on this inner strength to achieve their goals in spite of obstacles. Courage and perseverance make their home in a strong spirit. The lives of Jacob Riis, Franklin D. Roosevelt, Benjamin Franklin, Jane Addams, and countless others attest to this fact. This resource can be of value to all Americans in adjusting to the present energy shortage. More important, it will provide us with the wisdom to insist upon the forethoughts necessary to forestall other shortages.

- In line 3, "prosperous" means:
(healthy) (thriving) (industrial)
- "Material" means things pertaining to "matter" or physical. How is the meaning of "spiritual" different?
- In line 4, "high places" means:
(mountain areas) (costing a lot) (positions of importance)
- The verb "administer" means "to manage or direct affairs." Does that tell you what an "administrator" is?
- A custodian is someone who guards and takes care of things. What are the administrators going to take care of?
- Look up the word "editor." What do you think is the difference between an editor and a reporter?
- In line 10, to what does the word "its" refer?
- In line 11, "dedication" means "devoted to the service of" and "conviction" in this case means "firm belief" or "faith." What do you suppose spiritual strength gives us faith in, that we also want to devote our service to?
- In line 13, "compensate" means:
(to say something nice about) (to pay for) (to make up for)
- The word "dogged" in line 17 means:
(like a dog) (wretched) (stubborn)
- What word in this paragraph is an antonym for "professionally drilled?"
- A word often has more than one meaning, depending on the way it is used in a sentence or a passage. This is called the context of a word. Think of, or find in the dictionary, two synonyms for the word "goal" according to its context in line 22.
- How does the writer express the fact that a person with spiritual strength will be brave and not give up easily?

- Which of the following statements best expresses the main idea of the article?

  -In spite of drawbacks, the colonial soldiers were victorious.
  -Spiritual strength is an important energy resource that is available to everyone.
  -All great Americans have possessed spiritual strength.

An editorial is an article that gives the editor's views or ideas on news of the day. Have the pupils think of some good subjects for an editorial. Then have them write an editorial on the energy shortage. Include ideas as to what things caused it, how it is related to conservation practices, and what should be done about it.

(*Environmental Understandings:* [Ethically, we are stewards rather than owners of the resource base.] [As natural resources become scarcer, the inexhaustible supply of human energy, resolve, determination, and ingenuity must be fully utilized.])

(*Syllabus References:* English Language Arts: Reading Section K-12, *Vocabulary Acquisition Skills, pp. 22-25; Comprehension Skills, pp. 37-39)**

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Activity 13 - Read the following review of a scientific spoof to the children, or have mimeographed copies available. Use the questions which follow to stimulate discussion (Draw Conclusions; Make Inferences)*.

> An Arizona newswriter has projected our gasoline shortage 1,100 years into the future. He reports that a memo in A.D. 3100 states that during the twentieth century the earth was inhabited by huge metallic-looking beasts called "autosaurs." These monsters weighed between 1,000 and 4,000 pounds, and could travel at terrific rates of speeds. Although they could be ridden, he relates, they were never completely domesticated by the natives. Apparently thousands of natives lost their lives to them each year.
>
> Around the last few decades of the century, he tells us, the "autosaurs" mysteriously disappeared. Scientists entertain the possibility of their having starved to death because of some inexplicable depletion of their food supply. A picture unearthed near Los Angeles supporting this theory shows great lines of these creatures queued up before a feeding station. One of the natives, in an obvious attempt to forestall extinction, is force feeding the leader by means of a hose injected into its "surprisingly small orifice." This effort was evidently unsuccessful.

Our writer continues, "While the extinction of any species is to be mourned, it does not appear that the ecological balance of that period was upset by the autosaurs' disappearance. There is even some proof that it was improved."

- Why does the name "autosaur" sound scientifically valid?
- What characteristics does the writer attribute to the "autosaur" that reveals its identity?
- Which of the author's remarkably logical sounding statements indicates that man is not always the master of his inventions?
- Humor can be instructive as well as entertaining. Do you find an underlying truth in this playful piece of prose? What is it?
- Do you think the humor is enhanced by the fact that the story sounds possible and believable?
- Which of the following conclusions do you think the author intended the reader to arrive at?

  -We should more carefully protect our endangered species.
  -Automobiles kill a great many people.
  -The gasoline shortage, in the long run, will be beneficial to mankind and his environment.

- Does there seem to be any advantage in occasionally using a light, humorous touch, such as the author employed here, when you want to make a point? Why?

(*Environmental Understandings:* [The waste of natural resources can limit the options available to future generations.] [The material welfare and aspirations of a culture largely determine the use and management of natural resources.])

(*Syllabus References:* English Language Arts: Reading Section K-12, *Critical and Interpretive Reading, pp. 46-47)**

## MATHEMATICS

The syllabus reference for all of the activities in this section is Mathematics K-6, a recommended program. The grade levels at which each activity would be effective are provided as suggestions only. The use of the activity at a specific grade level is left to the teacher to determine, based upon knowledge of pupil ability and upon the teacher's willingness to modify an activity (e.g., Activity 1, K-4) in terms of suitability. Thus, it may be necessary to limit the skill expectations of an activity in adapting it to the lowest grade level (K) of the suggested range or to utilize the activity's most ambitious skill expectation in adapting it to the other extreme (4).

Activity 1 - (K-4) Taking obvious precautions, establish a traffic-counting station at an intersection near your school. Preparatory to beginning the counting, have the children bring in toy cars, trucks, and buses, or pictures of same, to be used for recording the results of the counting. The class should be divided into teams or groups which would observe and count the traffic for 10 minutes at each of three different times during the day for a week. Then, using the cutouts or toys, display the results in chart form, showing the types and numbers of vehicles which passed at each time period, for the day, and for the week.

- At what time of day was the traffic heaviest and when was the traffic lightest? Why?
- Which day of the week had the heaviest traffic and which had the lightest?
- What was the total number of vehicles that passed during the 1-week tally?
- Is the traffic troublesome in anyway at any time? (crowded streets, fumes and odors, wasteful)
- Were you surprised that there were not more buses? Why? Should there be more buses? Why?
- Should there be fewer cars? Why?

(*Environmental Understanding:* [As population expands and becomes more mobile, man's demands for natural resources increase.])

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Activity 2 - (K-2) Take a trip to the grocery store with your class. Have the children notice the shapes of the various containers used for both liquid and dry foods. Discuss with them the different types of materials used to make the containers. Decide with the children which containers can be reused, returned, or recycled. When you return to class, have each child make a drawing for each of the different shapes he observed.

- What shapes were the containers that you saw?
- What shapes were used to contain what food products?
- Of what materials are the containers made?
- What containers can be reused? Returned? Recycled?

(*Environmental Understanding:* [The renewable resource base can be extended by reproduction, growth, management, and recycling.])

---

Activity 3 (K-2) - Have each child bring in two or three magazines that his family has finished reading. Then, have them cut out all of the animal pictures by using the following categories on a bulletin board:

-animals with feathers
-animals with fur
-animals with scales
-animals with shells

- Which set has the greatest number of pictures?
- Which set has the least?
- How many more pictures are in the largest set than are in the smallest?
- Are there any sets with the same number?
- Can you think of any other ways in which to group animals?
- Choose one animal from each set and explain how it is useful to man?
- Are any of these useful animals in danger today?
- What can we do to protect them?

Other sets for animals could be:

-woodland
-desert
-meadow
-prairie
-jungle
-extinct
-nonextinct
-endangered species

A similar activity can be developed using plants. When the class is finished with the magazines, contribute them to a local paper drive or recycling center.

(*Environmental Understandings:* [Natural resources are interdependent and the use or misuse of one will affect others.] [Man must acknowledge that the interdependence of all living things dictates the manner in which and the extent to which resources may be used.])

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Activity 4 (1-2) - Write to a paper company asking for sets of pictures or charts which illustrate the steps of the paper recycling process. Have the children arrange the pictures, in their proper sequence, in a straight line on the floor. Space the pictures a foot or so apart, and tape them to the floor. Have some of the children respond to such directions as: "Start at the beginning and take three steps," or, "Take one step and then two more; on which picture (or step) are you?", or, "Who is standing on the fifth step?"

- How many steps are there in the recycling of paper?
- What happens first?
- What is the fourth step?
- How many steps are there between the first and second pictures, etc.?
- Which picture is two steps from the third picture (both to the right and to the left)?
- Is it worth while for us to take the steps necessary to recycle paper? Why?

(*Environmental Understandings:* [The renewable resource base can be extended by reproduction, growth, management, and recycling.] [Most resources are vulnerable to depletion in quantity and quality.]

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Activity 5 (3-6) - Refer to Activity 1. Using similar preparation, have the children make a listing of the first 100 vehicles to pass by the counting station, arranging the list by type of vehicle (cars, motorcycles, trucks, buses).

At the end of the survey, the children should use this information to work out the probability of the next vehicle to pass being a car, a truck, etc. Then, they might try to guess what types and numbers of vehicles would be represented by the next 20 cars, using the results compiled from the first 100 vehicles. The actual result should be checked against the guess or prediction made earlier. Repeat several times.

- How many categories did you tally? What were they?
- Which vehicles were in the greatest number and which were in the least number?
- How many of each kind of vehicle did you observe?
- Did any categories have the same number of vehicles?
- How well were you able to predict the numbers of each vehicle type after having recorded the passing of the first 100 vehicles?

- Did you notice anything about this traffic that places unnecessary burdens upon the environment?
- How many automobiles had only one person in them?
- Did many of the vehicles seem to release excessive amounts of exhaust smoke and fumes?
- What would the planting of numerous large trees accomplish by way of improving the area around the intersection?

(*Environmental Understanding:* [The material welfare and aspirations of a culture largely determine the use and management of natural resources.])

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Activity 6 (3-6) - Have several members of the class do research to find what the average price of gasoline was during each of the last 10 years in the United States. They should include information about the total number of gallons sold each year as well, and present all their findings to the class using some form of pictorial representation.

- In what year was the most gasoline sold? Why?
- In what year was the least amount sold? Why?
- What was the lowest average annual price per gallon and in what year did it occur?
- What was the highest average price per gallon and for what year did this happen?
- What are some of the factors that cause changes in the price of gasoline?
- What is the difference between the highest and lowest average price per gallon?

To continue the activity, help the class conduct a survey of gas station operations in your community. Divide the class into three groups, each of which will cover one of three stations selected for observation. The groups should record the grades of gasoline sold and the price per gallon of each at their respective locations. (Have them graph the results back in the classroom.) Next, the teams should record for one hour the number of customers, the amount of gas purchased, and each total sale. At the end of the hour, the teams should produce figures for total gallons sold and the total cash receipts for the gas station.

- What will 10 gallons of each of the grades available cost at the three stations?

- How many cars purchased gasoline in one hour at each station?
- How many gallons of gasoline were sold at each station?
- What was the highest individual sale, and what was the lowest?
- What was the total amount of money taken in at each station in one hour?
- Which station took in the most?
- How much more was taken in at this station than at each of the other two?
- Can you find out how much of the gross receipts (the total amount taken in) is profit? Is the profit high or low in your opinion? Why?
- How many customers kept their engines running for more than 1 or 2 minutes as they waited in line? What do you have to say about that?
- Do we waste gasoline in this country? Explain.
- Would the price of gasoline be any lower if we were more careful about conserving gasoline? Why or why not?

(*Environmental Understandings:* [Individuals should become well-informed about the best ways to manage and conserve our energy supplies.] [The prevailing condition of scarcity which underlies all economic considerations forces changes in the lifestyles of individuals and societies.])

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Activity 7 (3-6) - Each spring, the Department of Environmental Conservation sells bulk quantities of trees (seedlings) and shrubs for a nominal fee to people who have at least an acre of land and who meet certain requirements. Schools may purchase these trees and shrubs.

Investigate the possibility of purchasing these trees and shrubs for your school. Considering the various plans for purchasing, have the class figure the cost of each tree and/or shrub. Measure off the proper amount of land needed for planting on the school grounds according to the instructions or the advice given by the Department. Measure the proper distances between the holes to be used for the seedlings. The class should then submit its findings to the appropriate school officials and seek to have the planting program initiated.

- What is the total cost of the trees and/or shrubs you are buying for the school?
- What does each tree or shrub cost?

- How big an area must your school have to be able to purchase the smallest bulk quantity of trees?
- What are the dimensions of the area you measured off?
- How far apart did you measure the holes and rows? Why?
- What do the words nominal and bulk mean?
- What are the advantages of having these trees planted on the school property (or anywhere)?

(*Environmental Understandings:* [The renewable resource base can be extended by reproduction, growth, management, and recycling.] [Plants and animal populations are renewable resources.])

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Activity 8 (5-6) - Help your class determine the market value of the shade trees in your schoolyard.

Choose one of the large trees in the schoolyard for this study. Contact the local lumber yard to learn the price per board foot of oak, or maple, or whatever tree has been chosen for the study. Using a Biltmore stick, compute the number of board feet in the tree. Then figure the tree's worth in terms of the lumber it represents.

- What is the height of the tree?
- What is the diameter and circumference of the tree?
- What is the number of board feet in the tree?
- What is the tree worth in terms of building lumber?
- Should trees be thought of only in terms of their timber value? Explain.
- How are trees helpful in the summertime?
- How do trees help in soil conservation?
- What is the relationship of trees to other elements of the surrounding natural community? (birds, small animals, air, sun, water, soil)

Select a fifty square foot area in a neighborhood woodlot (or similarly sized area measured metrically). Have pupils use various measuring techniques and instruments, such as the Biltmore stick, to compute the number of board feet of lumber are used in the average new house.

- What is the amount of board feet available in the area marked off?

- How many houses could be constructed with the lumber from the measured area?
- How much is it worth at current prices?
- Do you think lumber companies replace trees as rapidly as they use them? Discuss this thoroughly in explaining your answer.
- What happens to the timber industry when there is a continual increase in population?
- Does consideration of this change your answer to the question above in any way?

(*Environmental Understandings:* [As population expands and becomes more mobile, man's demands for natural resources increase.] [Natural resources are interdependent and the use or misuse of one will affect others.])

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Activity 9 (5-6) - Have the children conduct an investigation into the meaning and worth of a cord of wood. They should find out the dimensions of a cord of wood in terms of length, height, and width, and the current price of a cord of wood in your area.

Construct a cord of wood. Go into the woods near your school and stack cut logs or perhaps seek the cooperation of a local lumber mill. If these methods are impractical, the children can construct a facsimile in the classroom by marking off the dimensions of a cord and filling the area with solid objects.

A cord of wood has the heating value of 1 ton of coal or 200 gallons of fuel oil. (This will vary slightly with the type of wood). Compare the cost of using wood versus coal or fuel oil for heating your home for one year.

- What are the dimensions of a cord of wood?
- What is the approximate cost of a cord of wood?
- Did you learn the definition of a "face cord" along the way? What is it?
- What information do you need concerning a cord of wood, a ton of coal and 200 gallons of fuel oil before you can compare costs of heating using the three methods?
- Which method is cheaper?
- Which method gives you the most exercise?
- What are the advantages and disadvantages of heating by the three methods discussed?

- Is the use of a renewable resource such as wood for heating a practical solution to our fuel shortage? Why not? What are some practical solutions?

(*Environmental Understandings:* [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.] [Man must develop the technical and sociological knowledge needed to control population growth, modify environments, and alter resource use patterns.])

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Activity 10 (4-6) - We are a nation of wasters. Explore the "waste of waste paper" with your class. Begin by dividing your class into several teams. Make each team responsible for a certain number of classrooms in the school. Have the teams collect the waste paper from each classroom every day (or accompany and assist the custodial staff as it does this for one week). The teams should estimate and record the weight of waste paper that is collected on each of the 5 days.

At the end of the week, the pupils should compute the average daily weight collected. Using the average daily weight figures, they then arrive at the amount of waste paper that will be collected in one school year (180 days). The next step is for them to determine the approximate number of trees that were needed to produce all of the paper used (17 trees = 1 ton). (These computations may be done in either English or metric calculations.)

- What was the average daily weight of the waste paper collected?
- On which day did you collect the most paper?
- How much waste paper would be collected in one school year (180 days)?
- How many trees were needed to supply us with all the paper used?
- How would you suggest that this rate of paper consumption be reduced?
- What would be the benefit, in reducing paper consumption by a noticeable percentage? (as little as 5-10 percent)

(*Environmental Understandings:* [The renewable resource base can be extended by reproduction, growth, management, and recycling.] [The rate of resource consumption increases in direct proportion to the expansion of our wants, needs, and markets.])

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Activity 11 (5-6) - Organize a newspaper drive with your class. Ask several other classes to join in with you. Have the students bring in newspapers from home for one week.

At the end of the week, have the children compute the amount of papers collected by stacking them and measuring the stacks. (36" of stacked paper = 1 tree and every 30" = 100 lbs.)

- How many inches of paper did each class collect?
- How many pounds of paper did each class collect?
- What is the present rate paid for 1 ton of recyclable newspaper?
- How much will the students earn from the paper they collected?
- How many trees will be used in one year if the classes continue using newspapers at the same rate?
- How many tons of paper will be collected in a week, or a month, or a year?
- How many trees are saved when these amounts of paper are recycled? (Students will have to inquire of a paper mill or a paper dealer as to the diminishing return on recycling scrap newspaper into usable newsprint, if this is the case.)

(*Environmental Understandings:* [Individuals should become well-informed about the best ways to manage and conserve our energy supplies.] [Raw materials and energy supplies are generally obtained from those resources available at least cost, with supply and demand determining their economic value.])

## Kindergarten

Activity 1 - Bring two pumpkins into the classroom. With the children, cut up and cook one pumpkin in preparation for making pudding for the class from a pie filling recipe. Save the seeds. Use the second pumpkin to make a Jack-o-Lantern for classroom Halloween decorations. Remove and save the seeds. Dry the seeds for several days. Have each child plant a few seeds in small pots of soil, water, and place in a sunny spot. Seedlings should appear in a few days or a week.

Keep the Jack-o-Lantern in the room as long as possible after it has started to decay. Discuss with the class how best to dispose of it when necessary. Suggest that it can be added to a pile of compost, which can be used to enrich the soil for other plants.

- How many seeds are in one pumpkin? (Probably too many for kindergarten children to count, but the nonnumerical concept, "many," can be developed.)
- How many new plants did the class get by planting some of the seeds from two pumpkins?
- Were the pumpkins "used up" when the one was cooked and the other decayed? (Indicate that the individual plants were used up, but that the seeds produced many new plants to replace the two that were used up.)
- In what other way did the decayed plant help to make new plants?

(*Environmental Understandings:* [Plants and animal populations are renewable resources.] [The renewable resource base can be extended by reproduction, growth, management, and recycling.])

(*Syllabus References:* Science for Children, K-3, *Understanding 4, p. 15; Project 5, p. 15*)

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Activity 2 - Animals need water as much as people and plants. Water is a metabolic necessity for all animals and provides an environment for some animals. Animals obtain and use water in different ways. Ask children to collect pictures of all kinds of animals, and make separate displays of the pictures, dividing them into the following four categories:

-live in water (all or part of the time)
-live near water
-need water daily
-can be away from water more than one day

- Why do all animals need water?
- Why do animals use water in the ways they do?

- What animals get the water they need from the dew?
- Which group has the most animals?
- What happens to animals when their water supply is reduced to less than their needs?

(*Environmental Understandings:* [Natural resources are interdependent and the use or misuse of one will affect others.] [Any one of an environment's components, such as space, water, air, food, or energy, may become a limiting factor.])

(*Syllabus Reference:* Science for Children, K-3, *Understanding 4, p. 15*)

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Activity 3 - On a sunny day in early spring, take the class into a room on the sunny (south) side of the school building. Then go into a room on the shaded (north) side of the building. Ask the children if the air temperature in the two rooms felt different. Elicit that the first room felt warmer, and that the sun has warmed it.

Ask which side of the school usually gets the most sun. If the children cannot remember, take the class outside at different times on a sunny day. They will probably discover that one side (south) gets the most sun, while one other side (north) gets less. Explain that the side facing the sun should have many large windows to take advantage of the sun's warmth, and that the opposite side of the building should have fewer windows.

Encourage the children to plan and build several diorama "houses" which would utilize the sun's warmth for heating. Place the completed houses on the window ledge in a sunny room. Discuss with the children how the houses should be oriented. To test their hypothesis, several houses should have the big windows facing away from the sun. Place small dishes of water in each of the model houses. After several hours, have the children test the temperature of the water with a lab thermometer.

- In which of the model houses would the children expect to have the water feel warmer? Why?
- If real houses were built with many windows facing the sun, how would that affect the amount of fuel necessary to heat them?
- What problem might occur in the summer?
- How could this problem be prevented?

(*Environmental Understanding:* [Natural resource depletion can be slowed by the development and adoption of substitutes for nonrenewable resources, prevalent lifestyles, and current priorities.])

(*Syllabus Reference:* Science for Children, K-3, *Understanding 3, p. 30*)

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Grade 1

Activity 4 - Due to the energy shortage, most schools maintain lower thermostat settings than previously. There is often a period during the day when the room is noticeably cool. During one of these periods, call attention to the change in temperature. Discuss with the children how we keep the air in our homes and classrooms warm in the winter. Elicit that the air is heated by the radiators, and that when the room is cooler, it is usually because the radiator is cooler. Ask how the radiators are heated.

Arrange with the school custodian for a guided tour of the boiler room. Have the children plan a list of questions to ask on the tour.

- How does the heating system operate?
- What fuel is used to heat the school?
- Why is it cooler at some periods of the day than at others?
- Why are the thermostats set lower than they used to be?
- Has the school had any difficulty getting fuel?
- Which of the following users would find it most difficult to obtain fuel during an energy crisis? Why?

| | |
|---|---|
| -homeowners | -truck drivers |
| -schools | -auto owners |
| -factories | -ski resorts |

- Of these users, should any be favored in their efforts to obtain fuel? Who? Why?

(*Environmental Understandings:* [Individuals should become well-informed about the best ways to manage and conserve our energy supplies.] [The prevailing condition of scarcity, which underlies all economic considerations, forces changes in the lifestyles of individuals and societies.])

*(Syllabus References:* Science for Children, K-3, *Teacher Directed Activity 5, p. 52; Understandings 3 & 4, p. 64)*

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Activity 5 - Show children a picture of people sitting around a campfire. Ask what the main uses of the heat of the campfire are. Children will probably say to cook and to keep warm. Ask children how many different things they think they have in their houses to perform these two basic functions of cooking and heating. Their guesses will probably cover a broad range. Give children old magazines and department store brochures advertising housewares and appliances. Have them cut out everything they can find that helps people use heat energy.

After a large variety of pictures has been collected, recall the campfire, and ask what fuel was used to provide its heat (wood). Discuss what fuels are used to produce the energy needed for most of the items shown in the pictures. Start a bulletin board display titled, "How We Use Heat Energy In Our Homes." Set up columns for the different fuels suggested by the children: natural gas, gasoline, oil, wood, and charcoal. Add the pictures to the appropriate column. When the display is completed, ask the children to count the different objects shown. Compare this number with their estimate of the number of appliances they have in their homes which provide heat and the number which do work.

- What are the advantages and disadvantages of using a campfire for cooking and for keeping warm?
- Which column on the bulletin board has the most pictures: natural gas, gasoline, oil, wood, or charcoal, or others?
- How many of the jobs done by the appliances shown on the bulletin board could have been achieved without using an appliance at all?
- Why do Americans use all of these different items? (Consider advertising, merchandising techniques, relative affluence, and need for convenience.)
- What is happening to the amount of oil and natural gas available as we use energy in ever-increasing amounts?

(*Environmental Understandings:* [Most resources are vulnerable to depletion in quantity and quality.] [Choices between essential needs and nonessential desires are often in conflict.])

(*Syllabus References:* Science for Children, K-3, *Summary Questions 4 & 5, p. 63; Understanding 4, p. 64*)

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Activity 6 - Ask a group of pupils to obtain and bring to class labeled samples of each of the following:

| | |
|---|---|
| -coal or charcoal | -iron |
| -wood | -lead |
| -oil | -copper |
| -water | -building stone (granite or marble) |
| -soil | |

Have these children present their samples and ask the rest of the class the questions below.

- Where are these materials found?
- Are we running short of any of these materials? Explain.

- Which of these materials do you think are most important to us? Why?
- Are some of the most important ones the same as those we are running short of?
- How may these materials be more wisely used or saved?

(*Environmental Understandings:* [Individuals should become well-informed about the best ways to manage and conserve our energy supplies.] [Most resources are vulnerable to depletion in quantity and quality.])

*(Syllabus References:* Science for Children, K-3, *Summary Question 4, p. 63; Understandings 3 & 4, p. 56; Understanding 4, p. 64)*

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Grade 2

Activity 7 - Discuss with the class the importance of soil as a resource, considering the fact that it is renewable, albeit through a long and complicated process. The children should use magnifying glasses to examine soil samples taken from the school grounds and nearby wooded areas. Have them identify the objects they see in the soil which will probably include sand, pebbles, twigs, seeds, dead plants, rootlets, and insects.

Have the children find places outside where there is evidence of soil being formed from leaf litter, decaying logs, and the action of earthworms (see activity 8). The children should feel the soil and the rotting logs. Mention the action of water on stones and pebbles as contributing another element to the process of soil formation. Illustrate with smooth rocks and pebbles. Discuss the length of time that is required for such a process.

- What role is played by the insects in a decaying log?
- Why are these dead trees important in the process of soil renewal?
- Can you see more than one layer of leaf litter?
- Does it take long for these leaves to become part of the soil? How long?
- What is topsoil? Why is it valuable?
- Why must we use our topsoil wisely?
- Why is good soil important to the growing number of people in the world?
- What is the result of changing more and more farmland into roads, housing developments, shopping centers, and industrial complexes?

(*Environmental Understandings:* [Soil and water are classified as renewable resources but, because their renewal or revitalization requires a major investment in time and effort, they may be more realistically considered depletable resources.] [As population expands and becomes more mobile, man's demands for natural resources increase.])

(*Syllabus References:* Science for Children, K-3, *Topics 2 & 5, p. 87; Summary Questions 5 & 6, p. 87; Understandings 2, 3, 4, & 6, p. 88*)

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Activity 8 - By way of developing one specific part of the process of soil formation, develop the following activity on the earthworm. Take the class to a field, forest, or to the edge of a pond and locate several earthworms. Note where the worms are most numerous (wet or dry, exposed soil, sand or humus). Help the children prepare an environment in which earthworms will be able to live using an aquarium filled with light soil on top of dark soil. Plant grass seed.

Measure several worms, recording minimum and maximum length, width, and the average number of segments. The children should bring back some worms to be placed in the tank after their grass is an inch above the soil. Cover the sides of the tank with black paper to block out the light. Keep the soil moist and do not disturb for 4 to 6 days. Remove the paper and watch the churning action.

- What does the earthworm do to the soil that makes it a better place for plants and animals?
- In what kind of soil do earthworms live?
- Why do earthworms come to the surface when it rains?
- Is the earthworm a consumer or decomposer?
- What animal eats earthworms?

(*Environmental Understanding:* [Living things are interdependent with one another and with their environment.])

(*Syllabus References:* Science for Children, K-3, *Topic 8, p. 87; Understandings 3 & 4, p. 88*)

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Activity 9 - At the end of the day have children pick up any paper and other litter they have dropped on the floor, or thrown into their desks. Place all of this material in a pile on a piece of newspaper or in a box. Then empty the wastebasket into another pile. Ask the class what state of matter these items represent. Write "Solid" on the chalkboard. Add the word, "Waste." Discuss the meaning of the word waste and the meaning of the new expressing, "Solid Waste." Indicate that, although our society has environmental problems related to gaseous and liquid waste, it is the collection of solids we throw

away that is becoming one of our most serious problems. Show that the contents of both piles of "Solid Waste" are quite similar, and the only difference is that the wastebasket is a tidier way of disposing of classroom waste than littering is. Stress that an object thrown into a wastebasket is as much a "waste" as one thrown on the floor.

Taking appropriate sanitary precautions, have the children sort through the "solid waste" accumulated by the class (and you) in one day, and discuss the following questions:

- What type of material is found in the greatest quantity in this accumulation? (probably paper)
- Which items could be salvaged on second thought? (Large pieces of paper with little written on them, rubber bands, crayons, pencils, and paper clips are examples.)
- What does this tell the children about our habits of discarding things?
- How can some of the wasted items be reused? (Memo pads from discarded paper, milk container planters, and writing on both sides of a page are examples.)
- Which things could be recycled? What does recycling mean? Are there recycling centers in town? Can the school set up a newspaper collection center for recycling? How is recycled paper used?
- How does solid waste create problems? How does your community dispose of solid waste?
- Do we need all of the things we use? Is there any danger that some of the solids we are using might someday be used up? (aluminum, copper, paper)
- Why do Americans use and waste so many things?
- How do we compare with other nations in this regard?

(*Environmental Understandings:* [The rate of resource consumption increases in direct proportion to the expansion of our wants, needs, and markets.] [The waste of natural resources can limit the options available to future generations.])

(*Syllabus References:* Science for Children, K-3, *Summary Question 3, p. 96; Understanding 3, p. 96)*

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Grade 3

Activity 10 - The commercial recycling of paper requires huge machines and many people. If possible, schedule a trip to a recycling plant. If there is no plant in your area, write to a company that

recycles paper and find out the steps of the process, the cost of recycling, and the utility of recycled paper.

Gather the following materials and recycle paper right in the classroom. Collect an old newspaper, a mixing bowl, an egg beater, a wood block, a square of window screen (3 to 4 inches square), a plastic sandwich bag, wallpaper paste or corn starch, water, and a tablespoon.

Fill the bowl one-fourth full of water. Tear one-half of a newspaper page into pieces. Place the pieces in a bowl and let them soak for an hour. After the paper has become thoroughly soaked, beat it with the egg beater. The action will break up the paper into fibers. When the mixture has been thoroughly beaten, it should be creamy like wood pulp.

Dissolve two heaping tablespoons of wallpaper paste or corn starch in a pint of water. Pour into and stir in the pulp. Hold the piece of window screen flat and lower it into the pulp. Repeat this step until you accumulate a layer of pulp about one-tenth of an inch thick. Set the pulp-covered screen on a newspaper and place a plastic sandwich bag over it. Press down with the wood block, gently, then with more pressure. The water will filter through the screen onto the newspaper. Allow the fibers to dry for about 24 hours. Peel the fiber, then the paper from the screen.

- How does a paper recycling plant make paper?
- What fuel furnishes energy for the process?
- How does recycled paper compare in cost with paper from virgin timber?
- Find out how many trees are saved when a given quantity of scrap paper is recycled.
- How many articles can you find that have been made of recycled paper?
- Does your town pick up newspapers for recycling?
- What ways can you help to recycle paper?

(*Environmental Understandings:* [The renewable resource base can be extended by reproduction, growth, management, and recycling.] [As population expands and becomes more mobile, man's demands for natural resources increase.])

(*Syllabus References:* Science for Children, K-3, *Understandings 4 & 5, p. 108*)

Activity 11 - Devise an experiment with the class to determine the effect of heated water on fish. Use goldfish or minnows. Be careful not to let the temperature of the water get above 35° C. (95° F.) or the fish might be killed. One of the best indicators of the effect of the raised temperature on the fish is the change in respiration rate.

Relate this experiment to thermal pollution resulting from energy conversion plants, and to the effects these elevated water temperatures have on the fish and their life cycles. Have the class determine the increase in the water temperature in the vicinity of a large "power" plant.

Have the children draw a diagram showing how cool water is taken into energy conversion plants from nearby bodies of water, used for cooling purposes, and then returned to the water.

- What other industrial plants besides "power" plants discharge heated water into lakes and rivers?
- What other effects would this change in temperature have on the ecosystem in addition to harming the fish?
- What effect have oil leaks had on fish and other marine life? What causes oil leaks? What are some of the arguments for and against off-shore drilling for oil?
- Are any fin fish or shell fish, which were formerly a plentiful supply of food for man, now hard to get? (Children might ask the local fishmonger for his opinion on this question.)
- How does dumping of garbage in the ocean affect fish and other marine life? How much of this ocean dumping of garbage is being done? Where? Why?
- What problems are associated with the increase in radioactive wastes which would be accumulated by extended use of nuclear plants for the conversion of energy?

(*Environmental Understandings:* [Man must acknowledge that the interdependence of all living things dictates the manner in which and the extent to which resources may be used.] [Water is a reusable and transient resource, but the usable quantity may be reduced by impaired quality.])

*(Syllabus Reference:* Science for Children, K-3, *Understanding 4, p. 108)*

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Activity 12 - Have children bring in to school empty soda cans. Ask what the cans are made of. Children may suggest tin, iron, or aluminum. Some may say "metal." Discussion should lead to the understanding that tin, steel, and aluminum are all metals with different characteristics. Explain that most "tin" cans are steel covered with tin.

Ask how the steel cans could be sorted from the aluminum. Children will probably recommend using a magnet. Remind children to test both the sides and the ends of the cans. A magnet will not be attracted to the sides of an aluminum can. If the can is bimetal, the magnet will be attracted to the ends. Aluminum cans are also lightweight and smooth. They have rounded bottoms and no side seam.

Discuss the impact soda cans are having on the environment in terms of litter, solid waste disposal, and resource consumption.

Consider planning a school-wide aluminum recycling drive.

- Which creates more environmental problems, aluminum or iron cans? (Iron rusts and becomes degradable; aluminum does not; aluminum is becoming a scarce resource.)
- Where does the United States get most of its aluminum? Are there any predictions about how long the world's supply will last at our present rate of consumption?
- What are some of the other uses we make of aluminum? If we had to make choices among the various uses of aluminum, which uses would we find most important?
- What can you find out about the amount of energy used in making aluminum products?
- What are the steps in setting up an aluminum recycling program? How is recycled aluminum used? What are the advantages of recycling aluminum soda cans rather than throwing them away?

(*Environmental Understandings:* [The renewable resource base can be extended by reproduction, growth, management, and recycling.] [The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures.])

(*Syllabus References:* Science for Children, K-3, *Summary Question 1, p. 132; Understanding 1, p. 133*)

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Grade 4

Activity 13 - Depending on the availability of the supplies, perform one of the following experiments with the class.

(1) Prepare two pots of tea (use identical pots). While the tea is still boiling hot, cover one pot with a tea cosy. Leave the other pot uncovered. After 5 or 10 minutes, use a thermometer to determine the temperature of the tea in each pot. Ask children to predict which will probably be warmer, and why.

(2) Use two small, identical beakers and two shoe boxes. Insulate one of the boxes (cover box edge) as well as possible using paper, cotton, ceiling or roof insulation, etc. Leave the other box uninsulated, and make a few small holes in it. Insert a thermometer in a slit in the top of each cover. Pour the same amount of boiling water into each beaker, place them in the boxes, and quickly cover the boxes. On the insulated box, be sure that the crack around the thermometer has been well sealed, and that the lid is sealed onto the box. Watch the thermometer and note changes in the temperature of the water in each box. Ask children to predict what they think will happen, and to explain their predictions. Discuss the results. Use the experiments as a lead-in to discuss insulation in our houses.

- Which construction materials provide the best insulation? (If possible, arrange for children to visit an old stone building and a newly constructed building on a hot day).
- What is *thermopane*? How is it used? Why is it used? Why is it not used in some houses? (It is expensive.)
- Is good insulation important only in the winter when fuel is being used to heat the house? Explain.
- What is the advantage of storm windows and doors?
- What kinds of materials are used for insulating houses? Prepare a display of some of the more common ones.
- How can room decorating (rugs, draperies) help in insulation?
- What steps can the average homeowner take to achieve better insulation? (Caulking of windows, storm sashes covering air conditioners in winter, and keeping fireplace drafts closed when not in use, are examples.)
- If a well insulated house saves money in fuel for heating and electricity for air conditioning, why are more new houses not better insulated?

(*Environmental Understandings:* [The prevailing condition of scarcity which underlies all economic considerations forces changes in the lifestyles of individuals and societies.] [The waste of natural resources can limit the options available to future generations.])

*(Syllabus References:* Science for Children, 4-6; *Project 1, p. 55; Summary Questions 1-4, p. 56; Understandings 1 & 2, p. 56)*

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Activity 14 - Have children prepare a display of common metal objects collected in the home and classroom. Included might be: aluminum pots and pans, aluminum cans, chromium from the trim of an old car or bicycle, silver dimes and quarters, copper pennies, tin or

steel from the cover of cans, and iron or steel from discarded refrigerators or cars. For each metal, have the children prepare a label indicating its characteristics, the mineral from which it was derived, general properties (aluminum is lightweight, silver-white in color, and practically impossible to disintegrate), and some of its major uses. Classify these minerals as being plentiful or scarce. On the labels for each mineral, indicate the point in time (estimated) at which the mineral will be depleted given our present rate of consumption.

- How does the twentieth century rate of consumption of these minerals compare with that of the past?
- What rates of consumption are predicted for the near future, based on the growth in our economy during the recent past?
- How does the United States' consumption of each of these minerals compare with that of the rest of the world on a gross basis and on a per capita basis?
- If the rest of the world consumed these minerals at the same rate as the United States, when would the supply be depleted?
- What is the explanation for our disproportionate rate of consumption of the world's minerals?
- Are steps being taken to decrease the use of any of these minerals in the United States? If so, what measures, specifically?
- Are substitutes or alternatives being found for any of the minerals?
- Are there any environmental problems connected with the use of any of these alternatives?
- How would our lives be affected if the supply of any of these minerals was completely exhausted?
- Select any one mineral, such as copper, and list as many uses of it as the class can think of. Is it possible to rate these according to their importance to us? Which, if any, does the class consider essential? Which are unnecessary?
- In a democracy, how should the decision be made concerning the use to which scarce materials should be put?

(*Environmental Understandings:* [Historically, cultures with high technological development have used disproportionately more natural resources than those with lower levels of technological development.] [In a democracy, people must consent to, or insist upon restrictions on resource allocation and use.])

(*Syllabus Reference:* Science for Children, 4-6, *Understanding 5, p. 43*)

Activity 15 - If the class is familiar with the children's word game *Hangman*, suggest this variation. On the chalkboard, instead of writing the first and last letters of a word, make drawings like the ones below:

Ask the children to suggest the drawings that should be in the spaces between the sun and the automobile. As children suggest correct responses, have them make the drawing in the space. Incorrect responses are used to build the "Hangman." (Correct responses are: sun, plant, protozoans, sedimentary rocks containing oil, oil, and automobile.) Discussion should lead to the understanding that the energy to drive a car came from the sun via green plants.

Using a drop of hay infusion or pond water, show children living protozoans through a microscope or microprojector. Discuss how these one-celled animals get their food. Ask what happens to the excess food we store. Elicit that it is stored as fat. Rub a peanut or a piece of animal fat on a piece of paper. Elicit that it leaves an oily spot.

Have children do research to find out how fossils were formed millions of years ago when dead protozoans combined with sediments to form sedimentary rocks containing fossils. Place a drop of oil on a piece of igneous rock (granite), a sedimentary rock (sandstone or limestone), and a metamorphic rock (gneiss or marble). Which absorbs and stores the oil? (The sedimentary rock does because it is porous.) Discuss the way oil is trapped in domes in sedimentary rock.

- Why is oil called a *fossil fuel*?
- What are other fossil fuels? How was coal formed? How was natural gas formed?
- Are fossil fuels still being formed? If so, why are we concerned about the depletion of fossil fuels?
- Use a map to show where most of the world's supply of oil is located. Where is most of the natural gas? Where is most of the coal? If fossils were formed in ancient oceans, how can it be explained that many fossil fuels are found in hills and mountains?
- Which of the three fossil fuels (coal, natural gas, and oil) is now in shortest supply? Which is most plentiful?
- What are the problems associated with each of the three in connection with using them as sources for our growing energy needs?

- If consumption continues to increase by the rates estimated, what are the predictions for how long fossil fuels will be able to continue to supply the world with energy?

(*Environmental Understandings:* [The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures.] [As population expands and becomes more mobile, man's demands for natural resources increase.])

(*Syllabus References:* Science for Children, 4-6, *Summary Questions 1-10; Understandings 1-5 & 7, pp. 42-3)*

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Activity 16 - Water is one of our most vital resources, one which we use in an endless variety of ways. Yet, we take its availability and quality for granted. This water which plants, animals, and people use is available to us through the process of the *water cycle*. Explain the water cycle to the class and then have them draw simple diagrams of the water cycle.

Have the pupils list all of their activities in a typical day which are in some way related to the use of water. Remind them of the less likely things such as riding in a bus with a water-cooled engine to wearing clothes which have their color (dyes) because of a process which relies on water use. From this list, eliminate the items which do not relate directly or indirectly to survival.

- Do these deletions reduce our reliance upon water significantly? Why or why not?
- How would our way of life change if we relied on water for only our most basic needs?

The children should ask their families to cooperate in recording the types of home water use, and in tabulating the quantities used for each type over a given period of time (one week). Be certain that they check the water meters before and after the observation period to determine the accuracy of the tabulations.

- How much water did the family use in a week?
- How much is that per person?
- What would the per family and per person figures be for one year?
- Is more water used taking a shower or a bath?
- How much water is used doing a load of laundry? How much is used by the dishwasher?
- List the ways we can use water more carefully.

- Find out how much water is used by industry and agriculture in comparison with that used in the home.

- If this tremendous amount used by industry and agriculture cannot be reduced without serious economic consequences, what must we do to safeguard water quality so that it is truly a renewable resource?

(*Environmental Understandings:* [Soil and water are classified as renewable resources but, because their renewal or revitalization requires a major investment in time and effort, they may be more realistically considered depletable resources.] [Water is a reusable and transient resource, but the usable quantity may be reduced by impaired quality.])

(*Syllabus References:* Science for Children, 4-6, *Project 1, p. 35; Understandings 1, 2, 3, 5, & 7, p. 36)*

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Grade 5

Activity 17 - In discussing the the contributions of green plants to all living things, emphasize that their role in supplying oxygen is as important as their role in supplying food. Have children do research to find out how much oxygen is supplied by an acre of trees. Relate this information to man's use of trees for the manufacture of paper. Discuss the uses of paper and the environmental problems associated with the accelerating demand for paper. Refer to the present scarcity of paper bags, toilet tissue, and other paper products.

If the school is experiencing a paper shortage, share this information with the class. If it is not, assume that such a situation might develop in the near future. With the children, try to determine the best ways to use the supply allocated to your class and to the school in a time of shortages. Have the children work out the details for the best utilization of the class supply of paper. Try to develop the concept of planning as a fundamental approach to such situations, and show the class the relationship of this concept to other scarcity situations our country and the world are now facing.

- What are the uses to which paper has formerly been put in the classroom?

- Which of these uses might be considered essential? Which are less so? Are any completely useless? Which uses should be assigned the highest priority?

- How much paper is usually wasted? (Perhaps the class might want to make normal, excessive use of paper for a few days, and then analyze the contents of the wastebasket to determine the quantity that is usually wasted.) How can this waste be stopped? What methods can be devised to help students remind themselves not to waste paper?

- What further use can be made of paper after its initial use?
- How is paper wasted in the home, in institutions, in business, and in industry?
- What can be done about recycling paper?

(*Environmental Understandings:* [The renewable resource base can be extended by reproduction, growth, management, and recycling.] [Energy is initially supplied to an ecosystem by the activities of green plants.])

(*Syllabus References:* Science for Children, 4-6, *Understandings 1, 9 & 11, pp. 66-7; Understanding 12, p. 85)*

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Activity 18 - Divide the class into four or five committees of "resource sleuths," each of which will conduct an investigation into one section of the classroom. Explain that they, as "detectives," are to compile as complete a list as possible of the different objects (desks, papers, doorknobs, plastic globe, blackboard, chalk) in their territory, and then ferret out information about the natural resource used to make each of these objects. Some will be of mineral origin; others will come from plants or animals. Many will be plastic. The school custodian, as well as encyclopedias and other books, may be helpful to the students in their research.

Have pupils enter their findings on a chart such as the one below:

| OBJECT | NATURAL RESOURCE(S) |
|---|---|
| blackboard | slate |
| desk | wood, iron (steel) |
| sink | iron (steel), porcelain |
| book | tree |
| doorknob | copper and zinc (brass) |
| book jacket or plastic globe (dust cover) | petroleum (cellophane or plastic) |

Add columns to the chart as answers to the following questions are obtained:

- What is a renewable resource?
- Which of these resources are renewable?
- Which, if any, of the renewble resources are in short supply currently?
- If any are scarce, or are becoming scarce, is government or industry doing anything to improve the situation? What?
- Which of these resources are nonrenewable?

- Which of the nonrenewable resources are scarce, or becoming scarce?
- How long will it be before a serious crisis occurs for each of these resources now in short supply?
- What steps are being taken by government or industry to meet the problems presented by these growing shortages of nonrenewable resources?

(*Environmental Understandings:* [The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures.] [The limited nature of productive resources makes it imperative that a society define its economic objectives in terms of environmental reality.])

(*Syllabus References:* Science for Children, 4-6, *Topic 1, p. 41; Understanding 5, p. 43*)

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Activity 19 - Use a magneto (model generator) to light a bulb. As pupils turn the crank of the magneto, they observe that a metal bar or coil of wire is turning between the poles of a large horseshoe magnet, thereby causing electricity to be generated.

Ask where the energy to turn the coil of wire came from. Discuss that human muscle supplied this energy. Recall that the definition of energy is the ability to do work. Explain that the principle governing the generation of electrical energy in large "power" plants is similar, but that the energy to turn the turbines usually comes from steam. Discuss that fuel is required to produce this steam. Have pupils do research to learn which fuels are most commonly used in these plants to generate electricity.

- What are the fossil fuels? Why are they called fossil fuels?
- Which kind of fossil fuel is used in your city for generating electrical energy? Why?
- Which air pollutants are produced by "power" plants burning fossil fuels?
- Why has oil been used more widely during the past few years than coal or natural gas?
- What does *low sulfur content fuel* mean? Why has it been used during the past few years?
- Where does the United States obtain the oil to meet our country's growing demand for it as a source of energy?

- What suggestions are being considered to increase the availability of oil?
- What alternate sources of energy are under consideration?

Have pupils "pinpoint" on a map of the State the locations of the major "power" plants. Categorize and list these plants according to the type of fuel used to produce electrical energy. The class may obtain information about total electrical energy produced (annually) and the areas and populations served by these plants from the New York State Power Authority and the New York State Public Service Commission.

- How do the generators in these plants work?
- How many different electric companies serve the State?
- How many generating plants does New York State have? What is the total amount of electrical energy generated by these plants in one year?
- What type of fuel is most commonly used by these plants?
- Would a cutback in the use of electrical energy be an alternative to building new plants? If so, how significant or important an alternative would this be?
- Should certain unnecessary electrical appliances be banned?
- Should government decide who can have how much energy for what as a means of eliminating inequities in usage? Explain.

(*Environmental Understandings:* [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.] [Man must develop the technical and sociological knowledge needed to control population growth, modify environments, and alter resource use patterns.])

(*Syllabus References:* Science for Children, 4-6, *Understandings 2, 3, & 4, p. 100)*

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Activity 20 - Ask the children to estimate how many different uses are made of electrical energy in their homes. Distribute a checklist of some common household appliances which are operated by electricity. Ask children to check those they have in their own homes, and to put a double check next to those they use themselves.

Compile the results of this questionnaire in a tally sheet. Note the average number of electrical appliances in the children's homes, the median number, and the range. Compare these figures to what the children estimated before they used the checklist.

## SCIENCE

### CHECKLIST - USING ELECTRICITY IN THE HOME

Listed below are many electrical appliances used in American homes every day. Check each item you have in your home. If you use (operate) the item yourself, use a double check. If you think of other items you or your family use, add them to the list.

___ air conditioner
___ food blender
___ dehumidifier
___ humidifier
___ dishwasher
___ doorbell
___ back massager
___ electric blanket
___ can opener
___ clock
___ coffeemaker
___ slide viewer
___ shoe polisher
___ electric circular saw
___ drill sander
___ electric toothbrush
___ washing machine
___ electric mixer
___ hairdryer
___ hair curler
___ clothes dryer
___ electric fan
___ space heater
___ lamps
___ musical instruments
___ refrigerator
___ tank (aquarium) filter
___ hedgecutter
___ electric knife
___ electric typewriter
___ iron
___ vacuum cleaner
___ radio
___ television
___ warming tray
___ bun warmer
___ floor polisher
___ record player
___ orange squeezer
___ pencil sharpener
___ electric stove
___ waffle iron
___ toaster
___ sandwich grill
___ griddle
___ frying pan
___ electric oven
___ electric shaver
___ rug shampooer
___ slide projector
___ home movie projector
___ tape recorder
___ garage door opener
___ water softener
___ snowblower (electric)
___ mower (electric)

- Which appliances are in everyone's home? What percentage is this of the total number listed?
- Which of the items checked are the most essential? Which are the least? Is it possible to agree about these answers? Why or why not?
- Are there some jobs that you can accomplish without the appliance you are now using for it?
- How might children in other parts of the world respond to the same checklist?
- How does consumption of energy in the United States compare to that of the rest of the world?
- Why do Americans consume as much electrical energy as they do? (Consider advertising, merchandising, comparative affluence, convenience orientation, as examples.)
- If it were necessary to reduce electrical energy consumption, which of the items checked would we be most willing to give up?
- Who should decide what we will give up?

(Environmental Understandings: [Choices between essential needs and nonessential desires are often in conflict.] [The rate of resource consumption increases in direct proportion to the expansion of our wants, needs, and markets.] [The material welfare and aspirations of a culture largely determine the use and management of natural resources.])

*(Syllabus Reference:* Science for Children, 4-6, *Understanding 4, p. 100)*

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Grade 6

Activity 21 - Obtain a map of New York State minerals. Prepare graphs of the minerals mined in the State showing the amounts of each mineral mined. Make a bulletin board using the map to pinpoint where each mineral is obtained. Locate abandoned mines on the map.

Have the children write to major mining companies in the State to find out about the cost of mining, methods of mining, the energy used in the process, the products made from the minerals, and research and exploration being undertaken to increase the amounts of known reserves.

- What is a mineral?
- What minerals are mined in New York State?
- What products are produced from these minerals?
- Are these minerals used within the State for manufacturing?
- Is it necessary to transport them out of the State for processing or refining?
- What fuels are used to provide energy for extracting these minerals from the ground?
- Has the fuel shortage curtailed mining operations?
- For what reasons were mines abandoned?
- Is water power used in any of the mining activities?
- Where else in the United States and in the world are these minerals found?
- What will happen when these mineral resources are depleted?

(*Environmental Understandings:* [Most resources are vulnerable to depletion in quantity and quality.] [The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures.]

[Natural resources are unequally distributed with respect to land areas and political boundaries, thus creating conflicts over priorities in the use, management, and conservation of these resources.])

*(Syllabus References:* Science for Children, 4-6, *Motivating Questions 1-6, p. 132; Understandings 3-6, p. 137)*

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Activity 22 - Show the class a picture of an open pit mine, and ask whether or not they think this large hole in the ground was caused by water erosion, as was the Grand Canyon. Many of the clues in the picture (indications of man's activity and man's equipment) will lead to the conclusion that this hole in the ground was man-made. Have children do research to find out about open pit mining, or strip mining, and where it has been done. Use a map of the United States, and place pins on the areas where it has been most prevalent. Discuss some of the reasons for strip mining, and some of the environmental objections to it. Develop the understanding that this is a very complex problem, as are many of the environmental questions facing our society, especially in this period of energy shortage.

Plan a role-playing activity with the children. Have one group study the position of industry, one group that of the environmentalists, and one group that of the local community whose jobs depend on the mining industry. After the committees have had an opportunity to do research (interviews, films, books), they can set up a mock hearing at which each group will present its point of view. The following questions can be used to guide the project.

- How has most of our coal been mined until recent years? What were some of the advantages of this type of mining?
- How does strip mining hurt the environment? What is its effect on water? On flooding? On the nearby vegetation? On the appearance of the land?
- What are some ways to prevent the harmful effects of strip mining? Why have these precautions not been taken before?
- What is the government doing about strip mining?
- Why might local people not be opposed to strip mining?
- What suggestions have been made concerning the disposal of strip mining waste? What are some of the advantages and disadvantages of these suggestions?
- How has the energy crisis affected opinions about strip mining?
- Who should have to pay the costs brought about by making open pit mining more acceptable environmentally?

- Who should make the decision about whether or not strip mining, as it has been practiced, should continue? Why?

(*Environmental Understandings:* [Raw materials and energy supplies are generally obtained from those resources available at least cost, with supply and demand determining their economic value.] [Individuals tend to select short term economic gains, often at the expense of greater long term environmental benefits.] [Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.])

(*Syllabus References:* Science for Children, K-6, *Understandings 5 & 6, p. 137*)

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Activity 23 - Have the class list the materials necessary for building the kinds of houses with which they are familiar (wood, stone, plastic, glass, copper, lead, asphalt). On a map of the United States, pinpoint the primary sources of supply for each of the raw materials. Consider the cost of transporting materials not readily available in your area.

- Do you think houses are cheaper to build in parts of the country where many of the building materials are available locally? Explain.
- Can all materials be obtained within New York State?
- Do we need to buy raw materials from other countries?
- Is it cheaper buying from other countries?
- What will happen if we run out of these necessary resources in our State and country?
- How can we prevent the exhaustion of these materials?
- Are any of these raw materials recyclable from other resources?
- How many different kinds of materials were used in one house?
- Why were these materials used instead of others?
- What will our alternatives be for constructing shelter when some of these resources are in short supply?

(*Environmental Understandings:* [Natural resources are unequally distributed with respect to land areas and political boundaries, thus creating conflicts over priorities in the use, management, and conservation of these resources.] [Trade will be mutually beneficial if trading partners specialize in those products in which they have the greatest productive efficiency.] [The limited nature of productive resources makes it imperative that a society define its economic objectives in terms of environmental reality.])

*(Syllabus References:* Science for Children, 4-6, *Understandings 1-6, p. 137)*

Activity 24 - Most school children have at some time used a magnifying glass to focus the sun's rays on a piece of paper to scorch it. Taking the appropriate precautions, do this demonstration with the class, and discuss the implications concerning the strength of solar radiation. Establish that the sun is the basis for all of the energy we use on earth, but that in most cases this energy has been stored on earth in some other form. Elicit that now, because of the approaching depletion of traditional supplies of energy, scientists are seeking ways to harness the sun's rays. Draw a diagram to show a solar furnace in which parabolic mirrors focused on large boilers would provide enough energy to turn a steam turbine, thereby generating electrical energy.

Based on what the children have read or heard about other means of producing electrical energy, have them prepare a list of any of these sources which are dependent upon natural forces. This list might include: tidal power, wind power, geyser power, and such forms of solar energy as solar cells, solar energy satellites, and space heating by direct use of solar energy.

Assign committees to study each of these possible alternate sources of electrical energy, and to prepare dioramas describing them. Each diorama should be labeled, and should contain the answers to the following questions:

- Is this method of generating electrical energy in use anywhere in the world at present? If so, where?
- What, if any, are the geographical limiting factors?
- In the case of solar, tidal, and wind power, what compensations would have to be made for the intermittent availability of the source of the energy?
- Why can it correctly be said that wind power is related to solar energy?
- What are the biggest problems presented by each of these alternate sources of electrical energy?
- What, if any, are the negative environmental implications of each of these methods? How do these problems compare with the environmental impact of other possible alternates such as nuclear power, geothermal, recovery of oil from shale, or coal liquefaction and gasification?
- Find out the estimated amount of time necessary to make each of these sources (solar, tidal, wind) practical as a significant energy resource for our country.

- How can solar energy for space heating be used on a limited scale in a practical way without any further technological advances?
- What are the best steps we can take to assure an adequate supply of energy, and preservation of our environment?

(*Environmental Understandings:* [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.] [Man must develop the technical and sociological knowledge needed to control population growth, modify environments, and alter resource use patterns.] [As natural resources become scarcer, the inexhaustible supply of human energy, resolve, determination, and ingenuity must be fully utilized.])

(*Syllabus References:* Science for Children, 4-6, *Enrichment Question 1, p. 148; Topic 7, p. 149*)

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Kindergarten

Activity 1 - Man, like other animals, has certain basic needs which must be met if he is to survive. Beyond these, the things that he acquires and uses reflect his wants and desires. Have the children either draw or cut out pictures of "Things We All (Really) Need" and "Things We Would Like To Have." Assemble the pictures according to these two categories and display them.

- Which pictures or drawings show things that all boys and girls everywhere in the world need?
- Why does everyone need them?
- Are there some things that people in the United States really need that other people in the world do not? Explain.
- How does the size of a country's population affect how well their needs are taken care of?

Have the children examine the second group of pictures, those things which they would like to have (nonessential or luxury items). Determine whether children have essentially the same wants.

- Why are there differences in the things you want?
- Can we get all of the things we want all of the time? Why or why not?
- What factors decide whether or not and when we can have these things? (money, supply, our age)
- Why is sharing important and necessary?
- What are some rules you would make to insure that everyone got his "fair share?" What do we mean by "fair share?"
- Using things that we do or things we have in the classroom as examples, show how sharing can benefit everyone, and satisfy many of our needs.

(*Environmental Understanding:* [Choices between essential needs and nonessential desires are often in conflict.])

(*Syllabus Reference:* Social Studies, K-3, *Economic Organization: Understanding 1, pp. 6-7*)

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Activity 2 - Discuss with the children our basic needs in terms of ourselves and our families. In what ways are these needs satisfied for us? Have several family-size groups of children play the roles of family members while the rest of the class lists the

responsibilities of each member of the household. Separate the tasks into those done by the children and those done by the adults. Emphasize the necessity of cooperation among members of the family and the dependence of some upon others for certain needs.

- What members of your family earn money to pay for the things you need (house or apartment, clothing, food)?
- Who buys and prepares the food?
- Who cleans the home and takes care of the property?
- What jobs do you help with? Why are the jobs you do important to the family?
- Why must all members of the family cooperate to get everything done?
- What happens when one family member cannot do his job?
- What happens if this person is the "breadwinner?" Why might this happen?
- Are there any "breadwinners" losing their jobs these days? Why?
- How are all families alike and how are they different?
- List the advantages and disadvantages of being a member of a small family. List the advantages and disadvantages of being part of a large family.
- Which families need more food, clothing, and shelter? Why?
- What would happen if there were more and more big families in our neighborhood? What would be needed?

(*Environmental Understandings:* [As population expands and becomes more mobile, man's demands for natural resources increase.] [Earth's resources and recycling system can support only a limited number of people; therefore as populations increase and as resource supplies decrease, the freedom of the individual to use the resources as he wishes diminishes.])

(*Syllabus References:* Social Studies, K-3, *Economic Organization: Understanding 2, p. 7; Social Organization: Understanding 1, pp. 6-7*)

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Activity 3 - As an introduction to a unit on food, have the children play the following sensory game. Place in a large plastic bag a banana, a walnut, a marshmallow, and corn on the cob. Either blindfold or ask individual children to close their eyes and reach in and "feel" the objects and guess what they are. Using their sense of smell, they

should identify lemon, peanut butter, onion, and discuss the characteristics of each. Ask what one word (food) would describe all of these objects. What group of people do we depend on to grow these foods? (farmers)

- What is a farmer?
- What do farmers do?
- What do they need to grow their crops?
- What animals do we usually find on a farm? (Sing, "Old McDonald Had a Farm.")
- What everyday foods do we eat that come from these animals and crops?

To illustrate the process of making farm or dairy products into the foods we use in the home, select one of the following to make in class:

-butter from cream
-corn meal or popcorn from corn kernels
-cranberry sauce from boiled cranberries

After sampling the selection, have children describe how the product comes to the home from market and farm. Some of the children could assume the roles of the people involved in the various stages of this process using labels or hats, while the rest of the class determines how they should line up in the proper sequence (farmer, truck driver, factory worker, supermarket manager, customer or consumer).

- What do all plants need to grow? (sun, water, soil/land)
- What would happen if there were too much or too little of these things?
- Is the availability of any of these things in danger now? Which one or ones? Why?
- Is this truer in some places (of the world) than others?
- Why is the sun so important to all living things?

(*Environmental Understandings:* [Plants and animal populations are renewable resources.] [Soil and water are classified as renewable resources but, because their renewal or revitalization requires a major investment in time and effort, they may be more realistically considered depletable resources.])

*(Syllabus Reference:* Social Studies, K-3, *Economic Organization: Understanding 1, pp. 6-7)*

Activity 4 - Discuss with the children the idea of food as a source of fuel for our bodies. The similarities of fuel-use by people (food) and fuel-use by machines (gas, gasoline, oil) should be established. When they have identified basic sources of energy, several in the class might play the role of "energy inspectors." The "inspectors" would examine the classroom, the school building, and the home to determine where, how, and what kind of energy is used (electrical outlets, lights, radiators, furnaces, school buses, projectors, television). As an extended or continuing activity, have the children draw or collect pictures of energy-using devices in home or school.

- Why is energy so important?
- What would happen if the supply of energy were reduced or cut off entirely?
- Are all of the energy-using devices reported on <u>really</u> necessary?
- Which of them can we not do without?
- Which of them can we do without easily?
- Which of them can we do without only with some difficulty?
- If you could keep only five things in your home which use energy, which would you choose? Why?

(*Environmental Understandings:* [Any one of an environment's components, such as space, water, air, food, or energy may become a limiting factor.] [Individuals should become well-informed about the best ways to manage and conserve our energy supplies.])

(*Syllabus Reference:* <u>Social Studies</u>, <u>K-3</u>, *Economic Organization: Understanding 1, pp. 6-7)*

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Grade 1

Activity 5 - Compile or collect a series of pictures showing families participating in everyday activities such as eating meals, going to a picnic, or watching television. Ask the children to identify each "member" of the group and to tell what kind of group (family) it is. Have the children draw pictures of their own families, comparing their drawings with the pictures and noting similarities and differences. To develop an understanding of family life in the past, ask if the children think families of long ago (when their grandmothers were little) were like theirs are today. Have them guess what family life might have been like and compile a list of their "guesses." To verify which guesses were correct, invite at least five grandparents or members of a local senior citizens group (particularly, ask grandparents who have lived on a farm or lived near farms) to the class.

Have them verify through their recollections which ideas of the children were correct. To facilitate the discussion and the grandparents' descriptions, the following outline might prove helpful.

Long Ago (ca. 1930) vs. Today

- Where did people live?
- What was the family like?
- What kind of home did it have?
- What kinds of work were done by the "breadwinners?"
- Things that were better or problems we didn't have. Things that were worse or harder or problems we had.

After the panel discussion among the class and the grandparents, have the children begin to compile a diary in which the pages are folded in half (Long Ago/Today) and either draw or collect and paste pictures of any item that has changed; for example, potbellied stove vs. furnace or heater, hand fan vs. electric fan, horse and buggy vs. car, and long dress vs. pantsuit.

- Do the changes make our lives easier or more difficult? How?
- Should we be happier or less happy than our grandparents were? Why?
- Will any of the advantages we have be the cause of problems for us in the near future? Explain.
- Does the way we live today cause us any serious problems that were unheard of 50 years ago? (200 million autos = gasoline shortage)

(*Environmental Understandings:* [The rate of resource consumption increases in direct proportion to the expansion of our wants, needs, and markets.] [The waste of natural resources can limit the options available to future generations.])

(*Syllabus References:* Social Studies, K-3, *Social Organization: Understandings 1-2, pp. 11-12)*

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Activity 6 - Display two pictures, one of a small farm showing manual labor and one of a large, modern, mechanized farm. Have the children identify the items found in each and discuss the similarities and

differences between the two. Continue the discussion and explain that we are learning that there are limits to the supply of fuel for energy. Have children describe instances of energy shortages and try to explain what caused these shortages. (brownouts, fallen lines, oil shortage)

- What do you see in pictures "A" (small farm) and "B" (mechanized farm)?
- How are the pictures alike and how are they different?
- Which farm do you think produces or grows more food? Why?
- What specific items in picture "B" make work a lot easier and faster? Why?
- What other machines do you know of that make jobs easier for us? (mixer, vacuum cleaner, power lawnmower)
- If our fuel for running machines becomes less plentiful, how would the work on farms, like in picture "B," be affected?
- How would what happens on farms affect other workers and you?
- What machines do you consider to be most important to your family's life?
- What rules would you make to decide what machines should or should not be used if there were not enough fuel for all?
- What and who would you have to consider in making these fuels?

(*Environmental Understandings:* [Most resources are vulnerable to depletion in quantity and quality.] [Social, economic, and technological changes affect the interrelationships, quality, availability, and use of natural resources.])

*(Syllabus References:* Social Studies, K-3, *Social Organization: Understandings 1-2, pp. 11-12; Economic Organization: Understandings 1-2, pp. 12-13)*

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Activity 7 - Sketch on the chalkboard a simple diagram of the city neighborhood, village, or suburban community in which most of the children live. Add representations of the main streets, buildings, parks, and land features (hills, streams, woods, vacant lots) to the sketch. Discuss with the class what the area might have been like before the man-made features were added. Then, by using the questions below, have them consider how the changes came about, whether or not they were always good changes, and what changes are likely in the near future.

- How old (approximately) are the oldest buildings?

- Were there other buildings before that, or was the land unused by man except for farming, hunting, and mining?
- Was the land changed to permit construction or did the man-made additions fit into the natural setting easily? Explain.
- Of the places not yet used by man, how many would be good places to build? What should be built there? Why?
- Why is it important that we give much thought to how we use the land?
- What happens when we do not give careful thought to land use?
- Why do people live where they do?

*(Environmental Understandings:* [Natural resources (e.g., land, soil, minerals) are interdependent and the use or misuse of one will affect others.] [Natural resources are unequally distributed with respect to land areas and political boundaries, thus creating conflicts over priorities in the use, management, and conservation of these resources.])

*(Syllabus References:* Social Studies, K-3, *Social Organization: Understanding 3, p. 12; Economic Organization: Understanding 3, pp. 13-14; Geography: Understanding 2, p. 15)*

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Grade 2

Activity 8 - Preparatory to introducing the concept of "community," write the following question on the chalkboard: "Where do you live?" Distribute to each child a slip of paper which contains the incomplete statement, "I live...," with spaces for several responses. Allow the children 5 to 10 minutes to complete the statement and then collect their responses. Introduce the term "community" and explain it, giving examples. Compare the children's responses with what they now understand "community" to mean. Show that several answers were appropriate because people belong to a number of "communities" at the same time.

- To what different kinds of communities do your parents belong?
- Besides people, what other living things belong to communities?
- How are animal and people communities related or dependent upon each other? (food supply, land use)
- How do both kinds of communities rely upon land, water and, often, upon each other?

Have the class collect pictures which show how communities are related to each other (the communications media, trucking services, roads, the postal service) and how they depend upon one another. (A farm community provides food to other communities, etc.).

- Why must communities be concerned with the care and protection of other communities?

- How should communities cooperate? Why should they?

(*Environmental Understandings:* [Living things are interdependent with one another and with their environment.] [Man must acknowledge that the interdependence of all living things dictates the manner in which and the extent to which resources may be used.])

(*Syllabus References:* Social Studies, K-3, *Social Organization: Understanding 1, p. 18; Economic Organization: Understandings 1, 3, & 4, pp. 20-22*)

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Activity 9 - Explain to the class that *natural resources* are the things we find in nature (such as iron and other ores, water, trees, soil) which become the ("raw") materials used in agriculture, manufacturing, and building. Have the youngsters make a list of products they use or eat and, next to each, list the natural resource or raw material which went into it. For example:

| Product | Natural Resource(s) |
|---|---|
| automobile | iron (steel), chromium |
| desk | wood (tree) |
| clothing | wool (sheep), cotton (plant) |
| bread | wheat (plant), soil, water |
| jewelry | tin, gold, copper, diamonds |

Have the class list five businesses or industries (found in their community or elsewhere) and name the single most important natural resource upon which each depends for its operation. For example:

| Business | Natural Resource |
|---|---|
| gasoline station | oil |
| newspaper | trees (newsprint) |
| farm | soil, water (and sun) |

Continue the discussion and introduce the concept of "shortage" (limited supply; scarcity - smallness of quantity in relation to needs or demands). After identifying lumber from trees as the source of paper and pencils (with graphite) ask:

- What would happen if our forests were burned or cut down?

- What effect would this have on our activities in class?

- What kinds of substitutions could be made?

- What kinds of present-day shortages do you know about?

- What has happened because of them?

To facilitate the understanding of supply and of shortage (or scarcity), use as part of your everyday vocabulary the words supply and shortage whenever feasible. ("Please distribute or give out our supply of paper... books... toys... . Please collect our supply of scissors... erasers... . Is there a shortage of chalk, ideas, or equipment today?) Encourage the children to respond in a similar fashion throughout their activities, and have them regularly identify what materials are, or might easily become, limited.

(*Environmental Understandings:* [The prevailing condition of scarcity which underlies all economic considerations forces changes in the lifestyles of individuals and societies.] [Raw materials and energy supplies are generally obtained from those resources available at least cost, with supply and demand determining their economic value.])

(*Syllabus References:* Social Studies, K-3, *Economic Organization: Understandings 1, 2, & 4, pp. 20-22*)

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Activity 10 - Of increasing importance in these days of recurring shortages is the relationship of a product's value to its availability and to demand for that product. Conduct the following game activity with the class to illustrate this relationship. Mark off an area roughly 10 feet by 20 feet on a grassy surface outside the school building. Scatter 150 colored gumballs, gumdrops, or marbles (25 red, 25 green, 25 white, 25 black, 25 blue, 25 orange) in the grass (assuming that the grass is at least one inch high). Ask a team of youngsters to recover as many as possible within a set time limit. Because of their color and the color of the grass, fewer green objects should be found. Have the children explain why.

Now, start the game again, changing the color distribution of the objects to: 50 white, 30 red, 30 black, 30 blue, 10 green. Repeat the exercise.

- Which color proved easiest to find (in terms of the number recovered)? Why?
- Which color proved most difficult to find? Why?
- If points were given for each object found, which color should be worth the most? Which color should be worth the least? Why?
- What products (minerals for example) can you think of that are high in price because they are in short supply?
- What raw materials are high in price because they are wanted by so many people for so many things?

(*Environmental Understandings:* [Raw materials and energy supplies are generally obtained from those resources available at least cost, with supply and demand determining their economic value.]) [The limited nature of productive resources makes it imperative that a society define its economic objectives in terms of environmental reality.])

*(Syllabus Reference:* Social Studies, K-3, *Economic Organization: Understanding 3, p. 21)*

Grade 3

Activity 11 - Discuss the term "natural resources" and have the children bring in and display samples of "raw materials" with drawings and pictures of derivative products. Using relief maps or a globe, locate and identify the region under study (desert, mountains, grasslands, northern forest, and rainforest). As applied to any one of the regions ask:

- What kinds of natural resources might be found within the given region and why? (mountain - minerals, grasslands - good soil)
- Either with transparencies or maps and books, have class committees, each representing a different community, find information on the following categories:

  -natural resources
  -jobs, employment
  -products (exports)
  -industries
  -land use

Each group should present its findings and compare them with the others.

- How is the land used and by whom?
- What jobs are needed and who does them?
- What products are made or what goods and services are produced?
- How is the work done? What tools and machines are used or needed and by whom?
- Are the natural resources of the region valuable to the community or to others? Why?
- How has the discovery of a natural resource affected the community studied? Are living conditions better or worse and why?
- Do new ideas and modern equipment make life easier, better, happier? Why or why not?
- What problems does the community face and how are they being solved?
- Is change always a good thing? Explain.

(*Environmental Understandings:* [Natural resources are unequally distributed with respect to land areas and political boundaries, thus creating conflicts over priorities in the use, management, and conservation of these resources.] [Trade will be mutually beneficial if trading partners specialize in those products in which they have the greatest productive efficiency.])

(*Syllabus References:* Social Studies, K-3. *Refer to the Understandings listed under Economic Organization in each of the sections [Desert Communities, Northern Forest Communities, etc.] beginning on p. 30)*

**NOTE:**

Only one activity is provided for the third grade inasmuch as the entire Social Studies program at this level is an examination of the impact of environment on man and man on environment. The normal classroom activities suggested by the syllabus should relate to many of the environmental understandings listed herein on pp. 2-4. Particular emphasis should be given to resource-use priorities, valuing, and planning as they pertain to the political, social, and economic organization of the variety of communities studied.

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Grade 4

Activity 12 - Develop a map exercise with the class which will illustrate the routes of early explorers who sought a shortcut to the lucrative markets in Asia. Have the children list these articles of trade which were so eagerly sought by the nations of Western Europe.

- How did Europeans first learn of the bounty of "consumer goods" which were available from the East?
- Did Europeans treasure these silks, spices, gems, and other articles because they somehow improved their lifestyle? Explain.
- Did these goods make life easier and better for Europeans or were many of these things valued merely because they were a rarity (scarce or unavailable at first) to most people in the West, or both? Explain.
- If the populations of the Eastern nations could have produced as many of these goods as Europeans could trade for or buy, would the demand for them have increased, decreased, or remained the same? Why? How would this have affected the price of the goods?
- If the hoped for, short route to the Indies had existed and been found, how would this have changed the European way of life? Would great numbers of peasants have eventually shared these luxuries?

- What are the similarities between the search for these 15th and 16th century resources and the comforts they provided and those which American and European nations seek today?

- Do large numbers of people today still find they are excluded from the benefits of such trade or resource development? Why?

- Do the people who produce the raw materials or resources derive as many benefits as those who refine or resell them? Why or why not?

(*Environmental Understandings:* [Trade will be mutually beneficial if trading partners specialize in those products in which they have the greatest productive efficiency.] [The material welfare and aspirations of a culture largely determine the use and management of natural resources.])

(*Syllabus Reference:* Social Studies, 4-6, *Geographic Introduction: Understanding 2, pp. 2-3*)

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Activity 13 - To develop an awareness of the impact of inventions on our economy, have pairs of classmates research the lives and inventions of such men as Eli Whitney, Cyrus McCormick, Thomas Edison, Alexander Graham Bell, Andrew Carnegie, Henry Ford, the Wright Brothers, and others. Have one child research the inventor's personal life while the other examines how the economy and society was affected by the individual's accomplishment. One child could narrate the personal struggles of the inventor with emphasis on the obstacles, discovery, and their effects on his life (possibly as a first person narrative). The other child could then describe how work, travel, communication, and industry were changed and list the products, conveniences, and economic advantages generated by the invention. Once the reports have been given, the class should select several of the inventions (reaper, auto, etc.) and discuss what raw materials or natural resources were needed to manufacture, operate, or utilize these inventions.

- As a result of these inventions, what natural resources became more important and valuable?

- How did these inventions create millions of new jobs or businesses?

- What new problems were created as a result of these inventions? (air pollution, noise pollution, flight from farm to crowded urban centers)

- Why must man carefully examine what effect a new invention will have on his environment?

- Why shouldn't low cost and convenience be the only considerations man uses in determining the worth of new machines or technology?

- What list of considerations or rules would you make before allowing a new invention to be marketed or used? Why?

(*Environmental Understandings:* [The rate of resource consumption increases in direct proportion to the expansion of our wants, needs, and markets.] [Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.])

(*Syllabus Reference:* Social Studies, 4-6, *People and Leaders: Understanding 6, pp. 7-8*)

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Grade 5

Activity 14 - Mobility has always been a prominent characteristic of the American way of life. Discuss or have children chronicle this feature of our way of life which might be summarized by the phrase, "America - A Nation on Wheels."

- What does the phrase mean?
- What industries, jobs, and activities are directly related to the various transportation industries?
- How are your lives and your parents' lives dependent on these forms of transportation?

Continue the discussion and divide the class into four groups, assigning each group one of the following categories of transportation as a research assignment: Cars/Trucks/Planes/Trains. The following questions might be helpful in guiding this phase of the activity:

- How many people own, operate, or use your mode of transportation?
- What natural resources are essential to production in, and the operation of, your industry?
- How does either a decrease in supply or demand affect your industry?
- How does increased demand coupled with decreased supply affect price and availability to consumers?
- What effect has your industry had on the environment? What problems need to be solved?
- What government practices have been initiated or have been proposed with regard to your industry? Why?
- How responsive has your industry been to public demand for environmental protection?

- Why have consumer groups like Nader's Raiders and Consumers Union been organized?

- What is your industry doing to better serve the public as well as its own interests?

As the class shares the data gathered in the form of reports, charts, pictures, statistics, and the like, have the pupils decide:

-what priorities should these industries have
-whether or not the public interest and the environment have or have not been adequately considered by these industries in the past
-what actions should be taken in the future to safeguard the general welfare (public and private)

(*Environmental Understandings:* [As population expands and becomes more mobile, man's demands for natural resources increase.] [Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.])

*(Syllabus Reference:* Social Studies, 4-6, *Social Organization: Understanding 4, p. 21)*

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Activity 15 - Initiate a discussion on the topic, "Oil - The Blood of Industry." List as many derivatives of oil as possible (gasoline, synthetic fibers, plastics). On a natural resource map, locate where oil deposits have been found here in the United States. Have the class learn which American companies are leaders in this industry (Exxon, Mobil, Texaco, Sunoco) and whether their major source of oil is domestic or imported.

- How much oil is needed or consumed here in the United States each year?

- What major industries are dependent upon oil?

- What percentage of our total yearly consumption of oil is obtained here in the U.S.?

- How much oil from other countries do we use? Why have many known oil deposits (reserves) here in the United States not been used to date?

- What political factors have contributed to the present energy crisis?

- What actions have our governments (national, State, local) taken so far to meet the demand for oil?

- What additional action might be necessary and why?

- What is rationing? When has it been practiced before in our nation's history? Why?
- What alternative sources of energy are now being explored?
- What has been the impact of the energy crisis on you and your family?

(*Environmental Understandings:* [In a democracy, people must consent to, or insist upon restrictions on resource allocation and use.] [Man must develop the technical and sociological knowledge needed to control population growth, modify environments, and alter resource use patterns.])

(*Syllabus References:* Social Studies, 4-6, *Geographic Introduction: Understanding 5, p. 15; Economic Organization: Understandings 1-3, 5-6, pp. 22-26)*

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Activity 16 - Many Americans have begun to question the practices of government and industry insofar as these practices threaten dwindling resources, and intrude upon elements of the environment with which people are interdependent (water supply, food chains, public lands). The question that arises is one of how can these objections, or at least reservations, of individuals be best expressed collectively in the democratic political system. Further, how may these concerns be reflected in the modified private enterprise market economy which characterizes our way of life? Have the class examine the procedures of a large industry whose resource use, manufacturing, or marketing operations have some adverse effect upon the environment.

- How does the corporate structure permit stockholders to exercise judgement over these actions?
- Do their reasons for being stockholders create conflict of interest between corporate objectives and environmental objectives?
- How may interested citizens, other than stockholders, hold the corporation liable for its actions?
- When do private interests abuse public interests?
- How can the judicial system aid the "environmentally concerned" citizen?
- What role and responsibility does the government have in this matter?
- Does the weight and influence of an organized lobby group frequently work against the common good? Explain.

- As population grows and governmental operations increase correspondingly, do the people lose some of their ability to influence governmental actions? Explain.

(*Environmental Understandings:* [Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.] [In a democracy, people must consent to, or insist upon restrictions on resource allocation and use.])

(*Syllabus References:* Social Studies, 4-6, *Economic Organization: Understandings 1-3, pp. 22-25; Political Organization: Understandings 1-3, pp. 28-29*)

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Activity 17 - As part of a unit on the geographical diversity of the United States, have the class study a transparency which depicts land forms and then overlay this with a transparency showing land use (mining, farming, shipping).

- Which geographical features determine the economic activity of a region?
- Match the topographies of various regions with the natural resources which can be found in them.
- Is there a pattern which indicates the reasons for, and location of, urban developments that is apparent from examination of the land forms? Explain.
- Consider New York State and list the economic and political characteristics of the State which seem to have been influenced by geography. (For example, why are large paper mills located on Lake Champlain?)

As a second step in the activity, try to show the degree of *interdependence* among various states, or within regions, in terms of economic developments (industry, transportation, mining).

- What are the raw materials essential to the economy of your area which must necessarily come from other states or regions?
- What kinds of systems have been established to distribute goods and services among the regions (transportation, communication, constitutional law [re: interstate commerce])?
- What additional thought must be given to some of these systems in the future if they are to continue to meet the needs for which they were intended? Consider the plight of our network of railroads today as an example. Or, how many more highways can we safely build in this country?

- Explain the relationship between a nation's natural resources and its standard of living. Is it always the same? (Use Libya, the United States, and Venezuela as initial examples.)

- How many arguments could you successfully make in favor of conserving natural resources? Explain each.

- Simply because some resources are renewable (soil, water, timber), should we be any less cautious in using them? Explain.

(*Environmental Understandings:* [Soil and water are classified as renewable resources but, because their renewal or revitalization requires a major investment in time and effort, they may be more realistically considered depletable resources.] [Man must acknowledge that the interdependence of all living things dictates the manner in which and the extent to which resources may be used.] [Natural resources are unequally distributed with respect to land areas and political boundaries, thus creating conflicts over priorities in the use, management, and conservation of these resources.])

(*Syllabus References:* Social Studies, 4-6, *Geographic Overview: Understanding 2 [esp. Discussion Questions], pp. 16-17; Economic Organization: Understanding 1, p. 22*)

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Grade 6

Activity 18 - Divide the class into four committees and assign each group one of the following major regions of the world: Southeast Asia, North Africa, Western Europe, and North America. Instruct each committee to select a representative nation in its assigned region and to list three of the nation's resources (e.g., oil, water, soil, timber, people) which are scarce. The committees should be prepared to defend their choices. Conduct a discussion of the "survey" results using the following questions:

- Do any items appear on all four lists? If so, would you be able to eliminate the condition of scarcity by substituting other countries in the same region, or is there a general (worldwide) scarcity of the item?

- For items which do not appear on all lists, is there a solution to the problem of scarcity for the region affected? What is it?

- How does unrestricted trade solve regional problems of scarcity?

- What is an embargo?

- When have embargos been used in United States history? Were they effective?

- Excluding wartime, is the use of an embargo a fair and reasonable tactic?

- Considering the recent Arab oil embargo against the United States (and the Netherlands), do you feel that those actions of the Middle Eastern nations were justified from their point of view. Why or why not?

- The technology of the United States and Europe places them far ahead of the rest of the world economically. However, this economic standing can only be maintained by using a huge share of the earth's resources. Are the people of the United States and Europe entitled to this disproportionately large share of resources? Explain.

(*Environmental Understandings:* [The material welfare and aspirations of a culture largely determine the use and management of natural resources.] [Historically, cultures with high technological development have used disproportionately more natural resources than those with lower levels of technological development.])

(*Syllabus References:* Social Studies, 4-6, *Economic Organization: Understandings 3-4, pp. 70-71; Western Europe - Economic Organization: Understanding 1, pp. 88-89)*

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Activity 19 - Select two committees from the class and ask one to construct a daily routine for a Cro-Magnon man and the other for an American man (head of household) in the 1970's. Next to each item on the lists of activities, indicate a natural resource or a part of the environment which is affected by the activity. Using an estimate of the world's human population then and the population of the world in 1970, establish a ratio using these figures and the instances of environmental infringement.

- What conclusions can you draw from the ratio?

- What kind of a prediction or ratio can you make for each of several time intervals in the future?

- Do you suspect that Cro-Magnon man understood or, at least, faced the problem of scarcity? How?

- Do you find any similarities between Neanderthal man's (Cro-Magnon man's predecessor) practice of burying food, tools, and weapons with the dead and modern man's tendency to bury the earth beneath asphalt and cement?

(*Environmental Understandings:* [The demands of population growth coupled with man's tremendous waste of energy are responsible for some of our more serious environmental problems.] [As population expands and becomes more mobile, man's demands for natural resources increase.])

(*Syllabus Reference:* Social Studies, 4-6, *Historical Summary: Understanding 1, pp. 62-63)*

Activity 20 - As part of the study of ancient civilizations, have the children locate on maps of the ancient world the major river systems, (Tigris, Euphrates, and Nile). Have the class report on the climate and geography of the area and discuss how important water was to the region.

- How much rainfall does this region get annually?
- What landforms are found in the area and where?
- Where would you expect the people to have gathered, settled, and built cities? Why?
- Why was the area around these rivers called the "Fertile Crescent?"
- What was the relationship between the oasis dwellers and the nomadic herders?
- What goods and services were exchanged by these two groups of people?
- What form of irrigation was used in these ancient civilizations and what was the effect on their lands?
- What can we learn today about the importance of the wise use of land from these ancient civilizations?
- How do modern irrigation projects compare with those in the ancient world? (Consider the Aswan Dam.)
- What have been the effects so far of the Aswan Dam on the economy and the life of Egypt?

(*Environmental Understandings:* [Any one of an environment's components, such as space, water, air, food, or energy, may become a limiting factor.] [Living things are interdependent with one another and with their environment.])

(*Syllabus References:* Social Studies, 4-6, *Geographic Overview: Understandings 2-5, pp. 59-62; Historical Summary: Understanding 2, p. 63)*

# Appendix

This appendix contains a bibliography of reference books and articles dealing with environmental education with a special emphasis on energy. These annotated references were selected from a bibliography of teacher resources on the energy crisis which was prepared by New York State United Teachers, Inc. NYSUT acknowledged the contribution of the Instruction and Professional Development staff of the National Education Association and special mention was made of the assistance provided by Mrs. Jane Streiff, Librarian, Bethlehem Central High School. Also included are subject headings and a list of general indexes which will facilitate the use of library resources by teachers and children.

REFERENCE BOOKS AND ARTICLES

American Gas Association. Action in the Atlantic. Arlington, Va.: American Gas Association, 1973. 17 pp.

Brief presentation on off shore sources of petroleum and natural gas in the Atlantic. Excellent charts and graphs. Appropriate for classroom use.

American Gas Association. New Sources of Gas...Where and When? Arlington, Va.: American Gas Association, 1973. 15 pp.

Brief description of causes of shortage of natural gas, as well as discussion of potential new sources, such as off shore drilling, synthetic gases, liquified natural gas, Alaskan and Canadian deposits, coal gasification, and nuclear stimulation.

Caudill, H. M. Night Comes to the Cumberland. Boston: Little, Brown & Co., 1963.

A very readable definitive account of the coal industry.

Citizens' Advisory Committee on Environmental Quality. Citizen Action Guide to Energy Conservation. Washington: Government Printing Office, 1973. 64 pp. $1.75.

Contains a factual account of the energy crisis, including practical tips for energy conservation. Offers suggestions on organizing for energy conservation efforts. List of selected references. Glossary of energy terms.

Council on Environmental Quality. Energy and the Environment-Electric Power. Washington: Government Printing Office, 1973.

A brief consideration of the facts leading to an increased demand for electric power.

Do It Yourself Ecology. Washington: Environmental Protection Agency. (1346 Connecticut Avenue, N.W., Washington, D.C. 20036).

Brochure and bi-weekly newsletter carrying regular articles on the energy crisis. (25 cents/copy - $7.50/24 issues).

The Economy of Energy Conservation in Educational Facilities. New York: Educational Facilities Laboratory, 1973.

Practical suggestions for decreasing the use of energy in schools.

The Energy Index: A Select Guide to Energy Information Since 1970. New York: Environment Information Center, Inc., 1973.

Contains abstracts of significant energy documents, lists of books, films, and resources, charts, patents, official statements, etc. on energy. Suitable for libraries.

The Environment Index '73: A Guide to the Key Literature of the Year. New York: Environment Information Center, Inc., 1973.

Contains resources on the environment published during 1973, including a directory of control officials. Suitable for libraries.

Fabun, Don. Dimensions of Change. Beverly Hills, California: Glencoe Press, 1971.

Chapter 3, "Energy: Transaction in Time," is especially useful.

Frank, Helmut J.; and Jean E. Weber. Energy Consumption by States. Tucson: University of Arizona, 1973.

Scholarly monograph that investigates the relationship between energy demand and key economic and demographic factors. Covers the period 1957-1971 and offers projections for 1975 and 1980.

Freeman, S. David. "The Energy Crisis, What Makes It So Complex," Vital Issues, November 1973, p. 6.

The material was prepared primarily for upper elementary students.

Freeman, S. David. "The Energy Joyride is Over," Science and Public Affairs, October 1973, pp. 39-40.

An intelligent prognosis for the current energy shortage. Includes a number of practical and reasonable methods through which energy consumption can be lessened.

Hammond, Allen, et al. Energy and the Future. Washington: American Association for the Advancement of Science, 1973.

Surveys current and future sources of energy from a scientific and technological viewpoint. Authoritative resource.

Hobart, Thomas Y., Jr., "Where We Stand: The Energy Crisis and the Schools." The New York Teacher, December 2, 1973, p. 9.

Hobart, Thomas Y., Jr., "Where We Stand: Children, Conservation, and the Commissioner," The New York Teacher, January 13, 1974, p. 7.

Holdren, John, and Philip Herrera. Energy: A Crisis in Power. San Francisco: Sierra Club, 1971.

An excellent general account of the background and realities of the energy crisis.

Hunter, Robert E. The Energy "Crisis" and U.S. Foreign Policy. New York: Foreign Policy Association, 1973. 79 pp.

Explores current crisis in fossil fuels with specific reference to U.S. foreign relations with the Soviet Union, Israel, and the Arab nations. Excellent list of references.

Knapp, Clifford, and Stuart S. Seim. Bulletin Boards for Environmental Studies. Dansville, N.Y.: The Instructor Publications, Inc., 1973.

Kraft, R. Wayne. "The World's Energy and Teilhard's Vision," America, December 15, 1973, pp. 457-460.

Intriguing and scholarly examination of our present energy predicament and the concept of energy in the context of the universal human dilemma.

Large, David B., ed. Hidden Wastes: Potentials for Energy Conservation. Washington: Conservation Foundation, 1973.

Analyzes methods for reducing energy waste.

Mancke, Richard B. "Blackmail by Oil," The New Republic, October 1973, pp. 8-9.

An analysis of the Arabian oil boycott, including a convincing argument why it ultimately cannot succeed.

Meadows, Donella H., et al. The Limits to Growth. New York: Universe Books, 1972.

A highly controversial work covering natural resources and economic growth.

Metzger, H. Peter. The Atomic Establishment. New York: Simon and Schuster, 1972.

Critical analysis of nuclear power business written for the general reader.

Perus, Bruce. "Those Ingenious Exotic Fuels," The Sciences, June 1973, pp. 6-11.

Explores alternative power sources, including solar energy, wind, tides, and gas thermal heat.

Portola Institute. The Last Whole Earth Catalog. New York: Random House, 1971.

Excellent source material on alternative energy sources, including solar power, wind, and water.

Rand, Christopher. "The Arabian Fantasy," Harper's. January 1974, pp. 42-46, 51-54.

A cogent and well reasoned dissenting view of the oil crisis by a Middle East specialist.

Scientific American, Energy and Power. San Francisco: W. H. Freeman and Co., 1971.

An essay collection on the energy situation. Some are rather scholarly and narrow in scope, but the graphic materials are outstanding.

Winger, John G., et al. Outlook for Energy in the United States to 1985. New York: Chase Manhattan Bank, N.A., 1972. 55 pp.

Surveys supply and demand factors in the energy requirements of the United States.

Winger, John G., et al. Outlook for Energy in the United States. New York: Chase Manhattan Bank, N.A., 1970. 60 pp.

Somewhat dated survey of the economics of energy in terms of both supply and demand.

Whittemore, F. Case. "How Much in Reserve?" Environment, September 1973, pp. 16-20, 31-35.

Article discusses strengths and weaknesses of present methods of estimating reserves of coal, uranium, oil, and gas. Generally optimistic about potential reserves.

GENERAL INDEXES

Applied Science and Technology Index
Education Index
Educational Resources Information Center (ERIC) Research in Education
Essay and General Literature Index
Facts on File
Monthly Catalog of U.S. Government Publications
New York Times Index
Reader's Guide to Periodical Literature
Social Science and Humanities Index

SUBJECT HEADINGS

1.

ENVIRONMENTAL EDUCATION

see also

Adaptation (Biology)
Aeroplanes. Noise
Air. Poluttion (or Air pollution)
Air purification
Atomic energy
Atomic power
Atomic power industry
Atomic research
Automobile exhaust gas
Automobiles
Automobiles. Engines

2.

Birth control
Cities and towns. Growth
Cities and towns. Planning
City noise
Cleaning compounds
Coal mines and mining
Coal research
Community development
Conservation
Conservation education
Conservation of energy
Conservation of natural resources (or: .... of resources)
Detergent pollution

3.

Diesel engines
Disinfection and disinfectants
Dust
Ecology
Economics
Electric power
Electric utilities
Electric vehicles
Electricity
Energy crisis

Energy crisis and the environmental movement
Energy crisis. U.S. foreign policy
Energy crisis. Sources (of information)

4.

Environment
Environmental .... For example: Environmental health, policy, education, etc.
Factory and trade waste
Forests and forestry
Fuel
Fuel research
Fuel resources
Gas, industry
Gas, natural
Gas, manufacture and works
Gas supply
Gasoline
Gasoline industry

5.

Geothermal energy
Human ecology
Hydroelectric plants
Hydrogen
Hydrogen, liquid
Hygiene. Public
Industry and state
Industry and the environmental movement
Insecticides
Insulation
International Atomic Energy Agency
Jet planes. Noise
Man. Influence of environment
Man. Influence on nature

6.

Marine pollution
Marine resources
Mines and mineral resources

Natural resources (with subdivisions)
Nature conservation
Noise (with subdivision - example: Noise. Physiological effect.)

7.

Noise control
Nuclear fuels
Nuclear fusion
Nuclear reactors
Odor control
Oil lands
Oil pollution of rivers, harbors, etc.
Organization of petroleum exporting countries
Pesticides
Pesticides and the environment
Petroleum
Petroleum industry
Petroleum refineries
Petroleum supply

8.

Pollution
Population
Power resources
Radioactive fallout
Radioactive pollution (or contamination) of water; the sea; the atmosphere
Radioactive waste disposal in rivers, lakes, etc.
Radioecology
Reclamation of land
Refuse and refuse disposal
Sanitary engineering
Sanitation
Sewage engineering
Slums

9.

Smog
Smoke
Soil Conservation

Soil erosion
Soil exhaustion
Soil pollution

10.

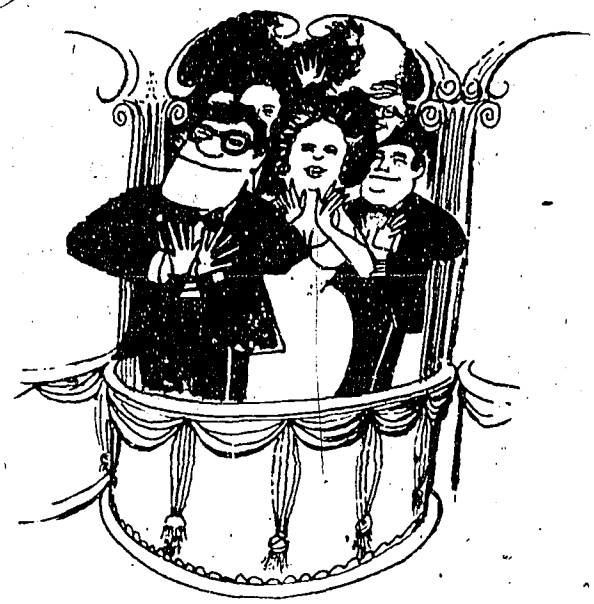
Solar energy
Solar furnaces
Solar heating
Spraying and dusting residues in agriculture
Strip mining
Thermal pollution of rivers, lakes, etc.
Traffic noise
Waste disposal in the ocean
Water. Pollution (or: Water pollution)
Water. Purification (or: Water purification)
Water conservation
Water quality
Water resources development
Water - supply

11.

Wildlife. Conservation
Wind power

# Acknowledgments

This publication has been produced under the direction of Barry W. Jamason, who coordinates the Department's environmental education program. Appreciation is expressed to the individuals listed below for their contributions to the planning and development of this curricular document.



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