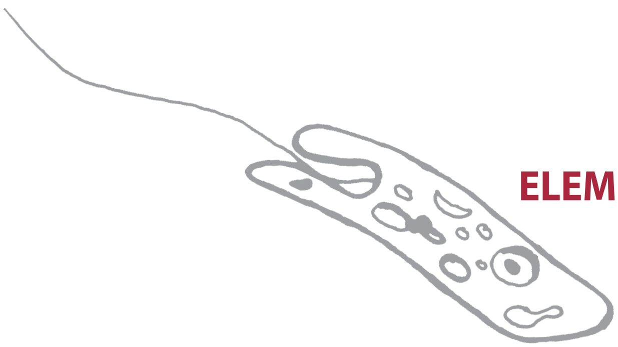
ECOLOGY ACTIVITIES



Section 1
ELEMENTS OF ECOSYSTEMS

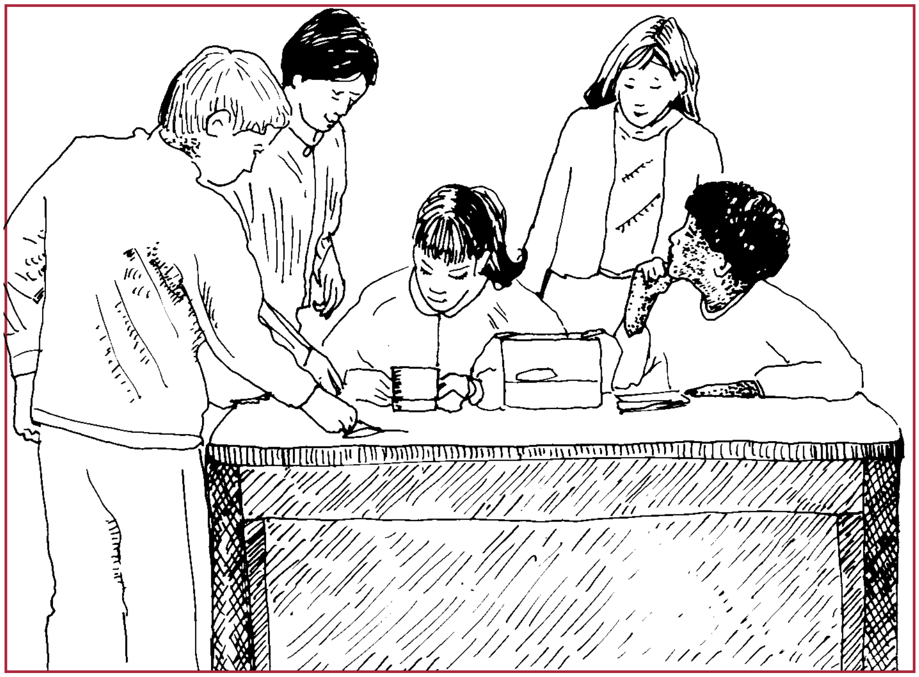
Section 2
ECOSYSTEMS – COMMUNITY CONNECTIONS

Section 3
LIVING THINGS IN THEIR HABITATS

Section 4
HUMAN IMPACTS ON ECOSYSTEMS

It's Alive! Or is It?

1 EXTENSION



Section 1
ECOLOGY ACTIVITIES

Grade Level: 3 - 12

State Standards: S B-1, S B-2, S B-5, S B-6
NGSS: MS-LS1-1

Subject: Science, language arts

Skills: Observing, classifying, note-taking, predicting

Duration: One or two 50-minute periods over one week

Group Size: 2-3

Setting: Indoors

Vocabulary: Ecosystem, living, microscopic, mold, nonliving, organism, spores, yeast

Objectives:

1. Given a variety of living and nonliving objects, students will be able to identify some of the differences between living and nonliving things.

2. Students will work in groups to describe and perform some experiments to determine whether an object is living or nonliving.

Teaching Strategy:

Students examine and classify a variety of living and nonliving things and then test their conclusions.

Complementary Activities:

"Five Kingdoms But No King," "Investigating Heat Energy," "Investigating Soil," "Investigating Water," "Investigating Air," *and* "Take a Deep Breath" *in this section. All the* "Investigating ..." activities *in Section 3, Living Things in Their Habitats.*

Materials:

A jar of water, a jar of air, soil, a rock, a ray of sunlight *(if possible),* a wind-up toy, a group of rocks *(two large and several small),* sugar crystals *(a jar of water with sugar dissolved in it and a string – allow to set for a day prior to class).* Photocopies of data sheet – one per group per station *(following),* microscopes, slides and covers, hand lenses, or bug boxes.

A small bird or mammal, several different live insects and/or other invertebrates *(such as flat worms, shellfish),* microscopic organisms, yeast, bread mold, spores from a fern or mushroom, and various kinds of plant seeds. Try to include at least some small living things that are unfamiliar to your students. Number the objects.

Background:

See INSIGHTS, *Section 1, Elements of Ecosystems.*

Procedure:

IN ADVANCE: at least one day earlier, dissolve sugar in hot water and hang a string into the water so that crystals will form. Number the objects to be identified and label them or their containers with any specific rules *(e.g. "Do not open" or "Handle Gently").*

BEFORE CLASS: place the selected materials at numbered stations around the room.

1. *IN CLASS,* discuss the differences between living and nonliving things. *All living things are able to move, to reproduce in some way, to change, and to respond to stimuli from their outside environment.* Use examples of things commonly found in the classroom as a basis for discussion.

2. On the chalkboard, create a class list of the traits of living things.

3. Explain that students are scientists from another planet, and that the items placed around the room were found on Planet Earth by their expedition. As scientists, they must create and use tests to determine which of the objects are living and which are nonliving.

4. Discuss a few questions that might be asked in these tests to start the students thinking. *Does the object die without sun, water, or oxygen? Does it move? What happens when you poke it?* The students may conclude that further tests are needed, but they must describe these further tests.

5. Divide into groups. Each group determines the tests that it will use to decide whether an object is alive.

6. Groups then visit each station, performing their tests on each object and recording the results. Tasks can be divided so that all students are involved in testing and recording data during the experiments.

(Teachers may want to model how to take data and summarize findings into conclusions before sending groups out to the stations.)

7. Before leaving each station, students should summarize their conclusions regarding which objects are living and which are not, based on the tests performed by their group. Before students switch stations, give them five minutes to write their summaries. Remind the scientists that before they return to the spaceship, all data must in writing!

8. After students have visited all stations, tally the class findings for each item on the blackboard.

9. Ask students to explain why their group classified the item as living or nonliving. What tests did they conduct and what were the results? What other tests might they conduct to better determine the classification of items? *Prompt students to think of observing the questionable objects over time to see if they grow, change or reproduce.*

10. Keep the stations in question in place for several days or a week, so students can compare the items over time. You may want to grow the seeds and the spores to prove they are alive, but explain they need to be placed in the proper environment to grow.

11. Ask whether further observations change any opinions about the classification of the various items. In the end, reveal the actual classification of the items, and discuss any discrepancies between the students' conclusions and the facts.

Evaluation:

1. Students name living and nonliving things in their report as space scientists and tell what tests they used as the basis for their conclusions.

2. Give students a set of new, ambiguous objects. Have them tell or write how they would test the objects to see if they are living or nonliving.

3. Students write their own definitions of the terms "living" and "nonliving."

EXTENSION:

Living and nonliving charades. Review the differences between living and nonliving things *(the ability to move, respond to environment, grow, and reproduce)* with the class. Place drawings, photos, or names of various living and nonliving things in a jar. Divide the class into groups and have each group choose an item from the jar. Allow the group time to decide how to pantomime their item. Groups take turns performing.

Each group in the audience has one chance to determine if the item is a living or nonliving thing. Each group should either write down its answer or tell it to the teacher. Each group that answers living or nonliving correctly, gets one point. The actors receive one point for each group that answered correctly, indicating that they were good actors.

You may choose to award bonus points to both the actors and answering groups if any can identify the pantomimed item more specifically *(i.e., animal, plant, fungi, microscopic organism, seaweed, or other categories)*. Play one or more rounds. The group with the most points wins.

Curriculum Connections:
(See appendix for full citations)

Books:
Ecology (Pollock)

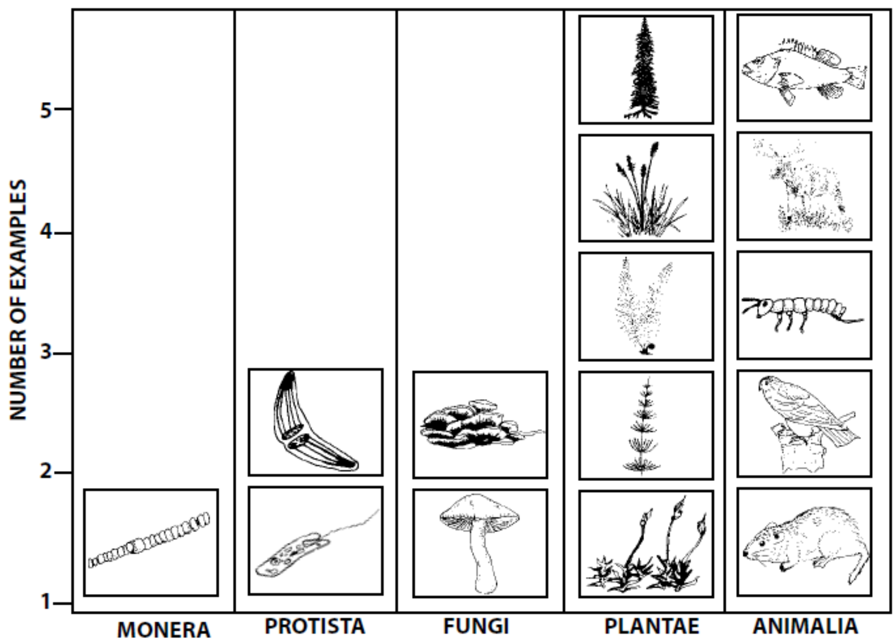
DK Science Encyclopedia (also on CD)

How Nature Works (Burnie)

Teacher Resources:
(See appendix)

Five Kingdoms But No King

ALERT: ALASKA ECOLOGY CARDS OPTIONAL



Section 1
ECOLOGY ACTIVITIES

Grade Levels: 1 - 6

Subjects: Science, language arts, art

NGSS: 3-LS1-1, MS-LS4-2

Skills: Classifying, applying, drawing, listening, sorting

Duration: Two 30-minute periods

Group Size: Any

Setting: Indoors

Vocabulary: Algae, Animalia, bacteria, detritivores, eukaryotic, Fungi, living things, kingdoms, Monera, nonliving things, Plantae, prokarotic, Protista

Objectives:

1. Students will name the five kingdoms of living things.

2. Students will be able to identify an example from each kingdom.

Teaching Strategy:

Students become more familiar with living and nonliving things in an ecosystem and with the five kingdoms by classifying sets of pictures.

Complementary Activities:

"It's Alive, Isn't It?" *in this section. And all* "Investigating...." *living things in their habitats* activities *in Section 3.*

Materials:

"Five Living Kingdoms" fact sheets *(from* INSIGHTS *Section 1). Alaska Ecology Cards* or magazines and/or books *(that can be cut)* with pictures of nature or wildlife. Index cards (3x5 or 5x7) at least five per student, glue, crayons or markers, and something to represent each of the five kingdoms *(pond water for protists, mushrooms and lichens for fungi, microscope slides of bacteria for monerans).*

Background:

See INSIGHTS, *Section 1, Elements of Ecosystems.*

Procedure:

1. Review definitions for the terms **living** and **nonliving**. Brainstorm with students a list of living and nonliving things. Introduce the Five Kingdoms of Living Things and discuss the differences between each. Ask students to think of representatives of each kingdom.

VARIATION FOR YOUNGER STUDENTS

For younger students, teachers may want to focus on the plant and animal kingdoms, or on the concepts of "living" and "nonliving."

2. *This step may be done in class, as homework, or as preparation by the teacher:* Ask students to go through the resource materials and make a collection of pictures of living things from the five kingdoms and some nonliving things. Encourage students to look for microscopic living things as well as large, easily recognizable things.

3. Students draw or paste their pictures on separate index cards. Each student makes five cards, one image per card.

If appropriate, students write the name of the pictured item on the card. Collect the cards.

3. Divide the class into teams or have students play individually. Shuffle all the cards together.

4. Pass 5-10 cards to each team, leaving a small class pile in the center. Explain that the object of the game is for each team to get rid of all its cards by correctly classifying the item pictured.

5. Depending on grade level and experience, the cards can be classified as living or nonliving, or by kingdoms. The teacher calls out a category, living or nonliving (or plants, animals, fungi, etc.).

6. If a team has a card that fits the category, the students should hold it up. If their classification is correct, they discard the card to the central pile. If their classification is wrong, they have to draw another card from the pile and they can't discard. Allow the teams time to come to a decision among themselves about which card to hold up.

7. The first team to discard all of its cards wins.

Evaluation:

1. Students list the five kingdoms of living things and give an example for each.

2. The teacher posts a blank bar graph of the Five Kingdoms of Living Things. Each student randomly chooses any five cards and sorts them according to the appropriate kingdom. Students glue their cards on the graph in the appropriate column. The teacher checks each student's placement.

Curriculum Connections:

(See appendix for full citations)

Books:

DK Science Encyclopedia (also on CD)

How Nature Works (Burnie)

Nature (Rainis)

Website:

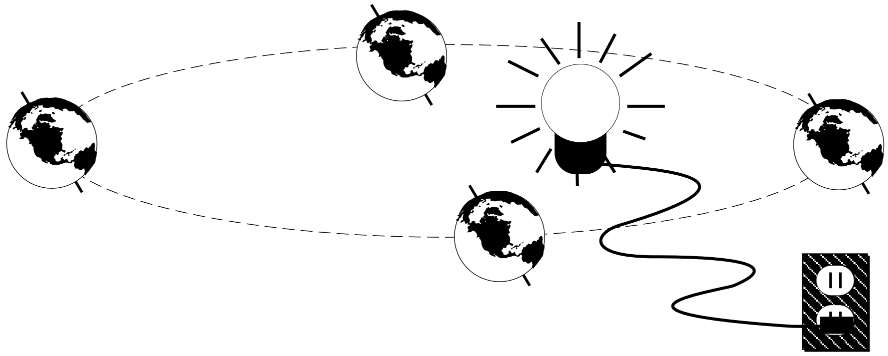
Natural Perspective (on-line periodical) <www.perpective.com/nature>

Teacher Resources:

(See appendix

Investigating Heat Energy

2 ACTIVITIES and 1 EXTENSION



Section 1
ECOLOGY ACTIVITIES

Grade Level: 4 - 12

State Standards: S B-1, S B-5, S B-6, Geo C-1
NGSS: 4-PS3-2**,** MS-PS3-3
Subjects: Science, language, arts, geography

Skills: Measuring, inferring, predicting, synthesizing, reading, writing

Duration: 45-60 minutes per station

Group Size: Small

Setting: Indoors

Vocabulary: Atmosphere, boreal forest, tundra, solar energy

Objective:
Students will explain how sunlight differs in its heating potential in different parts of the world.

Teaching Strategy:
Students make observations and measurements in two experiments and then make predictions about the distribution of cold environments on the earth.

Prerequisite:
Familiarity with the earth's rotation and revolution, day and night, and seasons *(see* INSIGHTS *Section 1, Elements of Ecosystems).*

Materials:
An atlas showing world environments, a world almanac, and the following materials to set up each experiment:

HEAT ENERGY AND THE SUN
Materials: An incandescent lamp or direct, bright sunlight; modeling clay; two metal lids from frozen juice containers, both painted black; one or two thermometers; a flashlight; a piece of cardboard; a ball or globe.

Setup: Place two lumps of clay and the rest of the materials and the "Science Card" *(following pages)* at a station.

WIND AND AIR TEMPERATURE
Materials: An electric fan; two thermometers; two identical empty cans; pail of warm water; pan of ice.
Setup: Place the materials and the "Science Card" *(following pages)* at this station.

Background:
See INSIGHTS, *Section 1, Elements of Ecosystems.*

Procedure:
IN ADVANCE: set up the two stations as described above.

1. *IN CLASS:* either have all groups of students do all investigations, or have separate groups do separate investigations and then report their findings to the class.

2. The last questions on each of the "Science Cards" require students to apply their findings to make predictions. Discuss each of these beforehand to ensure that students understand the questions and arrive at reasonable predictions.

3. Ask students to test their predictions. (They may initially think they need to go to various places on the earth and test the intensity of solar radiation or the rate of heat loss.) Encourage them to question how the amount of solar energy and the rate of heat loss of a particular site would affect its climate and ecosystem.

4. Can students infer that the places on the earth that receive the least solar energy and that lose heat most quickly have the coldest climates? Based on their experimental findings, what regions of earth would have cold environments? Ask students to use an almanac or web search to determine the climate at various latitudes and elevations on earth.

5. Explain that **tundra** and **boreal forest** ecosystems are the environments found in the parts of the earth with the coldest climates.

6. Ask students to look at an atlas showing photos of tundra and boreal forest environments throughout the world.

Evaluation:

1. Write a paragraph explaining why environments at high latitudes are cold.

2. Predict how cold temperatures might influence the living things in cold ecosystems.

EXTENSION:

Create another planet. Students work individually or in teams of 2-4 to create a planet similar to Earth, using balloons and paper-mâché or drawing paper. After marking continents and land forms, students label tundra areas and state their reasoning.

Curriculum Connections:

(See appendix for full citations)

Books:

Atlas of the World (National Geographic Society) or any other world atlas

DK Science Encyclopedia (also on CD)

Facts on File Environment Atlas (Wright)

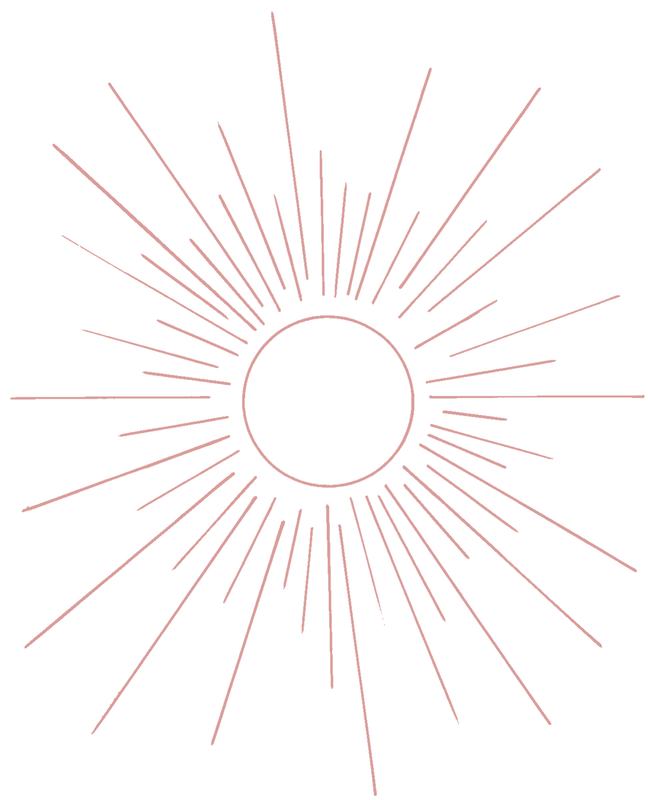
World Almanac

Websites:

Various atlas websites <www.maps.com > or <www.3datlas.com>

Teacher Resources:

(See appendix)



SCIENCE CARD

Heat Energy and the Sun

Sunlight is made of heat and light energy. When sunlight strikes molecules in the air or on a solid surface, its energy is either reflected or absorbed as heat. Each ray of sunlight contains the same amount of heat and light energy.

Question?

How does the angle at which sunlight strikes an object – the *angle of incidence* – affect the amount of heat and light energy received? This experiment will help you find out whether your ideas are correct.

1. Stand two metal can lids, painted black, at different angles, using modeling clay as a base. *(See the diagram)*. Place these an equal distance from an incandescent light bulb (but within a short enough distance that you can feel the heat of the light bulb on your hand), or in direct, bright sunlight.

Wait 15 minutes (go on to the next step while waiting), then feel the temperature difference with your fingers. Which one is warmer? Which one received the most light and heat energy?

2. Shine a penlight against a piece of cardboard. Keep the light close enough that you can see a distinct circle of light. First hold the cardboard straight up and down, and note the size of the circle of light. Then, slowly tilt the cardboard either toward or away from the light. What happens to the circle of light?

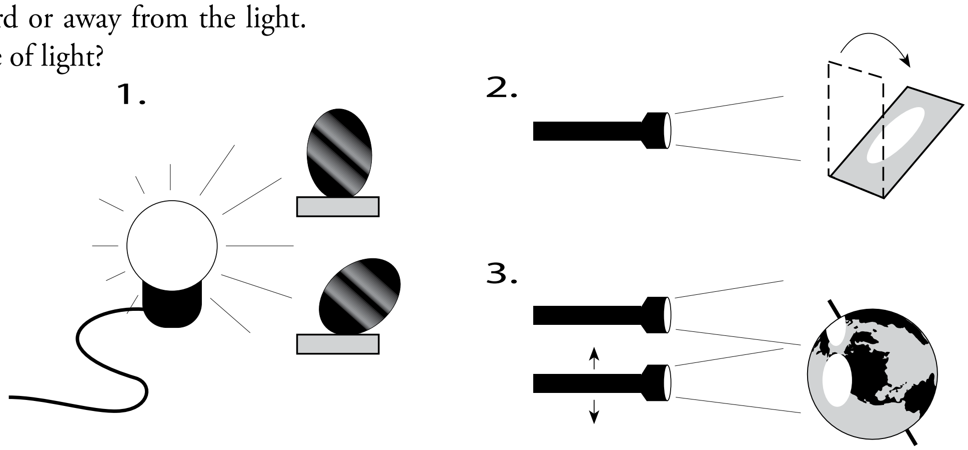
Considering the amount of light generated by the flashlight has remained the same, how do you think the amount of light energy received per unit area changes as the **tilt** of the cardboard (angle of incidence) increases?

Based on this investigation, can you predict what difference you will find when you measure the temperature of the lids in Step 1?

3. Imagine the penlight represents the sun. Keeping in mind the earth tilts on its **axis**, shine the penlight on the globe or ball (representing the earth). Hold the light so that the beam of light is *perpendicular to the equator*. Hold the light close enough to the globe that you can see a small, distinct circle of light.

Compare the size of the circle that appears when the light is shown on the equator to the size of the circle when the light is shown at the poles. Be sure to hold the light beam *perpendicular to the equator* in both cases.

Based on your observations, what regions of earth receive the most solar energy per unit area (the highest intensity of solar energy)? Which regions receive the lowest?



SCIENCE CARD

Wind and Air Temperature

Question?

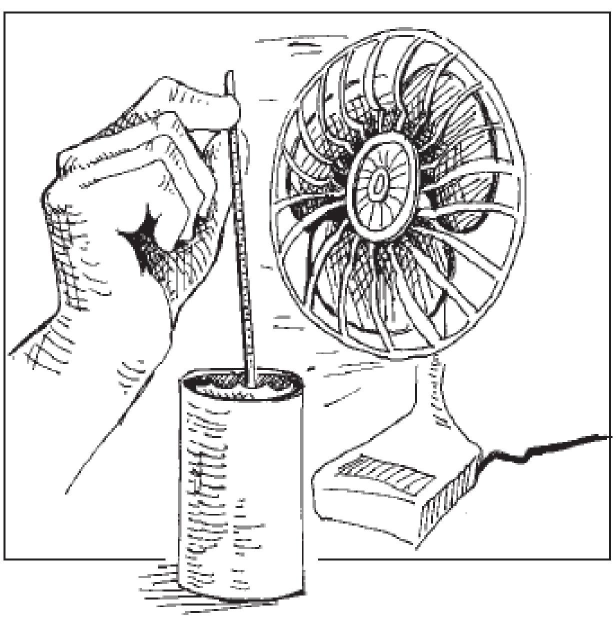
Do you think wind affects the temperature of our environment? This experiment will help you find out whether your ideas are correct.

1. **Experiment A.** Measure the air temperature about 2 feet (.61 meters) in front of the electric fan, but with the fan turned off. Record this temperature.

2. Turn the fan on high and measure the air temperature again. Wait a few minutes to allow the thermometer to respond to any change. Record any changes.

3.**Experiment B.** Fill the two cans with warm water and place a thermometer in each one. Record the starting temperature of each. This is important because even if the water temperature in the two containers is the same, the two thermometers may register slightly differently.

Place one can of water aside, away from the fan, and the other one in front of the fan. Wait about 15 minutes, then record the temperature of the water in both containers again. Did the temperature in both containers drop the same number of degrees? Which one dropped further? The drop in temperature is a measure of heat loss. After this experiment, how do you think wind affects the temperature of the environment?



4.**Experiment C.** Repeat the step above, placing a pan of ice between the fan and the can. Wait 15 minutes. Did the temperature in this can drop more, less, or the same amount as in the last experiment? Did it drop more, less, or the same amount as the temperature of the other can? Explain why. What do you predict would occur if you placed a heated surface between the fan and the can?

5. Based on what you observed in these experiments, choose the scenario from each of the following in which a living thing would have the most difficulty keeping warm:

(a) coastal environment with winds blowing toward the shore OR coastal environment with winds blowing toward the sea?
(b) cold, calm environment OR cold, windy environment?

Investigating Soil
2 EXTENSIONS

Section 1
ECOLOGY ACTIVITIES

Grade Level: 4 - 12

State Standards: S B-1, S B-5, S B-6, S A-15
NGSS: 5-LS2-1, 5-ESS2-1, MS-ESS-1
Subject: Science, math, language arts

Skills: Observing, recording, computing, analyzing, describing, drawing

Duration: 100 minutes

Group Size: 2-4

Setting: Outdoors /indoors

Vocabulary: Dormant, ecosystem, leaf litter, living things, habitat, nonliving things, soil, temperature

Objectives:
1. Students will describe soil as an element of the local ecosystem.

2. Students will observe the relationship between soil (nonliving) and the living elements of the local ecosystem.

Teaching Strategy:
Students observe and collect data on soil, then evaluate their data, and make predictions about living things and soil.

Complementary Activities:
"Investigating Air," "Investigating Water," *and* "Investigating Heat Energy" *in this section. Also* "Investigating Fungi Habitat," "Investigating Plant Habitat," "Investigating Animals in Soils," *and* "Investigating Insects" in *Section 3.*

Materials:
For each student: a journal or paper, pencil, a hard surface to write on. For each group: trowel, container to carry soil, yard or meter stick, thermometer, several bags for holding soil samples, hand lens or microscope, at least one copy of the Science Card.

OPTIONAL: Laminate the Science Cards.

Background:
See INSIGHTS, *Section 1, Elements of Ecosystems.*

Procedure:
IN ADVANCE: determine an outdoor area suitable for digging soil pits.

1. *IN CLASS:* review the definition of **ecosystem.** Tell students they will be investigating **soil** – one of the **nonliving** elements of ecosystems that must be present for most **living things** to survive.

2. Give each team the "Science Card: Investigating Soil."

Classroom Follow-Up:
1. Students either work together or alone to evaluate their data and make predictions about which living things might use the nonliving environment of soil and why.

Students can use examples of living things they noticed while investigating soil, but should note why these living things can live in this environment. *For example, if their environment is cold, dry, and dark in the winter, then only plants that are **dormant** in the winter should live there.*

Student predictions can be expressed in writing and/ or with drawings. Encourage students to think creatively and imagine the environments throughout the year and under unusual circumstances. *For example, a bear might be comfortable in the nonliving environment of the schoolyard, but may not choose to live there for other reasons.*

2. Students present their information to a small group or to the class. Information can be mounted on a mural, poster, or bulletin board. If each student focused on only a small area within the local ecosystem, a class mural could be made, resulting in a overall picture of a larger, nonliving area. These displays can be combined later with experiments on the living environment for a complete illustration of an ecosystem.

Evaluation:

1. Collect soil data and present findings to the class.

2. Summarize data and draw conclusions on the nature of their nonliving environment.

3. Make predictions about which living organisms might thrive in their local soil and why.

4. Given examples of organisms that would not thrive in their local soil, students will determine why these living things could not survive.

EXTENSIONS:

A. Students return to the site of their explorations at different times of the year to note changes in the soil and perform similar experiments with different results.

B. Discuss how living things might change to adapt to the changes in the soil.

Curriculum Connections:

(See appendix for full citations)

Books:

Ecology (Pollock)

Handful of Dirt (Bial)

How Nature Works (Burnie)

One Small Square: Backyard (Silver)

Our Endangered Planet: Soil (Winckler)

Rocks and Soil (Snedden)

The Science of Soil (Bocknek)

Teacher Resources:

(See appendix)

SCIENCE CARD

Investigating Soil

1. Dig a hole in the soil 12-18 inches deep. Make a large enough hole so you can see layers in the soil.

2. Draw a side view of the hole, labeling the different layers where the color or texture of the soil changes.

3. Measure the width of each layer and note the measurement on your drawing. Stop digging if you encounter water or ice and measure the distance from the surface to the water.

4. Take the temperature of each layer of the soil and record it on your drawing.

5. Take samples of each layer, label them, and bring them back to the classroom for further investigation.

Questions:

NOTE: Each of you answer the following questions in your own journal. Everyone can contribute ideas.

(a) Write what you see when you look at each layer of soil using a microscope or hand lens. You may make a drawing in addition to your written observations. How far is each layer is from the surface? How thick is each layer?

(b) Of what does the soil in each layer seem to be made? Is the soil made of rocks? Gravel? Dirt? Leaf litter?

(c) Take a handful of soil from each layer. What does it feel like? Does it hold together if you squeeze it? Describe the texture of each layer.

(d) What color is the soil in each layer?

(e) Do any of the soil layers have a smell?

(f) Do you think it's easy for water to flow through this soil layer? Why or why not?

(g) Did you find any evidence of humans in your soil sample? Did you notice any evidence of plants or animals in your sample? If so, describe, and note the layer in which you found the human evidence.

Investigating Water

1 ACTIVITY, 2 EXTENSIONS

Section 1
ECOLOGY ACTIVITIES

Grade Level: 4 - 12

State Standards: S B-1, S B-5, S B-6, S A-15
NGSS: 5-LS2-1, 5-ESS2-1, MS-LS2-1, MS-LS2-5, 5-ESS3-1, MS-ESS3-3

Subject: Science, math, language arts

Skills: Observing, recording, computing, analyzing, describing, drawing

Duration: 100 minutes

Group Size: 2-4

Setting: Outdoors

Vocabulary: Acidic, basic, ecosystem, living things, neutral, nonliving things, pH, water

Objectives:

1. Students will describe water as an element of the local ecosystem.

2. Students will observe the relationship between water (nonliving) and the living elements of the local ecosystem.

Teaching Strategy:

Students observe and collect data on water, then evaluate their data, and make predictions about living things and water.

Complementary Activities:

"Snow Blanket," "Investigating Wind and Air Temperature," "Investigating Soil," *and* "Investigating Air" *in this section. Also* "Investigating Plant Habitat" *and* "Investigating Animals in Soils" in *Section 3.*

Materials:

Paper and pencil, thermometer, pH paper, containers to collect samples, masking tape and marker, ruler, hand lens or microscope, instructions on how to measure pH *(following page),* and a copy of the Science Card *(following)*.

OPTIONAL: Laminate the Science cards.

Background:

See INSIGHTS, ***Section 1, Elements of Ecosystems.***

Procedure:

IN ADVANCE: determine an outdoor area suitable for water investigations.

1. *IN CLASS:* review the definition of **ecosystem.** Tell the students they will be investigating **water** – one of the **non-living** elements of ecosystems that must be present for most **living things** to survive.

2. Give each team the "Science Card: Investigating Water."

Classroom Follow-Up:
1. Students either work together or alone to evaluate their data and make predictions about which living things might use the nonliving environment of water and why.

Students can use examples of living things they noticed while investigating water, but should note why these living things can live in this environment.

Student predictions can be expressed in writing and/ or with drawings. Encourage students to think creatively and imagine the environments throughout the year and under unusual circumstances.

2. Students present their information to a small group or to the class. Information can be mounted on a mural, poster, or bulletin board. If each student focused on only a small area within the local ecosystem, a class mural could be made, resulting in a overall picture of a larger, nonliving area. These displays can be combined later with experiments on the living environment for a complete illustration of an ecosystem.

Evaluation:

1. Collect water data and present findings to the class.

2. Summarize data and draw conclusions on the nature of their nonliving environment.

3. Make predictions about which living organisms might thrive in their local water and why.

4. Given examples of organisms that would not thrive in their local water, students will determine why these living things could not survive.

EXTENSIONS:

A. Students return to the site of their explorations at different times of the year to note changes in the water and perform similar experiments with different results.

B. Discuss how living things might change to adapt to changes in the water.

Curriculum Connections:

(See appendix for full citations)

Books:

The Drop in My Drink (Hopper)

A Drop of Water (Wick)

How Nature Works (Burnie)

Keeping Water Clean (McLeish)

Our Endangered Planet: Rivers and Lakes (Hoff)

River and Stream (Sayre)

Rivers, Ponds, and Lakes (Ganeri)

Teacher Resources:

(See appendix)

How To Measure pH

Background:
The pH of a solution is a measure of how many hydrogen ions (OH) are in that solution. The pH of most solutions ranges from 0 to 14. This scale separates acids, bases, and neutral solutions into regions.

The middle point, pH = 7, is neutral. A solution with a pH of 7 is neither an acid nor a base.

Acids have pH of less than 7. The stronger the acid, the lower the number on the pH scale. *For example the pH of lemon juice is about 2.3, while tomato juice, which is less acidic, has a pH of 4.*

Bases have a pH higher than 7. The higher the number above 7 on the pH scale, the stronger the base. *Sea water is slightly basic, having a pH of 8. Drain cleaners are strongly basic solutions, having a pH of 14.*

Many plants and animal are sensitive to changes in pH in both water and soil. Most lake water has a pH between 6 and 7, which makes it slightly acidic.

Materials:
*Either pH paper or a water chemistry ki*t:
1. The pH paper is the cheapest and simplest tool for measuring pH. A supply of universal indicator pH paper, adequate for several classes, can be obtained for under $15 from most chemical supply houses. Use according to accompanying instructions.

2. Water chemistry kits are also available from chemistry supply houses. These include pH indicator solutions and instructions that junior high or high school students can follow.

SCIENCE CARD

Investigating Water

1. Examine your local ecosystem for water. Water can be found in puddles, on leaves, in streams or ponds, at the bottom of a hole that you've dug, or in snow.

2. Collect the following data for each area where you find water, completing as many as time allows. Use a separate piece of paper or page in your notebook for writing about each area of water.

(a) Describe the location of the water.

(b) Describe the color of the water.

(c) Where do you think the water came from?

(d) Put the thermometer in the water, if possible, and record the temperature after a few minutes.

(e) Record the pH of the water. Is the water acidic, basic or neutral? (pH at 7 is neutral, pH greater than 7 is basic (alkaline), and pH less than 7 is acidic.)

(f) How deep is the water in your sample? (Give an estimate if the water is too deep to measure.)

(g) Is the water moving or stationary?

(h) Take a sample of the water and put a label on the sample container that tells where it came from. If possible, examine the water with a hand lens or microscope in the classroom. Is there anything floating in the water?

(i) Perform the same experiments on snow, if available.

Investigating Air

Section 1
ECOLOGY ACTIVITIES

Grade: K - 12

State Standards: S B-1, S B-5, S B-6
NGSS: K-ESS2-1,K-ESS2-2, 3-LS4-4. 5-LS2-1,5-ESS2-1, MS-LS2-3, MS-ESS2-4
Subjects: Science, social studies

Skills: Observing, measuring, predicting, comparing, contrasting, inferring

Duration: 2 days, 30 minutes classroom, 60 minutes outdoors each day

Group Size: 2

Setting: Outdoors/indoors

Vocabulary: Carbon dioxide, hypothesize, oxygen, plant, transpiration

Objectives:
After conducting an identical set of experiments in densely vegetated and lightly vegetated sites on the presence of wind, dust, and water vapor (transpiration), students will compare the results.

Complementary Activities:
"Snow Blanket," "Investigating Wind and Air Temperature," "Investigating Soil," *and* "Investigating Water" *in this section. Also* "Investigating Plant Habitat" in *Section 3.*

Materials:
Small plastic bags, rubber bands, petroleum jelly, index cards, string, pinwheels or wind gauges, and hand lenses for each site. Clipboards and writing paper or field note books, pencils or pens for each student. "Science Cards" for both vegetated and non-vegetated sites *(following pages).*

Background:
See INSIGHTS, *Section 1, Elements of Ecosystems.*

Procedure:
IN ADVANCE: locate 2 sites for taking measurements, one vegetated and one without much vegetation *(for example: forested and non-forested; tundra and rocky or sandy; or shrubs and grass).*

DAY ONE

1. Brainstorm potential differences between your two sites. Lead the discussion to the differences in wind, dust, and water vapor.

2. Introduce the experiment by asking for ideas on how to measure the differences.

3. Introduce the tools that will be used: wind gauge, petroleum-jelly-smeared cards, and plastic bags. Explain that the students will use these to conduct identical experiments at two different sites.

4. Introduce the Science Cards.

5. Have students prepare their observation notebooks by writing the heading "Air in Ecosystems" across the top of a page. Tell them to draw a line down the center of the page, and put the heading "Ecosystem #1" at the top of the left side and "Ecosystem #2" at the top of the right side.

6. OUTDOORS: Each team will set up its experiments at the sites and take initial wind measurements.

7. ***At the densely vegetated site***, each team places plastic bags around a plant – leafy branches of a tree, bush, flowers, or clump of grass – and some vegetation that is dead – a dead stick or fallen leaf or brown grasses. Tightly seal each bag around the object with a rubber band. *This experiment will work well only if the ground is thawed.*

8. Each team ties an index card to a branch of a tree or shrub or a clump of grasses, and then spread petroleum jelly over it. This will trap dust in the air.

9. Using the pinwheels or a wind gauge, measure the wind at the site. Students record in their notebooks *(under the appropriate column)* whether they observe any wind at this site and whether the wind caused the gauge or pinwheel to turn: (1) not at all, (2) very slowly, (3) slowly, (4) fairly quickly, or (5) very quickly.

10. ***At the lightly vegetated site***, each team places plastic bags around a leafy branch, grasses, and a dead stick. Tightly seal each bag around each object with a rubber band. *This experiment will work well only if the ground is thawed.*

11. Each team ties an index card to a plant (or tie it to a stick shoved into the ground if no standing vegetation). Then spread petroleum jelly over it. This will trap dust in the air.

12. Using the pinwheels or a wind gauge, measure the wind at the site. Ask students to record in their notebooks *(under the appropriate column)* whether they observe any wind at this site and whether the wind caused the gauge or pinwheel to turn: (1) not at all, (2) very slowly, (3) slowly, (4) fairly quickly, or (5) very quickly.

DAY TWO
Go OUTDOORS. Using the Science Cards as format, students observe, collect, and record data from both sites.

Classroom Follow-Up:
Compare the two sites. Discussion questions include:
(a) Did one site have stronger wind? Which one? Why do students think there was a difference? If students did not observe a difference, do they think they would have found a difference on a windy day? Which do students **hypothesize** (guess) would be more windy? Why do they hypothesize this?

(b) Which site had the least dust? Why do students think this difference occurred? Did the leaves of any plants trap dust? How might this affect the air quality?

(c) Based on the bags sealed on branches, did students conclude that the plants were putting moisture into the air (**transpiration**)? *If they did, their answer is correct. For example, a tree may pump 80 gallons of water into the air in a single day.* Which of the two sites do they think is most likely to have moist air?

Students should find less wind and less dust in the densely vegetated site, and predict that the densely vegetated site would have the most moisture in the air. Students should conclude that plants break the wind, remove dust from the air, and add moisture. They should remember that trees and other plants add **oxygen** and remove **carbon dioxide** from the air.

Curriculum Connections:
(See appendix for full citations)

Books:
How Nature Works (Burnie)

The Lorax (Seuss)

Our Endangered Planet: Air (Yount)

Media:
The Lorax

Teacher Resources:
(See appendix)

SCIENCE CARD

Air in Ecosystem #1

1. Record the data under the column "Ecosystem #1" on the page "Air in Ecosystems."

2. Measure the wind on this day also. Hold the pinwheel or wind gauge over your head and slowly turn around. If there is any wind, the gauge or wheel will turn. Record whether you observe any wind at this site and whether the wind caused the gauge or pinwheel to turn: (1) not at all, (2) very slowly, (3) slowly, (4) fairly quickly, or (5) very quickly.

3. The card tied on the tree or plant is a trap for dust in the air. Use a hand lens to look at it closely. Record the amount of dust it has collected: (1) none, (2) a few specks, (3) 10-20 specks, (4) 20- 50 specks, (5) over 50 specks.

4. Look at the leaf of a tree or plant using a hand lens. Record the number of dust specks on it using the same scale as above.

5. Look at the leaf of a different kind of tree or plant for dust specks. Record the number of dust specks on the leaf using the same scale.

6. The plastic bags that are tied around live branches or plants and a dead branch or plant were all dry when tied to these objects. Record which, if any, bags now contain water. How do you think this water got into the bag?

SCIENCE CARD

Air in Ecosystem #2

1. Record the data under the column "Ecosystem #2" on the page "Air in Ecosystems."

2. Measure the wind on this day also. Hold the pinwheel or wind gauge over your head and slowly turn around. If there is any wind, the gauge or wheel will turn. Record whether you observe any wind at this site and whether the wind caused the gauge or pinwheel to turn: (1) not at all, (2) very slowly, (3) slowly, (4) fairly quickly, or (5) very quickly.

3. The card tied on the tree or plant is a trap for dust in the air. Use a hand lens to look at it closely. Record the amount of dust it has collected: (1) none, (2) a few specks, (3) 10-20 specks, (4) 20- 50 specks, (5) over 50 specks.

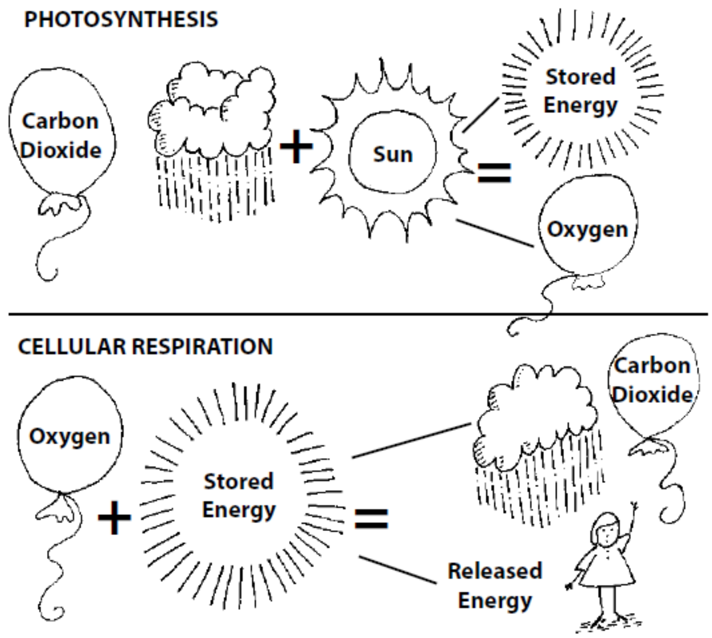
4. Look at the leaves of a plant using a hand lens. Record the number of dust specks on it using the same scale as above.

5. Look at grass blades for dust specks. Record the number of dust specks using the same scale.

6. The plastic bags that are tied around live plants and a dead stick were all dry when tied. Record which, if any, bags now contain water. How do you think this water got into the bag?

Take A Deep Breath

2 EXTENSIONS



Section 1
ECOLOGY ACTIVITIES

Grade level: K - 6

State Standard: S A-14
NGSS: K-LS1-1.,K-ESS3-1,5-LS1-1 5-LS2-1, MS-LS2-3,5-PS3-1
Subjects: Science

Skills: Inferring, generalizing, applying, predicting

Duration: 50 minutes

Group Size: small

Setting: Indoors

Vocabulary: Carbon dioxide, cellular respiration, energy, gas, living things, minerals, oxygen, photosynthesis, respire

Objective:
Students will explain that plants are needed by all other living things to survive.

Teaching Strategy:
Students play a card game that involves holding their breath to demonstrate photosynthesis.

Materials:
For each student: 4 or 5 Carbon Dioxide and Oxygen Cards *(following)*. Table or floor space.
OPTIONAL: Stopwatch or watch/clock with a second-hand.

Background:
See INSIGHTS, *Section 1, Elements of Ecosystems: "Energy Exchange."*

Procedure:
1. Time students while they hold their breaths. Record the lengths of time if desired.

2. With the class, discuss why students had to stop and breathe. Explain that most **living things** need **oxygen** in order to use the **energy** and **minerals** in their foods. *Humans and most other living things, including plants and algae, breathe in oxygen and breathe out **carbon dioxide*** (this is called **cellular respiration** - *see the extension at the end of this activity*). The teacher may want to pantomime this process.

3. Spread the Oxygen and Carbon Dioxide Cards on a table or on the floor. Explain that each card represents the air of an ecosystem.

4. Ask 4 students to volunteer to be "animals," to model what might happen if there were no plants on earth to produce oxygen.

5. As each "animal" takes a turn, it breathes in, turns over an Oxygen Card into Carbon Dioxide, and breathes out to show the exchange of gasses that occurs when we breathe.

6. Animals must hold their breath until the next turn. Each animal can continue playing as long as it can hold its breath and as long as it has oxygen to breathe.

7. Ask the class to guess what will happen to the players. Play the game to find out. (*Students will run out of breath as they deplete the oxygen cards.*)

8. Explain that plants and algae are very special because they take the carbon dioxide out of the air and put oxygen back in. No other group of living things does this to the extent plants and algae do. Explain that when plants and algae **photosynthesize**, they remove carbon dioxide from the air, combine it with water and sunlight, and make food (which they use) and oxygen (which they put into the air).

NOTE: *Although plants* ***respire*** *(take in oxygen and release carbon dioxide), they produce much more oxygen through photosynthesis than they take in through cellular respiration.*

9. Ask for 4 more volunteers to act like plants and algae in the game. Pair each animal with a plant or algae and place partners across the table from each other.

10. Take turns and breathe as before, but this time, the animals can breathe not only when they turn over an Oxygen Card, but also when their plant/algae partner turns over his or her plant/algae Carbon Dioxide Card.

11. Ask the class to predict what will happen when they replay the game with some players who are plants and algae and others who are living things. Replay the game to test the prediction.

VARIATION FOR OLDER STUDENTS

12. Play several rounds of the game and ask the students to adjust the number of plant players so that just enough oxygen get produced to support the cellular respirators, and just enough carbon dioxide gets produced to support the plants.

13. Discuss the need for a balance between the population of plants and animals as it relates to current environmental concerns (*human over-population, deforestation, ongoing development, pollution, etc.*)

Evaluation:

Students draw a picture or describe in writing the relationship between plants, animals, and the oxygen and carbon dioxide found in the air.

EXTENSION:

A. **Experiment with plants.** Put a well-watered potted plant inside a plastic bag and seal the bag (with a twist-tie or tape). Put the plant in a sunny or well-lighted spot. Observe what happens to the inside surface of the bag. Ask students where the water droplets came from. Discuss cellular respiration *(reverse of photosynthesis).*

B. ***Discuss The Lorax.*** *Read The Lorax* by Dr. Suess aloud to the students. Ask them to describe in writing, if possible, what problem wasn't discussed in the book when the Oncelers cut down all of the trees (*the depletion of oxygen*). Students should defend their ideas.

Curriculum Connections:

(See appendix for full citations)

Books:

The Air I Breathe (Kalman)

Ecology (Pollock)

The Lorax (Seuss)

Photosynthesis (Silverstein)

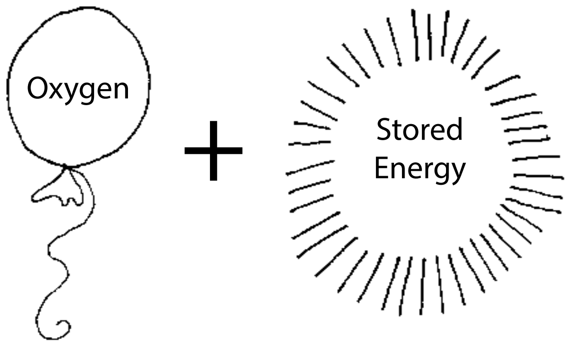
Media:

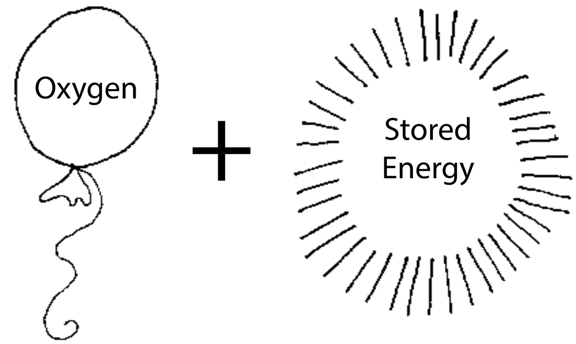
The Lorax

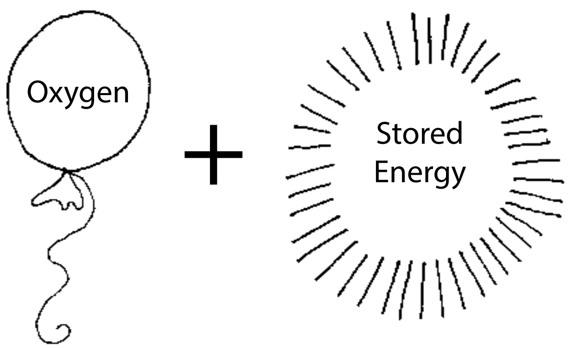
Teacher Resources:

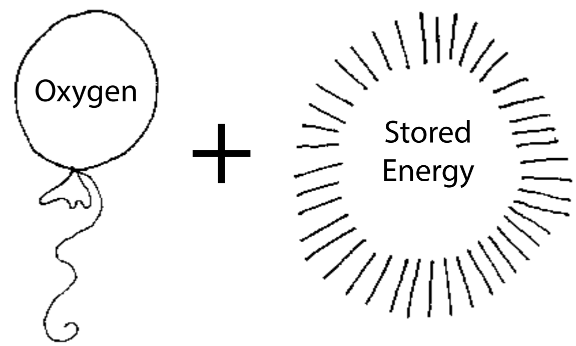
(See appendix)

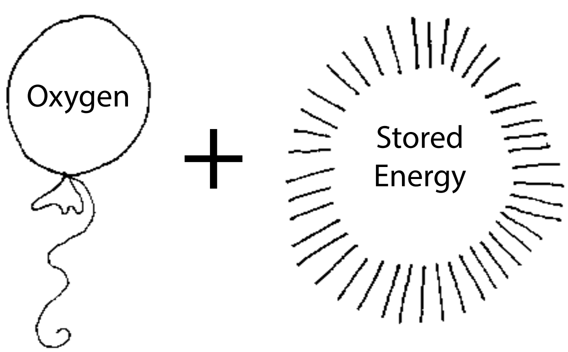
Oxygen Cards for "Take A Deep Breath"

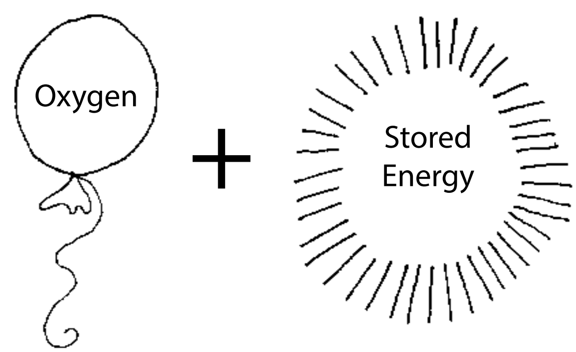


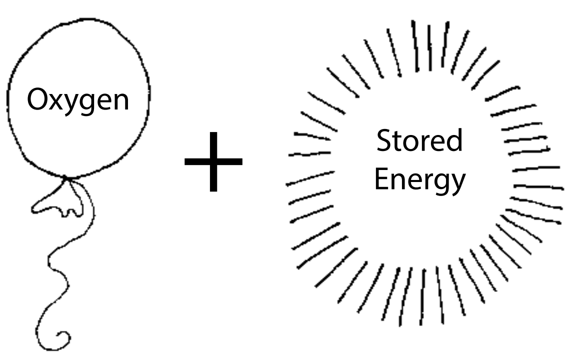


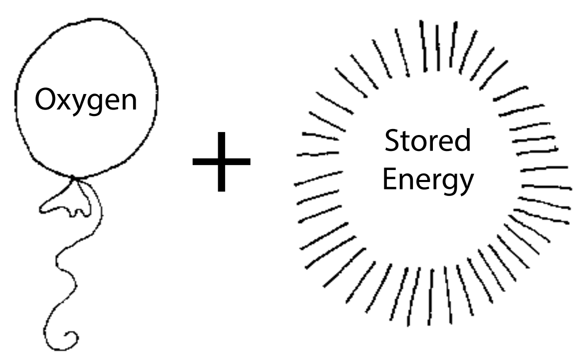




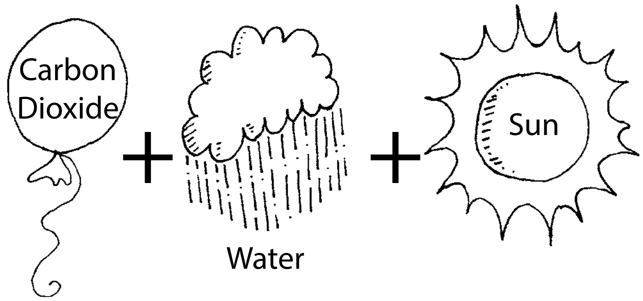


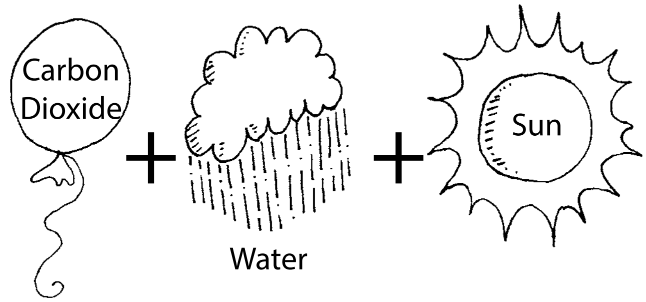


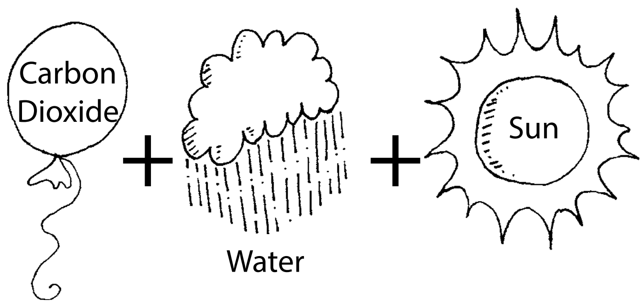


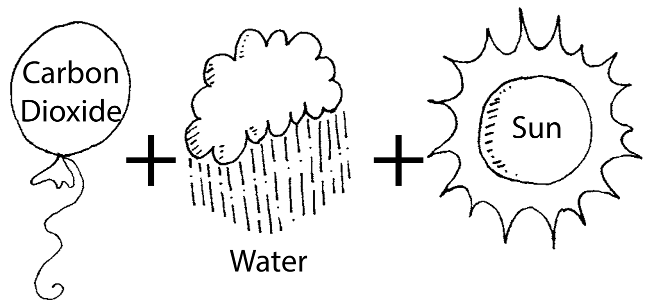


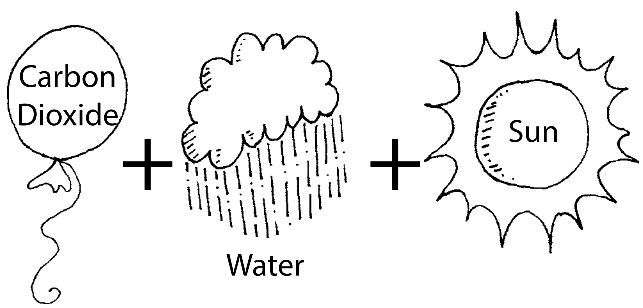
Carbon Dioxide Cards For "Take A Deep Breath"

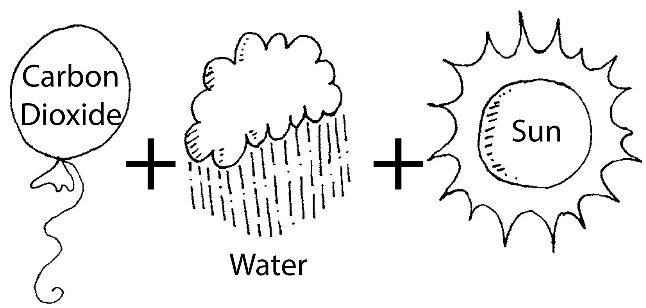


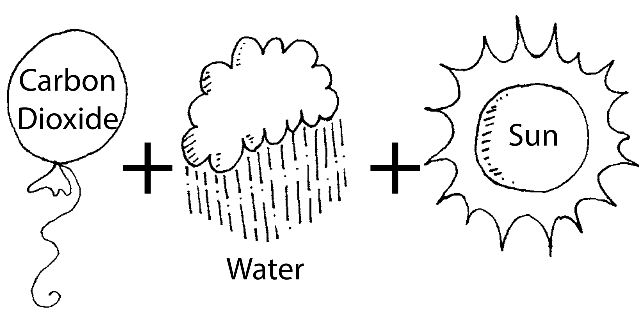


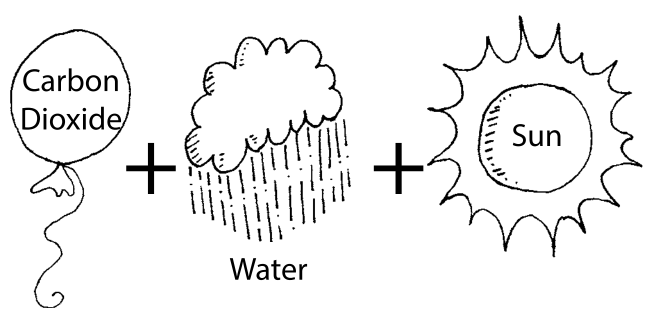






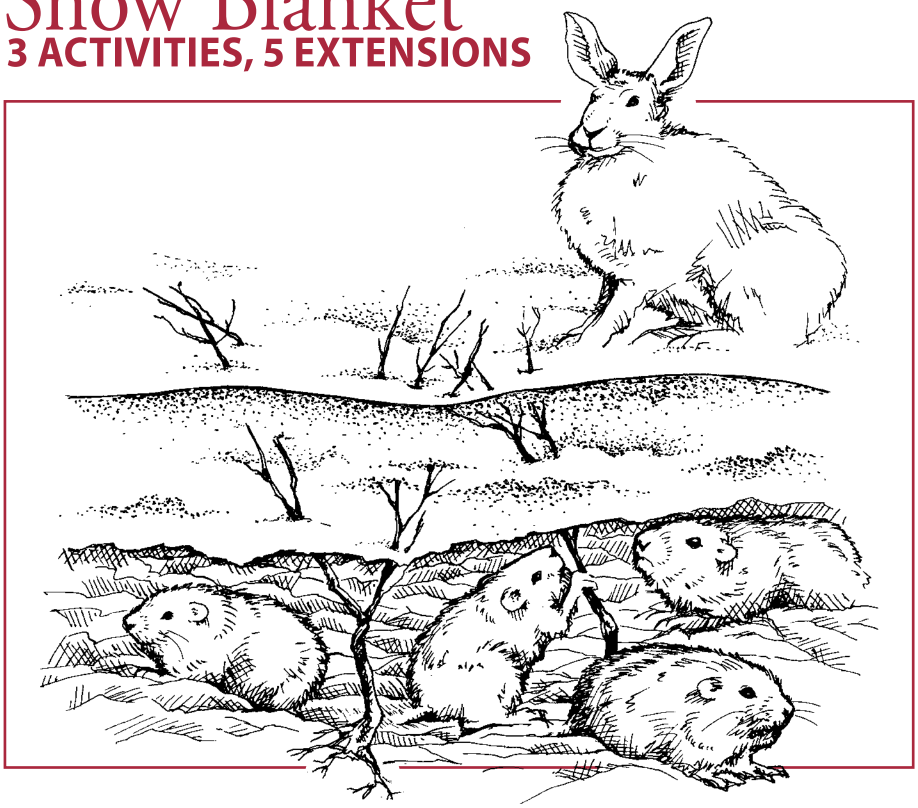






Snow Blanket

3 ACTIVITIES, 5 EXTENSIONS



Section 1
ECOLOGY ACTIVITIES

Grade Level: K - 9

State Standards: S A-14, S B-1, S B-2, S B-5, S B-6
NGSS: K-LS-1,3-LS4-3

Subjects: Science

Skills: Analyzing, estimating, predicting

Duration: Two one-day sessions of 45 minutes

Day two: 45 minutes

Group Size: 2-3

Setting: Indoors/outdoors

Vocabulary: Air, conductor, heat energy, insulator, snow crystals

Objective:

Students will describe the insulating function of snow in an ecosystem.

Teaching Strategy:

Students perform a series of simple experiments to show that snow insulation can keep animals warm.

Complementary Activities:

"Investigating Wind and Air Temperature" *and* "Investigating Water," *in this section. Also* "Investigating Plant Habitat," *and* "Investigating Animals in Soils" in *Section 3.*

Materials:

For each group: two clear jars, marking pen or tape, box of corn flakes, two film canisters or margarine tubs (at least one container per group should have a lid), powdered gelatin, two thermometers, snow shovel or trowel.

OPTIONAL: hand lenses, embroidery hoops, down-filled clothing or sleeping bag, clear plastic or dark fabric.

Background:

See INSIGHTS, *Section 1, Elements of Ecosystems: "Snow Blanket."*

Procedure:

DAY ONE
EXPERIMENT A
Optional: IN ADVANCE, prepare enough hand lenses and snow catchers so that each team of 2-3 students has one of each. Tie hand lenses to a yarn necklace. Make snow catchers by stretching clear plastic wrap or dark fabric over a small embroidery hoop.

1. Ask students to pretend they have a visitor from a hot sunny country who has never seen snow. Ask them to describe snow to the visitor. Make at least three categories on the board as you record their ideas. For example, students may describe snow's appearance, the games they play in it, and the effects it has on our lives or animals' lives.

2. Take the class outside to look at falling snowflakes. Tell students they will measure snow. A volunteer should carry a clear jar or pitcher to collect fresh snow. Explain

that each snowflake snow crystal has six sides, but no two snowflakes are identical.

3. Students may "catch" snowflakes on their jacket sleeves (darker colors show the snow better) or other snow catchers, and examine each flake's design. If possible, students should use hand lenses.

4. Collect a snow sample in the jar and mark the level of snow on its side by using a marking pen or tape.

5. After returning to the classroom, ask students to estimate how many minutes it will take for the snow to melt. Record all of the students' estimates on the board.

VARIATION
Collect two samples and place one near the heater and one near the window.

6. Ask one student to be the official "snow checker." She will announce when the snow has melted. After the snow has melted, check the students' estimates to discover who was closest to the right time.

7. Mark the level of water in the jar with a marker or tape. Ask students what they think was taking up the space between the snow mark and the water mark. *Snow crystals are solid water molecules separated by air until they melt. Liquid water molecules have little or no air between them.*

EXPERIMENT B
1. Prepare for the next demonstration by asking students to brainstorm another way to do the first experiment using something besides snow flakes. Suggest food items containing air. For example, anything that is whipped or frothy like whipped cream; or, anything dry that can be crushed or squished to lesser volume like crackers or cold cereal.

2. Fill a jar or pitcher with a box of corn flakes. Mark the fill level on the jar. Ask a volunteer to crush the flakes to simulate melting snow. Mark the new level of flakes in the jar and discuss how much space in the jar (and in the cereal box) was taken by air.

3. Help students generalize and apply what they've observed in the above demonstrations. Some animals such as mice, lemmings and insects live beneath the snow in the winter. How can the air in the snow help these animals? Explain that *they can breathe the air and the trapped air insulates them from the cold.*

DAY TWO
EXPERIMENT C
1. Choose a shaded area and perform this experiment early in the day to avoid the warmth of direct sun.

2. Explain to the students that they will be working with a powder called gelatin that dissolves in hot water and thickens when cooled.

Snow is a good insulator because air is trapped between snow crystals. Air is a poor conductor of heat; therefore, objects surrounded by snow-trapped air stay warm

3. Fill a measuring cup with hot water. Empty one package of gelatin into water and stir thoroughly. Fill all film canisters or margarine tubs half full with the gelatin solution.

4. Divide students into groups of 2 or 3. Each group chooses a shaded site to dig a snow pit one foot deep. Give each group two film canisters, one lid, and two thermometers. Students place the canister without the lid on the surface of the snow and bury the other canister with the lid one foot deep in the snow. Place one thermometer next to each of the canisters.

5. After five minutes, check the surface canisters for signs of jelling. When they begin to jell, students dig up the buried container and compare the progress of the two. *(The container above the snow should have jelled first.)*

6. Check the thermometers. Students should find the top layer of snow is cooler than the deeper, more thickly insulated levels.

7. Discuss with the students that snow acts as an insulator, just like a blanket or a jacket. Some animals depend on snow to keep them from getting too cold in the winter. For example, lemmings in the Arctic spend their entire winter under the snow, not hibernating, but actively scurrying around eating, avoiding predators, and having babies.

8. Discuss the basic similarity between snow and many common insulation materials such as down and Styrofoam. *(They all trap air!)*

Evaluation:

1. Finish the sentence "Snow is like a blanket because...."

2. Could people live under the snow? Why or why not?

3. Windblown ridges in the North are often barren of plant life. Apply what you know about snow to speculate why plants don't grow on these ridges.

EXTENSIONS:

A. **How much insulating air is in compacted snow?** Fill two clear containers, one with fresh snow and one with snow that has been crammed into the container by students to represent compacted snow. Fill to the same level. Allow the snow to melt and compare the amount of air in the fresh snow to the lesser amount in the compacted snow.

B. **Compare the insulating value of tracked and untracked snow.** Repeat the DAY TWO part of this activity in compacted snow. Choose a site that has been trodden by people or vehicles. Be sure to read thermometers carefully.

C. **Make "Baked Alaska!"** Follow cookbook directions to prepare this delicious dessert. Baked Alaska is a layer of cake topped by a thick layer of ice cream, covered by an inch of meringue (whipped egg whites), and then baked for 3-5 minutes! The ice cream does not melt because the meringue is a poor heat conductor. Like snow, meringue is full of air bubbles that don't carry heat well. Meringue insulates the ice cream from the oven's heat.

D. **Design a make-believe "animal" that could thrive under or in the snow** during the winter *(see also "Design Your Tundra Animal" in Alaska's Tundra & Wildlife, Section 3).*

***Credit**:*
EXPERIMENT C of this activity was adapted and reproduced from Hands-On-Nature, 1986, with permission of the publisher: Vermont Institute of Natural Science, 27023 Church Hill Road, Woodstock, VT 05091.

Curriculum Connections:

(See appendix for full citations)

Books:
One Small Square: Arctic Tundra (Silver)

Scholastic's The Magic School Bus in the Arctic: A Book About Heat (Cole) (Gr. K-3)

The Secret Language of Snow (Williams)

Teacher Resources:

(See appendix)