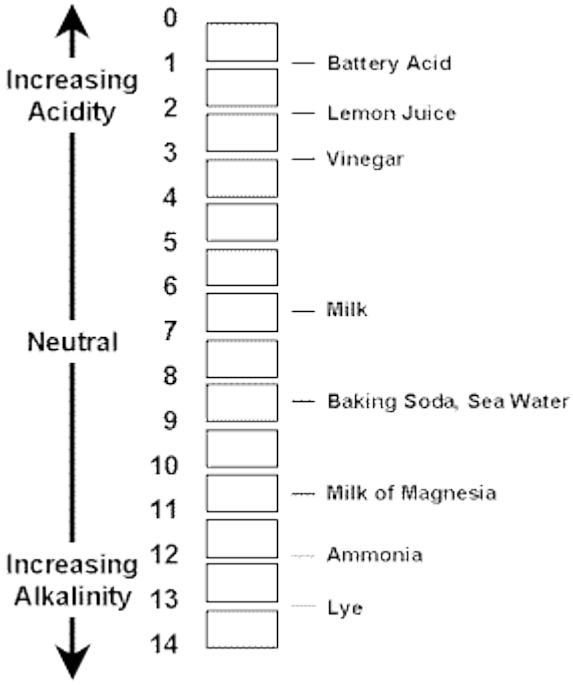
http://www.mothersforcleanair.org/aqinfo/lessons.html

kids' corner pH scale

What does pH mean?

http://www.ec.gc.ca/acidrain/kids.html

This is a measure of how acidic or alkaline a substance is. The initials pH stand for "Potential of Hydrogen." Acids have pH values under 7, and alkalis have pH values over 7. If a substance has a pH value of 7, it is neutral-neither acidic or alkaline.



Because the pH scale is logarithmic, a difference of one pH unit represents a tenfold, or ten times change. For example, the acidity of a sample with a pH of 5 is ten times greater than that of a sample with a pH of 6. A difference of 2 units, from 6 to 4, would mean that the acidity is one hundred times greater, and so on.

How is the pH of a substance measured?

A pH can be measured by dipping a pH paper into solutions such as water or other substances.

What is pH paper?

Also known as litmus paper, this is a special type of paper containing a chemical that will tell you the pH of a substance by the colour it turns when it is dipped into the substance.

Where I can get pH paper?

You can usually find pH paper at any beer or wine making shop. Other possibilities include your local pharmacy or hair salon. You could also ask your science teacher. Be sure to use the wide range pH paper showing pH of 1 to 12.

What is the pH of normal rain?

Normal rain has a pH of about 5.6. It is slightly acidic because naturally present carbon dioxide from the Earth's atmosphere dissolves in the rain drops to form carbonic acid.

acid rain and... water

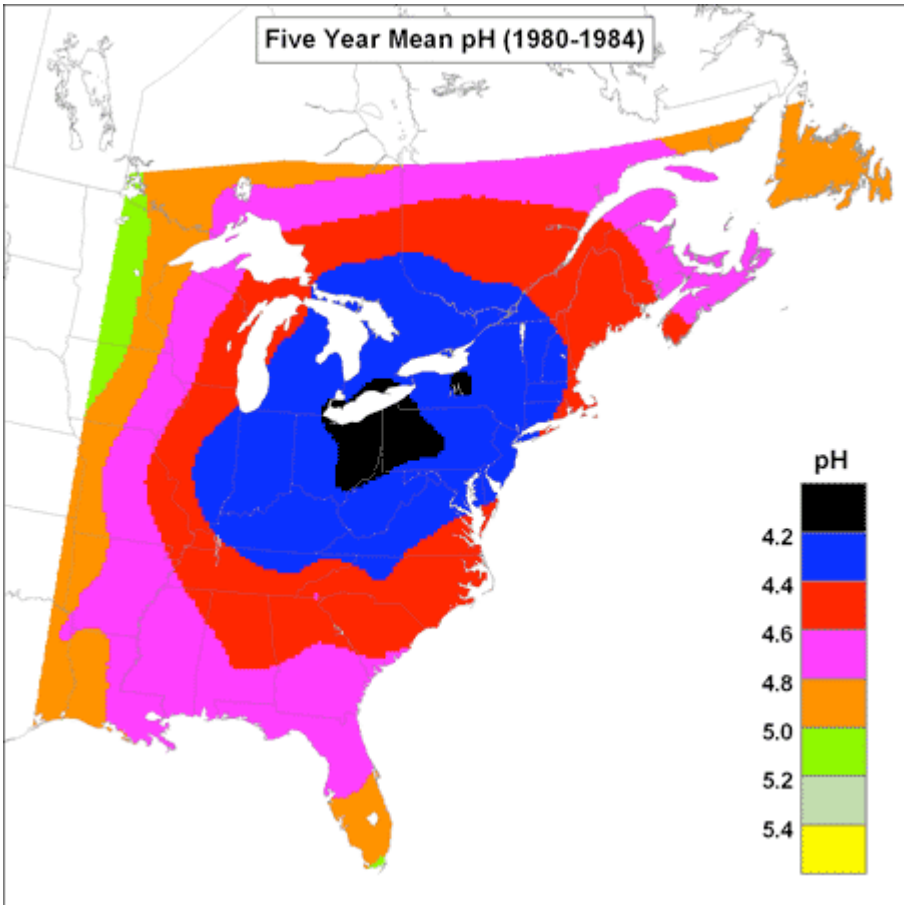
http://www.ec.gc.ca/acidrain/acidwater.html

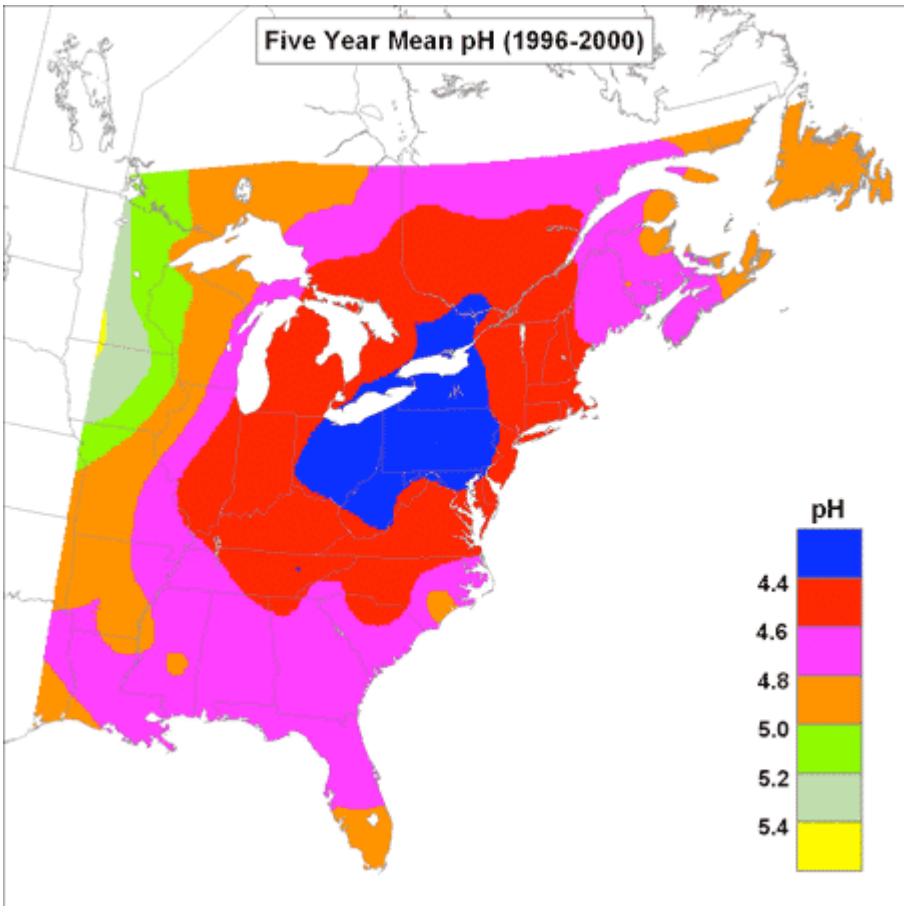
Is rain getting more or less acidic?

One measure of the acidity of acid rain is the pH. The pH of rain depends on two things: the presence of acid-forming substances such as sulphates, and the availability of acid-neutralizing substances such as calcium and magnesium salts. Clean rain has a pH value of about 5.6. By comparison, vinegar has a pH of 3.

Although the acidity of acid rain has declined since 1980, rain is still acidic in eastern Canada. For example, the average pH of rain in Ontario's Muskoka-Haliburton area is about 4.5 - about 40 times more acidic than normal.

Reductions in the acidity of acid rain are due to reductions in emissions of SO_2.


Five Year Mean pH (1980-1984)
pH
4.2
4.4
4.6
4.8
5.0
5.2
5.4


Five Year Mean pH (1996-2000)
pH
4.4
4.6
4.8
5.0
5.2
5.4

How does acid rain affect lakes, rivers and streams?

Lakes that have been acidified cannot support the same variety of life as healthy lakes. As a lake becomes more acidic, crayfish and clam populations are the first to disappear, then various types of fish. Many types of plankton-minute organisms that form the basis of the lake's food chain-are also affected. As fish stocks dwindle, so do populations of loons and other water birds that feed on them. The lakes, however, do not become totally dead. Some life forms actually benefit from the increased acidity. Lake-bottom plants and mosses, for instance, thrive in acid lakes. So do blackfly larvae.

Not all lakes that are exposed to acid rain become acidified. In areas where there is plenty of limestone rock, lakes are better able to neutralize acid. In areas where rock is mostly granite, the lakes cannot neutralize acid. Unfortunately, much of eastern Canada-where most of the acid rain falls-has a lot of granite rock and therefore a very low capacity for neutralizing acids.

What happens to the fish, frogs, birds and bugs that live there?

There are many ways the acidification of lakes, rivers and streams harm fish. Mass fish mortalities occur (during the spring snow melt) when highly acidic pollutants-that have built up in the snow over the winter-begin to drain into common waterways. Such happenings have been well documented for salmon and trout in Norway.

More often, fish gradually disappear from these waterways as their environment slowly becomes intolerable. Some kinds of fish such as smallmouth bass, walleye, brook trout and salmon, are more sensitive to acidity than others and tend to disappear first.

Even those species that appear to be surviving may be suffering from acid stress in a number of different ways. One of the first signs of acid stress is the failure of females to spawn. Sometimes, even if the female is successful in spawning the hatchlings or fry are unable to survive in the highly acidic waters. This explains why some acidic lakes only have older fish in them. A good catch of adult fish in such a lake could mislead an angler into thinking that all is well.

Other effects of acidified lakes on fish include: decreased growth, inability to regulate their own body chemistry, reduced egg deposition, deformities in young fish and increased susceptibility to naturally occurring diseases.

Here are the effects of an acidified ecosystem on the natural environment:

As water pH approaches	Effects
6.0	• crustaceans, insects, and some plankton species begin to disappear.
5.0	• major changes in the makeup of the plankton community occur. • less desirable species of mosses and plankton may begin to invade. • the progressive loss of some fish populations is likely, with the more highly valued species being generally the least tolerant of acidity.
Less than 5.0	• the water is largely devoid of fish. • the bottom is covered with undecayed material. • the nearshore areas may be dominated by mosses. • terrestrial animals, dependent on aquatic ecosystems, are affected. Waterfowl, for example, depend on aquatic organisms for nourishment and nutrients. As these food sources are reduced or eliminated, the quality of habitat declines and the reproductive success of birds is affected.

Are the lakes recovering?

Some acidified lakes are recovering, but many more are not. Of 202 lakes that have been studied since the early 1980s, 33% have reduced levels of acidity while 56% have shown no change and 11% have actually become more acidic. The greatest improvements have been seen in the Sudbury area, where local emissions of acid-causing pollutants have declined by 90% in the last three decades. Here, fish populations have rebounded and fish-eating birds, such as loons, have increased. However, no substantial wildlife recovery has been seen beyond the Sudbury area. The least improvement has been seen in Atlantic Canada, even though lakes in this region were never as highly acidified as those in some parts of Ontario and Quebec. Since 1990, scientists have confirmed that maintaining lake pH at 6.0 or more is the most appropriate criterion for calculating critical loads. This pH level encourages healthy aquatic systems in lakes, rivers and streams.

Air quality experiment

http://www.nps.gov/archive/lacl/kids/air.htm

acid rain

http://www.nps.gov/archive/lacl/kids/acidrain.htm

How Pollution Disrupts Our Natural Environment

http://www.iit.edu/~smile/cb1198.htm

Sheila Mckinnon
11556 South Hale St.
Chicago IL 60643
(773) 239-4178

Sherman Elementary School
1000 W. 52nd Street
Chicago IL 60609
(773) 535-1757

Objective(s):

1. The pupils will be able to design and conduct simple scientific investigations and /or experiments in which observations are made, data are gathered and organized, and reasonable conclusions are drawn.
2. Conduct simple experiments and observations and explain what was discovered.
3. Demonstrate how repeated observations improve confidence in results.
4. Describe conditions that influence change during an investigation.
5. Describe ways that technology is helping to solve the problems of pollution.
6. List 3 causes of air pollution and how it affects plant and animal life.
7. Describe how Global Warming has effected our atmosphere.

Materials Needed:

Experiment No. 1: Each student will participate in the following experiment. (*Note: this can also be a group activity).* The materials needed in this experiment are: 1 pair of plastic gloves, a thermometer, and 3 plastic grocery bags

Experiment No. 2: The following materials are for a group of 3 to 4 students.

2 clear plastic cups, 1 clear glass bowl, 2 thermometers, water, paper and pencil.

Strategy:

Introduction: Three major problems involved in atmospheric depletion are: 1) ozone-destroying gases, 2) acid rain, and 3) deforestation. All of these problems together cause global warming. The problem with global warming will be discussed and analyzed.

General Information:

Our atmosphere is under increasing pressure from greenhouse gases which threaten to change the climate and put holes in the ozone layer. When the atmosphere is healthy it is an efficient system able to adapt to changes. Without this ability life on Earth would be non-existent. The greenhouse gases have massively traumatized the earth's atmosphere. Chloro-fluorocarbons (**CFC)** from our refrigerators and fire extinguishers destroy and damage the ozone layer. The earth is acidified by sulfur and nitrogen oxides from our cars and factories. The life expectancy of our earth as we know it, today, can no longer sustain good quality air as we know it today for our future generations.

Experiment No. 1:

Note: Gloved hand represents the EARTH

The gloved hand wrapped in plastic bags represents the toxins emitted in the atmosphere.

- Students will take the temperature of the room and record its temperature **(this represents the gloved hand).**

- Distribute 3 plastic bags, 1 pair of rubber gloves and 1 thermometer to each student.
- Students are then to put on the rubber gloves
- Students will wrap one hand with the 3 plastic bags, leaving the other hand in the rubber glove.
- Students will slide the thermometer between the glove and the plastic bags and record the temperature in their journals
- Please note : the temperature of the gloved hand will not be recorded

The students will compare their data with one another and discuss their findings.

Experiment No. 2

The students in this experiment will show how the greenhouse effect gives off toxic gasses that are enclosed in our environment heating up the earth's atmosphere. **Note: This activity should be cone on a sunny day, if this is not possible use a lamp.**

- Fill each cup ¾ full of water
- Before you place the bowl over the glass of water record the temperature in the journals
- Put a glass bowl upside down over one of the cups
- (Note: both cups need to be in the sun)
- Leave the cups in the sun for about an hour before temperature is taken
- Observe the glass bowl and note the changes if any. Record data in journal
- Remove the bowl, take the temperature of the container of water, and record
- Take the temperature of the container of water that was not covered, and record
- Compare temperatures to find the difference
- Through discovery student should be able to note the differences in temperatures.

Performance Assessment:

The students will be assessed by the instructor in the following ways:

- Through their journal writing

- By their ability to execute the experiments
- Through discussions, and
- Through their written explanations on the causes and affects of Global Warming.

References:

Knabel, R., Berey, D., and Matthias, G.. ***Observation and Interpretation of Earth Science. Cebco*** Standard Publishing Company, 1972.

Turk, Jonathan and Amos. ***Environmental Science.*** Saunders College Publishing, Chicago, Il., 1978.

Bayer, J., Warick, D., Heimans, J., ***Rescue Mission Planet Earth***. Kingfisher Books, New York, 1994.

Carbon Dioxide and Air Pollution

http://web.archive.org/web/20050305130757/www.tnrcc.state.tx.us/air/monops/lessons/carbdiolesson.html

Purpose

To test for different concentrations of carbon dioxide gas.

Grade Level

4th & 5th grade

Essential Elements

Environmental Essential Elements Across the Curriculum - 75.25 (2) Acquire data through the senses. The student shall be given opportunities to (B) observe properties and patterns of objects, organisms, and events in the environment, and (E) explore the environment.

(3) Classify, order, and sequence data. The student shall be given opportunities to (B) classify matter, forces, energy, organisms, actions, and events from the environment according to similarities and differences.

(4) Communicate data and information in appropriate oral and written form. The student shall be given opportunities to (D) describe changes that occur to objects and organisms in the environment.

Objective

1. Students will observe the effects of carbon dioxide gas.
2. Students will test for the presence of carbon dioxide gas.
3. Students will compare concentrations of carbon dioxide gas.
4. Students will conclude high concentrations of carbon dioxide gas are unhealthy for human beings.

Materials

- matches
- baking soda
- vinegar
- bromothymol blue (BTB)
- straw
- candle
- 2 clear cups or glasses or beakers for each group of students
- round balloons

Background

During the day, the sun's light causes particles in the atmosphere to move more quickly, creating heat due to friction. Due to increased level of carbon dioxide, the trapped heat cannot pass through the atmosphere into space because heat's longer, infrared waves are too large. This causes a rise in the ambient temperature on Earth known as the greenhouse effect. Some scientists fear that the rise in temperature will disrupt weather patterns, causing the polar icecaps to melt and release more water into the ocean. This increase in water level might cause two things to happen (1) the ocean's saline concentration would weaken, threatening marine species, and (2) coastal areas would flood.

The build up of carbon dioxide in the atmosphere is caused by deforestation, which reduces the number of trees available to absorb carbon dioxide, and the burning of fossil fuels in power plants.

Carbon dioxide is produced when vinegar and baking soda are mixed. One can then "pour" the gas (carbon dioxide is heavier than air) over a flame and extinguish it. The gas will replace the oxygen and without oxygen, the flame will go out. BTB is an indicator for carbon dioxide. BTB will change from dark blue to light blue, green to yellow depending on the concentration of carbon dioxide. Students can test for the concentration of carbon dioxide using the gas produced when they exhale and when vinegar and baking soda are mixed.

Procedure

1. Demonstrate how carbon dioxide gas will extinguish a flame. Mix vinegar and baking soda in a beaker. Tilt the gas over a burning candle. (Do not tilt the beaker or bottle so much that the liquid runs out and extinguishes the flame.) Have students explain why the flame went out. Discuss each theory. Repeat the demonstration, explaining each step. (See explanation in background section.) Explain to students that they will create this same gas for an experiment.
2. Pour 50 ml of vinegar in a beaker or narrow-necked bottle. Place 45 grams of baking soda in a balloon.
3. Tip the balloon so the baking soda falls into the vinegar. Observe the inflation of the balloon. Twist the balloon shut so that the gas will not escape.
4. Put a straw into the balloon; a little carbon dioxide might escape.
5. Pour 50 ml of BTB solution into a clear container and place the straw with the balloon into the solution.
6. Allow the carbon dioxide to be released into the BTB solution.
7. Have students observe and infer what has happened. Have students record results in a science journal or data collection sheet.

Possible answers:

- BTB is a test for carbon dioxide
- carbon dioxide was created when the baking soda and vinegar combined
- a record of the color change

Ask students to name the gas that animals exhale. Have students repeat the procedure to test for the concentration of carbon dioxide gas they exhale. Have students predict if the results will be the same or different. Will human exhaled air have a higher concentration of carbon dioxide gas than that created when vinegar and baking soda are mixed. Observe and record results.

Evaluation

Some people think the levels of carbon dioxide in our atmosphere are too high. They are afraid Earth's temperature will rise making it unhealthy for life. The World Resources Institute says electric utility companies, industry, business and homes, and transportation cause carbon dioxide levels to build up in our atmoshpere. Using pictures and words, explain how you could help reduce the levels of carbon dioxide.

Time Allotment

This experiment will take two class periods to complete.

Reference

Adapted from "Heating Up the Planet?" from *Environmental Issues, a Teacher Created Material*

Acknowledgment

Cheryl Hubley-Moore, University of Texas at El Paso TES Course, 1995

The Rubber Band Air Test

Purpose

To discover effects of air pollution.

Grade Level

2nd - 4th grades

Essential Elements

Environmental Essential Elements Across the Curriculum - 75.25 (2) Acquire data through the senses. The student shall be given opportunities to (B) observe properties and patterns of objects, organisms and events in the environment. (4) Communicate data and information in appropriate oral and written form. The student shall be given opportunities to (D) describe changes that occur to objects and organisms in the environment.

Objective

To determine if the air in your community is polluted.

Focus

Show students a variety of pictures showing air pollution. Explain that sometimes air pollution is very easy to see, but sometimes it is very hard to detect.

Materials

4 small rubber bands, 1 wire clothes hanger, magnifying glass

Background

The atmosphere is almost completely made up of invisible gaseous substances. Most major air pollutants are also invisible, although large amounts of them concentrated in areas such as cities can be see as smog. Sometimes we can see smog, but most of the time it's invisible. Carbon dioxide is one of the gases that contributes to the greenhouse effect and is the primary gas that makes up smog. This lesson will help you see that air pollution is all around you even if you can't see it. It will also give you an idea of the effect air pollution has on our earth.

Procedure

1. Discuss causes and effects of air pollution.
2. Bend the hanger so that when you stretch the rubber bands over the hanger, they are tight.
3. Hang the hanger outdoors in a shady place so it's out of the sun and leave it there for two weeks.
4. When two weeks are up, look at the rubber bands. Do they look the way they did before, or are they cracked? Check with the magnifying glass too!
5. Touch the rubber bands. Do they feel the way they did before, or are they hard? If they look and feel the way they did before, then the air is quite clean. If they look cracked and feel hard, then the air is polluted.
6. Leave rubber bands out for a few more weeks.
7. Discuss their observations and inferences.

Enrichment

To discover another type of pollution in the air, coat index cards with vaseline and tape them to surfaces in different areas of the community. Leave the cards up for a week. After taking them down, inspect them with magnifying glasses. What do you see? Which area had the most pollutants in the air? Why do you suppose this is true?

Acknowledgment

Kim Paxton, Stephen F. Austin University Nacogdoches TES Course, 1995
