Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
2000 Volume VI: The Chemistry of Photosynthesis

How Plants Help Us Breathe

Curriculum Unit 00.06.02
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This is an interdisciplinary unit, which includes math, social studies, art and writing activities, as well as science. I will use the unit with my third grade class and link it to our yearlong study of the community.

Ideally the unit should run about four to six weeks depending on the frequency of the lessons and the availability of time. Most units on plants are taught in the spring but, with its use of photosynthesis as a center concept, it could be useful to start a discussion of the process while looking at the changing leaves in the fall.

The unit came from a desire to deal with the requirements of the third grade curriculum in New Haven, as well as, to introduce the far-reaching social implications of the topic of photosynthesis. Plants are one of the main stays in the preschool and elementary classrooms. By dealing with this topic with an emphasis on photosynthesis, I hope students will see a broader implication of how plants influence other life cycles on the earth. The social issues should help to bridge a gap between science and the practical every day life of my students. In the case of photosynthesis, it is important for student to understand that the results of not taking care of the vast plant life that now exists could have devastating effects on their lives. Hopefully, this would help them to see a connection between what we try to do in the classroom and the wider world they live in. Much of the problem is the result of decisions civilization has made. People can and must make a difference if the potential crisis is to be averted. These problems pose great questions and debates within the community and are not easily solved.

I believe the unit can be more meaningful to them because of the basic need it deals with, namely, air quality. Increasingly over the last ten years (and this has been mentioned in countless publications) the cases of asthma and other allergies has risen greatly among school age children. I can attest to that increase among the students I have had the past few years. Many miss significant time from school and have experienced periodic hospitalization because of various respiratory problems. I hope to use the contrast with their own breathing problems and human respiration as a bridge to help them understand the similarity of the process in plants.

Unit Objectives

Students will:

1.Explain how humans breathe.
2.Identify the basic parts of a plant - roots, stem, leaves, and flower.
3.Explain what the basic plant parts do.
4.Compare and contrast the breathing of plants and humans.
5.Explain how plants produce food (photosynthesis).
6.Predict what happens when plants do not have light, water, or air.
7.Predict what would happen if there were not enough plants in the environment.
8.Identify ways to help improve air quality and improve the environment.

Introducing the Unit

Before actually beginning the unit I would like to take a moment to talk about the science journal. It is an excellent way to tie writing into the unit and also makes students sharpen their powers of observation. The structure of the journal that is proposed requires the students to keep track of class demonstrations and experiments using the scientific method as an organizing tool. A few years ago I was introduced to this learning tool when I was part of a language and vocabulary project that the bilingual classes in our school were piloting. Even though our students were English speaking many of the teachers in our school saw the project as one that would benefit our students. Within each science journal entry there is an opportunity for the students to broaden their vocabulary and use new terminology while doing activities they enjoy. The journal not only familiarizes the students with the scientific method but also helps to build a foundation for participation in the citywide science fair. Making this a permanent part of the science curriculum will reap benefits beyond the scope of this unit. Every child is to have a science journal and if they aren't familiar with the scientific method they should be introduced to that as they do the first experiments. All demonstrations and experiments should be entered in their journal during the unit. See Lesson Plan #1 in Appendix for more details.

In beginning the unit, there are two main teaching objectives. First, to get the children interested in the topic, and second, to begin with a familiar or relevant experience from their own lives, which they can relate to. In this unit, the process of human respiration is the starting place. Again, I would begin with a question: What do

all humans and animals need to live? Children will readily mention food and water, and inevitably mention air. At this point the children would be asked to do a simple demonstration.

Breathing is an involuntary activity that we do automatically. What would happen if we try to consciously alter the rate at which we breathe? If we ask the children to breathe very rapidly and deeply they should very quickly feel a bit dizzy and their breathing will slow down. What happens is that we are building up the amount of oxygen in our blood while the amount of carbon dioxide was falling. Soon our brain sends out signals that we have enough oxygen and our breathing automatically slows. If they then do the opposite and try to refrain from breathing no matter how long they are successful they will soon be forced to breathe because the air in their lungs must be released and fresh air brought in.

The first experiment is going to have each child do three main breathing activities: How fast do they breathe when they are inactive? How fast do they breathe after exercising? And, how long can they hold their breathe? (See Appendix A, Experiment #1) 1

Coming from this first activity the children should understand that breathing is important to all human beings and animals. It is so much a part of us that we cannot control it and it is something we must do.

Since we know that we need to breathe just what happens when we breathe? What is the process? The teaching objective here is to have the children understand the breathing process in humans so we can compare it to the process in plants.

Human Respiration

How do our lungs help us breathe?

There are a number of books listed in the bibliography that have excellent illustrations. Teachers might also consider use of a purchased or homemade chart of the process of respiration.

All human beings need air to survive. Actually, we need oxygen contained in the air. While food is also a necessity, we can survive for days without it. Without air, however, we would quickly die. During the process we call respiration we breathe in air into our lungs. When we release or exhale, carbon dioxide and water vapor are released. The oxygen we take in helps to oxidize or “burn food.” Plants are the corner stone of this process. All living things depend upon food synthesized from raw materials in the leaves of green plants. Plants depend on their parts to help produce this food.

Humans and animals breathe through their lungs. As we breathe in air passes through the nasal passages above the mouth where it is warmed and filtered. The air then moves through the voice box or larynx where two tubes are found. One channels food into the stomach and the other called the windpipe goes into the lungs. When we eat or drink a flap of tissue covers the windpipe so we do not swallow food into our lungs. From there the windpipe divides into two tubes called bronchi. At the end of each bronchus tube is one of our two lungs. Within the lungs are a series of progressively smaller branches of tubes. At the end of the tiniest tube is a tiny air sac. These sacs swell like tiny balloons when we breathe air into our lungs. Surrounding these sacs are many capillaries. Oxygen breathed into the sacs pass through the sacs’ thin walls into the capillaries. Carbon dioxide and water vapor in the capillaries pass the opposite way into the air sacs. Children should

remember oxygen in, carbon dioxide out.2

There are a couple of experiments that should be done here. First, we want to show that people do exhale carbon dioxide. It can be simply done by utilizing Experiment # 2 in Appendix A.3 The limewater in the experiment reacts with carbon dioxide and turns milky white and, thereby, shows the presence of carbon dioxide. Experiment #3 in Appendix A4 demonstrates that humans exhale water vapor. Children will breathe on a mirror and the mirror will fog showing the visible water vapor.

The Earth's Atmosphere

What is air and where does it come from?

Many children when talking about the air would simultaneously mention oxygen and air as the same thing. Our next discussion of the air should help to clear this up. At this point we have established that all humans and animals breathe. When we take in air what part or parts are we using and what are we exhaling? Is air the same as oxygen?

An ocean of air surrounds the earth. The air we breathe is a mixture of several different gases. The three most important that are needed for survival are oxygen, nitrogen, and carbon dioxide. We breathe in oxygen that combines with sugars in our body cells and releases heat energy. Students may believe that the air is pure oxygen. While we can breathe pure oxygen for short periods of time, too much pure oxygen is poisonous to our system and we would die.

Oxygen makes up about 21% of the air, and nitrogen 78%. There is really only a small amount of carbon dioxide in the air – about 3/100 of 1%. There are less than 1% of other gases such as argon, krypton, helium, neon, radon, and xenon. All the gases get mixed by the wind and are covering cover the earth in a five to six mile deep layer. Of course this mixture of gases is not all we breathe. There are other substances in the air like pollens, dust, smoke, salt particles, water vapor, chemicals, spores, bacteria and viruses.5

Billions of years ago when the earth was first developing the air around the earth was made up of gases that evaporated from water that seeped out of the soil and escaped from the hot lava that came from beneath the earth's crust. The first atmosphere that the earth had would not have been able to sustain life, as we know it. When the first living organisms appeared in the water there was still no oxygen in the air. When the first plants appeared they changed the air by using up carbon dioxide and giving off oxygen. Over the subsequent years the atmosphere as we know it developed.6

Doing Experiment #47 in Appendix A will demonstrate to the class that air is composed of more than one gas. In this experiment the oxygen combines with the steel wool to make rust. Water comes in to replace the air but the tube will still have air in it. Most of the oxygen has been removed so what is in the air that remains? There must be gases that do not react with the wool. Therefore there is more than oxygen in the air.

Plant Anatomy

At this point, the unit has covered human respiration, air and its components. We have also gone over the basic gas exchange that happens when we breathe. We are now ready to turn to plants. My third grade students would invariably have studied plants in some way perhaps in preschool and/or in previous grades. As we turn the unit in the direction of plants, I would probably begin with a review of the basic parts of a plant and their functions. One way I might do this depending on my timeframe is to take my class to the library media center to research plant parts. In that case, I might give them a copy of a plant drawing and a list of the parts and have them look them up, label the picture, and write the function of the parts. You could also do this with tree parts and then compare and contrast parts of trees and parts of plants. I have not included in my list the parts of a flower but that can also be included depending on what the objectives are. As the unit moves on and we begin to talk about how plants breathe, the children might research the parts of a leaf. As a learning technique, this type of activity will usually result in the children retaining the subject matter longer and with better understanding than if they are given the diagrams already labeled.

What are the basic parts of a plant?

Roots: One of the basic functions of roots is to help anchor the plant into the ground. It is also through the roots that the plant absorbs water from the soil. The roots are also a storage place for food that the plant needs to store for those times when it cannot produce its own food.

Stems: These parts function like arteries carrying water from the roots throughout the plant. Minerals in the water are deposited in the leaves. When water reaches the leaves some of it evaporates into the air.

Leaves: Inside leaf cells are green-pigmented chemicals, chlorophyll. Chlorophyll enables a plant to combine carbon dioxide into a simple sugar. The energy to do this comes from sunlight that is absorbed by the chlorophyll. The process called photosynthesis literally means, “to put together with light.”

From the sugar the plants make starch that they store throughout the plant. With compounds from the soil and soil bacteria, plants can manufacture vitamins and proteins.8

The size of plants leaves is a good indicator of how quickly water will evaporate from it. Broad leaf plants like maple will evaporate water quicker than other smaller leafed plants. Desert plants usually have thick, round leaves which reduce the surface and thereby the evaporation rate. They also have a waxy covering, which inhibits evaporation (see Appendix A, Experiment #5). 9

Photosynthesis

So far we have talked in general terms about the breathing process of animals and humans. Now the aim is to talk about the breathing process in plants. We now want to get more specific about what happens during the breathing process of plants. The teaching point here is for students to see the reciprocity between the two life forms. We will begin with animals and then spend more time on what the exchange of gases is like in plants; this should lead into a direct discussion of photosynthesis.

How do plants breathe?

Essentially the leaves on a plant act much like lungs. Thousands of microscopic openings called stomata are located largely, but not exclusively on the underside of leaves. Each stomata is surrounded by special cells, which regulate the size of the opening. Water in the leaf evaporates into the air (transpiration)(see Appendix A, Experiment #6). 10 The stomata play an important part in a plants' survival. In dry spells and at night the stomata can close and keep the plant from losing moisture. Experiment #711 in Appendix A will allow students to see why the stomata are likened to lungs on a plant. In the procedure, a few leaves on a plant are covered with Vaseline. After leaving the plant for a couple of days, the leaves will begin to wilt and die. Oxygen is not being released and carbon dioxide is not entering the problem so the leaves' system is backing up.

The word photosynthesis means, "putting together with light." Plants do this when they use carbon dioxide, water, and sunlight to produce the food they need to survive (see Appendix A, Experiment #8). 12 Photosynthesis takes place mainly in a plant's leaves. Because leaves are so thin no plant cell is very far from the surface. When the sunlight hits the leaves the leaf absorbs the light. Cells in leaves contain chloroplasts that contain a green pigment called chlorophyll. This material gives leaves their green color. When light is absorbed the electrons in the chlorophyll become so filled with energy that they break out of their molecule. Every chlorophyll molecule that loses an electron is incomplete. The only way it can be complete is to take an electron from a water molecule. When an electron is taken away from a water molecule the molecule splits into hydrogen and oxygen. The oxygen returns back into the air where animals and humans breathe it. The hydrogen is used to make glucose a simple form of sugar. The released electron is used to make ATP (adenosine triphosphate). ATP is used by all living things to store, carry, and transfer energy. It has three phosphorus atoms bonded together. When energy is needed the last bond is broken and ATP becomes ADP. In this process, light energy becomes chemical energy that the cells in the plant can use. Carbon dioxide comes into the plant when the stomata are open. It provides the oxygen and hydrogen atoms needed to make glucose. The glucose is made through a series of reactions that are driven by the energy released from the ATP molecule. When the ATP molecules lose their energy they become ADP (adenosine diphosphate). The ATP can be reenergized if the ADP can pick up more energy and reform its bonds. They return to be reenergized. Glucose is used by the plant to make cellulose and fats. The Glucose that is not used is stored as starch. This is the basic food used by plants. Most important to human beings and other life on earth is that in this process of photosynthesis, plants use less than they produce. That left over is returned to the atmosphere. Therefore the plants and trees around us help to balance the gases in our air by using up carbon dioxide and making oxygen. In the case of plants, the opposite of humans and animals is true - carbon dioxide in, oxygen out.13

Ecosystems

Before we begin talking about the social issues involved with photosynthesis it would be helpful here to explain to students that the earth is considered a closed system. The earth is referred to as a closed eco system because all of the materials we need for life are here. We get no new infusions of material and so the earth must continually recycle these materials so that life can continue. We have already spoken about one of the cycles the carbon dioxide-oxygen cycle. It might be useful to also mention and illustrate two other important cycles.

What is the Nitrogen Cycle?

Nitrogen is also an important element in a living cell. There is nitrogen in the air but plants and humans cannot use it in the gaseous form. Plants get nitrogen when bacteria attach themselves to the roots of plants. The bacteria combine gaseous nitrogen and hydrogen to make a chemical compound called ammonia. Plants absorb the ammonia. Animals eat plants and get the nitrogen they rely on.14

What is the Water Cycle?

Water on the earth's surface continually condenses in the sky and falls again as rain, snow or sleet. Living things need water to carry chemicals to cells and remove waste materials from cells. Plants release water through transpiration, a process in which water vapor is given off through leaves and into the air. Animals release water through exhalation, perspiration, and in waste products. This released water goes into the air and becomes part of the water cycle.15

Saving the Earth

Having now seen how the plant and animal life are tied in this reciprocal relationship it makes us aware of the necessity to take care of the earth for future generations and ourselves. As part of our third grade curriculum on communities, we would be studying the rights and responsibilities of the people and the government in helping to prevent possible problems with the ecology of the earth. This, however, is not an easy thing and students need to see that there are two sides to a problem (sometimes more) and that it may not be as easy as they think to change things. In this area, there are many possible projects but for my third grade class I would like them to research one of a group of air pollution sources and gather information about what it is. There are a number of web sites that provide information and are child friendly. Then they will offer two suggestions as to how the problem could be solved.

After they have done this each student will plan out a poster and title illustrating the problem they have chosen (see Lesson Plan #2).

As an addition to this research they will then compose a letter to a local government official stating the problem they are concerned about and requesting that that person do something about it (see Lesson Plan #3).

How does pollution affect plants? How Can We Help?

While we are still able to breathe, there are many days when the pollution levels make it difficult. Chemicals and gases in the air that should not be present cause air pollution. Three main environmental problems that affect plants include: Acid Rain, Global Warming, and Ozone Depletion.

Acid rain begins as normal rain but when it falls through clouds of pollution the rain changes into a weak acid. Water vapor sometimes mixes with the exhaust from cars, and factory smoke stacks as it moves over the land. This combination of nitric oxide and sulfur dioxide dissolves in the clouds. This acid can sometimes be as strong as vinegar (se Appendix A, Experiment #9). 16 This acid is strong enough to damage trees, dissolve marble, and kill fish in ponds and lakes. Small lakes and ponds can be helped temporarily by the addition of baking soda or limestone. The best cure, however, is to control the pollution that is the cause. Acid rain can measure 2.0 or lower on the pH scale.17

Global Warming or the greenhouse affect is connected to the fact that the earth is a closed ecosystem. The temperatures are kept to a certain level so that plant life can thrive. The earth's temperature is partly the result of the stratosphere that traps gases in the troposphere and stratosphere. Too much heat would make the earth warmer and with hotter temperatures the balance of life would begin to erode. The so-called greenhouse gases – carbon dioxide, water vapor, ozone, methane, nitrous oxide, and chlorofluorocarbons - trap heat that is reflected off the earth's surface. Nature tries to balance itself, but the things that people do upset it. When people burn wood, coal, and oil, more carbon dioxide is released into the air. The carbon dioxide slows down the movement of heat and acts as an insulator. The result is what would happen if the earth were put inside a closed jar (see Appendix A, Experiment #10). 18 The earth gets increasingly warm from the sun but it cannot cool off. Trees are an important solution to the problem since the trees help to remove carbon out of the air. Saving the rain forests from destruction would help. Some scientists speculate that if the earth's atmosphere rises a few degrees it could have a devastating affect on the planet. Plant life would be negatively impacted and the polar ice caps would begin to melt. People often confuse the issue of global warming with that of the ozone depletion but they are two separate occurrences though both are major environmental problems.19

The ozone is a thin layer of gas that is about 12 miles up in the earth's stratosphere. This gas helps to protect the earth by filtering the sunlight that hits the earth. Without that layer higher than normal levels of the sun's ultraviolet radiation would come down and affect the population. These harmful rays mean more skin cancer, cataracts, and lung problems from increased smog levels. Chemicals like the chlorofluorocarbons in refrigerators and air conditioners harm the ozone layer as they rise into the air. Again people can help if they change their buying habits. Don't purchase foam products that can damage the ozone when they are burned or put in landfills. Use recyclable paper or plastic cups instead of Styrofoam that is also toxic. Refrigerators and freezers should be kept in good running order and if possible limit use of air conditioning or use a fan instead. Scientists measure Ozone depletion by using satellites. The layer is getting thinner, and over places like Antarctica it is completely gone. 20

As a culminating activity the class would make a hypermedia presentation about the need to take care of the earth using a student PowerPoint program.

Appendix A - Experiments

Experiment #1 - Test your Breathing

Materials: graphic organizer to keep track of data. The chart should have four columns titled: breaths while sitting, breaths after exercising, holding my breath, and holding my breath after deep breaths. There should be a row for students to enter a prediction of what they think they will do in each of the 4 categories.

Clock, or timer with second hand

Procedure: Working with partner students

1. Students will each have a graphic organizer (chart). After explaining each column, the students will write down their prediction of what they will do.

2. Student keeps time while the other student sits quietly and counts breaths taken in 1 minute. Record on the chart. Partners exchange places.
3. Student keeps time while partner runs in place for 2 minutes. Then partner counts breaths taken in one minute while student keeps time for 1 minute. Record on the chart. Partners exchange places.
4. One student keeps time while partner holds his breath. Records number on the chart.
5. Student immediately takes 6 deep breaths and then holds his breath again. Record the time on the chart. Partner now does steps 3 and 4. Records data.

Experiment #2 - People Exhale Carbon Dioxide

Materials: limewater, glass, drinking straw

Procedure:

1. Fill the glass half-full with limewater and blow bubbles of air into the water through the straw. After a short time the water will turn milky white. This shows that there is carbon dioxide in the bubbles of air blown into the water.

Experiment #3 - People Exhale Water Vapor

Materials: small mirror

Procedure: Breathe on the mirror to show that you are exhaling water vapor. The water will condense on the mirror leaving a moist haze on the glass.

Experiment #4 - There is more than one gas in the air

Materials: two test tubes, two wide mouth jars or beakers, steel wool

Procedure:

1.Make sure that the steel wool has been rinsed off to remove any rust inhibitors. Put the piece of the steel wool at the bottom of the test tube.
2. Fill a jar with water and invert the test tube upside down into the water without letting any water bubbling into it.
3. Fill the other jar and invert the second empty test tube into the water like the first.
4. Let both tubes stand for a few days. As the oxygen combines with the steel wool to make rust, water will enter the tube to take the place of the oxygen. How much of the steel wool test tube

becomes filled with water? What happens in the second tube? What accounts for the differences?

Experiment #5 - Leaf Shape Influences Water Evaporation

Materials: four paper towels, wax paper, paper clips, water

Procedure:

1.Take a sheet of wax paper approximately two to three feet long and put it flat on a table.
2.Dampen the four towel papers so they are wet but not dripping. Lay the first one flat on the wax paper. Fold the second one in half, then in half again, and put on the wax paper. The towel papers should not touch one another. The third one fold and fasten the ends with two paperclips and put it on the wax paper. Finally, take the last sheet and put it on a piece of wax paper the same size and roll up the two sheets (wax paper on the outside) and fasten with a paper clip on each end. Place that also on the larger wax paper.
3.Take the wax paper with the four towel papers on top and put it near a sunny window.
4.Observe the wetness the next day. The flat sheet should be dry, the folded sheet may have a damp spot near the edge, the third paper will have several wet spots, and the last towel paper wrapped in wax paper should be damp all over.

Experiment #6 - Transpiration – Plants Lose Water

Materials: Leafy plant, sandwich bag, tape

Procedure: Put the sandwich bag over one of the leaves and seal the bag securely around the stem. Put the plant in the sunlight for several hours. The bag should become cloudy as water collects and, eventually water droplets should appear on the bag.

Experiment #7 - What happens to a plant if the stomata are blocked?

Materials: petroleum jelly, leafy plant (geraniums work well)

Procedure:

1.Keep the plant in the dark for a few days.
2.Pick two leaves and coat the underside with the petroleum jelly.
3.Place the plant in a sunny window for a week and observe. The leaves will begin to die as time

goes on because there is no way for air to enter.

Experiment #8 - Plants Grow Toward The Light (Phototropism)

Materials: paring knife, large carrot, plate, paper towel, wooden toothpick, thread or string, water

Procedure:

1.Cut off two to three inches of the carrot.
2. Put the carrot on a moist towel and put the plate in the sun.
3. Once shoots begin to grow, cut out the cavity of the carrot and stick a toothpick through the sides.
4. Attach the thread and hang the carrot top upside down in the window.
5.Fill the cavity with water and keep it filled. More shoots will appear and they will all grow up toward the light.

Experiment #9 - Testing for Acids and Acid Rain

Materials: Red cabbage, sauce pan, grater, water, hot plate

Procedure:

1. Finely grate red cabbage until you have two cups.
2. Put cabbage in the pan and fill with water until cabbage is covered.
3. Simmer the cabbage for about 15 minutes.
4. Let it cool, and then strain and save the liquid.
You now have an acid tester. You can use it to test different things. Take a small amount of the liquid and add a teaspoon of vinegar. It should change to pink for acids. If you do the same test with baking soda the mixture will turn green for alkaline or bases. To try it on rainwater put out a clean jar when it rains. Do a test.

Experiment #10 - The Greenhouse Effect

Materials: two trays to hold soil, flower seeds, water, plastic food wrap, two thermometers, large rubber band, and ice cream sticks, or wooden skewers

Procedure:

1. Fill the seed trays with soil, and plant a few flower seeds. Make sure the soil is moist.
2. Put a thermometer in each tray.
3. Cover one tray with plastic wrap and secure it with a rubber band.
4. Expose both trays to full sunlight but not rain.
5. As the seed lings begin to grow use the ice cream sticks or skewers to keep the plants from touching the plastic. Keep track of the temperature. You should find that the closed environment is warmer than the other tray.

Appendix B – Lesson Plans

#1 Science Journals

Objective: Students will record information as they do the experiments. They will write in their own words what they did during the experiment and what they learned. The teacher will use the scientific method: problem, hypothesis, experiment, data, analysis, results, and application, as an organizing tool for each entry.

Materials: notebook, pencils, crayons, colored pencils.

Procedure: Students will keep a dated record of each experiment and /or teacher demonstration.

1. Before every experiment or demonstration students will be given a graphic organizer to help them gather data from the experiment.
2. The teacher will list the purpose of the experiment and the materials to be used.
3. Students will put down their prediction (hypothesis).
4. After each experiment the teacher will gather classroom data and create a chart of the results.
5. Students will offer their observations and try to come to a consensus about the results.
6. After the experiment is completed students will take out their notebooks and record purpose, hypothesis, materials used, procedure followed in doing the experiment, data collected, results, and draw an illustration to go along with what they did.

#2 Art – Poster

Objective: Students will imagine that they are science reporters who must create a poster that informs the citizens of New Haven abut how they can improve the quality of air in the community.

Material: tag board, pencils, markers, crayons

Procedure:

1. Select one idea from the problems we have identified in our study: greenhouse affect, acid rain, smog, community gardens, etc.
2. Select a title or slogan for your poster.
3. Have your idea checked by the teacher for spelling and appropriateness before you begin.
4. Make poster.

#3 Language Arts/ Social Studies

Objective: Students will write a letter to a public official identifying an environmental problem they have identified in their research on air quality.

Materials: paper, list of officials and addresses, pencils, envelops

Procedure:

1. Students choose one problem they have identified that affects plant life.
2. Using the correct letter form includes: heading, greeting, body, and closing; write the first draft of a persuasive letter asking the official to help.
3. Check with teacher before going on.
4. Revise and rewrite final draft.
5. Word-process your letter.

Notes

1. Dr. Alvin, Virginia, and Robert Silverstein, The Respiratory System, (New York: Henry Holt & Co., 1994) 41

2. Peter C. Gega, Science in Elementary Education, (New York: Macmillan Pub., 1986) 434 – 435

3. Thomas Kardos, 75 Easy life Science Demonstration, (Portland, Maine: J. Weston Walch, Pub., 1996) 6

4. Kardos, 15

5. Gega, 510

6. Paul R. Ehrlich, The Machinery of Nature, (New York: Simon and Schuster, 1986) 24

7. William J. Jacobson and Abby Farry Bergman, Science for Children, (Englewood Cliffs, New Jersey: Prentice Hall, Inc. 1987) 307

8. Ehrlich, 36-38

9. Kardos, 16

10. Kardos, 12

11. Kardos, 11

12. Kardos, 4

13. Donald M. Silver, Life On Earth: Biology Today, (New York, Random House, 1983) 13-15

14. Gega, 402

15. Gega, 402

16. Gega, 402

17. Gega, 507

18. Kardos, 20

19. Suzuki, David, Looking at the Environment, (New York: John Wiley and Sons, 1991) 30-31

20. Suzuki, 33

Teacher's Bibliography

Gega, Peter C., Science In Elementary Education. New York: Macmillan Publishing, 1986.

This book offers ideas about teaching science as well as some activities and background information in a number of areas of science.

Hall, David and Rao, Krishna, Photosynthesis. Cambridge: Cambridge University Press, 1999.

This is a clear, concise, and illustrated account of photosynthesis. This was one of the textbooks used in the Yale Institute Seminar on Photosynthesis.

Harlow, Rosie, and Morgan, Gareth, 175 Amazing Nature Experiments. New York: Random House, 1991.

This is a collection of hands-on nature experiments, activities, and crafts.

Jacobson, Williard J. and Bergman, Abby Barry, Science for Children: A Book For Teachers. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1987.

A book filled with ideas about different areas of science with investigative Philosophy.

Kardos, Thomas, 75 Easy Life Science Demonstrations. Portland, Maine: Walch Publishing, 1996.

This book offers demonstrations and experiments in a number of areas including plants. Many of the experiments in the unit were adapted from this book.

Levenson, Elaine, Teaching Children About Science: Ideas and Activities Every Teacher Can Use. Portland, Maine: Walch Publishers, 1996.

This book deals with how to teach science and gives activities.

Mattson, Matt, Scholastic Environmental Atlas of the United States. New York: Scholastic Inc., 1993.

This atlas includes bibliographical references, glossary, and index.

Silver, Donald M., Life On Earth: Biology Today. New York: Random House, 1983.

A basic explanation of how plants and animals function and relate to each other.

Suzuki, David, Looking at the Environment. New York: John Wiley & Sons, Inc. 1992.

Facts and activities centered on the environment for children and adults to do.

Suzuki, David, Looking at Plants. New York: John Wiley & Sons, Inc. 1991.

Facts and activities centered on plants for children and adults to do.

Walker, David, Energy, Plants, and Man. East Sussex: Oxygraphics Limited, 1992.

This book was the main text in the seminar from which this unit was developed. It explains the process of photosynthesis, and the inter-relationships between energy, plants, humans, and the environment.

Children's Bibliography

Johnson, Sylvia A., How Leaves Change. Minneapolis: Lerner Publication Co., 1986.

Describes the structure and purpose of leaves, the ways in which they change as part of the natural cycle of the seasons, and the process that creates their autumn colors.

Kalman, Bobbie, The Air I Breathe. New York: Crabtree Publishing Company, 1993.

This book explores the importance of air to all living things, how weather is made, and how air pollution threatens the earth.

Lauber, Patricia, Be a Friend to Trees. New York: Harper Collins, 1994.

This book discusses the importance of trees as a source of food, oxygen, and other essential things.

Maestro, Betsy, Why Do Leaves Change Color? New York: Harper Collins Publishers, Inc., 1994.

Explains how leaves change their colors in autumn and then separate from the tree as the tree prepares for winter.

Parker, Steven, Look At Your Body: Lungs. Brookfield, Connecticut, 1996.

This book presents a look at the respiratory system done with great drawings.

Royston, Anyla, Plants and Us. Des Plains, Illinois: Heinemann Library, 1999.

Surveys the many uses of plants, including food, drink, spices, and herbs, creams, and perfumes, medicine, wood and paper, clothes, and decoration for gardens and parks.

Silverstein, Dr. Alvin, Virginia, and Robert, The Respiratory System. New York: Twenty-First Century Books, 1994.

This book explains the respiratory system. It has many diagrams, pictures, and a comprehensive glossary.

Suess, Dr., The Lorax. New York: Random House, 1971.

Story with ecological warning about what will happen if we do not heed the warnings to take care of the earth.

Zion, Gene, The Plant Sitter.

This book is out of print but if you can find a copy in your local or school library it is a good story to begin a plant unit.

Videos and Web Sites

Schlessinger Science Library, Plant Life for Children, grades K-4 5-volume set. Second volume deals with plant and animal interdependency (photosynthesis). Check the web: libraryvideo.com Arizona State University Photosynthesis Center home page:

HYPERLINK "http://photoscience.la.asu.edu/photosyn/study.html"

http://photoscience.la.asu.edu/photosyn/study.html

Introduction to photosynthesis – MIT website

HYPERLINK "http://esg.www.mit.edu.8001/esgbio/ps/intro.html"

http://esg.www.mit.edu.8001/esgbio/ps/intro.html

Kid friendly links from the EPA

HYPERLINK "http://www.epa.gov/glob.warming/links/kids_links.html"

http://www.epa.gov/glob.warming/links/kids_links.html