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Environmental Studies: An Approach to Educate and Preserve Our Planet

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This curriculum unit is designed to make younger students aware of their environment. I teach fifth grade science at Troup Magnet Academy of Sciences where I find that most of my students lack the necessary background in science to begin to understand concepts as the "greenhouse effect" and "acid rain" which are the two main environmental issues that I plan to present to my students. Therefore, within this unit I will give the students an introduction to earth science so that they can grasp the previously mentioned concepts.

Upon the completion of this unit, the students will be aware of the earth's atmosphere, how our planet preserves itself, and some of the current problems that they will have to start confronting in order to provide a safe environment for themselves and their families. Hopefully, they will become advocates of current environmental issues and force their parents and other adults to realize that we all must do our part in helping to save our planet.

The curriculum unit, "Environmental Studies: An Approach to Educate and Save Our Planet", will include the following components:

I. Introduction to Environmental Studies

- (A) The Four Major Layers of the Earth's Atmosphere
  - (1) Troposphere
  - (2) Stratosphere
  - (3) Mesosphere
  - (4) Thermosphere
    - (a) Ionosphere
    - (b) Exosphere
- (B) The Heating of the Earth's Atmosphere
- (C) Examples of Natural Cycles Which Occur on Our Planet
  - (1) The Carbon Cycle
  - (2) The Nitrogen Cycle
  - 3) The Water Cycle

II. The Greenhouse Effect and Its Gases

III. The Acid Rain Controversy

I plan to include as many scientific investigations as possible in my lesson plans so that the students can witness that the environmental problems presented within this unit actually exist, and that they should be concerned about them. Therefore, the focal point of my lesson plans will be geared towards “hands-on” experiences in order to reinforce the objects and concepts which are presented within this curriculum.

Planet Earth is enclosed or surrounded by a mixture of invisible gases called atmosphere. Nitrogen (N) and oxygen (O) alone make up approximately 97 percent of the gaseous mixture of air. Other gases such as argon, carbon dioxide, neon, helium, krypton, hydrogen and xeon make up the remaining one percent. Since these gases make up such a small component of air, they are know as trace gases.

Scientist measure trace gases in units called parts per million or ppm rather than by percentage. For example, neon makes up about .0018 percent of air. But scientists find it much easier to express that number as 18 parts per million, or 18 ppm. This means that in a sample of one million molecules of air, eighteen of the molecules are neon. The chart below will express the percentage that each gas makes up in the composition of air.

GAS	PERCENTAGE IN DRY AIR
Nitrogen	78.08
Oxygen	20.95
Argon	0.93
Carbon Dioxide	0.03
Neon	0.0018
Helium	0.0005
Krypton	0.0001
Hydrogen	0.00005
Xenon	0.000009

The atmosphere is divided into four distinct regions or layers on the basis of its physical properties. The lower atmosphere or the one closest to the earth is called the troposphere and it extends about seven miles upward from the earth’s surface. Above the troposphere lies the stratosphere which extends from seven to twenty-two miles above the surface of the earth. Above the stratosphere lies the mesosphere which rises from twenty-two to fifty miles above the earth’s surface. Above the mesosphere lies the thermosphere. Some scientist prefer to subdivide the thermosphere into two distinct regions the ionosphere and the exosphere.

THE TROPOSPHERE

The troposphere is the layer closest to the earth. This region is probably the best known because the air that we breathe is housed in this layer. Most of the water vapor in the sky is also contained in this area; therefore, most of the clouds in the atmosphere are formed here. Thunderstorms and other types of weather occurs in this layer of the atmosphere.

In addition to the large amounts of water vapor, the troposphere also houses gas and dust particles. As the sunlight passes through the atmosphere, especially the troposphere, it is broken down into spectrum and gives the sky its color. Therefore, white light is broken down into its basic colors- violet, blue, yellow and red. Different particles within the atmosphere scatter different colors. The blue and violet colors of the spectrum are usually scattered more than the yellow and red colors. The sky appears to be blue because the blue and violet rays are reflected into our line of vision. If large particles of dust, smoke, or fog are present, the red and yellow colors scatter just as much as the blue and violet color causing the sky to appear white.

Immediately following a rainstorm usually a natural spectrum of light known as a rainbow may appear in the sky. Rainbows are caused by the separation of sunlight into a range of colors. In this case, rain drops are the means of separation. Bending and reflection of light rays in the falling raindrops separate each separate each ray of white light into a spectrum of colors.

Another characteristic of the troposphere is that its temperature drops as it goes higher. The troposphere's temperature drops about 6.5 degrees Celsius for every kilometer in which one travels from the earth's surface. However, after about 12 kilometers above the earth's surface the temperature seems to stop dropping. The zone at which the temperature starts to remain constant is called the tropopause. It divides the troposphere from the next layer of the atmosphere.

THE STRATOSPHERE

The stratosphere extends from the tropopause to approximately 50 kilometers. The lower part of the stratosphere interacts with the tropopause. In this part, strong winds blow in a circular motion and well defined channels, or layers horizontally around the earth. These winds are know as jet streams. The turbulent winds which blow in a circular motion are formed by friction and the dynamic interaction at the boundary between fast-moving and slow-moving air.

The stratosphere also contains the ozone layer which protects all living things on earth by shielding them from harmful forms of radiation that comes from the sun. Ozone is a pale blue gas that is composed of three oxygen atoms combined together. High concentrations of ozone can be poisonous to all living things. Near the earth's surface ozone can act as a pollutant in the air.

Ozone in the upper layer of the stratosphere is also responsible for the temperature increase in this area because it has the ability to absorb radiant energy. Radiant energy is the energy that moves in waves, such as visible, invisible light and ultraviolet radiation. If the ozone gas did not absorb most of the radiant energy, our skin would burn and we would loose our eyesight or vision. The small amounts of ultraviolet radiation that reach the earth's surface causes sunburn and suntans. Too much ultraviolet energy may cause skin cancer.

The temperatures in the lower part of the stratosphere remain constant, while the temperatures in the upper part increase as one moves away from the earth's surface. The place where the temperature is the highest is called the stratopause. The stratopause separates the stratosphere from the next layer of the atmosphere.

THE MESOSPHERE

In the area above the stratopause, the temperature begins to decrease which identifies the beginning of the mesosphere. The mesosphere extends from about 50 kilometers to about 80 kilometers above the earth's surface. In the upper mesosphere the temperatures drop to nearly -100 degrees Celsius, making it the coldest part of the atmosphere. The small amount of water vapor present in this layer of the atmosphere form thin clouds made of ice. They are sometimes seen as feathery clouds if struck by the sunlight when the sun is setting.

The mesosphere aids in protecting the earth from being struck by large rocklike materials in space called meteoroids. When meteoroids enter the atmosphere, they burn up in the mesosphere. The burning is caused by the friction between the meteoroid and the atmosphere. When this process occurs it can be seen the sky at night as a streak of light flashing across the sky. It is often referred to as a meteor in the sky. The majority of meteoroids usually burn completely, but sometimes a few pieces actually hit the earth's surface. These pieces are called meteorites. When artificial satellites fall from orbit, they also burn up when they reach the earth's atmosphere. However, a few pieces of the United States' Skylab and Russia's Cosmos reached the earth's surface.

THE THERMOSPHERE

The thermosphere begins above the mesosphere at a height of about 80 kilometers. It has no well-defined upper limits like the other layers of the atmosphere. As a matter of fact it can be subdivided into two layers called the ionosphere and exosphere. The word atmosphere means "heat sphere" or "warm layer". The temperature in this area is extremely high reaching over 2,000 degrees Celsius.

(A) The Ionosphere

The lower part of the thermosphere is referred to as the ionosphere. It extends from 80 kilometers to 550 kilometers above the earth's surface. The actual size of the ionosphere depends upon the number of ultraviolet rays and x-rays given off by the sun on a given day.

The ionosphere contains oxygen, nitrogen oxide, and other gas particles which absorb the ultraviolet rays and x-rays from the sun. These particles then become electrically charged and are called ions. Ions are atoms that have either gained or lost electrons, the negatively charged parts of an atom.

The ions located within the ionosphere are important to radio communication. Radio waves bounce off the ions in the ionosphere and return to the earth's surface thus allowing radio messages to be sent over great distances.

(B) The Exosphere

The upper region of the thermosphere is called the ionosphere. The exosphere is thousands of kilometers from the surface of the earth. Air within this region of the atmosphere is so thin that particles can travel great distances without hitting each other. Artificial satellites orbit the earth within this region. Satellites are important to people because they allow us to view events that occur all over the world through television, communicate through telephones and other types of technology, and take pictures of other planets, etc.

THE HEATING OF THE ATMOSPHERE

The sun is the major source of energy for the planet earth. Most of the energy is absorbed by the atmosphere and the solid earth. Solar energy forms by continuous explosive nuclear reactions that occur within the interior of the sun causing great amounts of solar energy to radiate from the sun's surface. The energy generated from the sun then travels through space in the form of electromagnetic radiation. The waves are characterized by their lengths. Thus the air is warmed and radiates energy in the form of very long infrared waves. An equilibrium is established between the solar energy from the sun, the heating of the earth and its atmosphere, and the reradiation back to space of heat energy.

Only infrared waves with wavelengths between seven to thirteen micrometers can easily pass through the atmosphere and out into space. Infrared waves possessing this characteristic are referred to as "windows" because they pass through the earth's atmosphere as if there is nothing in its path. As the atmospheric gases absorbs the infrared energy's waves, it becomes warmer and gives off infrared energy into the atmosphere. Dust within the environment, along with clouds, scatter some light back to space. Even though small amounts of carbon dioxide and water vapor absorb the infrared waves, the majority of the energy is absorbed by vegetation, rocks and water. Carbon dioxide and water vapor in the air absorb the infrared waves. This results in the trapping of heat energy in the low part of the earth's atmosphere. The trapping of heat in the lowest layer of the atmosphere is referred to as the "greenhouse effect".

Now that the students are introduced to the interaction of the four major layers of the atmosphere that surround planet earth, they realize that they do utilize the atmosphere in some manner and the atmosphere itself does interact with. However, I would like to focus mainly on the tropospheric layer because it houses the air we breathe and planet earth which provides us with our means of survival.

Our civilization has made insurmountable gains technologically. However, through our eagerness to invent more, produce more, and gain new height; we fail to reflect -until recently- on how we are affecting our means of survival.

Finally we are realizing the necessity of the need to recycle. Children also should be introduced to the fact that planet earth naturally recycles the elements that we need in order to survive. This can be seen through several of the natural cycles that I will present to you within this section of the paper. I will briefly describe just a few of these cycles including the carbon, nitrogen, and water cycles. We must keep in mind that a cycle has no true beginning or end but it continues to repeat itself over and over again.

THE CARBON CYCLE

Carbon is one of the chemicals which all organisms living on the planet earth need for survival. Carbon is constantly circulating in many different forms through the atmosphere, living things, and the soil. A description of the carbon cycle that occurs naturally on our planet and within the troposphere could begin with the carbon dioxide that is present in air or dissolved in water. Through the process of photosynthesis, carbon dioxide is transformed into the vast number of compounds which combine in various ways to make up the substance of organisms. These organic compounds are passed from producers to the consumers. Whenever the producer or the consumer remove energy from organic compounds, carbon dioxide may be released again, either into the air, or into the water depending upon where the organism lives. However, as long as any unusable energy remains, organic compounds also remain.

Both producers and consumers discard their carbon-bearing wastes and at some point in their life die, leaving their remains on earth in the form of carbon compounds. The saprovores complete the process of releasing the carbon (in the form of carbon dioxide) from such wastes and dead bodies. Most of these final consumers, the saprovores, are microorganisms though some, such as the toadstool, are visible to the naked eye.

The process carried on by the saprovores is extremely slow. Over millions of years large masses or carbon compounds may accumulate in the earth as peat, coal, and petroleum. Some organisms also sidetrack carbon into shells that are deposited as rock. However, the main pathway in the carbon cycle is from the earth’s atmosphere or waters into living things and the process starts all over again.

THE NITROGEN CYCLE

Nitrogen is essential to all living things. Most of the nitrogen that exist on earth is found in the atmosphere as a gas. Although nitrogen gas makes up about 78 percent of the atmosphere, neither plants nor animals can use nitrogen in that form. We inhale nitrogen with every breathe we take, but the unused portion is exhaled. Nitrogen cycles between the living and nonliving parts of the ecosystems.

All consumers get nitrogen-containing compounds in the things they eat and all foods can be traced back to the producer. Producers get their nitrogen-bearing compounds for the soil or water in which they grow. Nitrogen gas is present in the soil, dissolved in water. Living in the soil or in the roots of certain plants are nitrogen-fixing bacteria. They convert nitrogen to a form they or other organisms can use. Nitrogen fixers convert nitrogen gas to ammonia, which can be used to synthesized proteins and other nitrogen-containing compounds.

Decomposers in the soil breaks down the complex organic compounds in dead plant and animal bodies. They use the energy in those compounds and convert them to simpler substances. The main nitrogen containing substance is ammonia. Ammonia is a gas, and some of it escapes into the atmosphere. However, it also dissolves immediately in water. In watered soil, ammonia reacts chemically with hydrogen ions to form ammonia ions which is absorbed by the roots of plants. It is then built into living material again by plants. The nitrogen gas gradually escapes back into the atmosphere, and the cycle of nitrogen is complete.

THE WATER CYCLE

The water cycle is the continuous movement of water from the atmosphere to the earth. The water that moves from the atmosphere to the earth is called precipitation. However, the water return to the atmosphere through evaporation.

During a rain storm, some of the rainwater evaporates as it falls to the ground. But most of the rainwater runs along the surface of the ground and travels to rivers, streams and ponds. The water running along theses surfaces are known as runoff water. Large amounts of precipitation also enter the soil to become ground water. The warm air that rises through the atmosphere contains tiny droplets of water. This water cools as it climbs higher into the atmosphere causing the water vapor to condense into droplets of water which form clouds. The droplets collect to form drops that eventually fall from the clouds as rain. If the water vapor condenses at a temperature below the freezing point of water then snow is formed.

Ground water is also a part of the water cycle. The ground holds and receives water from precipitation. However, some of the water moves downward into subsoil and fills the spaces around the rock particles. In the upper level of the soil, where it is saturated with water, the water will run off the surface instead of penetrating into the soil. The depth of the water table depends on the amount of precipitation, the nature of the rock layer under the soil, the proximity of large bodies of water, and the conditions of the soil receiving water.

Land organisms may pick up water at various points in this cycle. Most commonly, land animals get their water by drinking, and the plants by absorbing it from the soil. In all organisms some water becomes chemically incorporated into living substances, later to reappear when the substances are broken down. Furthermore, all organism contain water in which most of the living processes take place. Thus water is always involved both in the structure and in the activities of living things.

On land, both plants and animals lose water to the atmosphere: in plants, largely from the leaves; in animals through breathing or evaporation from the skin. Still more water is released when animals discharge wastes. Eventually all water taken in by organisms return to the atmosphere.

These are just a few of the cycles that exist within nature. I will now focus on two of the many environmental crises that exist on our planet- the greenhouse effect and acid rain. I will attempt to explain what these concepts are and state the problems that they are creating on our planet. I will also list some of the ways in which we can help in preventing these processes from destroying our planet.

THE GREENHOUSE EFFECT AND ITS GASES

The entire warming effect of the earth's atmosphere is referred to as the greenhouse effect because heat-trapping gases in the atmosphere behave like the glass of a greenhouse. When the greenhouse effect first became a controversial issue, the increased levels of carbon dioxide was the major concern of scientist. However, over the past years scientists start noticed that the levels of the other less abundant greenhouse gases started to increase also. Most of the greenhouse gases form naturally on earth, but there are also man-made substances that we created which absorbs the long-wave radiation. Thus they trap heat near the earth's surface and contribute to the green- house effect. Some of the less abundant greenhouse gases include methane, nitrous oxide, and a group of chemicals called chlorofluorocarbons, or CFCs.

Next to carbon dioxide, methane gas is the second most important greenhouse gas. Even though there is far less methane in the air than carbon dioxide, a methane molecule absorbs twenty times more infrared rediation than one molecule of carbon dioxide. Methane is produced by several natural sources such as cattle, termites, and microorganisms that live in waterlogged soils. The burning of grasslands and rainforests also contributes to the methane in the air because it causes the soil microorganisms to increase their methane-producing activities.

Nitrous oxide is another greenhouse gas that is becoming more abundant in our atmosphere. It is a colorless gas known to most people as laughing gas. Nitrous oxide is released into the atmosphere through automobile exhaust, the burning of fossil fuels, and through farmers spreading nitrogen fertilizer on open fields. As these fertilizers break down into the soil, nitrous oxide is released into the air.

Scientists have analyzed air trapped in ice cores and found that the atmospheric concentration of nitrous oxide was about 0.20 ppm around the year 1900. However eighty years later they found that the atmospheric concentration of nitrous oxide had increased to 3.0 ppm. This may not seem alarming, but nitrous oxide has the potential to stay in the troposphere anywhere from 120 to 175 years before moving into the stratosphere. Therefore, the gas nitrous oxide has the potential to become extremely abundant in our atmosphere since we place an additional five million tons of this gas into our environment each year.

CHLOROFLUOROCARBONS

Chlorofluorocarbons do not occur naturally on earth, therefore they are considered to be synthetic chemicals. There is a large variety of chlorofluorocarbons, but they all are made up of different amounts of chlorine, fluorine, and carbon. When chlorofluorocarbons, also known as CFCs, was discovered in 1930 scientist had no clue that they would eventually become a threat to the environment. CFCs became extremely popular in the industrial setting because they were not flammable, toxic or corrosive, and it most valuable property- it did not easily react with other chemicals.

CFCs are used as a coolant in air conditioners and refrigerators. They are also used to clean computer chips, electronic circuit boards, and even to sterilize medical equipment. Chlorofluorocarbons are used as propellants in spray cans. They play a major role in the production of all plastic foam products.

Chlorofluorocarbons rise very slowly into the atmosphere. They have the ability to stay in the troposphere unchanged for seventy to one hundred fifty years. Once CFCs enter the stratosphere, they collide with the ultraviolet radiation released by the sun. The ultraviolet radiation reacts with the CFCs by breaking apart the molecules of CFCs to form chlorine. The chlorine atoms combines with ozone which aids in its depletion. One chlorine atom can destroy 100,000 molecules of ozone.

CFCs also have the ability to absorb ultraviolet radiation released from the sun. One molecule of CFC-11 has the same heat-trapping ability as ten thousand molecules of carbon dioxide. Since CFCs remain in our environment for such a long period of time, they can be extremely detrimental in the greenhouse effect.

Researchers have become concerned about the increases in chlorofluorocarbons, and the other greenhouse gases previously mentioned because they do not absorb infrared radiation with wavelengths between seven and thirteen micrometers. Thus, additional heat energy is trapped in the troposphere that would normally pass through. Therefore, the trapped heat energy lingers in the atmosphere causing the window to become dirty and trap even more heat into the earth’s atmosphere.

PREVENTIVE MEASURES TO COMBAT THE GREENHOUSE EFFECT

The best alternative presently available to control the greenhouse effect is to drastically reduce the amounts of heat-trapping gases being released and trapped into the atmosphere. Even though this measure will not eliminate the greenhouse gases presently trapped in the atmosphere, it will at least aid in the slowing up process of the amount of gases being trapped each year.

Energy conservation is the best method to reduce the buildup of carbon dioxide in the atmosphere. The average coal-fired plant adds over one million tons of carbon dioxide to the air annually. A car will ass at least its own weight in carbon dioxide to the atmosphere each year. This alone demonstrates that we need to change our attitudes and the way we live in order to aid in saving planet earth.

Some suggestive methods of saving energy could include the following, and I'm sure that you can make additions to the list: (a) use energy-efficient home appliances (b) weatherize and insulate your homes (c) reduce the amount of hot water usage (d) use alternative energy sources such as solar power (e) monitor television, radio and stereo usage (f) carpool and use mass transportation as much as possible (g) use recyclable products, etc. (h) plant trees (i) use nonchlorofluorocarbonated products.

ACID RAIN

As a consequence of burning tremendous amounts of fossil fuels such as coal and oil, the United States discharges nearly 40 millions metric tons of sulfur dioxides and nitrogen oxides into the atmosphere each year. Through a series of complex chemical reactions some of these pollutants are converted into acids, which then fall to the earth's surface as rain or snow. Another portion is deposited directly on surfaces and converted into acid after coming in contact with rain, dew, or fog.

Before discussing acid rain, we must first become acquainted with the pH scale. The pH scale is used to measure the degree of acidity or alkalinity of a solution. The scale ranges from 0 to 14, with the value of 7 representing that a solution is neutral. Values below 7 indicate greater acidity and numbers above 7 indicate greater alkalinity. The pH scale is logarithmic, meaning that each whole number indicates a ten-fold difference. Until recently it was believed that unpolluted rain naturally has a pH of about 5.6. However, studies in uncontaminated remote areas have shown that precipitation usually has a pH closer to 5. Unfortunately, in most areas within several hundred kilometers of large centers of human activity, precipitation has much lower pH values. Rain, or precipitation with these values is termed acid rain.

The best known effect of acid rain is the lowering of pH in thousands of lakes in Scandinavia, Canada, and the northeastern United States. As the pH drops, the organisms that live in or near lakes and streams are affected. Accompanying the lower pH have been a substantial increase in dissolved aluminum, which is leached from the soil by the acidic waters. This increase of dissolved aluminum is toxic to fish and wildlife. As a consequence, some lakes are devoid of fish while others are approaching this condition.

The effects of acid rain on lakes varies from one lake to another. These variations is related to the nature of the soil and rock materials surrounding the lake. Minerals such as calcite in some rocks and soils can neutralize acid solutions which would keep the lakes from becoming acidic. However, over a certain period of time, the pH of lakes that have not yet been acidified may drop as the buffering material in the surrounding rocks and soil become depleted. Lakes that lack the buffering materials such as calcite and limestone are more likely to be or become acidic.

Lakes at high altitudes are particularly sensitive to acid rain. Only about 5 or 10% of the water in a lake comes from precipitation that has directly fallen on lakes; the vast majority of water is from rain that has fallen on the surrounding watershed and run off into the lakes. Meaning that most of the water in a lake has had an opportunity to be neutralized by soil. However, lakes at a higher altitudes are often located in rocky outcropping, and comprise a large fraction of their whole watershed. In some cases the rainwater runs uninterrupted over a few bare rocks, directly into the lake. The problem is multiplied during the winter and spring when a carpet of snow or ice prevents rain and melted water from contacting the ground at all before running into a lake. In this case the lake receives a surge of acidic waters which can kill fish and other aquatic life outright.

There has been recent evidence to show that acid rain may be responsible for the widespread decline in the growth of evergreen forests in the eastern United States and Western Europe during the past decades. Acid rain has caused such severe damage to the forest in Germany that they have taken major action to reduce sulfur dioxide emissions.

Laboratory and field studies have shown that acid deposition can have the following effects on forest: (1) damage leaves, roots and microorganisms that form beneficial symbiotic association with roots; (2) decrease a plant’s resistance to other forms of stress, including climate, insects, and pathogens; (3) leach nutrients such as calcium and magnesium from soils; (4) dissolve metals in the soil such as aluminum at levels potentially toxic to plants; and (5) impair reproduction and the survival of seedlings.

PREVENTIVE MEASURES TO COMBAT ACID RAIN

Acid rain is produced through the massive burning of natural, nonrenewable fossil fuels. The three main sources or activities primarily responsible for this include- driving automobiles, industrial manufacturing and creating electricity. Therefore, if we concentrate on reducing the emission of sulfur dioxide and nitrous oxide half of the battle could be won.

The following actions will result in lowering the emission of deadly chemicals such as sulfur dioxide and nitrous oxide into the air, and in turn reduce acid rain: (a) use energy-efficient appliances (b) purchase products made from recycled materials because they take less energy to make. (c) purchase fuel-efficient cars (d) use compact fluorescent energy efficient light bulbs (e) minimize the use of automobiles by walking, carpooling, bicycling (f) use mass transportation as much as possible.

LESSON PLANS

Have the students complete the following experiments:

SOLAR ENERGY

MATERIALS NEEDED: Two cardboard shoe boxes with lids, scissors, clear plastic wrap transparent tape, two thermometers, compass
PROCEDURES: (1) Use scissors to cut out a rectangular hole in one side of each of the two shoe boxes. Cover the hole in each box with a piece of clear plastic wrap. Use transparent tape to attach the plastic wrap. (2) Place a thermometer inside each box and put the lids on. (3) Take the boxes outdoors on a sunny day. They represent buildings that receive solar energy. Use a compass to find north and south. Place one box so that its "window" faces south. Place the other box so that its "window" faces north. (4) Open the boxes and check the temperature in each box. Record these numbers as the starting temperature in your chart. Now close the boxes. Predict how the temperatures in the two boxes will change during the next forty minutes. (5) Every ten minutes, for the next forty minutes, record in your chart the temperatures inside each box.
RESULTS (1) In which box was the final temperature greater? (2) Make a graph showing how the temperature in each box changed.
THE GREENHOUSE EFFECT
MATERIALS NEEDED: three glass saucers, water, thermometer
PROCEDURES: (1) Take two glass saucers and place them in the sun. (2) Pour the same amount of water straight from the faucet. (3) Measure the temperature of the water, and record the temperature. (4) Cover one of the saucers with another saucer. (5) Measure the temperature every ten minutes in each saucer and record the temperatures. (6) Depict you data on a line graph.
RESULTS: (1) Which saucer had the highest temperature? (2) How does this experiment demonstrate the greenhouse effect?
WHAT DOES NATURE RECYCLE
MATERIALS NEEDED: plastic shoe box, small rock, enough soil to fill the shoebox, scissors, newspaper, a stick about 25 cm long, assorted liter- including plastic bag, polystrene foam, leaves, food scraps, aluminum foil, small piece of glass
PROCEDURES: (1) Place enough soil in the box until it is about one-third full. (2) Cut, crush, tear, of break the litter into small pieces. (3) Scatter the litter over the soil. (4) Cover the litter with soil until the pot is almost full. (5) Sprinkle the soil with water until it is thoroughly dampened but not completely soaked. (6) Place the plastic shoebox in a warm dark place. (7) Check the soil in the box regularly and add water as needed to keep it moist. (8) After about four weeks, empty the contents of the plastic shoebox onto open sheets of newspaper. (9) Use a platic ruler to spread the contents of the litter box over the newspaper. (10) Carefully observe and record the contents of the soil.
RESULTS: (1) Which materials decomposed and which did not? (2) What does nature recycle? (3) Compare your plastic box to a landfill (the students should be allowed to go to the library to find

any necessary information).

THE CARBON-OXYGEN CYCLE

MATERIALS NEEDED: living fresh-water snails, several sprigs of elodea (or other suitable aquatic plant), three test tubes, stoppers to fit the test tubes, test tube rack, glass-marking pencil, pond or aquarium water to put in test tubes

PROCEDURES: (1) Mark three test tubes one, two and three with a glassmarking pencil. (2) Fill each test tube three-quarters full of pond water or aquarium water. (3) Place a snail in tube one and place the stopper in the test tube. (4) Place a snail and two or more sprigs of elodea in test tube marked number two and close with a stopper. (5) Place an equal amount of elodea in the third test tube and close with a stopper. (6) Examime the tubes daily for five consecutive days and record observations.

RESULTS: As you examine the tubes, record your observations on the based on the following criteria: (A) Is the snail alive? If so, is it active, e.g., moving on the side of the tube, feeding on the elodea leaves, etc . . . (B) Does the elodea appear to be growing, or is there evidence that it is unhealthy or dying? (C) What is the condition of the water? Is it clear or cloudy (turbid), indicating decomposition of plant or animal substances? Record the observations you make each day on a chart or table.

TESTING ACIDITY IN LOCAL ENVIRONMENTS

(A) Making An Indicator- to test pH of pond water, soil, and rainwater samples

MATERIALS NEEDED: red cabbage leaves, a heat source, water, 250 ml beaker

PROCEDURES: (1) Boil several red cabbage leaves in water until the mixture turns dark red. (2) Let the mixture cool for about 1 hour or let set for the remainder of the day.

RESULTS: (1) What is the purpose of the indicator?

(B) Determining the pH of Pond Water and Rain Water Samples

MATERIALS NEEDED: jars or beakers, indicator (see above procedure to make indicator), samples of pond water collected from different ponds, samples of rain water collected over a period of time
PROCEDURES: (1) Assign students to collect pond water samples from different places in their community. Also tell students to collect and date rainwater samples whenever it rains. (2) Place 25ml of each sample in a labled beaker. (3) Test the rainwater and pond water samples with your indicator. (4) Record your results on a chart stating the color of the samples after adding two ml of indicator to your samples. (5) Use a ph chart to record the pH of each sample.
RESULTS: (1) What is the pH of your rain water samples? (2) How does the pH of your rainwater compare to that of normal rainwater (pH 5.6)? (3) Give some possible reasons why your think your rainwater is or is not very acidic. (4) What is the pH of your pond water samples? (5) How does the pH of your pond water sample compare to that of a healthy pond? (6) Do you think that the pond water sample is too acidic, why?

(C) Testing the pH of Soil Samples:

MATERIALS NEEDED: funnel, beaker, soil sample, water, heat source
PROCEDURES: (1) Place filter paper in a funnel and fill the funnel with your soil samples. (2) Hold the end of the funnel over a small beaker and pour 100 ml of boiled distilled water through the soil; dirty water will collect in the beaker. (3) Place about 20 ml of indicator into the water sample and stir. Record the color change of the sample on a chart for each sample taken. (4) Determine and record the pH of the collected water from the siol sample.
RESULTS: (1) What is the pH of the soil samples? (2) Consider the data on the pH of the rainwater of your area. In what way, if any, is this rainwater affecting the acidity of your soil?

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