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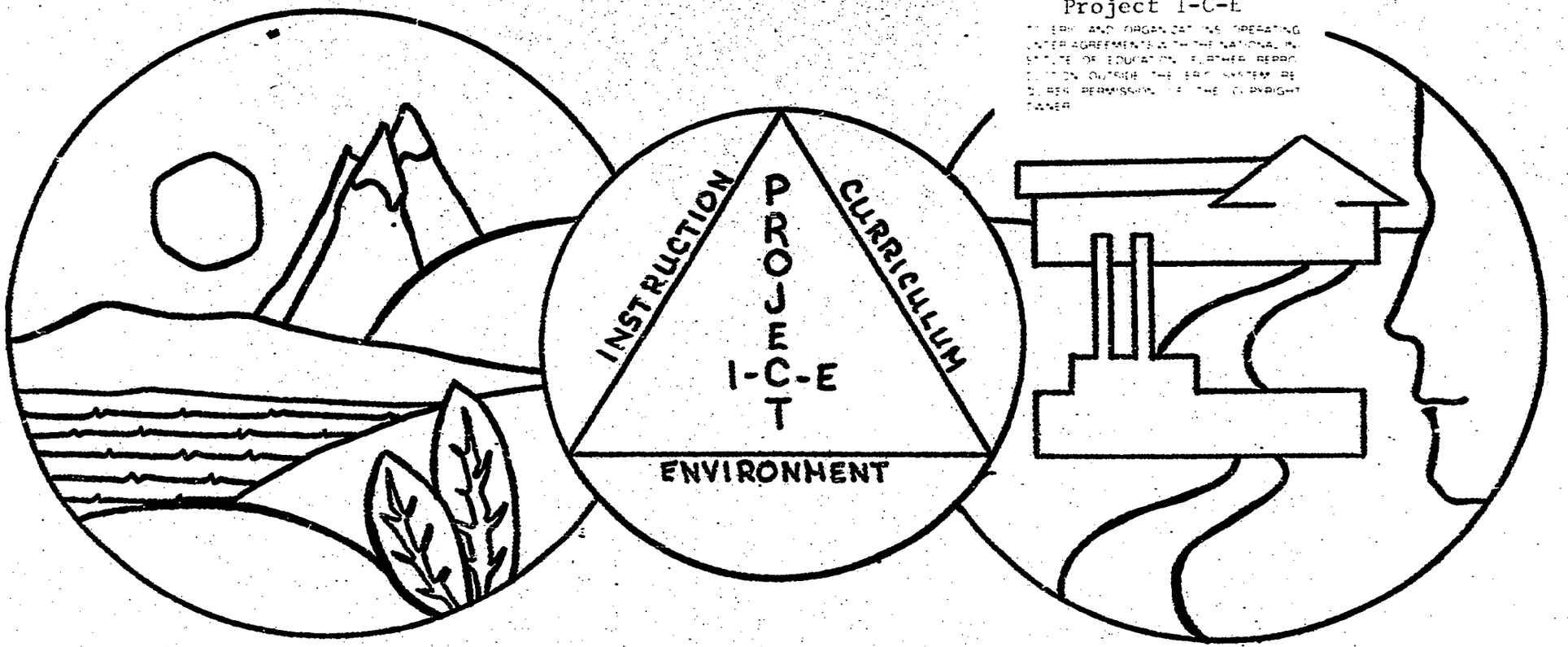
ABSTRACT

This physical science guide, for use at the secondary level, is one of a series of guides, K-12, that were developed by teachers to help introduce environmental education into the total curriculum. The guides are supplementary in design, containing a series of episodes (minilessons) that emphasize a student-centered, scientific approach to gain new and deeper understandings of ecology. The episodes are built around 12 major environmental concepts that form a framework for each grade or subject area, as well as for the entire K-12 program. Although the same concepts are used throughout the K-12 program, emphasis is placed on different aspects of each concept at different grade levels or subject areas. This guide focuses on aspects such as light, sound, and nuclear energy. Most of the 12 concepts are covered in one of the episodes contained in the guide. Further, each episode offers subject area integration, subject area activities, interdisciplinary activities, cognitive and affective behavioral objectives, and suggested references and resource materials useful to teachers and students. (Author/TK)

ENVIRONMENTAL EDUCATION GUIDE



PHYSICAL SCIENCE

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FORWARD TO PROJECT I-C-E ENVIRONMENTAL EDUCATION GUIDES

In 1969, the First Environmental Quality Education Act was proposed in the United States Congress. At the time of the introduction of that legislation, I stated:

"There is a dire need to improve the understanding by Americans of the ominous deterioration of the Nation's environment and the increasing threat of irreversible ecological catastrophe. We must all become stewards for the preservation of life on our resource-deficient planet."

In the three years since the Environmental Education Act was passed by the Congress, much has happened in the United States to reinforce the great need for effective environmental education for the Nation's young people. The intensive concern over adequate energy resources, the continuing degradation of our air and water, and the discussion over the economic costs of the war against pollution have all brought the question of the environmental quality of this nation to a concern not merely of aesthetics but of the survival of the human race.

The intense interest by the public in the quality of our lives as affected by the environment clearly indicates that we cannot just use incentives and prescriptions to industry and other sources of pollution. That is necessary, but not sufficient." The race between education and catastrophe can be won by education if we marshall our resources in a systematic manner and squarely confront the long-term approach to saving our environment through the process of education.

As the incessant conqueror of nature, we must reexamine our place and role. Our world is no longer an endless frontier. We constantly are feeling the backlash from many of our ill-conceived efforts to achieve progress.

Rachel Carson's theme of "reverence for life" is becoming less mystical and of more substance as our eyes are opened to much of the havoc we have wrought under the guise of progress. A strong commitment to an all-embracing program of environmental education will help us to find that new working definition of progress that is a pre-requisite to the continued presence of life on this planet.

- Senator Gaylord Nelson

PHYSICAL SCIENCE PREFACE

Concern for preservation and wise use of the environment are necessary if the student is to function as a responsible individual in our society. Therefore, it is desirable that schools incorporate as much environmental education as is feasible into the curriculum at a time when the young person is forming basic attitudes toward his culture. Ninth graders possess enthusiasm for activities which can be shown to have significant effects on their lives. The peer pressure and active zeal of adolescence can be valuable tools in creating positive behavior toward the environment.

Environmental education is necessarily a scientific problem. Fortunately educators are incorporating suitable material into the science curricula. This booklet utilizes physical science to gain new and deeper understandings of ecology.

A student-centered scientific approach is emphasized with many laboratory exercises included. For example, in dealing with air pollution under Concept #5, students go to the field to collect air samples. These samples are then analyzed and students calculate the amount of particulate matter in their air supply and make comparisons to air in other areas.

Environmental education definitely should be incorporated into physical science classes. There are many excellent opportunities present to make physical laws more relevant to the daily activities of the student. Students will hopefully realize that we have to control the technology made possible by science or suffer severe consequences.

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DIRECTIONS FOR USING THIS GUIDE

This guide contains a series of episodes (mini-lesson plans), each containing a number of suggested in and out of class learning activities. The episodes are built around 12 major environmental concepts that form a framework for each grade or subject area, as well as for the entire K-12 program. Further, each episode offers subject area integration, multi-disciplinary activities, where applicable, both cognitive and affective behavioral objectives and suggested reference and resource materials useful to the teacher and students.

1. This I-C-E guide is supplementary in design--it is not a complete course of study, nor is its arrangement sequential. You can teach environmentally within the context of your course of study or units by integrating the many ideas and activities suggested.

2. The suggested learning activities are departures from regular text or curriculum programs, while providing for skill development.

3. You decide when any concepts, objectives, activities and resources can conveniently be included in your unit.

4. All episodes can be adapted, modified, or expanded thereby providing great flexibility for any teaching situation.

5. While each grade level or subject area has its own topic or unit emphasis, inter-grade coordination or subject area articulation to avoid duplication and overlap is highly recommended for any school or district seeking effective implementation.

This total K-12 environmental education series is the product of 235 classroom teachers from Northeastern Wisconsin. They created, used, revised and edited these guides over a period of four years. To this first step in the 1,000 mile journey of human survival, we invite you to take the second step--by using this guide and by adding your own inspirations along the way.

PROJECT I-C-E TWELVE MAJOR ENVIRONMENTAL CONCEPTS

1. The sun is the basic source of energy on earth. Transformation of sun energy to other energy forms (often begun by plant photosynthesis) provides food, fuel and power for life systems and machines.

2. All living organisms interact among themselves and their environment, forming an intricate unit called an ecosystem.

3. Environmental factors are limiting on the numbers of organisms living within their influence. Thus, each ecosystem has a carrying capacity.

4. An adequate supply of clean water is essential to life.

5. An adequate supply of clean air is essential for life.

6. The distribution of natural resources and the interaction of physical environmental factors greatly affect the quality of life.

7. Factors such as facilitating transportation, economic conditions, population growth and increased leisure time influence changes in land use and population densities.

8. Cultural, economic, social, and political factors determine man's values and attitudes toward his environment.

9. Man has the ability to manage, manipulate and change his environment.

10. Short-term economic gains may produce long-term environmental losses.

11. Individual acts, duplicated or compounded, produce significant environmental alterations over time.

12. Each person must exercise stewardship of the earth for the benefit of mankind.

A "Concept Rationale" booklet and a slide/tape program "Man Needs His Environment" are available from the I-C-E RMC to more fully explain these concepts.

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E. S. E. A. Title III – PROJECT I–C–E 59–70–0135–4

Environmental: **Integrated with:**

CONCEPT NO. 1 - Energy **SUBJECT** Physical Science

ORIENTATION Energy Sources **TOPIC/UNIT** Light

BEHAVIORAL OBJECTIVES

Cognitive:

Explain why algae concentration can be used as a method of determining the extent of the pollution of a body of water. Determine the algae concentration of a body of water (river, lake, etc.) using the light penetration method and use this to predict the extent of the water pollution.

Affective:

Propose that algae concentration decreases light penetration in a water resource. Participate in class discussion relating the effect of light intensity upon plant and fish growth.

Skills Used:

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. Put 500 cc of lagoon water previously filtered thru a No. 1 filter paper into a 600 cc beaker.
B. Put 500 cc lagoon water loaded with algae into a 600 cc beaker.
C. Shine a flashlight or other suitable light source, 1 foot above the surface through the beakers, held a given distance above a light meter or piece of white paper. Observe amount of light passing thru.
D. Discussion Points:
   1. light is necessary for plant growth (photosynthesis)
   2. light penetration decreases with depth
   3. clear water can be penetrated to a great depth
   4. particulate plant and animal matter reduce this depth of penetration
   5. oxygen is necessary for fish life
   6. algae can reduce the fish population

(Continued)

Outside or Community:

1. Water for this investigation should be obtained from a local lagoon, pond or swamp by student team. The importance of this pond should also be discussed and how it fits into nature's plan.
2. Visit water purification plant.
3. Ask biology teacher to give lecture on photosynthesis.

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES
Publications: High School Biology text - 1969 or later. Modern Biology, Holt, Rinehart and Winston. **Audio—Visual:** Film: Photosynthesis, The Biochemical Process, 16 minutes, BAVI. **Community:**	In-class: (Continued) E. Student-Centered In-Class Activity - 1 hour. Additional investigation. 1. Obtain tt samples of water from several sources. 2. Place a drop of each sample on a different microscope slide and observe under high power. 3. Determine relative algae counts. 4. Correlate the results with the condition of the water resource.

E. S. E. A. Title III – PROJECT I–C–E 59–70–0135–4

Environmental: **Integrated with:**

CONCEPT NO. 1 - Energy **SUBJECT** Physical Science

ORIENTATION Energy Use **TOPIC/UNIT** Radiant Energy

BEHAVIORAL OBJECTIVES

Cognitive:

Illustrate through investigation and discussion that radiant energy from the sun can be changed to other forms of energy for practical use.

Affective:

Believe in the vast potential of using the sun's energy directly in helping to solve our energy problems. Examine the variety of problems to be solved before this energy can be used as a feasible substitute for fossil fuels.

Skills Used:

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. View Bell Solar Battery, motion picture.
B. Connect solar cell to small electric motor and/or light bulb and expose to sunlight.
   1. Students should be encouraged to invent ways of utilizing solar cells for application in solving our energy problems.
C. Discussion Points:
   1. "endless" supply of energy
   2. storage of energy for nights and dark days
   3. expense involved
   4. amount of research at present time compared to research of other energy sources
   5. theory of operation of solar cell
   6. solar furnace and other ways of utilizing the sun's energy

Outside or Community:

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES
Publications: Physics--A Basic Science, American Book Co., pp. 390-391. Physical Science--A Modern Approach, Van Nostrand, p. 142. **Audio-Visual:** Films: Bell Solar Battery, Bell Telephone. Our Mr. Sun, Bell Telephone Sun's Energy, BAVI. **Community:** Bell Telephone representative. Solar cell kits, available through Bell Telephone.	

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Environmental:

Integrated with:

CONCEPT NO. 2 - Ecosystem

SUBJECT Physical Science

ORIENTATION Noise Pollution

TOPIC/UNIT Sound

BEHAVIORAL OBJECTIVES

Cognitive:

Illustrate, through investigation and discussion, that the quality and intensity of sound has a definite effect upon living organisms.

Affective:

Suggest that sounds (noises, etc.) do affect animals and humans, therefore, is an environmental influence. Suggest to others that they keep sound levels (records, music, etc.) in an acceptable range so that it will not damage the hearing of people.

Skills Used:

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. Discuss the acoustics in several school areas, such as the auditorium, gym, classroom and band practice room. Show how they differ and tell why. Do this by actual listening.

B. Discussion Points:
   1. frequency of noise
   2. loudness
   3. individual variation in reaction to sound
   4. regularity of sound
   5. characteristics of pleasant and unpleasant sound

C. Investigate the reactions of animals to mild and loud sounds. Use both tame and wild captured animals if possible. Chart decibel rating and animal reaction (with audiometer or with decibel rating chart).

Outside or Community:

A. Check loudness of the following with a decibel meter:
   1. whisper
   2. conversation
   3. hammer pounding
   4. chain saw

B. Ask one of the following to talk on acoustics:
   1. Architects
   2. Engineer
   3. Contractor

C. Ask the music or band teacher to discuss and/or demonstrate the difference between noise and music and its effect upon individuals.

SUGGESTED RESOURCES

Publications:

Texts: Physical Science text.
Physics text books.
Biology text books.
Pamphlets:
Sounds and Silence,
Environmental Science Center
5400 Glenwood Avenue
Golden Valley, Minnesota.
Noise and You,
Channing L. Bete Co., Inc.
Greenfield, Massachusetts.

(Continued)

Audio–Visual:

Popular Science test record, (33 1/3 rpm)
Films:
Noise, 10 min., BAVI.
Noise is Pollution Too, 15 min., BAVI.
Noise Presentation, 11 min.,
Modern Talking Picture Service
160 East Grand Avenue
Chicago, Illinois.
Death be Not Loud, I-C-E RMC #490.

Community:

CONTINUED OR ADDED LEARNING ACTIVITIES

Publications: (Continued)

Noise and You	EPA
Noise	EPA
Noise and Transportation	EPA
Noise in the Environment	EPA
EPA's Noise Abatement Program	EPA

E. S. E. A. Title III – PROJECT I–C–E 59–70–0135–4

Environmental: **Integrated with:**

CONCEPT NO. 4 - Water **SUBJECT** Physical Science

ORIENTATION Water Pollution **TOPIC/UNIT** Water

BEHAVIORAL OBJECTIVES

Cognitive:

Explain the role of glaciation in the formation of Wisconsin lakes. Differentiate between normal lake aging and cultural eutrophication.

Affective:

Point out that man's effect on receiving waters has been detrimental to water quality when given the opportunity to make an ethical judgement. Suggest that civic action is needed to prevent further damage to these waters.

Skills Used:

Contrasting and comparison.
Following observations of field conditions.
Inferring real situations from lab model tests.

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

1. Introduce the concepts of lake formation by glaciers (kettle lake process) as part of unit on glacial geology.
2. Relate to present day tropic conditions of various Wisconsin lakes. Students relate observations on lakes visited during vacation trips. Consider plant growth especially.
3. Discuss natural eutrophications and cultural eutrophication.
4. In a large low pan or on a stream bed table, mix a thick, slurry of sand and chunks of ice of various sizes. Let the ice melt and the water drain or evaporate. Observe for depressions created.
5. Field trip to a lake or pond and then to a marsh, bog or swamp to contrast progress of lake aging.
6. Investigating local conditions by personal contact and by consulting published material.
7. Show a film or filmstrip depicting water pollution which emphasizes eutrophication speed up when man pollutes.

Outside or Community:

(Continued)

SUGGESTED RESOURCES

Publications:

ESCP text, Investigating the Earth, and ESCP Lab manual Modern Earth Science, Holt, Rinehart & Winston.
Fundamentals of Limnology, Franz Ruttner.
Limnology, Paul Welch.
Physical Geology, Leet & Judson, Prentice-Hall.
Any text on Physical Geology.

Audio-Visual:

Films:
Problems of Conservation, Water, Encyclopedia Brittanica.
Who Killed Lake Erie?, NBC.
The Spruce Bog, National Film Board of Canada.
Filmstrips:
Environmental Pollution,
Fresh Water Pollution,
Both by Wards Science.
ESGS contour maps of Wisconsin areas affected glacial deposits, especially northern Wisconsin

Community: (Continued)

DNR Fisheries biologist.
College-University faculty.
Ecologists.
DNR - Div. of Environmental Protection--Water Resources Section.

(Continued)

CONTINUED OR ADDED LEARNING ACTIVITIES

In-Class: (Continued)

8. Discuss the change on rate of the lake aging process when pollution enters a lake and apply this to the need to regulate water pollution.
9. Application. Students investigate the nature of local pollution additives which may speed up eutrophication and find what bodies of water are recipient of these wastes. Student investigates the present status of these bodies by consulting the local papers or talk to DNR agents, etc.

General Rationale:

Using the concept of lake types as devised by Thienemann into Oligotrophic, Eutrophic and Dystrophic, locate on a state map or preferably a county or area map, an example of each type.

Oligotrophic - steep sided geologically young, deep, cold, poor in phytoplankton and zooplankton, quantitatively poor, oxygen rich in lower zones.
Eutrophic - rich in nutrients, and plankton, quantitatively rich, oxygen poor in lower lake.
Dystrophic - poor in nutrients, phytoplankton, large amount of humus, bottom oxygen reduced, acid water, deep coffee color, due to little decomposition of humic material.

Audio-Visual: (Continued)

lakes and the Kettle Moraine.

Community: (Continued)

Local sewage plant, Industries, Agricultural operations as sources of Eutrophic additives.

E. S. E. A. Title III -- PROJECT I-C-E 59-70-0135-4

Environmental: **Integrated with:**

CONCEPT NO. 5 - Air **SUBJECT** Physical Science

ORIENTATION Clean Air **TOPIC/UNIT** Air Chemistry

BEHAVIORAL OBJECTIVES

Cognitive:

Demonstrate a technique for collecting and evaluating particulate matter in air.

Affective:

Accept the fact that polluted air is not good for people. Argue that everyone has the right to breathe clean air, therefore, everyone has an obligation not to pollute the air unnecessarily. Evaluate alternative methods to burning as a way of getting rid of combustible wastes.

Skills Used:

STUDENT-CENTERED LEARNING ACTIVITIES

In-Class:

A. Monitoring of particulate matter in air.
A determination of the amount and kinds of particulate matter in the air supply can help students to understand the problems encountered because of particulate pollution. Several methods can be used to sample the air.
1. Open jar technique
2. Durham sampler
3. Sedimentation foil technique
4. Millipore apparatus
5. Glass plate-petroleum jelly method.
6. Others as students may suggest.

B. Many films and filmstrip sets are available along with many other reference sources to aid the student in identifying the causes and effects of air pollution.

Outside or Community:

A. Open jar technique.
1. Materials needed:
   a. 1 gal. wide-mouth jar
   b. small mesh screen to fit jar mouth
   c. 1 qt. distilled water
   d. evaporating dish
   e. balance.
2. Students should label their jars and place them in an open, undisturbed area. The jar with 1 qt. of distilled water and screen on top to keep bugs out, should be checked periodically for adequate water level. Additional water may be added as needed.
3. At the end of a 30 day collecting period, the jars should be returned to the lab for study
4. Students can then transfer the liquid to a weighed evaporating dish. The jar should be flushed out with water and this water also transferred to the evaporating dish. (Continued)

SUGGESTED RESOURCES

Publications:

EPA Pamphlets on Air Pollution.
Ch. 4, Environmental Pollution, Prentice-Hall.
Environmental Science ISCS, Ch. 6, Silver Burdett.

Audio—Visual:

Filmstrips:
Environmental Pollution, Atmospheric Pollution, p. 2. Ward's Educational Filmstrips.
Film:
Air Pollution, BAVI.
Simulation Game:
Smog: The Air Pollution Game, Urban Systems, Inc.

Community:

CONTINUED OR ADDED LEARNING ACTIVITIES

Outside or Community: (Continued)

4. The dish should be gently heated to evaporate all of the water and the contents and dish re-weighed.
5. The diameter of the jar mouth should be measured to determine the area of the opening with the formula πr^2.
6. The amount of particulate material in mg per square cm of area for 30 days can now be calculated.
7. To be able to have a basis for comparison, the students should convert their figures to the commonly used unit of tons per square mile per year.

The following shows some sample collection results and an aid for conversion calculations.

Particulate Monitoring.
CALIFORNIA RESULTS. This experiment is modeled after one presented by the Department of Public Health, State of California. In that state the amount of dustfall in tons per square mile for 30 days was as follows:

PLACE	DATE	AVERAGE	MAXIMUM
Berkeley	1959	8	24
Santa Cruz	1959	31	250

Other locations reported values between these two.

CALCULATION. The start of the calculation for the change of mass units is given.

$$\text{"X"mg (weighed)} \times \frac{1\text{g}}{1000\text{ mg}} = \text{X'g}$$

$$\text{X'g} \times \frac{1\text{ lb}}{454\text{ g}} = \text{X" lb}$$

$$\text{X" lb} \times \frac{1\text{ ton}}{2000\text{ lb}} = \text{X' " tons}$$

The student should similarly complete the change of cm^2 to $miles^2$. The use of exponential calculations and of two or three significant figures

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Environmental:

CONCEPT NO. 7 - Land Use

ORIENTATION Land Uses

Integrated with:

SUBJECT Physical Science

TOPIC/UNIT Natural Resources

BEHAVIORAL OBJECTIVES

Cognitive:

Identify the factors determining land use and reasons for change in a given land use. Explain reasons for conflict when the use of a given land area is being decided.

Affective:

Show an awareness, that in determining land use, environmental conditions must be taken into consideration along with economic and population factors. Weigh alternative suggestions for the use to be made of a given land area.

Skills Used:

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. Divide the class into groups to conduct a debate on a hypothetical situation such as the following:
A proposal has been made regarding the construction of a superhighway connecting major industrial areas to a budding new industrial region in northern Wisconsin. Several interchanges will have to be built on marshland areas and the flow of some streams will be interrupted. Should the highway be built to the formerly remote wildlife region? What alternatives would there possibly be?

Possible Discussion Points:

1. improvement of existing highways
2. drop the project completely thereby stifling the economic and population growth of the region, but protecting the environment
3. reduction of the number of interchanges on the proposed highway
4. construct the highway as proposed in order to "build up" the region,

(Continued)

Outside or Community:

SUGGESTED RESOURCES

Publications:

Speaking by Doing,
National Textbook Company
Skokie, Illinois.
A Land Ethic, I-C-E Field Activity Guide.
Tips for a Good Field Experience,
I-C-E Field Activity Guide.

Audio—Visual:

Population growth films.
Cry of the Marsh, ACI Films, N.Y.
Filmstrip:
Ecological Imbalance: Six Systems
Dispoiled, Eye Gate House, Inc.
(6 filmstrips).
Ecology and Man Series, Competitive
Land Use, McGraw-Hill.
Game:
The Land Use Game, Education
Ventures, Inc.

Community:

Outside speaker,
local zoning and planning man.

CONTINUED OR ADDED LEARNING ACTIVITIES

In-Class: (Continued)

give jobs to workers, and provide needed goods to others.

C. Have students vote on the issue, panel or [illegible]

D. Divide students into groups and identify land uses from 1900 to the present on city maps. Have each student draw up a map with ideal land uses for the community. Ask each student to defend his map.

E. Take a field trip to a local marginal wooded lot and have the students determine the possible uses for the land. Students can then make a written report of possible land uses and their reasons.

1. "A Land Ethic," I-C-E field activity guide could be used very effectively for this activity.

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Environmental: **Integrated with:**

CONCEPT NO. 10 - Economic Planning **SUBJECT** Physical Science

ORIENTATION Solid Waste Disposal **TOPIC/UNIT** Chemistry - Plastics

BEHAVIORAL OBJECTIVES

Cognitive:

Explain several of the problems involved in solid waste disposal.

Affective:

Accept the fact that although new economic developments help make life easier for us, many new problems such as solid waste disposal, result. Reserve judgement about the good or bad of a particular development until its long range effect on the environment has been determined.

Skills Used:

STUDENT--CENTERED LEARNING ACTIVITIES

In-Class:

A. Students will devise a plan to dispose of a plastic bleach bottle through class.
   1. Discuss methods
   2. Discuss problems involved

B. Students should calculate the space necessary to dispose of a year's supply of bleach containers from their community.
   1. Alternatives to disposal should be discussed

C. Class discussion of disposing aluminum, wood, tin, iron and glass products.
   1. Discuss methods
   2. Discuss problems
   3. Discuss possibilities of recycling and problems encountered.

Outside or Community:

A. A visit to a local landfill operation guided by the local sanitation official would give the students a positive feeling for the problems involved in solid waste disposal and management.
   1. Students could prepare a report of possible alternatives to solid waste disposal.
      a. recycling
      b. composting
      c. student suggestions

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES
Publications: Solid Waste Recycling Research, U. S. Dept. of Agriculture, Forest Service. Solid Waste Pamphlets, EPA. **Audio-Visual:** Simulation Game: Recycling Resources, Continental Can. Film: Junkdump, ACI Films, Inc., film 310 I-C-E RMC. Recycling, Modern Talking Pictures. The Green Box, Modern Talking Pictures. **Community:** Solid waste disposal official from local area to guide field trip to landfill operation.	

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Environmental: **Integrated with:**

CONCEPT NO. 11 - Individual Acts **SUBJECT** Physical Science

ORIENTATION Energy Consumption **TOPIC/UNIT** Electricity

BEHAVIORAL OBJECTIVES

Cognitive:

Calculate electrical power and energy. Explain why the use of electrical appliances during non-peak periods as much as possible reduces the overall energy requirement.

Affective:

Perceive that an individual's use, when compounded, has a substantial effect upon our environment. Promote the use of electrical appliances during non-peak hours as much as is feasible as a way of reducing the peak energy requirement.

Skills Used:

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. The students should make a list of all electrical devices in their home.
   1. Amperage and voltage ratings should be included
   2. Power consumption should be calculated for each appliance.

B. Students should determine the average kilowatt hours of energy consumed per year for a family in their community.
   1. This information can then be used to calculate the average energy consumption for their community in one year.
   2. A class discussion could include the source of energy and the effect on the environment due to this energy production.

Outside or Community:

A. A visit to a local electrical generating plant would enable students to observe a method of energy production.
   1. Students should determine:
      a. type of power plant operation
      b. fuel or source of generating power
      c. amount of input needed for a unit of output
      d. periods of peak output and reasons for.

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES

Publications:

Pamphlets:
"Things You Can Do To Stop Pollution," EPA.
"Environmental Cost of Electrical Power," Abrahamson, Dean E., A Scientists' Institute for Public Information Workbook, 1970.
"The Electric Utility Industry and the Environment," Electric Utility Industry, Task Force on Environment, New York, New York.
"Never Do Harm," Environment Magazine reprint from Jan/Feb issues, 1971.

Audio-Visual:

Films:
Home Electrical Appliances, BAVI.
Air is for Breathing, Shell.

Community:

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Environmental: **Integrated with:**

CONCEPT NO. 12 - Stewardship **SUBJECT** Physical Science

ORIENTATION Erosion **TOPIC/UNIT** Forces of Nature

BEHAVIORAL OBJECTIVES	STUDENT–CENTERED LEARNING ACTIVITIES	
	In-Class:	**Outside or Community:**
Cognitive: Evaluate the role of Nature and of Man in changing existing land forms by erosion and depositional processes through written or oral communication.	A. By use of a stream table (can be student-made), students can observe the erosive force of water and the movement and deposit of eroded sediments. B. Teacher explanation and class discussion of weathering, erosion and sedimentation from chapters on a unit on sedimentary processes and discussion of man's role as land custodian. C. In studying physical forces on Earth, it would be wise to put strong emphasis on the natural processes of weathering as a land former and to integrate this knowledge with the practical problem of man's influence in changing the rate of this natural process. The teaching process should begin immediately in the lab with discussion explanation backing up direct observation. Discussion should include application to the role of man as change agent and as custodian of the land. Time should be spent investigating the	
Affective: Indicate concern that man sets long-term goals when working the land by inferring in their written and oral communications (discussion and tests) that man has a responsibility to maintain land in a usable condition for future generations.		
Skills Used:		

(Continued)

SUGGESTED RESOURCES

Publications:

Modern Earth Science,
Holt, Rinehart & Winston.
Earth and Space Science,
American Books - Van Nostrand.
Investigating the Earth,
ESCP Lab Manual.

Audio—Visual:

Film:
Grasslands - Despoilation and Imbalance,
(Ecological Imbalance)
Six disturbed systems.
Eye Gate Films.
Stream Erosion Cycle, Hubbard Sci.
Erosion - Leveling the Land,
14 min., color, Brittanica.
Problems of Conservation Soil,
14 min., color/bw, Brittanica.

Community:

SCS District Office.
Soils Technician.
County Extension Office Staff.
Earth Science Faculty-UWGB.

CONTINUED OR ADDED LEARNING ACTIVITIES

In-Class: (Continued)

C. reasons man abuses the land for short-term gains at the expense of long-term productivity of the land.
   1. Frost action - devise an experiment to measure the coefficient of expansion of ice upon freezing. Discuss the role this property of water plays in soil erosion and the time necessary to produce fine soils.
   2. Force of Friction - place several limestone chips in pop bottle. Draw shape of chips. Fill bottle with water and shake several hundred times. Draw shape of chips. Note rounded corners due to friction and collision. Note discoloration of water.
   3. Chemical weathering - drop several drops of acid upon calcite crystals. Note reaction and condition of crystals. Discuss the breakdown of calcite in nature as a weathering factor--Calcite acts as a cementing material in many rocks. Water will react with carbon dioxide from the air to produce a weak acid (carbonic). This acid will react with the calcite in the rock and the rock will eventually crumble.

D. Field trip observation of natural weathering on local land formation, vegetational retardation of weathering process, and man's hastening of weathering process by poor land use practice. (This can be agricultural primarily, but be alert to the effects of urban and industrial development, road construction,etc.)

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Environmental:

Integrated with:

CONCEPT NO. 12 - Stewardship

SUBJECT Physical Science

ORIENTATION Energy Use

TOPIC/UNIT Nuclear Energy

BEHAVIORAL OBJECTIVES

Cognitive:

Explain several advantages and disadvantages of nuclear powered electrical generators. Describe the present status of our knowledge of the long range effects of nuclear power on the environment.

Affective:

Suggest a personal commitment to sacrifice rather than demand the production of more power for use of a non-essential labor saving device. Propose evidence either in support of or against the development of more nuclear power plants. Reserve judgement as to whether nuclear powered electrical generators are good or bad for mankind.

Skills Used:

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. Discuss, with class, Nuclear Power Plant operation.
   1. reactor structure
   2. reactions involved
   3. locations used

B. Students should do research and write a report which will provide support for or evidence against more nuclear power plants.
   1. Students should support their views in a class debate.

C. A power company official should be asked to talk to the class about nuclear power generation if a field trip to a nuclear plant is not possible.

Outside or Community:

A. A class field trip to a Nuclear Power Plant should be made to familiarize students with this type of power production.
   1. Sources of generating power
   2. Reactor cooling
   3. effluent
   4. impact on environment

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES
Publications: Chemistry magazines. Our Atomic World, Lyceum AEC Pamphlets. **Audio–Visual:** A-V aides. Atomic Power Production, BAVI, #6378. **Community:** Atomic Energy Commission. Wisconsin Public Service. General Electric Company. Westinghouse Corp.	