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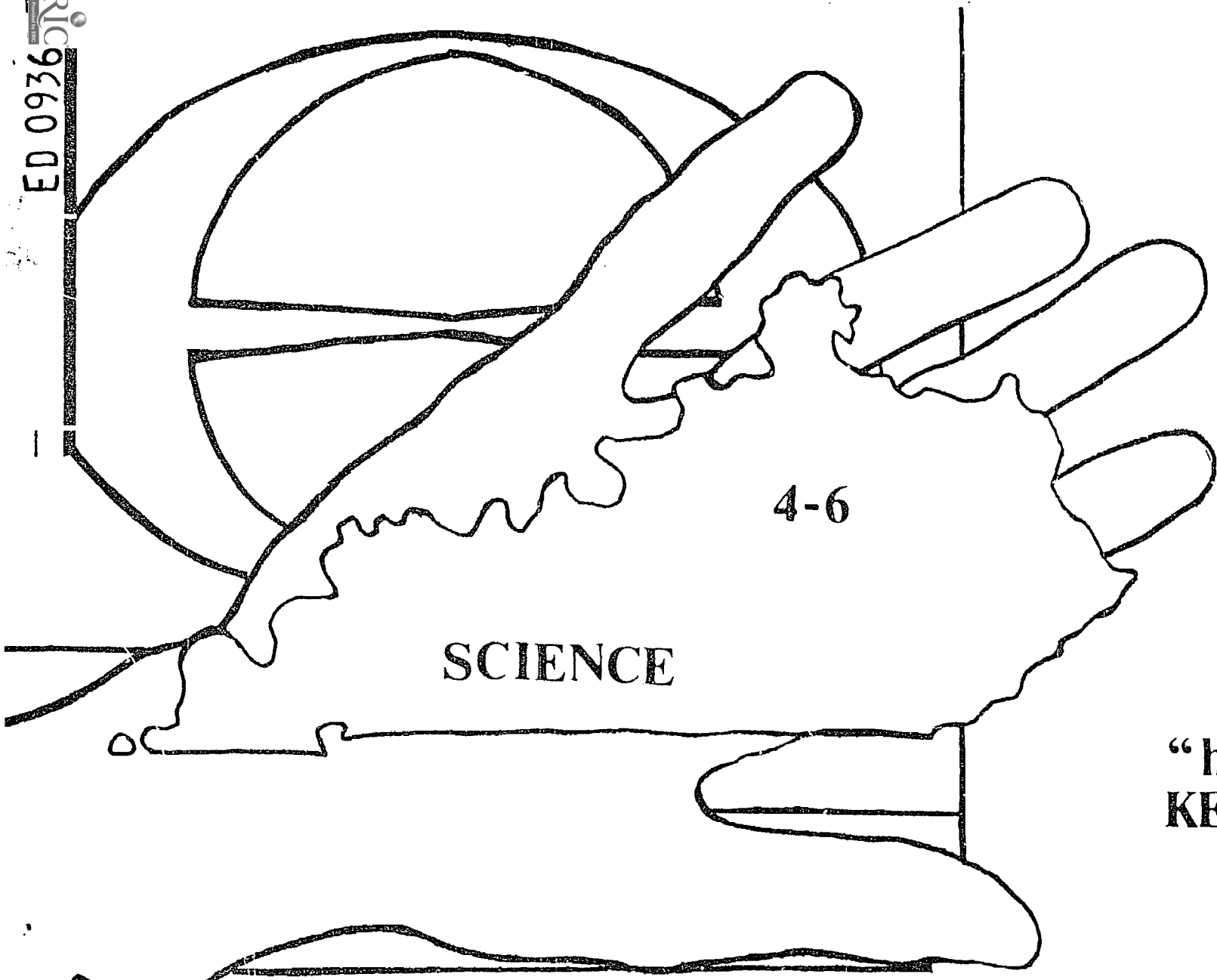
ABSTRACT

This unit of instruction for grades 4-6 is one of a series of curriculum units referred to as the Interdisciplinary Unit. Its purpose is to allow the individual teacher to expose the students to many experiences, ideas, and applications based on their environment (Kentucky). Each lesson is built on two basic concepts, each to balance the other. One concept is a positive statement and the other, its opposite. Each lesson has behavioral objectives and is developed in a three part sequence--showing, discussing, and applying the ideas and concepts of that lesson. The unit is considered as a model on which to build and expand, both for teachers and students. The basic concepts presented in this unit include air, water, land use, noise, and population. (EB)



"hands on KENTUCKY"

Kentucky's Environmental Education Program

COMMONWEALTH OF KENTUCKY
DEPARTMENT OF EDUCATION
FRANKFORT, KY. 40601

LYMAN V. GINGER
SUPERINTENDENT OF PUBLIC INSTRUCTION

As our pace of living becomes more complicated, our people are turning more and more to the environment for refuge and relaxation. Unfortunately, many of us are finding that our frantic utilization of natural resources, our wasteful life styles, and our neglect of balances that exist in our world has taken its toll in the lessening of the quality of our environment. Rather than refuge we find refuse, and rather than relaxation we experience the disgust and disappointment of pollution created by our own neglect and apathy. This disgust and disappointment is only heightened by our feelings of helplessness in solving the problems.

Education has a key role to play in assisting our citizenry with these conflicts. Education, as the means of developing knowledgeable citizens of the future, has a responsibility to teach the students of today the concepts they will need to function in the world of tomorrow. Local, state, and national priorities are being established for environmental utilization and protection. Awareness and a desire to protect and improve the quality of the environment will be essential to survival in tomorrow's world. The program developed by the Kentucky Department of Education to foster this awareness and to motivate towards action is environmental education. We feel that Kentucky's Environmental Education Program (KEEP) offers a beginning for school systems and teachers throughout our Commonwealth. We encourage teachers to use the curriculum materials developed for environmental education as a first step as a model for the development of their own curriculum centered around their individual school and community. Environmental education is one approach towards meeting the new challenges of modern education, and we invite all of Kentucky to join the Kentucky Department of Education in meeting these challenges.

Lyman V. Ginger
Superintendent of Public Instruction

FOREWORD

The impact of decisions made in today's society is seldom limited to the present time or present generations. Rather, today's decisions are often of such a crucial nature that their impact will be felt by many generations yet unborn. In no area will the impact be greater felt than in the realm of the environment. Education has a responsibility in the initiation of wise decision making with respect to the environment. As an effort towards meeting this responsibility, the Kentucky Department of Education has begun a program in Environmental Education. This program visualizes the environment both as the medium for teaching the academic aesthetic disciplines and as an area of study within these disciplines.

We feel that this program is applicable to all segments of Kentucky communities, and encourage educators within these communities to adapt these model curriculum units to local circumstances and environments. We are grateful to the many individuals who have assisted in the development of these units and hope that this material will serve as a motivating element in the future development of additional units and programs throughout the Commonwealth.

Don C. Bale, Assistant
Superintendent for Instruction
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ACKNOWLEDGMENTS

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Listed below are the schools and teachers piloting the Science and Sights and Sounds environmental education units for the Kentucky Department of Education.

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Howe Valley Elementary
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UNIT: AIR - NATURAL LESSON 1:

Objective: To create an awareness of and positive attitudes toward air in its natural state.

Concepts to be developed

Air takes up space and has weight.

Air is composed of gases.

Air contains organisms.

Air contains particulate matter.

Air supports life.

Air contains both favorable and unfavorable odorous materials.

Attitudes and values to be developed

Air in the natural state provides a healthful environment.

Skills - Observing, Counting, Measuring, Estimating, Ordering, Reading, Graphing, Chart Reading, and Writing.

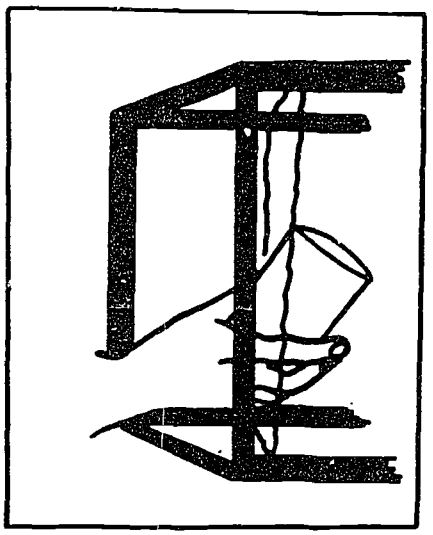
Activities

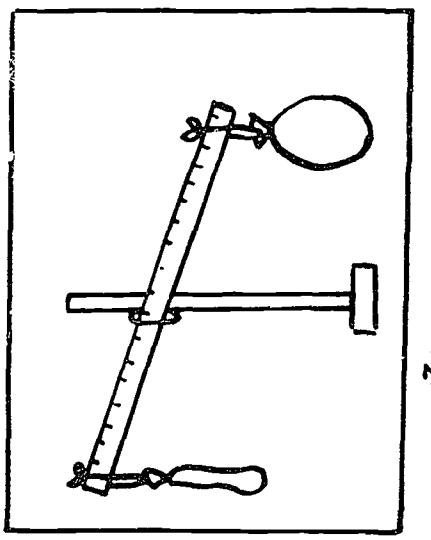
(Air occupies space)

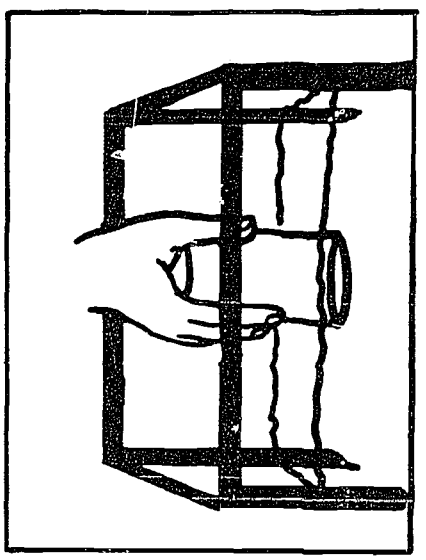
Students should fill in a plastic bag by waving it through the air or by blowing in it. Discuss the differences in the filled bags and unfilled ones. Allow students to invert an "empty" glass in a large container of water and then gently tip the glass to one side. Did something come out of the glass? Was it really empty? Was there something in the glass before the water ran into it?

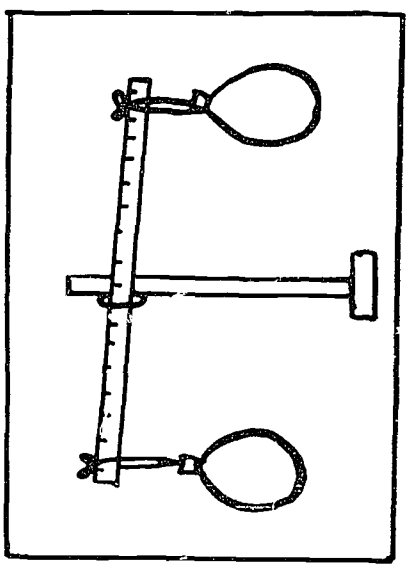
(Air has weight)

Using string, balloons, yardstick, and paper clips allow students to set up the following investigation. Use the paper clips to fasten the strings from the balloons to the yardstick. The paper clips can then be slipped along the yardstick until it is balanced.









Lead the group in discussing why the system is balanced and some ways it could be unbalanced. Discuss what would happen to the balance if one balloon suddenly lost all of its air. Let someone stick a burning match to one of the balloons. What happened? Why? What does the result prove?

(Temperature changes affect gas volume)

Place a balloon over an empty soft drink bottle. Set the bottle on a hot plate at low temperature. What happens to the balloon? Why did it start to expand? Where did the air come from? Now place the bottle with the balloon attached in a container of cold water. What happens? Why? Where did the air go?

(Water vapor is present in the air)

Place a cold container such as a soft drink or a bottle of milk that has been wiped completely dry in a warm room and observe it for several minutes. Does anything happen to the outside of the bottle? What? Was there water on the outside of the bottle? Where did it come from?

(Organisms - plant and animals - release water vapor into the air)

Observe the sides of a terrarium containing plants and/or animals. Does any water vapor collect on the sides of the glass? Does water vapor collect on the inside of any other glass container in the room? Where does the water vapor in the terrarium come from?

(Warm air rises and cold air falls)

Use a thermometer to measure the temperature of the air at different levels in the room, take readings at floor level, eye level, and near the ceiling. Are there any differences in the temperature readings? Which temperature reading was the lowest? Which was the highest? If warm air rises and cold air falls, why is there snow on top of a mountain when it is warm at the base of the mountain?

(There are organisms in the air)

Baby food jars are a good substitute for petri dishes in this experiment. The teacher should prepare this investigation. Sterilize the jars by boiling them in a pan of water for five minutes. Do not touch the inside of the jars after they have been sterilized. Place about a quarter inch layer of agar or unflavored gelatin, one package plus one cup boiling water, in each jar. Place the jars throughout the room and observe them for several days. Does anything happen? Are there spots on the surface of the gelatin? Where did these come from? Are these organisms from the air?

(Air contains particulate matter)

Use a rubber band to attach a small piece of white cloth over the intake nozzle of a vacuum cleaner and allow it to run for a short period of time. What has happened to the cloth? Where did the material come from? Stick the nozzle out a window and repeat the investigation. What was the result?

(Air is a carrier of odors)

Perform some of the following activities in the classroom. Strike a match, burn a candle, open a jar of peppermint oil, and burn a piece of incense. What did you notice after each activity? What effect does the distance you are from the object have? Do some objects have a pleasant aroma? Are some unpleasant?

(Air supports life)

Place about two inches of soil in the bottom of two quart jars and place some seeds, beans, peas, etc., in the soil. Allow the plants to grow. Be sure to keep the soil moist. After the plants are about two inches tall, seal one jar with a lid and leave the other open. Observe the jars over several days. Are there any differences in the plants? Did one stop growing or die? Why?

Obtain a jar of water with wrigglers in it, Pour enough oil on top of the water to cover the surface. Observe the wrigglers several days. What happens? Why?

Supportive information

Air is composed of the following gases:
- Nitrogen - 79%
- Oxygen - 20%
- Carbon Dioxide - 0.04%
- Other Gases - (Argon, Xenon, Neon, Helium, Hydrogen)

Relative humidity refers to the percentage of water vapor present in a given temperature. Decreasing temperature increases the relative humidity for a given quantity of water vapor in a given volume of air.

Plants and animals both use oxygen and release carbon dioxide all the time. (Cellular Respiration) Plants in the light are capable of producing more oxygen than they use and consuming more carbon dioxide than they release. (Photosynthesis)

100% of the carbon present in all living organisms has as its ultimate source carbon dioxide in the air. Wind is moving air.

Develop an understanding of the following terms

contract
expand
condense
condensation
organism
particulate matter
evaporate
autoclave (pressure cooker)
petri dish
relative humidity
respiration
cellular respiration
molecule
humidity
terrarium
thermometer
wet bulb - dry bulb
gas
oxygen
carbon dioxide
photosynthesis
nitrogen
wind

Materials needed

Petri dishes or baby food jars
gelatin or agar
balloons
yard stick

string
thermometers (one dry bulb, one with wick on bulb)
candle
peppermint oil
incense
fruit jars with lids
mineral oil
ladder (or long stick to raise to ceiling)
terrarium
vacuum cleaner
chilled soft drink
pressure cooker or autoclave
plastic bags (baggies, glad bags, etc.)

Topics for further exploration

weather & weather patterns
rain
snow
wind

Implications for other disciplines

Sociology
Psychology
Mathematics

Evaluation: The students should be able to demonstrate an acceptable degree of understanding of the concepts and attitudes of this unit as acquired through the activities they performed.

UNIT: AIR - MAN MADE LESSON 2:

Objective: To create an awareness of ways in which man's activities affect air negatively.

Concepts to be developed

Man can disrupt the natural system of air through a variety of his activities.

Burning of fossil fuels (coal, oil, natural gas)
Burning of forests and grasslands
Burning of garbage
Clearing of forests and grasslands
Production and release of chemical pollutants

Attitudes and values to be developed

Air in the polluted state provides an unhealthful environment.
Air in the polluted state is less pleasant.

Skills - Observing, Counting, Measuring, Estimating, Ordering, Reading, Graphing, Chart Reading, and Writing.

Activities

(The burning of fossil fuels produces air pollutants)

Fill a coffee can half full of crushed coal. Punch a single nail hole in the center of the lid and cover the can. Heat the can with a hot plate or hand torch such as a Benzomatic burner. This should be done out of doors due to the smoke and offensive odors released. After several minutes of heating, strike a match and hold it over the nail hole in the lid. Natural gas will be released from the coal and should be ignited by the match. What did you observe coming from the nail hole in the can? Is this a pollutant of the air? Was there a flame above the nail hole? What was burning? After the can has cooled, examine the material in the can. Has it changed? How is coke produced? How is it used? Can you think of ways coal is used which contribute to the pollution of the air?

Burn a candle. Hold a piece of shiny metal or a white plate a few inches above the flame. What happens? What is the material? Do you think you may have breathed some of this material.

Place a large clear plastic bag over the exhaust of an automobile. Does anything collect in the bag? Would this pollute the air? How many cars are in your school's parking lot? Do you think there would be a lot of pollution if they all were running at once? How many cars do you think there are in New York City? Would they produce a lot of air pollution? If this experiment can be done using a car that has just recently had a motor tuneup and a poorly tuned car, students will have visual proof of the extra pollutants produced by poorly tuned cars.

Burn a cigarette in one end of an open-ended glass tube or clear plastic soda straw which has a cotton plug at the other end. Place a rubber bulb over the end near the cotton to imitate the smoking action. What collects on the cotton? What collects inside tube? Are these pollutants? If you can not perform this experiment, collect some filters from smoked cigarettes and tear them open. Discuss your findings.

Lay several large strips of adhesive tape or glass plates covered with a thin layer of vaseline on an outside window ledge or in a place on the school grounds where it will not be disturbed. Observe it over several days. Do you notice anything sticking to the material. On the first day? Is there more the second day? Third day? Repeat this experiment on a day following a rain. Did more material collect before or after the rain? Does nature work to help us keep our environment clean?

A white sheet of paper can be partially exposed for a period of time to illustrate particulate matter. If one uses an 8½" by 11" sheet of paper and puts 20 one-inch circles arranged in a 4 x 5 pattern and removes one at a time, (time interval will have to be judged according to level of particulate pollution) the rate of deposit of particulate matter can be determined.

Supportive information

Essential facts and concepts

TABLE I
Types and Quantities of Pollutants
Produced in New York City

particulate matter (soot, fly ash*)	230,000 tons per year
sulfur dioxide	597,000
nitrogen oxides	298,000
hydrocarbons	567,000
carbon monoxide	1,536,000

*Soot is composed of black particles in smoke resulting from burning wood, coal, and oil. Fly ash is composed of the solid unburnable particles from .003 to 0.1 inch in diameter resulting from burning of fossil fuels.

TABLE 2
Air pollution in New York City on an average heating day (tons per week)

Space Heating	21
Vehicular Exhaust	695
Refuse Combustion	120
Miscellaneous Losses	
AUTOMOTIVE EVAPORATION	
SOLVENT EVAPORATION	
DRY CLEANING	24
SURFACE COATING	350
ALL OTHERS	176
Miscellaneous, Other	74
Overall Total (Rounded)	1,550

SOURCE: Air Pollution in New York City, Council of the City of New York, Report M-970, June 22, 1965.

TABLE 3
Estimated Weekly Amounts of Pollutants Emitted in New Jersey

Pollutant	Tons Per Week*
Carbon monoxide	64,000
Hydrocarbons	6,480

Oxides of nitrogen	2,160
Aldehydes	108
Sulfur compounds	162
Organic acids	43
Ammonia	43
Other solids	6.5

*It should be noted that tonnage may not be as important as concentration.

Tables 1, 2, and 3 are adopted from Our Precarious Habitat, by Melvin A. Bernarde, W. W. Norton & Co., Inc., New York, 1970, and are used by permission of the publisher.

Develop an understanding of the following terms

Fossil Fuel (coal, oil, natural gas)
Erosion
Pollutants
Coke (fuel)
Potassium Permanganate
Glycerine
Particulate Matter
Exhaust Emissions
Unaesthetic
Inversion (atmospheric)

Community Resources

(1) Visit local garbage dump, incinerator, or land fill.
(2) Visit a nearby industrial plant to see chemical pollution.
(3) Visit construction site to see dust pollution.
(4) Visit local weather bureau if available.
(5) Visit local air pollution control board.
(6) Visit local health department.

Materials needed

coffee can and lid
crushed coal

hot plate
candle
shiny plate (white)
glycerine
glass tube - 4 to 5 inches with rubber bulb on one end
cotton or glass wool for filter
cigarette
plastic bag for checking exhaust emission
adhesive tape or vaseline on glass plate

Implications for other disciplines

Sociology	Mathematics
Psychology	Physical Geography
Social Geography	Communicative Arts

Evaluation: The students should be able to demonstrate an acceptable degree of understanding of the concepts and attitudes of this unit as acquired through the activities they performed.

UNIT: AIR - MAN AFFECTED LESSON 3:

Objective: To create an awareness of and a positive attitude toward correcting the pollution of the air.

Concepts to be developed

Pollution problems can be corrected.

Corrective procedures will be expensive and will eventually cost the individual citizen.

Buildings, statues, automobiles, etc. will deteriorate less rapidly.

Attitudes and values

People will live in a clean air environment. For example, individuals having respiratory or circulatory conditions will live life more fully.

Skills - Observing, Counting, Measuring, Estimating, Ordering, Reading, Graphing, Chart Reading, and Writing.

Activities

Have any of the preceding activities suggested ways or correcting air pollution problems?

Can a return to the natural air system be achieved?

Is your community involved in correcting local air pollution problems.

What can you as an individual do to correct air pollution problems?

Supportive Information

Essential facts & concepts

Refer to the great variety of source materials on this subject.

Resources · Earlier studies will suggest resources.

Materials - As necessary in related experiments suggested earlier.

Related topics

Water pollution
Solid Waste
Visual aesthetics
Land use

Implications for other disciplines

Social Geography
Health
Psychology

Evaluation: The students should be able to demonstrate an acceptable degree of understanding of the concepts and attitudes of this unit as acquired through the activities they performed.

UNIT: WATER - NATURAL LESSON 1:

Objective: Create an awareness of and positive attitudes toward water in its natural state.

Concepts to be developed

The water cycle is the natural method for renewal of water supplies.

Water occurs in three forms (solid, liquid, and gas). Each plays a part in the conservation of water.

Water in its natural state supports a variety of living organisms and is a necessary requirement of all living organisms.

Attitudes and values

Water in its natural state is desirable from an aesthetic point of view.

Skills - Observing, Counting, Measuring, Estimating, Ordering, Reading, Graphing, Chart Reading, and Writing.

Activities

(Water occurs in three forms: solid, liquid, and gas or steam)

Place an ice cube in a beaker on a hot plate and heat to boiling. Put a cold or chilled glass plate over the steam being given off. What happens to the ice cube as it is being heated? What happens to the water that collects in the beaker? What collects on the chilled glass plate? Where did it come from? Is it a part of the ice cube?

(The Water Cycle is nature's water cleanser)

Place a teaspoon of salt in a clean beaker of water. Allow several students to taste the water by trapping some in clean soda straws or using clean teaspoons. Heat the salt water to boiling

and collect some of the condensed steam as you did in the preceding activity. Have some of the students taste the condensed steam. Does it have a salty taste? Why? Where is the salt? You may continue this activity by placing four teaspoons of salt in a ½ full beaker and continue boiling it until nearly all the water has evaporated. What is left in the beaker? Why does the ocean have a salty taste? Why does the Great Salt Lake have a salty taste?

Discuss the water cycle as nature's method of cleansing the water. The accompanying drawing may be useful. The water cycle should be tied into the salt activity as an example of the water cycle and the method nature uses to provide fresh water.

(Water supports and is necessary for life)

In forty paper cups filled half full of soil allow beans to germinate and grow several inches high. The plants should be kept in the sunlight and watered daily. After they have reached a height of about four inches, remove four of the cups from the watering schedule each day until only four remain. Keep a record of the plants as they are removed, recording the last day they received water. What happens to the plants which are denied water? Keep a record of the length of time the plants live without water. Do all live the same number of days? What was the most number of days a plant lived? The least?

Ten beakers or water tumblers have the following amounts of aquarium water added.

1) Filled to brim

2) Filled to 90% of capacity

3) Filled to 80% of capacity

4) Filled to 70% of capacity

5) Filled to 60% of capacity

6) Filled to 50% of capacity

7) Filled to 40% of capacity

8) Filled to 30% of capacity

9) Filled to 20% of capacity

10) Filled to 10% of capacity

A single small fish (guppy) is placed in each one. No water is added to the beakers.

What happens to the fish when the water is reduced by evaporation? (Note: return fish to the aquarium before they die)

Bring in some water from different places, and view it under a microscope. Several samples from along a stream may show differences.

Streak a small amount of water from several sources on sterile agar or gelatin in petri dishes or baby food jars. Note the variety of organisms (bacteria, fungi, algae) that develop from the water.

Using litmus paper, measure the acidity and basicity of several water samples.

Put salt in water and bring it to a boiling point and measure the temperature. (It will boil at a lower temperature than pure water.)

How will substances produced in strip mining and leached out during rainfall affect the temperature in streams. Could this have an effect on the life in the stream?

Supportive information

Water freezes at $0^{o}C$ or $32^{o}F$. Water boils at $100^{o}C$ or $212^{o}F$. Water can hold more gas (oxygen, carbon dioxide, etc.) the colder it is in the liquid state.

Warm air can hold more water vapor than can cold air.

Rain is water in its liquid state condensed above $32^{o}F$.

Snow is water in the solid (crystalline) state condensed below $32^{o}F$.

Sleet is water in the solid state condensed above $32^{o}F$ and frozen as it passes through air below $32^{o}F$. In other words, sleet is frozen rain.

Hail is water in the solid state, frozen in layers due to repeated additions of liquid water at lower altitudes then being blown (lifted) by strong wind currents to a higher altitude where it freezes again. This is repeated several times until it is too heavy to be lifted by the winds, in which case it falls to the earth.

Dew is water released in the liquid state by a plant when the relative humidity conditions are near 100%.

Clouds are formed due to evaporation and partial condensation caused by air temperature differences.

Frost on grass and other plants is frozen dew.

"Dew" on cars or other non-plant surfaces is due to condensation from the air (vapor state) to the object (liquid state). This may freeze to form "frost."

Glaze occurs when the object is below 32°F and rain freezes on the surface. Fog is a cloud at ground level.

Surface waters may be fresh (on most land surfaces), salt (in the oceans and some desert lakes), or brackish (where salt and fresh water sources meet).

Most water vapor is derived from evaporation of water in the oceans. Other sources are evaporation from lakes, rivers, and stream surfaces and from plants (transpiration).

Develop an understanding of the following terms

Beaker	Water Cycle
Boiling point	Temperature
Condense	Evaporation
Liquid	Transpiration
Gas	Seepage
Solid	

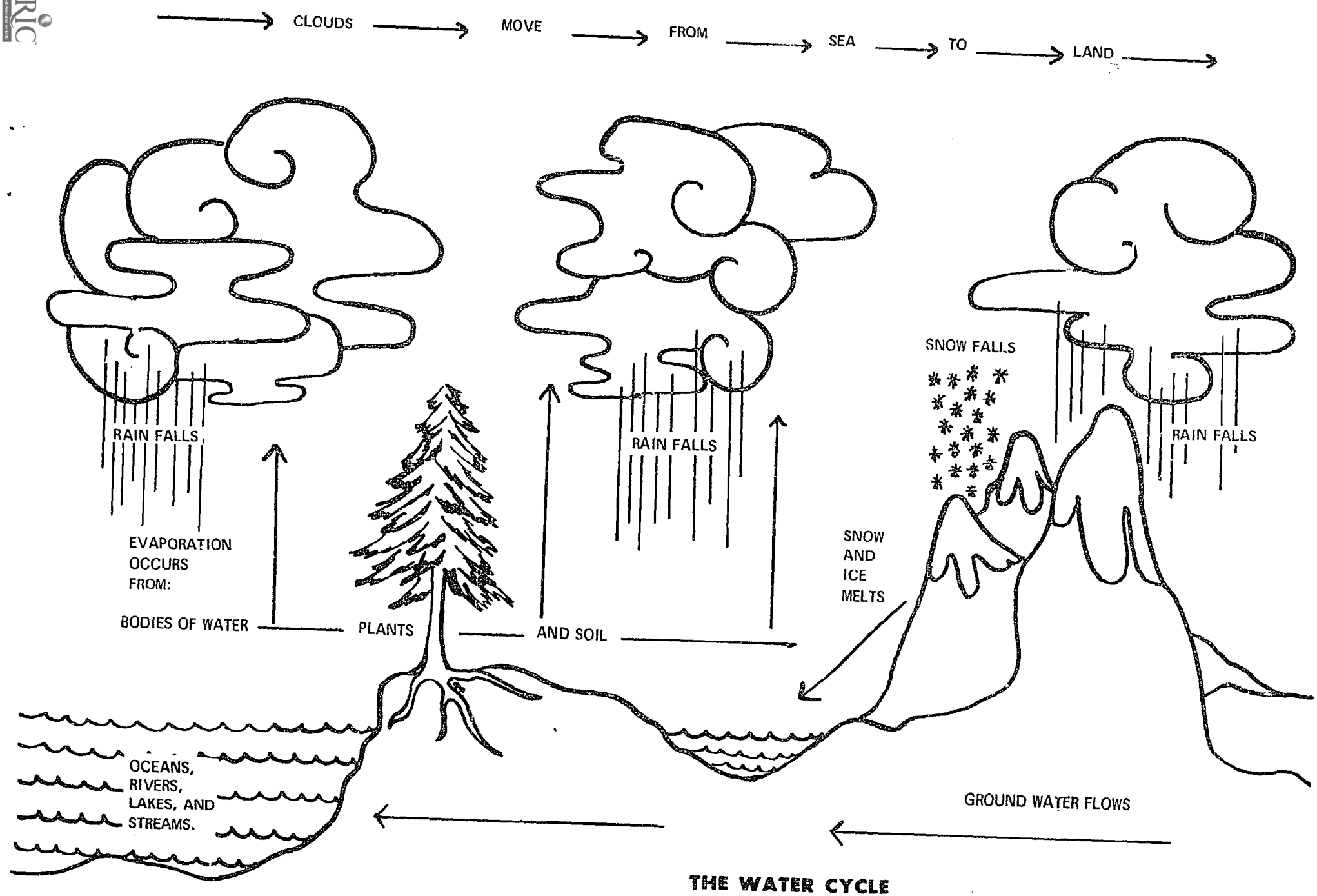
Materials needed

Beakers	Litmus paper - both red and blue
Ice	Aquarium with fish
Heat plate	Thermometer
Salt - (Na Cl)	Soil
Bean seeds	Microscope
Paper cup	Gelatin or agar
Water	Petri dishes or sterilized jars

Implications for other disciplines

Health
Mathematics
Natural History
Sociology
Economics
Political Science
Agriculture
Home Economics
Cultural Geography

Evaluation: The students should be able to demonstrate an acceptable degree of understanding of the concepts and attitudes in this unit as learned through the activities they performed.



THE WATER CYCLE

UNIT: WATER - MAN MADE LESSON 2:

Objective: To create an awareness of and a positive attitude toward water as disrupted by man.

Concepts to be developed

Man adds many things to his water systems that do direct damage to the organisms (including man himself) which are dependent on the water.

Man's activities contribute to unhealthful situations for plant and animal life, including man himself.

Man uses water for many things and at a rate that tends to waste the water and lower the water table to the danger level.

Man's land use activities do irreparable damage to water systems. For example, fertilizers, pesticides and herbicides used by farmers eventually get into the streams. Strip mine operations allow siltation and acid addition to the streams. Many industries dispose of waste products, some of which are toxic, into streams.

Attitudes and values

Man's activities contribute to an unaesthetic situation in our streams, lakes, and oceans.

Skills - Observing, Counting, Measuring, Estimating, Ordering, Reading, Chart Reading, Graphing, and Writing.

Activities

(Man damages the water system by adding things to it)

Measure the ph (acidity of alkalinity) of several water sources: tap water, well water, stream water, lake or pond water, dish water, (after detergents are added) etc., using litmus paper. What did you find? Are there differences? What do you think some reasons for the differences are? Could these have a harmful effect on living things that use the water?

NOTE: For the following activity the materials must be prepared exactly as they were in the similar activity in the Air-Natural Unit.

Determine the bacterial count of a sample of water from a stream by making dilutions of the water. Begin by placing 100 drops of the water sample in a sterile (boiled) container. Mark this container #1. Remove 10 drops to another container and add 90 drops of water which have been boiled five minutes. Mark this container #10. Repeat this process five times with succeeding containers being marked 100, 1000, etc. You should now have seven containers, each having 90 drops of water and marked 1, 10, 100, 1,000, 100,000, and 1,000,000. Take 10 drops from each container and place on the surface of an agar of gelatin medium, in 10 petri dishes or baby food jars, spreading it around over the surfaces by tilting the dish back and forth. (See note above for preparing these jars) Place lids on these containers and mark them with the same number as the container from which its water came. Allow these jars to sit in a warm place for four days. Count the number of bacteria present on the surface of each jar. (The more dense ones will be impossible to count.)

Multiply the number of colonies by the number on the jar from which you were able to count. For example, if you were able to count 70 colonies in the jar marked 10,000 then 70 x 10,000 or 700,000. If you now divide by 10 this would be approximately the number of bacteria colonies in one drop of your water sample. Do you think you would find more or fewer bacteria if you used a water sample from a polluted source? Why not try and see if your idea is correct.

(Pollutants Affect Aquatic Life)

Fill six beakers or large glasses with water. The first beaker will contain no table salt. Dissolve one pinch of salt in the second glass, three pinches in third glass, one-half teaspoon in the fourth glass, one teaspoon in the fifth glass, and one tablespoon of salt in the sixth glass. Place a small fish (guppy) in each glass. Does the guppy in glass #1 behave differently than any of the other guppies? Leave them in the glass throughout the day being sure to observe them often. Do any of them appear to be getting sick? Should that guppy be left in the salt water to see if it will die or should you place it back in the aquarium and not take a chance on letting it die? How much salt did it take to have an effect on a guppy's health? Are there materials that man is allowing to get into our rivers and oceans that will have the same effect on fish there? Did you let your guppy die? Should we allow the fish in our lakes and streams to die?

Place small fish in beakers containing water from several sources, including tap water. Observe for several days.

Place small fish in beakers containing various concentrations of vinegar, acid, and soap (basic). Observe them and note their reactions.

Allow ten beakers to develop plant growth. Have others with aquatic animal life. Put several (3-4) drops of oil on the surface of five of them. Observe the effect over several weeks.

Take field trips to a city water supply and treatment plant. Go to the sewage treatment plant. Visit sources of water pollution in your community.

Supportive information

Pollutants released into water by man:

Domestic wastes (sewage)
Industrial wastes
Salts
Acids
Bases
Oils, greeses
Dyes
Solid materials (garbage)

Continued addition of nutrients (nitrates, phosphates) to water supplies from fertilizers, detergents, etc. causes accelerated growth of plants which results in a process called eutrophication. In lakes this reduces the volume and use of the lake. In streams the channel may be reduced causing flooding of nearby agricultural areas.

The following information is extracted from: "Will There Be Enough Water?" by John C. Maxwell. From University, A Princeton Quarterly, No. 23, winter 1964-65.

240 billion gallons per day of metered water are sold in the U. S.

Various experts estimate that only about one quarter of our available 1300 billion gallons of water per day are actually consumed.

The supply of usuable water is always a function of total pure water versus waste.

The per capita daily use of water in the U.S. is in excess of 15,000 gallons per day per person, 95% of which is consumed, that is, lost to the atmosphere.

The following is from: Storin, Diane, Investigating Air, Land and Water Pollution, Pawnee Pub. Co., Inc., Bronxville, N. Y., 1971.

Water is used on the farms to grow the food one eats. Five gallons of water are used to produce one gallon of milk and, to produce 20 fresh-weight tons of crops, 2000 tons of crops, 2000 tons of water will pass into the plants at the roots.

Water is used in the power plants to produce the electricity one uses. About 80 gallons of water are used to generate one kilowatt-hour of electricity.

Water is used in the factories to produce the products you buy. The amount of water needed to produce one ton of steel is 65,000 gallons.

Develop an understanding of the following terms

Fertilizers
Pesticides
Herbicides
Siltation
Acid
Basic (alkaline)
Industrial waste
Garbage
Nutrients
Toxic
Domestic water (sewage)
Nitrates
Phosphates
Eutrophication
Per capita
pH (stands for Hydrogen ion concentration and is a measure of how acid or basic a system is)

Materials needed

Beakers
Salt - (Na Cl)
Vinegar
Soap
Fish
Oil
Wrigglers (mosquito larvae)
Snails
Algae
Pesticides - man made
Herbicides
Litmus paper
Microscope
Eye Dropper

Implications for other disciplines

Sociology
Psychology
Physiology
Agriculture
Home Economics
Political Science
Art - Aesthetic phase of nature

Evaluation: The students should be able to demonstrate an acceptable degree of understanding of the concepts and attitudes in this unit as acquired through the activities they performed.

UNIT: WATER - MAN AFFECTED LESSON 3:

Objective: To create an awareness of and a positive attitude toward correcting the pollution of water.

Concepts to be developed

Pollution can be corrected.

Water can be conserved.

Water can be recycled.

Attitudes and values

Water conserved and recycled will lower cost.

Water conserved will save wildlife, food, soil, and aid in the cleaning of the air.

Conservation of water produces a more aesthetic world in which to live.

Skills - Observing, Counting, Measuring, Estimating, Ordering, Reading, Graphing, Chart Reading, and Writing.

Activities

(Planting of grass and trees allows for the retention of water)

Plant a large pan or cookie with grass, sowing only on one-half of the area. Allow the grass to grow to 2" and trim to 1". Set the plot at an angle and sprinkle (use a sprinkler) with one gallon of water. Note how much water is retained on the grass plot as opposed to the bare ground.

Take a large tin can and punch nail holes in the bottom (20-30) and sides about one inch up. Place large gravel in the bottom two inches, cover with two inches of finer gravel, cover this with two inches of coarse sand, and finally with two inches of fine sand.

Now, pour water that contains plant materials, silt, and other materials onto the surface. Collect the water in a vessel at the bottom of the filter. Was the water clearer and cleaner after filtering? Is this pure water? Could one drink it?

Using the same type of can as in the preceding activity, place large gravel-sized pieces of charcoal in the bottom two inches and in two inch layers smaller and smaller pieces until fine charcoal is used. Pour water, colored with ink, through the filter. Is the coloring matter removed?

Place a brick in the commode tank so that less water will be used to fill it.

Use soap flakes or a biodegradable detergent. When possible visit a stream which shows effects of phosphate detergents.

Visit a plant which has produced a device to filter and recycle pollutants, such as mercury, before dumping into a stream.

The following activity is adopted from: Storin, Diane, Investigating Air, Land, and Water Pollution, Pawnee Pub. Co., Inc., Bronxville, N. Y., 1971.

(Measuring the water used in one day)

How much water did you use for your personal needs yesterday? Before you can answer that question, you will have to devise a method to measure water quantities for each of your daily activities.

Materials

Pencil
Notebook

Procedure

This investigation requires much inventiveness. For example, how will you determine how much water you use while showering? This is the way one student attacked the problem. He measured the amount of water released from the shower in one minute. (A quart milk bottle was a convenient measuring device.) He then timed himself to determine how much time he spent in the shower. By multiplying

the amount of time spent showering by the amount of water used in one minute, he calculated that he had used 12 gallons of water.

In some investigations, a glass may be a more convenient measuring device; in others a kitchen pot may be better. Measure the amount of water held by the glass or pot; you then have a means of measuring water quantity. If you perform the same activity more than once during the day, you will have to multiply the quantity of water used to perform the activity by the number of times the activity is performed. You may want to record your results on a table similar to this:

Activity	Volume of Water	Frequency	Total Volume of Water
Brushing teeth	1 cup = 8 oz.	2	2(8) = 16 oz.
Washing teeth	1½ cups = 12 oz.	4	4(12) = 48 oz.
			Total

You probably determined that you used between 50 and 150 gallons of water. How many persons are in your class? How much water was used by your class? Based on your calculation, how much water is used by the student population of your school? How much water is needed for the personal needs of the people in your community? Remember: these answers represent water used for personal needs in one day only! One day of personal needs! The figures would be much larger if you included water needed to grow and produce the food you ate during the day, or the water needed to manufacture the products that you used.

Develop an understanding of the following terms

Pollution
Conserved
Recycled
Retention
Charcoal
Biodegradable
Detergents

Materials needed

pan or cookie sheet
two large tin cans
sprinkler - may be constructed by punching several small nail holes in the bottom of a large can.

Implications for other disciplines

Sociology
Political Science
Agriculture
Mathematics
Economics

Evaluation: The students should demonstrate an acceptable degree of understanding of the concepts and attitudes in this unit as acquired through the activities they performed.

UNIT: LAND USE - NATURAL LESSON 1:

Objective: To create an awareness and positive attitudes toward the way in which land is "used" in the natural environment.

Concepts to be developed

Under natural conditions organisms, both plant and animal, adapted for a particular environment will occupy that environment.

Ecological limitations will maintain a balance of the organisms present, no one organism predominating.

Waste materials from organisms in their natural environment are capable of degradation by other organisms in the ecosytem and wastes rarely accumulate.

Attitudes and values

The natural environment with balanced systems is the desirable situation.

Skills - Observing, Counting, Measuring, Estimating, Ordering, Reading, Graphing, Chart Reading, and Writing.

Activities

(Natural waste materials are capable of degradation)

Visit a "natural" area in your vicinity. (Avoid farms having agriculture, well mowed parks, etc.) Look for ways in which dead or waste materials are returned to the soil (recycled). Discuss the length of time for recycling of various plant and animal matter.

(Under natural conditions organisms adapted to environment will occupy that environment.)

Place several pots of ordinary garden soil in a window or lighted area and water regularly. Watch the plants grow and eventually die. Do other plants take their place - in other words, is there a succession?

Place a potted plant in an aquarium full of water. How long does the plant live? Was it adapted to the aquatic environment or terrestrial environment?

(Ecological limitations will maintain a balance of organisms)

Now visit a pond, preferably one several years old. Note the different kinds of vegetation as one walks from the shore to several yards from the shore. Are the plants near the water more adapted to being wet than those farther away? You may wish to visit the pond several times during the year to see seasonal differences.

Supportive information

Essential facts and concepts

Each organism is adapted to the environment in which it lives. When an environmental factor changes slightly, the organism may survive, but not as well. However, if an environmental factor changes too much the organism may not survive.

Adaptive features for plants:

Aquatic - Small aquatic plants are one-celled plants. Large aquatic plants contain large air spaces between the cells. This can be demonstrated by cutting open a cattail or water lily.

Arid - Plants have reduced leaves or none at all. They are scattered far apart. They store lots of water (up to 95% in a cactus).

Adaptive features for animals:

Aquatic - Produce oil to protect thick fur or feathers in mammals or birds. Fish get oxygen directly from water rather than air. Crayfish, claws, and other aquatic animals also get their oxygen directly from the water.

Arid - Animals capable of getting sufficient water from their food. They are most active at night, when it is cooler and go under rocks or in burrows during the heat of day.

A consumer may be a parasite (lives on living organisms) or a saprophyte (gets its nutrition from dead organic matter).

Decay is the major method of recycling nature's water. Bacteria and fungi are the prime organisms for this function.

	Lots of Rain	Little Rain
Lots of Vegetation	Little Erosion	Little Erosion
Little Vegetation	Lots of Erosion	Some Erosion

Floods bring new nutrients to flood plants.

Vegetation cover allows slow perculation of water into the soil rather than as direct fun-off into streams.

Develop an understanding of the following terms

conditions
environment
degradation
balanced system
recycle
succession
aquatic
terrestrial
arid
producers
consumers
parasite
Saprophyte
bacteria
fungi
perculation

Resources:

Local soil conservation director.
Local conservation organization members.
Local park service - federal, state or local.

Materials needed:

Pots
Soil
Aquarium
Plants

Evaluation: The students should be able to demonstrate an acceptable degree of understanding of the concepts and attitudes in this unit as acquired through the activities they performed.

UNIT: LAND USE - MAN MADE LESSON 2:

Objective: To create an awareness of and a positive attitude toward Land Use as managed by man.

Concepts to be developed

Man uses land for purposes that are not ideal. Prime agricultural land becomes housing areas, and mountains are cleared of vegetation.

Many of man's waste materials are not degradable.

Man uses resources in an unwise and wasteful manner.

Attitudes and values

Land unwisely used loses productive value that is difficult to replace.

Excess waste is unsightly as well as being a loss to the economic system.

Skills - Observing, Counting, Measuring, Estimating, Ordering, Reading, Graphing, Chart Reading, and Writing.

Activities

(Man uses land for purposes that are not ideal)

Ask a member of the local planning and zoning commission to speak on land use policies within your community.

Tour a city or town. See ways in which the land has been used: Business districts, shopping centers, highways and roads, housing areas, parks, industrial areas, railroads, airports, agricultural regions, dams, canals, etc.

(Many of man's waste products are not biodegradable)

Visit the local land fill or incinerator to see what people throw away. Visit a junk car dealer.

Pick up and itemize all "throw away" objects you can find in 10 minutes on the school ground. Tabulate the results for the whole class. What if no one ever picked any trash up! Why should some one else have to pick up your candy wrapper, wastepaper, etc?

Bury the following kinds of items: cloth, plastic, paper, glass, can, wood, brick and etc., to depth one foot in the ground, mark or map the location, and leave it for one month. At the end of one month dig the items up and determine what items decay (and at what rate) and which ones do not. What implications does the result have for solid waste pollution?

(Man uses resources in an unwise and wasteful manner)

Have students determine wattage of all light bulbs used in their home. Discuss whether all are needed and how many are left on during unneeded times.

Have custodial service "save" the total waste from your school for one day and deposit it in one location for impact. Try to estimate the size waste-pile the entire school year would produce.

Have students determine the amount of waste from their own homes during a 24-hour period.

Supportive information

Essential facts and concepts

The following is from: Benarde, Melvin A., Our Precarious Habitat, W. W. Norton & Co., Inc., N.Y., 1970.

The typical city dweller discards four to five pounds of solid waste daily.

Throughout the United States, each year, we must dispose of forty-eight billion cans, twenty-six billion bottles and jars, and sixty-five billion metal and plastic caps.

Definitions

Rubbish - Combustible items such as cartons, boxes, paper, grass, plastics, bedding, and clothing and non-combustibles, such as ashes, cans, crockery, metal furniture, glass, bathtubs, etc.

Garbage - Waste resulting from growing, preparing, cooking, and serving food.

Dead Animals - Pets and wild animals killed by automobiles or other means.

Demolition waste - bricks, masonry, piping, and lumber.

Sewage-treatment residue - septic tank sludge and solids from sewage treatment plants.

Disposal methods

Open dumps
Sanitary land fills
Incineration
Composting
Animals as producers of waste
Seven to ten chickens produce as much body waste as one human.
One hog produces as much body waste as two humans.
One cow produces as much body waste as ten humans.

The following is from: Murdoch, William M., ENVIRONMENT, RESOURCES, POLLUTION, & SOCIETY, Sinaver Associates, Inc., Stanford, Conn., 1971.

U.S. Land Area	2,266,000,000 acres
Alaska	362,000,000 acres
Cropland	435,000,000 acres
Could be farmed permanently if reasonable care were taken for its conservation and wise management, and if demand for its output so justified.	775,000,000 acres
Forest and woodland	770,000,000 acres
Grazing Land - mostly not useful for anything else; grazing gets it by default	640,000,000 acres
Urban	29,000,000 acres
Recreation	47,000,000 acres

U. S. MAJOR CROPLAND USE

Kind of use	1950	1964
Cropland used only for pasture	69	57
Cropland idle or in cover crops	22	52
Cropland used for crops, including cultivated fallow	387	335
Total	478	444
Cropland harvested	345	296
Planted crop acreage[a]		
Feed grains	147	114
Food grains	82	62
Hay and forage	79	69
Oil crops	19	41
Cotton	24	10
Vegetables and potatoes	5	5
Fruits and nuts	3	3
Tobacco	2	1
Sugar crops	1	2

U. S. MAJOR CROPLAND USES. The data are given in million acres. The first four lines of figures are for the dates shown; for the rest of the Table, "1950" is the average of 1949-1951 and "1964" is the average of 1966-1968.

[a]Where date permitted, planted acreage; otherwise, harvested acreage.

USES OF LAND IN THE UNITED STATES

Use of land for	1900	1910	1920	1930	1940	1950	1980	2000
Cities of 2,500 or more population[a]	6	7	10	12	13	17	30	41
Public Recreation areas[b]	5	9	12	15	41	46	72	95
Agriculture:								
Crops[c]	319	347	402	413	399	409	388	388
Pastured[d]	77	84	78	73	68	69	70	70
Other[e]	53	57	58	45	44	45	45	45
Subtotal	449	448	538	531	511	523	503	503
Commercial forestry:								
Continuous management[f]	0	30	60	200	300	359	385	405
Little or no management	525	482	440	295	188	125	90	50
Subtotal								
Grazing[g]	808	775	730	735	740	700	700	680
Transportation	17	19	23	24	24	25	28	30
Reservoirs and water management[h]	*	1	2	3	7	10	15	20
Primarily for wildlife	*	*	1	1	12	14	18	20
Mineral production								
Deserts, swamps, mountain tops, some noncommercial forest, etc.	94	93	88	88	68	85	63	60
Miscellaneous and unaccounted for								
Total	1,904	1,904	1,904	1,904	1,904	1,904	1,904	1,904

* See next page for explanation of symbols.

PAST AND FUTURE U.S. LAND USE. Land use[a] is given in million acres for selected year, 1900-1950, and projections are given for 1980 and 2000. The data in this table are necessarily estimates in several instances, sometimes on a relatively scanty basis of fact. This table emphasizes land use, as separate from land ownership or control or from vegetative cover. An asterisk indicates negligible use. Source: Marion Clawson, R. Burnell Held, and C. H. Stoddard, Land for the Future, Table 5.1 pp. 442-443, Johns Hopkins Press, Baltimore, Maryland, 1960.

[a]Includes municipal parks.
[b]Excludes municipal parks. Includes national park system, areas within national forests reserved for recreation, state parks and acreages around TVA and Corps reservoirs reserved for recreation. Excludes all areas used primarily for other purposes even though they provide much recreation. Excludes actual water area of reservoirs, which is shown later under its own heading. Excludes also wildlife areas, which are shown below. We have assumed that only part of the increased potential demand will be met.
[c]Cropland harvested, crop failure, cultivated summer fallow, and cropland idle or in cover crops. See Tables 11 and 12, Agriculture Information Bulletin No. 168, U. S. Department of Agriculture, 1957.
[d]Only pasture on land which is considered cropland is included. This corresponds to the 1949 and 1954 Census of Agriculture definition. The 1900 figure is an estimate. The acreages for 1910 through 1940 are the difference between crops, as shown above, and estimates of cropland potential which included cropland pastured, given in Table I of Agriculture Information Bulletin No. 140, 1955.
[e]Farmsteads, farm roads, feed lots, lanes, ditches, and wasteland. See Tables 11 and 23, Agriculture Information Bulletin No. 168.
[f]This is a roughly estimated figure. For 1950, it excludes commercial forest land with no fire protection or poorly stocked as shown in Timber Resources for America's Future.
U. S. Forest Service, 1958. For earlier years, it is our estimate or comparable definition area.
[g]Includes some noncommercial forest land used primarily for grazing.
[h]Excluding land around reservoirs and conservation pools of reservoirs, which are included in the recreation areas.

Develop an understanding of the following terms

Agricultural land	Rubbish
Land fill	Garbage
Incinerator	Demolition wastes
Wattage	Woodland
Composting	Urban
Cropland	

Resources

Human -
Director of Local Soil Conservation Service
Members of Conservation Organizations
Members of Planning & Zoning Commissions

Community -
Sanitary land fill &/or incinerator

Print - See Bibliography

Implications for other disciplines

Sociology
Social Geography
Home Economics

Evaluation: The students should be able to demonstrate an acceptable degree of understanding of the concepts and attitudes in this unit as acquired through the activities they performed.

UNIT: LAND USE - MAN AFFECTED LESSON 3:

Objective: To create an awareness of and a positive attitude toward better methods of land management.

Concepts to be developed

Land use planning can provide for the needs of man and aid in the protection of the environment.

New towns can be placed in areas of low agricultural yield.

Man's wastes should be reduced.

Attitudes and values

Land use planning can provide a more aesthetic environment and allow for the well being of the ecosystem.

Clean streets, well planned cities, and natural areas all mean a better life for all citizens.

Skills - Observing, Counting, Measuring, Estimating, Ordering, Reading, Graphing, Chart Reading, and Writing.

Activities

Use a map of your country or city to determine how the available land can best be utilized. Where should there be factories? Where should parks be developed? How much for agriculture-cropland, forestry, and grazing land?

Organize a litter pick-up in the vicinity of the school or neighborhood.

Organize a program to encourage recycling, avoidance of throw-away packaging, reduction of energy (gas, oil, coal, electricity) use.

Essential facts and concepts

SEE LAND USE - NATURAL
and
LAND USE - MAN MADE

Develop an understanding of the following terms

New towns
ecosystem
throw-away packaging

Resources:

SEE LAND USE - NATURAL
and
LAND USE - MAN MADE

Materials needed

County Maps - obtainable from
Kentucky Department of Commerce
Frankfort, Kentucky 40601

City Maps - Usually obtainable from city hall.

Topographic Maps - Obtainable from
Kentucky Department of Commerce
Frankfort, Kentucky 40601
or
U. S. Department of Interior
Washington, D. C.

Related topics

SEE LAND USE - NATURAL
and
LAND USE - MAN MADE

Evaluation: The students should be able to demonstrate an acceptable degree of understanding of the concepts and attitudes in this unit as acquired through the activities they performed.

UNIT: NOISE - NATURAL LESSON 1:

Objective: To create an awareness of and positive attitudes toward sound at natural levels.

Concepts to be developed

Sound is produced by air waves in motion.

Noise is "unwanted sound."
From: Bernarde, Melvin A., Our Precarious Habitate, W.W. Norton & Co., Inc., New York, 1970.

The ear is the instrument through which we hear.

Nerve endings in the ear structure can be destroyed by sound at 85 or more decibels.

Attitudes and values

Noise at a natural decibel level provides for a more healthful environment.

Skills - Observing, Counting, Measuring, Estimating, Ordering, Reading, Graphing, Chart Reading, and Writing.

Activities

(The ear is the instrument through which we hear)

To study the ear mechanism, use a schematic diagram and ear model.

(Noise is unwanted sound)

Ask an audiologist or a physician (ear specialist) to visit the classroom and discuss hearing and causes of deafness.

Give every student an audiometer test. This can be done by a trained teacher or by the local Health Department.

Study the acoustics of different rooms in the building. Make a comparison of sound effects in the classroom, band room, library, and gym.

(Sound is produced by air waves in motion)

Demonstrate the difference in sound waves by use of a pan of water and tuning forks of different pitch.

(Loud sounds can be destructive to the ear)

Use a sound level meter and record normal sounds in working areas.

Go for a walk and listen to natural noises in open area. Record the decibel level.

Supportive information

Essential facts and concepts

Air waves produce sound at different levels.

Nerve endings in the labyrinth of the inner ear conduct the sound waves to the auditory nerve.

Develop an understanding of the following terms

Noise
Schematic
Decibels
Acoustics
Mechanism
Sound level meter
Pitch
Audiometer
Labyrinth
Auditory nerve

Audiologist
Tuning fork

Resources

See resource list
Health Department
Audiologist

Materials needed

Ear Model
Pictures · Schematic diagrams
Tuning fork
Pan
Water
Sound level meter
Audiometer

Implications for other disciplines

Music
Economics
Engineering
Psychology

Evaluation: The students should demonstrate a knowledge of the structure of the ear and the means of hearing.

The students should demonstrate an understanding of the causes of sound.

UNIT: NOISE - MAN MADE LESSON 2:

Objective: To create an awareness of the threshold of tolerance of man made noises.

Concepts to be developed

Sound Waves produced by man may be pleasant and valuable or may damage the hearing mechanism, the ear, beyond repair, resulting in deafness.

Sound Waves - Noise - produced by man cause physical, social, and economic problems.

Noise pollution is now above the tolerance levels in many areas, both in the city and in the country.

Noise is the third pollution and is a sound that is obnoxous. (Berland, Theodore, "Public Affairs Pamphlet," No. 449, p. 3)

There are sounds of such a high pitch that man can't hear them.

Different materials conduct sound waves at different rates of speed.

Attitudes and values

Noise at an unnatural level causes an unhealthful environment, and may have social, emotional, physical or economic effects.

Skills - Observing, Counting, Measuring, Estimating, Ordering, Reading, Graphing, Chart Reading, and Writing.

Activities

(Sound waves produced by man can be valuable or damaging to the ear)

Play a record that is normally pleasant to hear, but turn the volume up to an unpleasant - not dangerous - level. Discuss feelings with the students.

Play the same record a second time and at a low volume. What is the difference in behavior of those listening? What caused behavior change?

Use an audiometer to test hearing immediately following attendance where noise registers high on a sound meter. Examples - Basketball game or rock and roll band session.

Invite an audiologist to speak to the class on Man-Made noise and their effect on the human ear.

Stand near a marching band, especially near the drums. What did you feel and why? Stand near an expressway or interstate highway or railroad track as a train is passing. What did you feel and why?

(Sound waves may be economically damaging)

Find out by visits or by community resources what sonic booms have done to buildings and to human and animal life in the locale.

(Noise pollution can be above the human tolerance level)

Measure the decibel level of a pleasant and unpleasant noise.

(There are sounds man can not hear)

Obtain a dog whistle and experiment with it to show difference in pitch.

(Sounds travel in different mediums)

Use tuning forks to show pitch and blend of sounds that they make.

Use tuning forks to show how sounds travel in different mediums, water, air, wood, etc.

(Sound waves can cause social and emotional problems)

Invite a psychologist to speak on emotional effects of noise.

Supportive information

Man produces air waves that cause deafening sounds.

Noise above 85 decibels is harmful to man.

Noise annoys - It contributes to fatigue, interferes with sleep processes, thought processes and is akin to hunger and chill.

A quiet place and quiet corridors are more conducive to the recovery of a sick person.

Develop an understanding of the following terms

Noise
Schematic
Decibels
Acoustics
Mechanism
Sound level meter
Pitch
Audiometer
Labyrinth
Auditory Nerve
Audiologist
Tuning fork

Resources

Health Department
Audiologist
Community area where noise has caused difficulty

Materials needed

Ear model
Pictures - Schematic diagram
Tuning forks
Sound level meter
Audiometer
Record player and records (radio or T.V. could be substituted)
Dog whistle

Implications for other disciplines

Music
Psychology
Engineering
Economics

Evaluation: The students should be able to accurately read a sound meter.

The students should be able to demonstrate an understanding of the causes of sound.

The students should know the levels of comfort in decibels. (85 decibels or below)

The students should know the levels of danger in decibels. (above 85 decibels)

UNIT: NOISE - MAN AFFECTED LESSON 3:

Objectives: To create an awareness of unwanted and unnecessary noises in the school and community.

To create a positive attitude toward solving the problems of noise pollution.

Concepts to be developed

Noise pollution is a destroyer

Psychological effects
Physical effects
Economic effects (sonic booms)

Noise pollution is everybody's business.

Noise pollution can be controlled.

Attitudes and values

Noise at a natural level provides a more healthful environment.

Skills - Observing, Counting, Measuring, Estimating, Ordering, Reading, Graphing, Chart Reading, and Writing.

Activities

(Noise pollution is a destroyer)

Expose the students to very loud noises. Discuss feelings and behaviors of the group. Discuss ways to prevent the very unpleasant and sometimes painful noises that occur. Use an ear model and diagram to show the effects of noise on the ear mechanism.

(Noise pollution is everybody's business)

Lead a class discussion concerning the development of an attitude of respect toward rights of others when in the classroom, hallways, on the playground, or at home. You may start the discussion by asking if jet planes should be allowed to create sonic booms in the middle of the night which would disturb people's sleep. Then tie this discussion to the individual by using the more personal illustrations.

This activity should follow the preceding activity when it is presented to the students.

Lead the class in discussing unnecessary noise pollution in the school. Should students be allowed to have toys that are noise makers at school? What about bicycle sirens? Should there be school regulations against noise makers? Do you want to suggest some? How about a class project of drawing up school noise pollution regulations and presenting them to the principal?

(Noise pollution can be controlled)

Discuss ways each of us can cope with noise effects personally. Some suggestions are:

Cover the ears with the hands when loud noises occur.

If you must pass through an extremely noisy area, wear specially designed ear muffs. Have you ever noticed the ear muffs worn by people who work outside the terminal at an airport?

Find out ways buildings are designed to obstruct noises. Where is the play area, gym, in your school? Is it separated from the classroom? Where are the cafeteria, music room, or other rooms where noises occur in respect to the classroom?

Are there ways the furniture in the classroom could be rearranged to provide a quieter classroom? Work on designing various classroom layouts that might be quieter.

What can you do at home to cut down on the noise pollution? Are there household appliances that could be quieter? Have you ever been unable to get to sleep at night because of a noise, such as a dripping faucet or a loud ticking clock? Are these then, noise polluters?

Invite a biologist or physician to your class to discuss the effect of noise on the unborn.

Invite a psychologist to your class to discuss the effects of noise on emotions and behavior. A school guidance counselor could serve if a psychologist is unattainable.

Supportive information

Essential facts and concepts

Air waves produce sounds at different levels.

Noise pollution causes poor physical, social, and emotional health and by help of those concerned can be controlled to make a more pleasing and healthful environment.

Develop an understanding of the following terms

Noise
Schematic
Decibels
Acoustics
Mechanism
Sound level meter
Pitch
Audiometer
Labyrinth
Auditory nerve
Audiologist
Tuning fork

Resources

Health Department
Audiologist
Psychologist
Biologist
Physician
Guidance Counselor

Materials needed

Ear model
Schematic diagram of ear
Sound level meter

Implications for other disciplines

Health - physiology
Mathematics
Economics
Engineering
Psychology
Music

Evaluation: Students should be able to list dangers caused to physical, social, and emotional health due to noise pollution.

Students should be able to list ways that they as individuals can help control noise pollution at home and at school.

Students should be able to identify ways that buildings can be constructed to prevent noise pollution.

Students should be able to list toy noise-makers that should be outlawed.

Teacher judgment:

Evaluate behavior as to responsiveness to class work when noise is present and when abated. Record performance scores and compare. Record discipline problems and compare.

UNIT: POPULATION - NATURAL LESSON 1:

Objective: To create an awareness of and positive attitudes toward an understanding of a "natural population."

Concepts to be developed

Populations in the natural environment follow established ecological principals.

Population balance in the natural environment is a function of biological and physical limits (food, water, air, temperature, etc.).

Population increases occur during periods of abundance of desirable resources.

Population decreases occur during periods of lack or decrease of desirable resources.

Attitudes and values

Balanced populations allow for more healthy individuals.

Balanced populations allow for better distribution of resources.

Skills - Observing, Counting, Measuring, Estimating, Ordering, Reading, Graphing, Chart Reading, and Writing.

Activities

Set up an aquarium containing water, sand, aquatic plants and two guppies (one male-one female). Allow the guppies to reproduce and increase the population. Keep a record of the population increase. Does the population reach a maximum and then start to decrease? How do the guppies control their population? What happens to the weaker guppies? Is this an example of the survival of the fittest?

Use fruit flies, drosophila, to study natural populations. Fruit flies may be obtained during the spring or summer by placing an overripe banana outside for several hours. The fruit flies, about 1/8 inch long, will congregate on the banana and will lay their eggs there. Bottles for receiving the fruit flies must be prepared. Half-pint milk bottles make excellent containers for the fruit flies. Secure the appropriate number of milk bottles, each student should have his own, and wash them thoroughly. Boil the bottles for about five minutes to sterilize them. The following culture medium may be used to feed the flies. Dip a piece of a banana into a yeast solution, prepared according to package directions. Place one piece of banana in each of the milk jars.

Place the original banana with fruit flies and eggs on it in a quart jar. Mash a piece of yeast soaked banana in a teaspoon or small plastic spoon. Use this spoon to transfer one male and one female fly from the large container to each student's milk bottle. Cover the containers with milk bottle caps. Observe the container for about two weeks. Does the number of flies increase? How many days does it take for the flies to reach a maximum in your bottle? What causes their death? Is the milk bottle a small ecosystem for fruit flies? Is the earth an ecosystem for people? Can people pollute the earth until it can't sustain life? If the flies did, why can't it happen on earth?

Supportive information

From THE POPULATION BOMB by Dr. Paul R. Ehrlich. Copyright 1968, 1971 by Paul R. Ehrlich. Reprinted by permission of Ballantine Books, Inc.

"Population is far outstripping food production."

"More than half of the world is hungry. Many are dying of starvation."

"Population growth must come to an end."

"Our only choices are a lower birth rate or a bigger death rate."

"Long-term growth rate must be zero."

"It is necessary to plan for a stable population of optimum size."

"Family planning does not lead to population control."

"Change of attitudes is more important than contraceptive technology in population control."

"Need for better contraceptive methods is great, notwithstanding."

"Research in tropical ecology and agriculture is badly needed."

"Farm agriculture base is prerequisite for industrialization."

"Not all countries can be industrialized."

"DC's cannot feed UDC's."

"Environmental deterioration poses colossal threat to man's survival."

"Governmental attention to this entire problem is least significant."

The 1970 U. S. population was 204,000,000.

The U. S. population is increasing at the rate of over 1.0% per year. This is birth rate minus death rate. This means that at least 2,040,000 more people live in the U. S. each year or 5,600 per day.

The world population is about 3.75 billion. If one started counting each person at the rate of 1 per second it would take over 118 years to count them.

The world population is increasing at the rate of slightly over 2% per year. This is 75,000,000 per year or 205,480 per day.

Develop an understanding of the following terms

Industrialized
Contraceptive
Colossal

Materials

Aquarium	Fruit flies
Sand	Yeast
Plants	Banana
One pair guppies	Milk bottles (½ pint)

Implications for other disciplines

Psychology
Geography
Agriculture
Economics

Evaluation

The students should be able to demonstrate an acceptable degree of understanding of the concepts and attitudes of this unit as acquired through the activities they performed.

UNIT: POPULATION - MAN MADE LESSON 2:

Objective: To create an awareness of problems inherent in present population growth trends.

Concepts to be developed

The human population is increasing at such a rate that the entire natural system is threatened.

Increases place pressures on the amount of space available for housing and living conditions.

Increases place excessive pressures on the amount of natural resources (fuels, metals, water) available.

Increases place excessive pressure on the available food supplies.

Increases place pressures on the economic system that cannot be corrected easily.

Attitudes and Values

Population increase with increased density causes social problems that do not exist otherwise. The crime rate increases, health problems increase, and waste disposal becomes a real problem.

Skills - Observing, Counting, Measuring, Estimating, Ordering, Reading, Graphing, Chart Reading, and Writing.

Activities

Experiments discussed in the population-natural activities section will explain many of this section.

(Human population increases place pressures on the amount of space available)

Ask each student to bring in one of any item (preferably small) on the first day, two the second day, four the third day, eight the fourth day, etc. (doubling the number each day). How many does each student have at the end of 5 days? 10 days? Was it possible to continue the entire 3 weeks? How much total space do the items take up at the end of each day?

(The effects of population increase result in less space per person.)
The effects of this can be demonstrated by placing the chairs in the room such that only ½ of the floor space is occupied, denying the remainder of the room to the students' use. On the second day reduce the space even more and remove one or two chairs so that someone has to stand or sit on the floor. Repeat this for several days - halving the floor space occupied by the students. What effects were exhibited with respect to discipline, ability to learn etc? Stimulate discussion of this effect of reduced availability of space per person with respect to food supply, water supply, schools, homes, etc.

One can use toothpicks to illustrate in a personal manner the way population increases. Buy one package of flat toothpicks (to represent males) and one package of round toothpicks (to represent females). Start with one flat toothpick and one round toothpick. This will represent the father and mother of the first generation. Ask the first student in the class how many brothers and sisters they have. This will be the number of children this first generation will have. (Use flat or round toothpicks as necessary on the second row to represent the second generation.) Now provide round or flat toothpicks to represent marriage partners in this second generation.

For each of these marriages ask, in turn, as many children as necessary to state their number of brothers and sisters to represent children in the third generation. Repeat for a fourth generation. How many children are in the fourth generation?

Suppose 5% of all individuals have died. How many total individuals are there who are requiring food, clothing, housing, schools, water, waste disposal facilities, protection by firemen and policemen?

Supportive information

Essential facts and concepts

Each doubling of the population (3.75 billion to 7.50 billion will take approximately 33 years at the current rate of population growth) results in one-half as much surface area per person for the production of their food, housing, clothing, water, and aesthetic enjoyment. Methods used to increase many of these items to meet the needs result in pollution and degradation of the environment. For example, the use of DDT to increase production of food through insect control has resulted in destruction of some kinds of birds, a lessened photosynthetic rate in certain algal species, as well as potential damage to other animals, including man. The land surface area is 56,300,000 square

miles or 36,032,000,000 acres. This means that each of the 3,750,000,000 individuals on the earth has 9.6 acres available for his support. Much of this land surface is ice covered (Antarctica is 5,500,000 square miles) or mountainous or desert which produces little food. Now, if the population continues its current rate of growth, the land available per person will be reduced to 4.8 acres per person in just 33 years and 17 years after that it will be reduced to 2.4 acres. Can we continue this trend?

Kentucky has 40,395 square miles with 3,160,000 people. This allows each person approximately 8.1 acres. In other words, if Kentucky boundaries were sealed and Kentuckians had to rely on their own natural resources, each person would have to depend on his 8.1 acres (minus roads, parking lots, factories, buildings, cemeteries, etc.) to supply his needs.

The following five tables are adopted from Anthony Allison, editor, Population Control and are used with the permission of Penguin Books, Ltd., 7110 Ambassador Road, Baltimore, Maryland.

Essential Facts and Concepts

Estimates of the Pollution of the World by Regions, 1750-1968.

	Population (millions)					
Region	1750	1800	1850	1900	1950	1968
World total	791	978	1,262	1,650	2,517	3,481
Asia (excluding the U.S.S.R.)	498	630	801	925	1,381	1,945
Africa	106	107	111	133	222	332
Europe (excluding the U.S.S.R.)	125	152	208	296	392	457
U.S.S.R.	42	56	76	134	180	238
North America	2	7	26	82	166	223
Latin America	16	24	38	74	163	267
Oceania	2	2	2	6	13	19

Population in the More and Less Developed Regions of the World, 1850-1968.

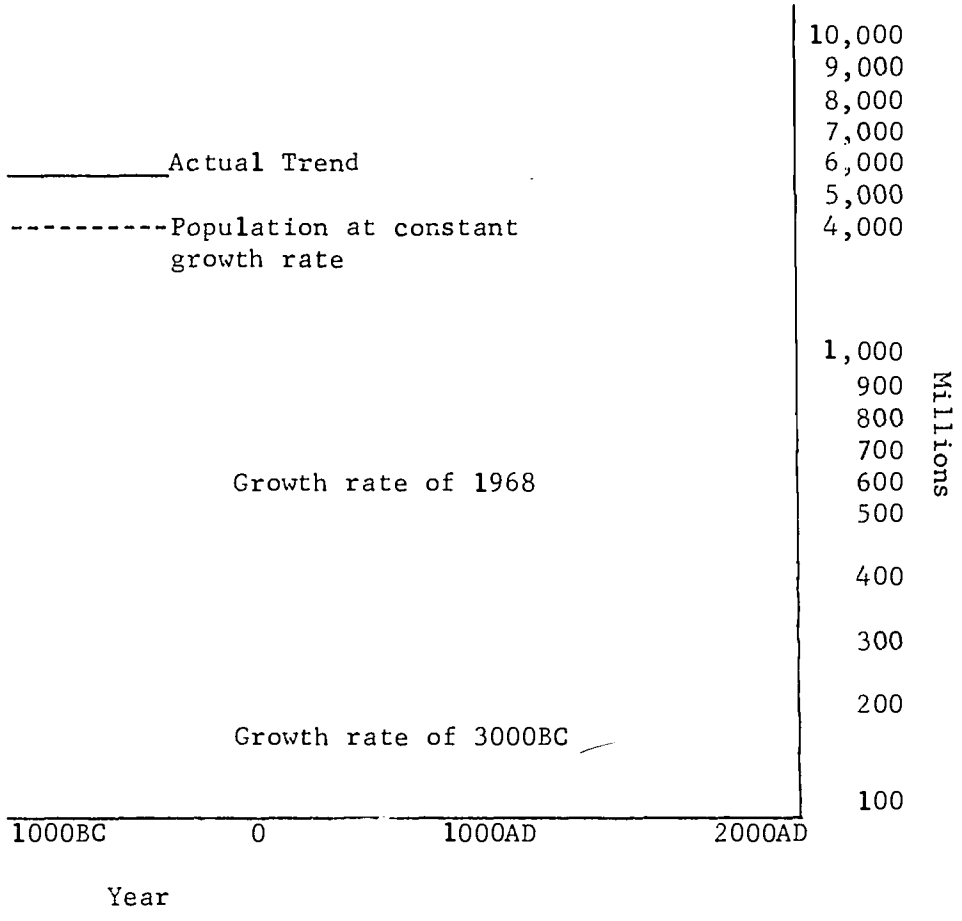
	1850	1900	1950	1968
	Population (millions)			
More developed regions	343	562	834	1,038
Less developed regions	919	1,088	1,683	2,443
	Per cent annual rate increase from preceding date			
More developed regions	-	1.0	0.8	1.2
Less developed regions	-	0.3	0.9	2.1
	Share of world total population (per cent)			
More developed regions	27	34	33	30
Less developed regions	73	66	67	70

The more developed regions are taken to be Europe, the U.S.S.R., North America, Oceania and Japan; the less developed are Asia (excluding Japan), Africa and Latin America.

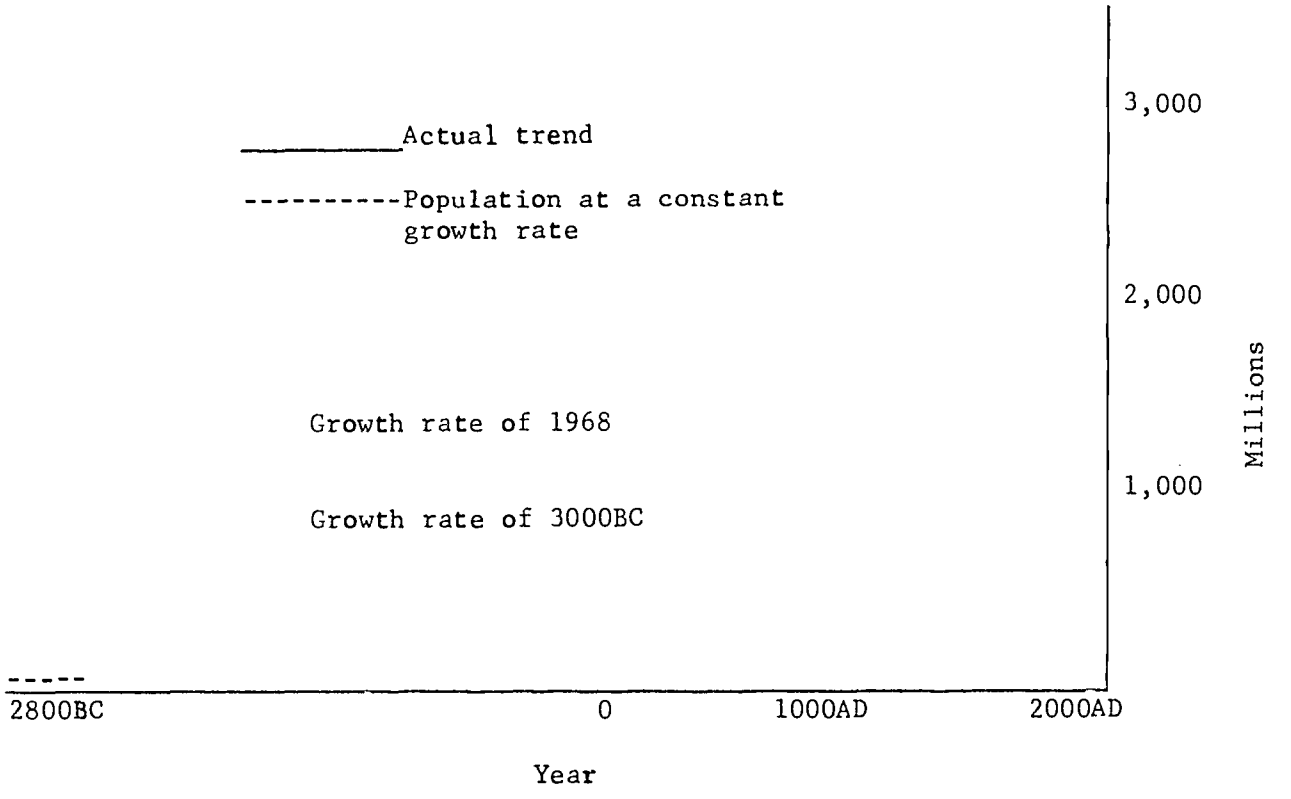
ANNUAL RATES OF INCREASES OF POPULATION

	Annual rate of increases (per cent), 1750-1968				
	1750-1800	1800-1850	1985-1900	1900-1950	1950-1968
World total	0.4	0.5	0.5	0.8	1.8
Asia (excluding the U.S.S.R.)	0.5	0.5	0.3	0.8	1.9
Africa	0.0	0.1	0.4	1.0	2.2
Europe (excluding the U.S.S.R.)	0.4	0.6	0.7	0.6	0.9
U.S.S.R.	0.6	0.6	1.1	0.6	1.5
North America	*	2.7	2.3	1.4	1.6
Latin America	0.8	0.9	1.3	1.6	2.7
Oceania	*	*	*	1.6	2.1

*Doubtful growth rates in relatively small numbers are not shown



Trend in World Population Growth on Logarithmic Scale.



Trend in World Population Growth on Linear Scale.

Develop an understanding of the following terms

Population	Population increase
Population density	Doubling time
Photosynthetic	Species
Aesthetic	Degradation
Conservation	

Resources

Ask a member of Zero Population Growth, the Sierra Club, or similar conservation organizations to speak on the subject of population.

Materials

Toothpicks

Implications for other disciplines

Social Geography	Mathematics
Sociology	History

Evaluation

The students should be able to demonstrate an acceptable degree of understanding of the concepts and attitudes of this unit as acquired through the activities they performed.

UNIT: POPULATION - MAN-AFFECTED LESSON 3:

Objective: To create an awareness of and positive attitude toward population adjustment.

Concepts to be developed

World population increase must be reduced drastically, with world population decrease being the desirable.

World population balance can be achieved.

Attitudes and values

Population balance will allow for greater benefits for each individual.

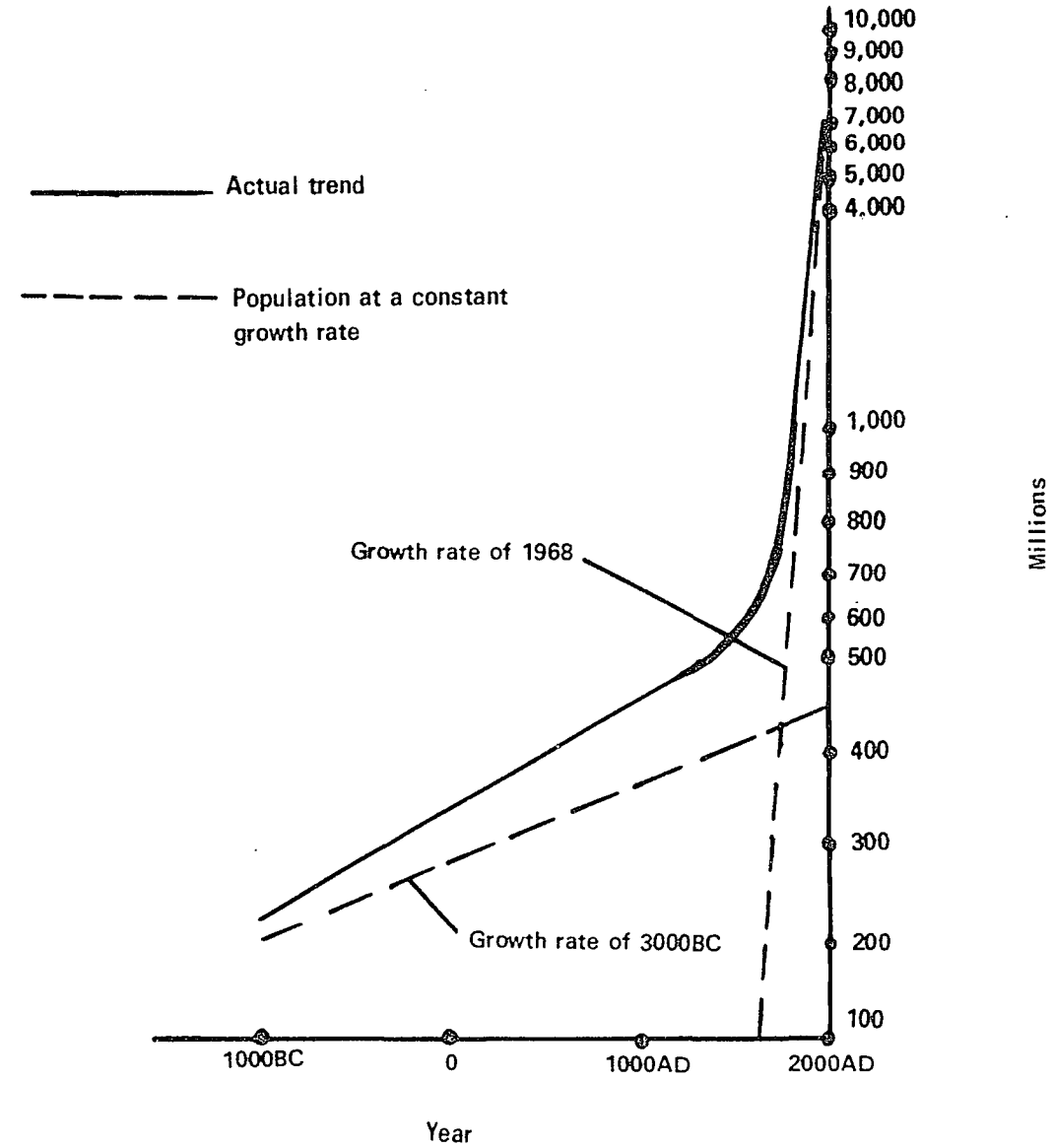
Population balance will enable every level of society to meet more adequately the basic human requirements. Food supplies could be more easily distributed, energy sources could be planned and developed in a more realistic manner, and housing needs could be improved.

Skills - Observing, Counting, Measuring, Estimating, Ordering, Reading, Graphing, Chart Reading, and Writing.

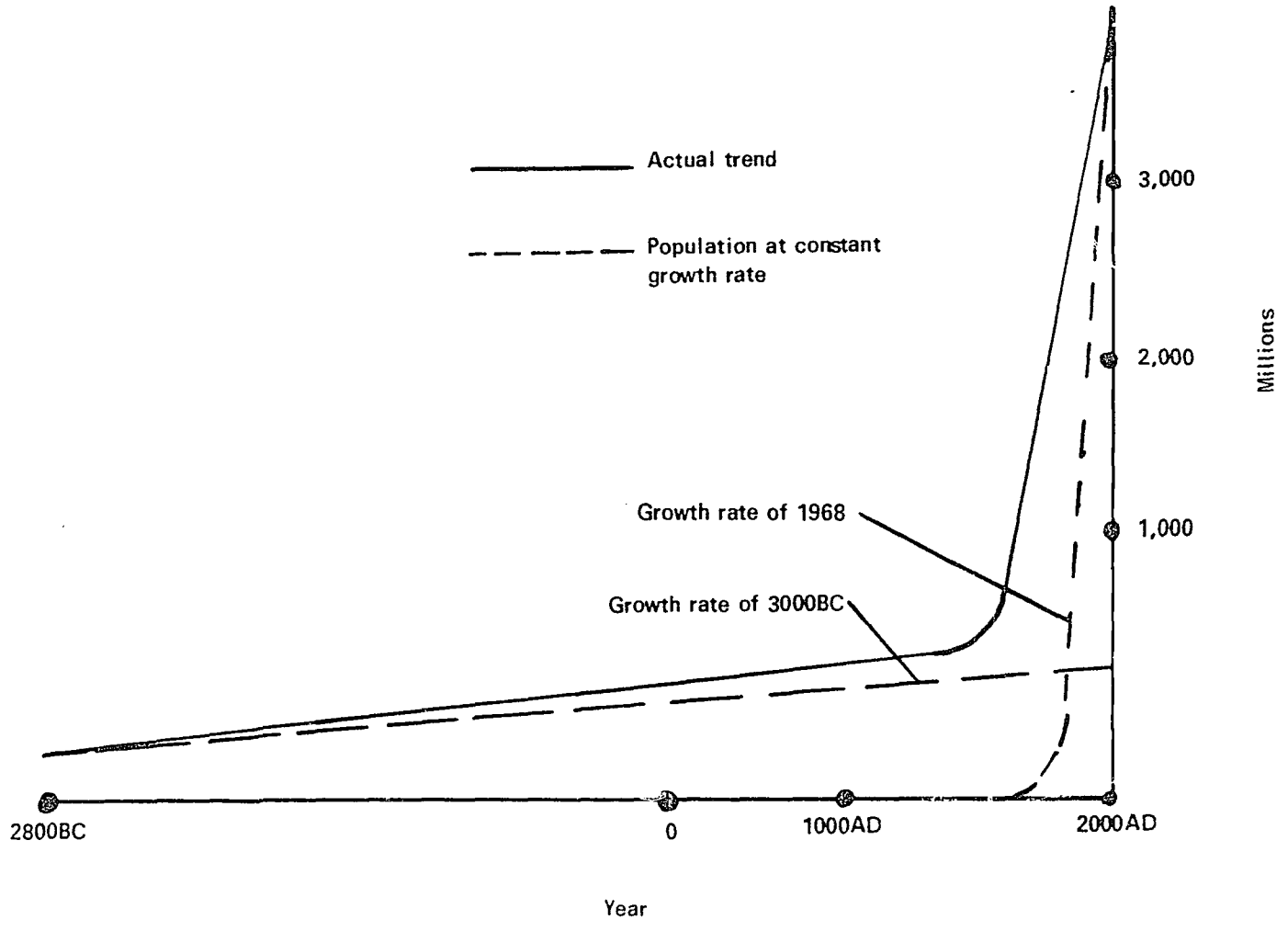
Activities: Repeat the toothpick experiment of "Population - Man-Made", but allow only two children per marriage at each generation level. Compare the results at each generation level with the experiment where children were not limited.

Develop an understanding of the following terms

generation
drastically
dramatization



Trend in World Population Growth on Logarithmic Scale.



Trend in World Population Growth on Linear Scale.

Materials

maps	charts
graphs	toothpicks
miscellaneous materials	provided by children

Implications for other disciplines

Mathematics	Sociology
Geography	Psychology
Economics	Agriculture
Home Economics	

Evaluation

The students should be able to demonstrate an acceptable degree of understanding of the concepts and attitudes of this unit as acquired through the activities they performed.