SCIENCE STANDARDS OF LEARNING
ENHANCED SCOPE & SEQUENCE

GRADE 2

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Introduction

The *Science Standards of Learning Enhanced Scope and Sequence* is a resource intended to help teachers align their classroom instruction with the Science Standards of Learning that were adopted by the Board of Education in January 2003. The Enhanced Scope and Sequence contains

- units organized by topics from the 2003 *Science Standards of Learning Sample Scope and Sequence.* Each topic lists the following:
  - Standards of Learning relating to that topic
  - essential understandings, knowledge, and skills from the *Science Standards of Learning Curriculum Framework* that students should acquire
- sample lesson plans aligned with the essential understandings, knowledge, and skills from the Curriculum Framework. Each lesson contains most or all of the following:
  - an overview
  - identification of the related Standard(s) of Learning
  - a list of objectives
  - a list of materials needed
  - a description of the instructional activity
  - one or more sample assessments
  - one or more follow-ups/extensions
  - a list of resources.

School divisions and teachers can use the Enhanced Scope and Sequence as a resource for developing sound curricular and instructional programs. These materials are intended as examples of ways the understandings, knowledge, and skills might be presented to students in a sequence of lessons that has been aligned with the Standards of Learning. Teachers who use the Enhanced Scope and Sequence should correlate the essential understandings, knowledge, and skills with available instructional resources as noted in the materials and determine the pacing of instruction as appropriate. This resource is not a complete curriculum and is neither required nor prescriptive, but it can be a valuable instructional tool.

Acknowledgments

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Organizing Topic — Investigation Skills

Related Standard of Learning

2.1 The student will conduct investigations in which
- a) observation is differentiated from personal interpretation, and conclusions are drawn based on observations;
- b) observations are repeated to ensure accuracy;
- c) two or more attributes are used to classify items;
- d) conditions that influence a change are defined;
- e) length, volume, mass, and temperature measurements are made in metric units (centimeters, meters, liters, degrees Celsius, grams, kilograms) and standard English units (inches, feet, yards, cups, pints, quarts, gallons, degrees Fahrenheit, ounces, pounds);
- f) pictures and bar graphs are constructed using numbered axes;
- g) unexpected or unusual quantitative data are recognized; and
- h) simple physical models are constructed.

Essential Understandings, Knowledge, and Skills	Correlation to Textbooks and Other Instructional Materials
The students should be able to	
• conduct simple experiments, make predictions, gather data from those experiments, repeat observations to improve accuracy, and draw conclusions;	_____
• classify items, using two or more attributes such as size, shape, color, texture, and weight;	_____
• differentiate among simple observations and personal interpretations. This requires students to comprehend what an *observation* is and apply the term in novel situations related to second grade SOL concepts;	_____
• construct and interpret simple models (for example, weathering and erosion of land surfaces—2.7)., and create basic categories to organize the data (descriptive or numerical);	_____
• construct and interpret picture and bar graphs with numbered axes depicting the distribution of data;	_____
• use centimeters, meters, liters, degrees Celsius, grams, and kilograms in measurement;	_____
• use inches, feet, yards, quarts, gallons, degrees Fahrenheit, ounces, and pounds in measurement;	_____
• judge which, if any, collected data in a small set appear to be unexpected or unusual.	_____

Observe & Classify

Organizing Topic Investigation Skills

Overview Students are introduced to basic investigation skills involving the science process skills of observing, classifying, and predicting.

Related Standards of Learning 2.1a, b, c

Objectives

The students should be able to

- conduct simple experiments, make predictions, gather data from those experiments, repeat observations to improve accuracy, and draw conclusions;
- classify items, using two or more attributes, such as size, shape, color, texture, and weight;
- differentiate among simple observations and personal interpretations. This requires students to comprehend what an *observation* is an apply the term in novel situations related to second grade SOL concepts.

Materials needed

- One banana for each group of students (Other objects, such as apples or unshelled peanuts may be used.)
- Attribute Blocks (or shapes cut from different-colored transparency film)
- Various types of beans in small plastic zip bags
- Paper or plastic plates or compartmentalized containers, such as microwave food trays (optional)
- "Classification Assessment" handouts (p. 5)
- "Multistage Classification Assessment" handouts (p. 6)

Instructional activity

Content/Teacher Notes

Observing is the skill of using the senses to gather information about the world and beyond. Observing is the most basic skill in science and is essential to the development of other science skills, such as inferring, predicting, and classifying. Through the use of their senses, students are able to perceive an object's characteristic properties. Quantitative observations are information about quantity, such as an amount or a measurement of size, while qualitative observations describe the qualities, properties, or attributes of an object, such as color or shape.

Classification is the sorting of objects or events into groups by common properties or attributes. To comprehend the overwhelming number of objects (including living things) and events in the world, it is necessary to impose some kind of order. We impose order by observing similarities and differences and by grouping objects accordingly to suit some purpose. Doctors classify diseases, libraries classify books, historians classify artifacts, car dealers classify cars, and parents classify laundry by colors. Classifying helps us organize our world. Classifying also allows us to identify objects around us. We recognize and classify an unfamiliar animal as a dog because of its properties, such as its fur, teeth, and bark that we associate with a dog. Classifying is the skill that allows us to develop and refine concepts, such as animals, mammals, dogs, and collies.

Procedure

Activity 1

1. Put students into small groups. Give each group a banana (or other object), and ask the students to work together to make a list of observations about their banana. Tell them to be as specific as possible. Have scales and rulers available, but do not specifically tell students to use them. Have students share their observations with the class.
2. Collect all the bananas into a pile, and ask the groups to locate their banana based on their observations. Students should *not* know ahead of time that they will be using their observations to identify their banana later. Have students share with the class what types of observations were the most helpful in identifying their banana.

Activity 2

1. Place the Attribute Blocks (or shapes cut from different colored transparency film) on the overhead. Ask students: What are some ways that we could sort (classify) these blocks into two groups? Sort the blocks according to their responses, and record a list of suggested ways for grouping them. This type of classification is called *single-stage classification* or *binary classification* because it uses a simple yes/no category system: that is, either an object has the attribute or it does not.

Activity 3

1. Give each student a "Classification Assessment" handout. Give each group of students a bag of various kinds of beans, and ask them to perform a single-stage classification on their beans by sorting them into two groups. Direct each student to record on the handout the classification attributes used for the sort. Have the students repeat this process, using different attributes. Discuss the classification attributes used.
2. Have the student sort the beans once again. Then have them sort each of the two groups (subsets) into two more groups or subsets. Ask: How many times could you sort the beans into subset groups? In other words, how do you know when you're finished? Students should see that they could continue sorting until they have only one kind of bean left in each subset, which cannot be sorted. This type of classification is called *multistage classification.*
3. Give each student a "Multistage Classification Assessment" handout. Direct the students to continue classifying/sorting each subset of beans until they have only one kind of bean remaining in each subset and they cannot sort any further. Have them record on the handout the attribute used for classifying each subset.

Sample assessment

- Assess the students' completed classification assessment handouts.

Follow-up/extension

- Have the students do a multistage classification of themselves by physically moving themselves into sets and then subsets. Record on the board the attributes used for each sort. Tell students that any attribute is okay except *weight* and *color*!

Resources

- *Outstanding Science Trade Books for Students K–12.* National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.
- *Teaching & Learning the Basic Science Skills: A Staff Development Program in Support of the Virginia Science Standards of Learning.* http://www.doe.virginia.gov/VDOE/Instruction/TLBSSGuide.doc. This lesson is adapted from this source.

Name: _____

Classification Assessment

Materials:

- **Bag of various kinds of beans**
- **Paper or plastic plate**

Directions:

- **Empty the bag of beans onto the plate. Observe the beans. Put the beans into two groups so that something is the same about all the beans in each group.**
- **Write one way all the beans you put into group 1 are the same.**

_____

- **Write one way all the beans you put into group 2 are the same.**

_____

- **Put the beans all back together on the plate. Observe them again. Think of another way to put the beans into two groups so that there is something the same about all the beans in each group. Put the beans into two groups.**
- **Write another way all the beans you put in group 1 are the same.**

_____

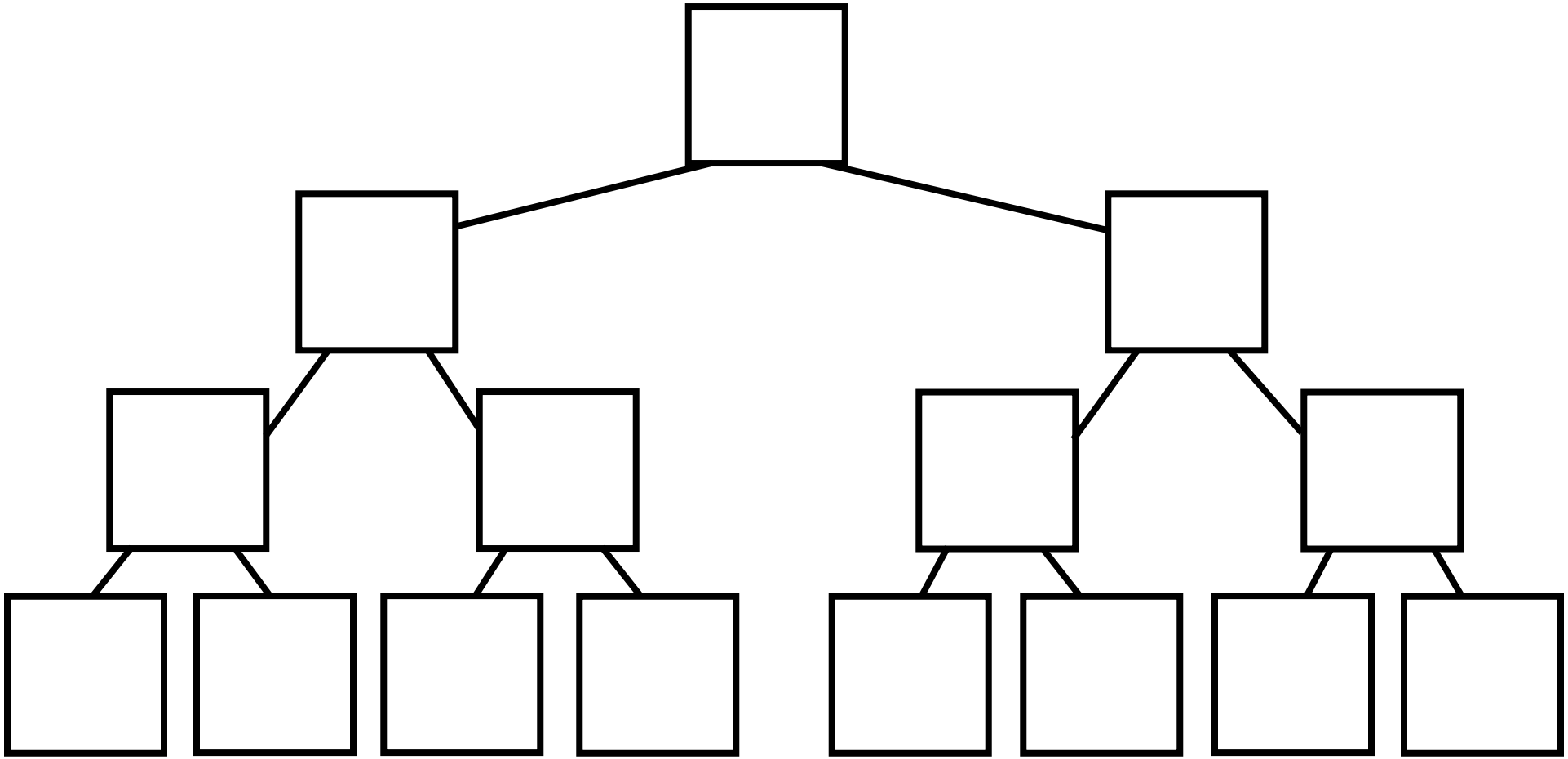
- **Write another way all the beans you put in group 2 are the same.**

_____

- **When you are done, put the beans back in the bag.**

Name: _____

Multistage Classification Assessment



Let's Find the Mass

Organizing Topic Investigation Skills

Overview Students estimate and then determine the mass of familiar objects in kilograms, using a balance scale.

Related Standards of Learning 2.1e

Objectives

The students should be able to

- use centimeters, meters, liters, degrees Celsius, grams, and kilograms in measurement.

Materials needed

- At least three balance scales that measure using kilograms
- Three objects for use at each balance scale — one with a mass of one kilogram, one with a mass greater than one kilogram, and one with a mass less than one kilogram
- A "Let's Find the Mass" recording sheets (p. 9), pen or crayon, and pencil for each student

Instructional activity

Content/Teacher Notes

It is important to introduce students at this age to the idea that in the everyday world, the terms *mass* and *weight* are used interchangeably. However, in the scientific world, they are different. The *mass* of something is a measure of how much "stuff" that thing contains. This is different from *weight*, which is a measure of the force of gravity on a thing. An apple weighs more on Jupiter than it does on Earth because Jupiter's gravity is stronger. However, the apple always has the same mass no matter where it is.

Have students learn to use the word *mass* in science class when using a balance scale. The concept of the difference between weight and mass will be reinforced and better understood by students as they continue with science lessons in later grades.

Procedure

1. Write the words *weight* and *mass* on the board. Ask students to think quietly about what they think each of these terms mean, and then allow them to share their ideas with a partner, using the Think-Pair-Share strategy. Then ask students where they can find the definitions or meanings of unfamiliar words. (dictionary) Use the dictionary to find and read the applicable definitions of *weight* and *mass* (or have students do it). If necessary, reword the definitions so that students can understand them, and write them on the board.
2. Explain to students that they will be working in groups to find the masses of some familiar objects. First they will estimate the mass of an object, and then they will measure its mass to determine how close their estimate was.
3. Explain to students that they will use *kilograms* (a metric measurement) when measuring the mass of an object. Show students something that has a mass of one kilogram. Pass this object around so that students can get a feel for an object that has a mass of one kilogram. Model how to measure the mass of the item, read the balance, and record the data. Write on the board: "The mass of the ____ is equal to one kilogram." Explain to students that at each of the three balance-scale stations, one of the objects has a mass *equal to* one kilogram, another object has a mass *greater than* one

kilogram, and the third has a mass *less than* one kilogram. They are to estimate which item's mass is equal to one kilogram, which is more than one kilogram, and which is less than one kilogram.

4. Divide the class into groups, and allow the groups to rotate through the three learning centers, estimating masses, measuring masses, and recording data on the "Let's Find the Mass" recording sheets.
5. When the groups have finished their work, review as a whole class the procedures used, the estimates made, and the data collected. Have the groups of students use the data to order all the items according to their mass from lightest to heaviest. Have students use the *less than, equal to, greater than* terminology to compare and contrast. Students should write a conclusion about what they discovered about mass and kilograms.

Sample assessment

- Circulate among students during the learning center rotations. Note who is having difficulty with understanding the process of estimating and comparing masses, and give help as necessary. As the students are working, observe their strategies and rationale for how to measure the mass of various items. Determine who is able to make the connections by using their prior knowledge to make future estimates. When students regroup at the end of the lesson, be sure to have them share this strategy as part of the summary. Collect their recording sheets to use as an assessment, paying close attention to their written conclusions.

Follow-up/extension

- Have students write in their journal an explanation of mass and why they would want to know the mass of an object. Have them give some examples.
- Have students redo this lesson, using different items to see how much their prior knowledge has helped them to make better estimates of mass.
- Have students go on a scavenger hunt at home to look for items whose mass equals exactly one kilogram or one pound. These items can be brought in the next day for actual measurement. Then a scavenger hunt can be done for items that equal five kilograms or five pounds.
- Create a bulletin board of clearly labeled familiar items that are equivalent to one kilogram or one pound. These will serve as benchmarks for the students when making future estimates about mass/weight.
- Compare pounds/kilograms to inches/centimeters and Fahrenheit/Celsius so that students understand the connections between U.S. customary and metric measurement.
- During science lessons, compare how making predictions and estimates is like making a *hypothesis*. Scientists use it as a basis for designing an experiment, which they then do and draw conclusions based on the data collected. The students have done the same thing in lessons in mathematics.

Resources

- *Outstanding Science Trade Books for Students K–12*. National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.

Name: _____

Let's Find the Mass

Object 1			
MASS	***Less than* one kilogram**	***Equal to* one kilogram**	***Greater than* one kilogram**
Estimate			
Actual			

Object 2			
MASS	***Less than* one kilogram**	***Equal to* one kilogram**	***Greater than* one kilogram**
Estimate			
Actual			

Object 3			
MASS	***Less than* one kilogram**	***Equal to* one kilogram**	***Greater than* one kilogram**
Estimate			
Actual			

Today I discovered that _____

_____

_____

Are All Containers Created Equal?

Organizing Topic Investigation Skills

Overview Students place grocery store boxes in order from least to greatest volume, using estimation, and then determine the actual order by filling the containers with cubes.

Related Standards of Learning 2.1e

Objectives

The students should be able to

- use centimeters, meters, liters, degrees Celsius, grams, and kilograms in measurement;
- use inches, feet, yards, quarts, gallons, degrees Fahrenheit, ounces, and pounds in measurement.

Materials needed

- Five different-size empty, numbered boxes from the grocery store (e.g., cereal box, graham cracker box, snack cake box) — one for each learning center
- Enough same-size cubes to fill all five empty boxes
- An "Are All Containers Created Equal?" recording sheets (p. 12), pen or crayon, and pencil for each student

Instructional activity

Procedure

1. Create five learning centers, each with an empty box and enough cubes to fill it. Give each box a number — 1 through 5. The students will use the cubes to find the volume of the box.
2. Write the word *volume* on the board. Ask students to think quietly about what they believe the term means, and then allow them to share their ideas with a partner, using the Think-Pair-Share strategy. Then ask students where they can find the definitions or meanings of unfamiliar words. (dictionary) Use the dictionary to find and read the applicable definition of *volume* (or have students do it). If necessary, reword the definition so that students can understand it, and write it on the board.
3. Explain to students that they will be working in groups to find the volumes of empty boxes. First they will estimate the volume of each box — the amount that each can hold. Then they will predict the arrangement of the boxes from *least* to *greatest* volume, and finally they will actually measure the volumes to determine if their estimates and predictions were correct.
4. Show students the five boxes and a cube, and have them estimate how many cubes they think will fit into each box. Have them write their estimates on the recording sheet, using a pen or crayon. Then have them write the order of their estimated volumes from *least* to *greatest* volume. Explain that they will not be changing these estimated answers once they find the actual answer, but that they will use this information so that they can do better next time. Compare it to when scientists or we make a hypothesis: the hypothesis does not get changed once the experiment is over. It is used to learn and to create a new hypothesis for another experiment. Scientists — and everybody — may learn just as much from their mistakes as they do from their successes.
5. Ask students for ideas about how to find the volume of each box. As they respond, remind them that in mathematics and science, there is most often more than one way to solve a problem. Explain and model how they will solve this problem today by carefully layering the cubes in the

box and then counting the cubes. Review how to fill the box, how to record the information, and how to clean up.

6. Divide the class into groups, and allow students to rotate through the five learning centers, filling the boxes with cubes and counting and recording them.
7. When the groups have finished their work, review as a whole class the procedures used, the estimates made, and the data collected. Students should write a conclusion about what they discovered about volume.

Observations and Conclusions

1. Have the students complete their recording sheets.

Sample assessment

- Circulate among the students during the learning center rotations. Note who is having difficulty with understanding the process and/or aligning the cubes, and give help as necessary. As the students are working, observe their strategies and rationale for how to measure the volume of the boxes. Determine who is able to make the connection between finding the area of the bottom of the box (the number of cubes in the bottom layer) and then finding the volume by adding that number for each layer of cubes. When students regroup at the end of the lesson, have them share this strategy as part of the summary. Collect their recording sheets to use as an assessment, paying close attention to their written conclusions.

Follow-up/extension

- Have students write in their journals a definition of *volume* and the reason they would want to know the volume of an object. Have them give some examples.
- Have students redo this lesson, using different containers to see how much their prior knowledge has helped them become better at estimating volume.
- Brainstorm other ways that the volume of an object can be determined.

Resources

- *Mathematics Enhanced Scope and Sequences, Grade 2.* http://www.doe.virginia.gov/VDOE/EnhancedSandS/mathematics.shtml. This lesson is also available, with minor differences, in this document.
- *Outstanding Science Trade Books for Students K–12.* National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.

Are All Containers Created Equal?

I predict that the volumes of the boxes from are

1. ___ cubes 2. ___ cubes 3. ___ cubes 4. ___ cubes 5. ___ cubes

Therefore, I predict the order of the boxes from the one with the *least* volume to the one with the *greatest* volume is

Number __ Number __ Number __ Number __ Number __

Box number	Estimated volume in cubes	Actual volume in cubes
1.		
2.		
3.		
4.		
5.		

The actual volumes of the boxes from are

1. ___ cubes 2. ___ cubes 3. ___ cubes 4. ___ cubes 5. ___ cubes

Therefore, the order of the boxes from the one with the *least* volume to the one with the *greatest* volume is

Number __ Number __ Number __ Number __ Number __

Today I discovered that _____

_____

_____

_____

Feelin' Hot, Hot, Hot

Organizing Topic Investigation Skills

Overview Students read, record, and compare temperatures, using Celsius and Fahrenheit thermometers.

Related Standards of Learning 2.1e

Objectives

The students should be able to

- use centimeters, meters, liters, degrees Celsius, grams, and kilograms in measurement;
- use inches, feet, yards, quarts, gallons, degrees Fahrenheit, ounces, and pounds in measurement.

Materials needed

- Chart paper
- Celsius/Fahrenheit thermometer for each student
- Cup of ice for each group of four students
- "Thermometer" worksheets (p. 16 or 17) pencil, and red crayon for each student
- "Thermometer" worksheet transparency
- Red overhead marker
- "Feelin' Hot, Hot, Hot" song, found at http://www.musiclegacy.com/hothothot.htm (optional)

Instructional activity

Content/Teacher Notes

Safety Notes: Students should not use mercury thermometers in the classroom at any time. Students should be reminded to use great care when handling glass thermometers.

Procedure

1. The lesson could begin with listening to the song and having students describe what it makes them think of. Steer the conversation toward talking about temperature.
2. Have students do a Think-Pair-Share about why knowing the temperature is important. Have students share their responses with the class, and record a list of responses on chart paper. Display this list throughout this lesson and beyond.
3. Show students a Celsius/Fahrenheit thermometer, and discuss safety precautions for handling it correctly and the consequences of not doing so.
4. Give each student a Celsius/Fahrenheit thermometer, and have each group discuss for three minutes what characteristics they notice about their thermometers. As a whole class, have students share their observations, and record the observations on chart paper. Continue to display this list so that you can add new observations during the summary portion of the lesson.
5. Demonstrate how to read a thermometer in Celsius and in Fahrenheit to the nearest 10 degrees.
6. Using the overhead, model recording the room temperature on the "Thermometer" worksheet. Then have the students read the room temperature on their thermometer and shade the temperature on their worksheet, using pencil. After checking their shading, allow them to color over with red crayon.
7. Give each group of four a cup of ice. Before students place their thermometers into the ice, have them predict what is going to happen to the temperature indicator. Allow students to place the

thermometers into the ice for one minute and observe. Have them remove their thermometers from the ice and place them on their desks. Have them discuss what happened to the temperature when the thermometers were in the cup and what is happening now that the thermometers are outside of the cup. Ask them to predict again what will happen if they place it back into the cup of ice. Have students return their thermometers to the cup of ice for two minutes. When they take their thermometer out of the cup the second time, have them read the thermometer quickly and record the temperature on their worksheet. Model on the overhead, if necessary. Allow students to color over the pencil shading in red crayon after you have checked their work.

8. Explain that the temperature of the ice is lower than the temperature of the air in the room. Ask students to brainstorm some ideas to locate places where the temperature is higher than the temperature of the air in the room. Have the students demonstrate this by rubbing their hands together very quickly for 30 seconds and then holding their thermometer in one palm. Have students discuss their observations.
9. Have students place their thermometer back in the cup of ice for 30 seconds while they create friction and heat again with their hands. This time the students will record how high they can make the temperature go by holding the thermometer in their hands.
10. Place a Celsius/Fahrenheit thermometer somewhere inside the classroom and another outside the classroom window. Have students read the two thermometers to the nearest 10 degrees, record the data, and graph it. Use the graph to make comparisons and predictions. Use this process throughout the year.

Observations and Conclusions

1. Make certain that students are recording data as the activity progresses. Review with the class what they did that day. Have students write a conclusion about how thermometers work and their usefulness. Have them name one place in the world that they are curious about the temperature, and ask them to explain why they are curious about the temperature in that place.

Sample assessment

- As the students are working, take note of their observations about the thermometers. Circulate among them during the reading and recording of temperatures. Note who is having difficulty with this process, and give help as necessary. Collect their worksheets as an assessment.

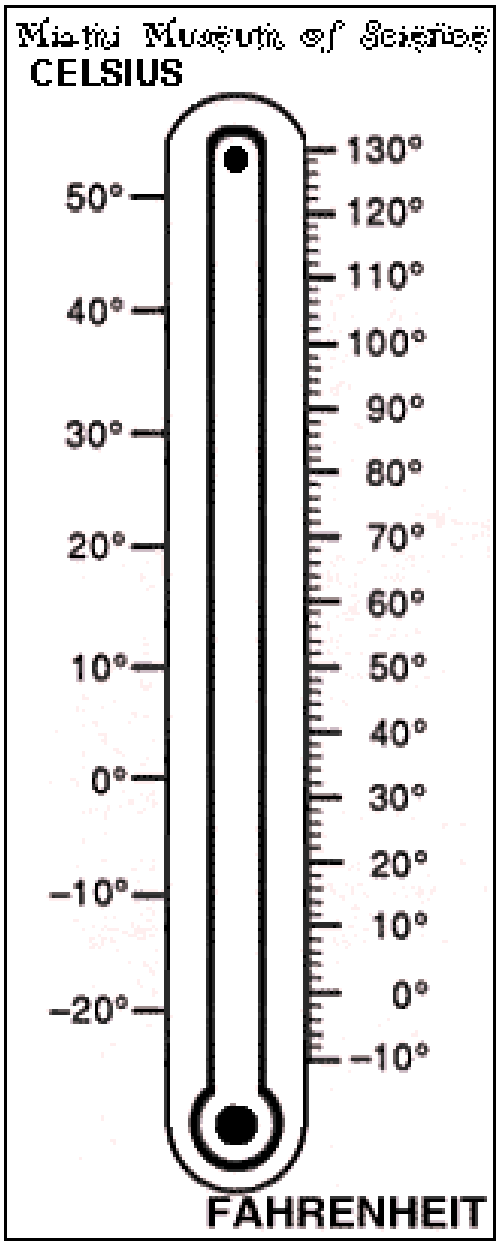
Follow-up/extension

- Show students seasonal pictures from books or magazines, and have them record a reasonable temperature for each picture in both degrees Celsius and degrees Fahrenheit.
- Have students predict the temperature for tomorrow and those for the next five days. Record their predictions, and have them determine their accuracy by reading the recording the outside thermometer each day. Have the students create generalizations based on prior knowledge of what the temperature has been. If done throughout the year, students can look for seasonal patterns.
- Have students research the temperatures of other places in the world and compare and contrast them with the temperatures here at home. Help the students make inferences about how temperature can affect things such as clothing, outside activities, housing, jobs, and recreation.

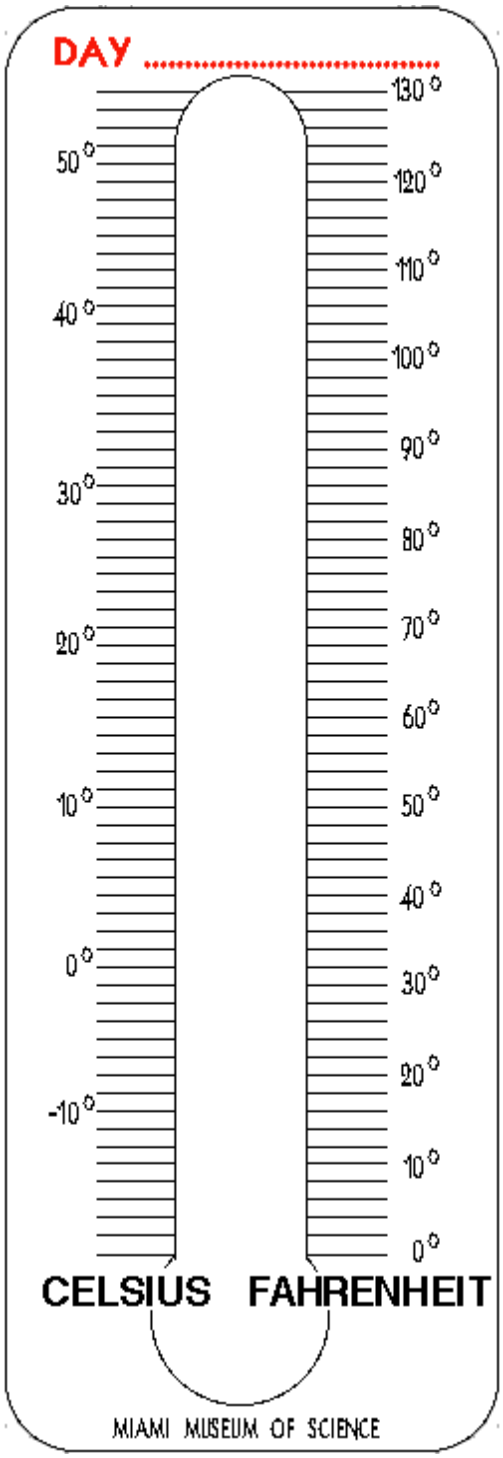
Resources

- *Mathematics Enhanced Scope and Sequences, Grade 2.* http://www.doe.virginia.gov/VDOE/EnhancedSandS/mathematics.shtml. This lesson is also available, with minor differences, in this document.
- *Outstanding Science Trade Books for Students K–12.* National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.
- *Weather around the World*. Math Cats. http://www.mathcats.com/explore/weather.html. This children-oriented Web site displays current weather from selected places around the world.

Thermometer



Thermometer



Organizing Topic — Investigating the Weather

Related Standards of Learning

2.1 The student will conduct investigations in which
- a) observation is differentiated from personal interpretation, and conclusions are drawn based on observations;
- b) observations are repeated to ensure accuracy;
- d) conditions that influence a change are defined;
- e) length, volume, mass, and temperature measurements are made in metric units (centimeters, meters, liters, degrees Celsius, grams, kilograms) and standard English units (inches, feet, yards, cups, pints, quarts, gallons, degrees Fahrenheit, ounces, pounds);
- f) pictures and bar graphs are constructed using numbered axes;
- g) unexpected or unusual quantitative data are recognized; and
- h) simple physical models are constructed.

2.6 The student will investigate and understand basic types, changes, and patterns of weather. Key concepts include
- a) temperature, wind, precipitation, drought, flood, and storms; and
- b) the uses and importance of measuring and recording weather data.

Essential Understandings, Knowledge, and Skills	Correlation to Textbooks and Other Instructional Materials
The students should be able to	
• observe and describe types of precipitation, including rain, snow, and ice (sleet and hail);	_____
• observe and describe precipitation in terms of evaporation and condensation of water;	_____
• observe and record daily weather conditions, such as sunny, cloudy, windy, rainy, or snowy;	_____
• describe weather in terms of temperature, wind, and precipitation;	_____
• measure and record weather data, using weather instruments, including a thermometer, rain gauge, and weather vane (standard English and metric measures);	_____
• record and interpret daily temperature, using a graph with numbered axes;	_____
• observe and describe seasonal weather patterns and local variations;	_____
• identify common types of storms. Examples include hurricanes, tornadoes, blizzards, and thunderstorms;	
• compare and contrast droughts and floods;	_____
• evaluate the influence of daily weather conditions on personal activities and dress.	_____

Backyard Weather

Organizing Topic Investigating the Weather

Overview Students observe weather conditions and discover weather-related things and phenomena in their own environment.

Related Standards of Learning 2.3a, b

Objectives

The students should be able to

- observe and describe types of precipitation, including rain, snow, and ice (sleet and hail);
- observe and record daily weather conditions, such as sunny, cloudy, windy, rainy, or snowy;
- describe weather in terms of temperature, wind, and precipitation.

Materials needed

- Science notebook/journal
- "Weather Scavenger Hunt" collection sheets (p. 21)

Instructional activity

Content/Teacher Notes

During this set of activities, students go outside to observe weather conditions and complete a scavenger hunt. In the first activity, students make observations about the weather and record data in their journals. In the second activity, students have another opportunity to reflect on weather, how it changes and the effects it has on people and things. They collect, list, or sketch things that are weather-related. This activity is best done on a sunny day with the students working in teams.

Activity 1

1. Before going outside, ask students what they think of when they hear the word "weather." What kinds of things would they look for if they wanted to describe the weather of a particular day to someone else? What kind of a day do they consider to be a "nice" day?
2. Lead a discussion on how weather affects their daily lives, considering such factors as the kinds of clothes they wear and the outdoor activities that they do.
3. Take students outside. Have them bring a pencil and a clipboard and, as they walk, write as many words as they can to describe the weather. Remind them to record things about weather that might not be visible but might be felt, such as wind.
4. Back in the classroom, have students share some of the words (e.g., *sunny, clear, blue, partly cloudy, cloudy, overcast, gray, calm, windy, rainy, wet, snowy, icy, sleet,* and *hail*) they used to describe the weather that day, and record their words on a "Weather Words" chart. Challenge them to come up with new words each day.
5. Have students complete this weather observation two or three times that week.
6. At the end of the week, have students focus on the "Weather Words" chart. Have them discuss the words in small groups and then, as a whole class, generate a list of the aspects of weather that are important to them and that they think would be important to study. Ask them the following questions:

- Why is it important to study weather?
- What are some things that you would like to know about weather everyday?
- What kind of information is important to collect?
- Is there a better way to study (or monitor) weather than just describing it in words and pictures?
- What kinds of instruments could you use to collect weather information?
- What things should these instruments measure?

Activity 2

1. Divide students into small groups, and provide each group with a "Weather Scavenger Hunt" collection sheet. One student should serve as the recorder.
2. After the students have completed the activity, have the groups report on their findings, explain the item found for each direction, and tell why they chose that item.

Sample assessment

- Assess student journals and "Weather Scavenger Hunt" sheets.

Follow-up/extension

- As an alternative, have students complete a scavenger hunt at home with their families.

Resources

- *CIESE Online Classroom Projects:* "Wonderful World of Weather." http://www.k12science.org/curriculum/weatherproj/index_NEW.html. This lesson is adapted from this source.
- *Outstanding Science Trade Books for Students K–12.* National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.
- *Severe Storms Online Meteorology Guide.* http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/svr/home.rxml.
- *USA Today Weather and Climate Information for Teachers.* http://www.usatoday.com/weather/wteach.htm.
- *The Weather Channel.* http://www.weather.com/.

Name _____

Weather Scavenger Hunt

Directions:

Hunt for the following items. Write down what you find.

Something that needs sun:	
Something that is blowing in the wind:	
Something that is bending in the wind:	
Something the cannot bend in the wind:	
Something that could protect you from rain:	
A place that gets no or very little sunshine:	
Something that reflects sunlight:	
Something the color of a cloud:	
Something the color of the sky on a sunny day:	
Something that is a sign of the season:	
Something that the wind has moved:	
A shadow of a living thing:	
A shadow of a nonliving thing:	
Something that has been damaged or changed by the weather:	
A piece of clothing that has something to do with the weather:	
Something that could soak up the rain:	
Something that feels warm from the sun:	
Something that is damp from rain:	

Weather Instruments

Organizing Topic Investigating the Weather

Overview Students are introduced to the use of some basic weather instruments.

Related Standards of Learning 2.6a, b

Objectives

The students should be able to

- measure and record weather data, using weather instruments, including a thermometer, rain gauge, and weather vane (standard English and metric measures).

Materials needed

- Science journals
- Thermometers — one for each student
- Compass
- Paper plates or large cardboard circles
- Clay
- Glue
- Straight pins
- Tag board
- Scissors
- New, unsharpened pencils with erasers
- Clear plastic ruler
- Clear, cylindrical jar or beaker (e.g., an olive jar)
- Rubber band
- Clear tape

Instructional activity

Introduction

1. Have students generate a list of weather attributes that they would like to investigate. Tell them that, although thermometers will be provided, they will have the task of constructing the other instruments themselves.
2. Ask them some focus questions, such as
   - How can we tell from which direction the wind is blowing?
   - How can we tell how fast the wind is blowing?
   - What kind of container would be good for collecting rain?
   - How could rain be measured?
   - How could we tell how cold or hot it is outside?
3. After a brief discussion, divide students into group, and have them brainstorm things or designs for things that they could use to measure wind direction, precipitation, and temperature. Gather groups together to report on their ideas. Complete discussion of all three weather-measurement instruments in one class, and have students record their data in their journal. The groups will come up with different solutions to each problem; for example, a group might decide to hold a long paper streamer straight up in the air and observe the direction in which it points in order to

discover wind direction. After allowing time for reports, tell them that, although there are many ways to measure these things, you are going to show them how to make three weather instruments to use in this unit.

Procedure

Activity 1

Temperature is measured with a thermometer, usually made of a glass tube containing colored alcohol. As the air gets hotter, the liquid expands and its level in the tube rises. As the air gets cooler, the level falls. Air temperature, a very important part of weather measurement, is always changing. For this activity, do the following:

1. Ask: Why is it better to use a thermometer for measuring temperatures rather than having people just tell whether it feels hot or cold?
2. Give each group a thermometer, and let each student practice reading the indoor temperature. Students should look straight at the thermometer at eye level and read the temperature in degrees Fahrenheit and degrees Celsius. If needed, review what each line between the larger numbers stands for.
3. Go over the directions for using the thermometer outdoors:
   - After you go outside, wait two minutes before you take a reading. This is to allow the thermometer to reach or adjust to the outside air temperature.
   - Take the outdoor reading away from the building, which may influence it.
   - Take the reading out of direct sunlight, which would make it too high.
   - Hold the thermometer at about eye level; it should never be at ground level.
   - Do not allow rain or snow to fall on the thermometer.
4. Have students go outdoors and record the air temperature in their journal. Check to make sure that they are following the above directions and reading their thermometers correctly.
5. After students come back inside, have them share the temperatures each of them found. Ask students why there may be some variations in the numbers and to give some reasons for this.

Activity 2

A wind vane is probably one of the first weather instruments ever used. Knowing the direction of the wind is an important part of predicting weather because wind brings us our weather. The part of the vane that points into the wind is usually shaped like an arrow. The other end is wide so that it catches the breeze. For directions to make a wind vane, see the *CIESE Online Projects* "Wonderful World of Weather" site at http://www.k12science.org/curriculum/weatherproj/vane_NEW.html.

The arrow points in the direction *from* which the wind is blowing: e.g., if it is pointing to the east, it means the wind is coming *from* the east. *Wind direction* is the direction *from* which the wind is blowing: e.g., a *west wind* is blowing *from the west*.

1. Have the students make wind vanes according to the directions found at the CIESE Web site. Also, have them mark their paper plates with the directions N, S, E, and W.
2. Determine the direction of north, south, east, and west by using a compass, if necessary.
3. Before taking the class outside, make sure that there is some breeze and that the wind vanes are well anchored in pieces of clay.
4. Have the students place their paper plates on a flat surface and put their wind vanes in the center. If it is very breezy, the students could work in pairs, one student holding down the paper plate and another taking the direction reading.

5. Use the compass to show the students the direction of north so that they can align the "N" marking on their plate to the north. If you have access to a blacktop area, mark the compass points in chalk on the blacktop to make it easier for the students to read the wind direction.
6. Have students observe the vane. The arrow will point in the direction *from* which the wind is blowing. Have the students read and mark that direction on the paper plate.
7. After students have collected the data, have them share it with the class. Account for sources of error.

Activity 3

1. Make a rain gauge for class use. For directions to make the gauge, see the *CIESE Online Projects* "Wonderful World of Weather" site at http://www.k12science.org/curriculum/weatherproj/raingauge_NEW.html.
2. Have students practice reading the measurement of a rain gauge. Fill the gauge with varying amounts of water, and have them take measurements to the nearest 1/4" (5 mm).
3. Have the students place the rain gauge outside, take a reading after each rainfall, and record it. Remember to empty the gauge after each reading. If the gauge cannot be left outside, have the students place it outside at the beginning of each rainy day and bring it in at the end of the day. It should not be put under or near trees or too close to buildings, which may block the rain. Have students record the amounts of rain in the gauge on their data sheet.

Sample assessment

- Check the data in students' journals to see that it is complete and correct.
- Determine whether students can take accurate measurements with a thermometer, a wind vane, and a rain gauge.

Follow-up/extension

- Put a thermometer in different locations outside around the school building, and have students compare the differences in temperature readings, recording the conditions around the thermometer in each location as well.

Resources

- *CIESE Online Classroom Projects:* "Wonderful World of Weather." http://www.k12science.org/curriculum/weatherproj/index_NEW.html. This lesson is adapted from this source.
- *Outstanding Science Trade Books for Students K–12.* National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.
- *Severe Storms Online Meteorology Guide.* http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/svr/home.rxml.
- *USA Today Weather and Climate Information for Teachers.* http://www.usatoday.com/weather/wteach.htm.
- *The Weather Channel.* http://www.weather.com/.

Collecting Weather Data

Organizing Topic Investigating the Weather

Overview Students collect weather data each day for two weeks and then analyze and discuss it with class.

Related Standards of Learning 2.1a, b, d, g, f, g, h; 2.6a, b

Objectives

The students should be able to

- record and interpret daily temperature, using a graph with numbered axes;
- observe and describe seasonal weather patterns and local variations;
- evaluate the influence of daily weather conditions on personal activities and dress;
- observe and record daily weather conditions, such as sunny, cloudy, windy, rainy, or snowy.
- describe weather in terms of temperature, wind, and precipitation;
- measure and record weather data, using weather instruments, including a thermometer, rain gauge, and weather vane (standard English and metric measures);
- observe and describe types of precipitation, including rain, snow, and ice (sleet and hail);
- identify common types of storms. Examples include hurricanes, tornadoes, blizzards, and thunderstorms;
- compare and contrast droughts and floods.

Materials needed

- "Weather Log" handouts (p. 28) — five for each student
- Weather instruments made during the previous lesson (p. 22)
- Wall chart for displaying daily weather data
- Compasses

Instructional activity

Content/Teacher Notes

Schedule a two-week period during which the students can go outside at the same time each day and collect weather data. Generally, late morning or early afternoon is best. Prepare a "weather calendar" for the data-collection time period. A good way to do this is to construct a calendar on a large piece of oaktag with a large block (at least 6" by 6" or 15 cm by 15 cm) for each day of the collection period. Allow 5 to 10 minutes each day for the students to make and record their observations and an additional 15 to 20 minutes for discussion and recording their information on the class chart.

Introduction

Tell the students that they are now going to go out and use the instruments that they have made and that they will be recording their measurements every day in a log. The log will be an important tool because they will use it to record other information as time goes on.

Procedure

1. Give each student enough Weather Logs to cover the 10 days of data collection (five pages). Allow them to make a booklet by adding a cover and decorating it.

2. The students will have practiced how to read and record measurements with each instrument, but they should now decide on a standardized way to report sky conditions. Have students work in groups to come up with some ways of reporting cloud cover, and then have the class come to a consensus as to the words to use, e.g., *cloudy*, *partly cloudy*, *overcast*, *gray*, *sunny*, *clear*, and/or *blue*.
3. Discuss and model how to make entries into the Weather Log. Place emphasis on making careful observations and recording them accurately in order to facilitate sharing of the information.
4. Take the groups outside and lead them through the first entries. On the following days, they should be able to do the data collection and recording themselves.
5. Average the students' readings, and record temperature and rain amounts on wall chart.
6. At the end of two weeks, give the students some time to look at their logs and make notes on patterns, trends, or anything else that interests them.
7. Have students make bar graphs of the temperature and precipitation data.
8. Hold a whole-class discussion in which students analyze the logs for patterns and trends. Ask questions such as:
    - In general, how did the weather change during the week?
    - How would you describe the weather for the two-week period?
    - Does the temperature seem to be going up, down, or staying the same?
    - Was there any relationship between the wind and the temperature the next day?
    - Was it colder on cloudy days?
    - Was it colder on days that the wind was coming from the north and warmer when the wind was coming from the south?

    Discuss with them how the weather affects their daily activities.
9. While discussing precipitation, it would be appropriate to discuss examples of storms and different types of precipitation associated with each. Hurricanes, tornadoes, blizzards, thunderstorms, floods, and droughts should all be discussed. Show students examples of each, using pictures or videos. Perhaps read a story relating to a storm or storms.

Sample assessment

- Have students use their logs to answer questions about the data they collected, e.g., coldest day, the warmest, the wettest, etc.

Follow-up/extension

- Have the students record the temperature at their house each morning, and compare all the readings from all the students' homes. If there are variations, discuss why.

Resources

- *CIESE Online Classroom Projects:* "Wonderful World of Weather." http://www.k12science.org/curriculum/weatherproj/index_NEW.html. This lesson is adapted from this source.
- *Outstanding Science Trade Books for Students K–12.* National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.

- *Severe Storms Online Meteorology Guide.* http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/svr/home.rxml.
- *USA Today Weather and Climate Information for Teachers.* http://www.usatoday.com/weather/wteach.htm.
- *The Weather Channel.* http://www.weather.com/.

Weather Log

Date:	
Time:	
Temperature:	
Sky:	
Wind:	
Wind Direction:	
Precipitation Type:	
Precipitation Amount:	

Date:	
Time:	
Temperature:	
Sky:	
Wind:	
Wind Direction:	
Precipitation Type:	
Precipitation Amount:	

Organizing Topic — Investigating the Effects of Seasonal Changes

Related Standards of Learning

2.1 The student will conduct investigations in which
- a) observation is differentiated from personal interpretation, and conclusions are drawn based on observations;
- b) observations are repeated to ensure accuracy;
- c) two or more attributes are used to classify items;
- d) conditions that influence a change are defined;
- f) pictures and bar graphs are constructed using numbered axes;
- h) simple physical models are constructed.

2.7 The student will investigate and understand that weather and seasonal changes affect plants, animals, and their surroundings. Key concepts include
- a) effects on growth and behavior of living things (migration, hibernation, camouflage, adaptation, dormancy); and
- b) weathering and erosion of the land surface.

Essential Understandings, Knowledge, and Skills	Correlation to Textbooks and Other Instructional Materials
The students should be able to	
• identify growth and behavioral responses of plants and animals to weather and seasonal changes. Examples of responses that are adaptive include migration, hibernation, and dormancy;	_____
• identify animals that migrate, hibernate, or show other changes throughout the seasons or in the presence of adverse environmental conditions;	_____
• evaluate the usefulness of camouflage in an animal's habitat (for example, coloration patterns in frogs);	_____
• compare and contrast the responses of plants and animals to weather and seasonal changes;	_____
• model the effects of weathering and erosion on the land surface.	_____

What Changes When the Seasons Change?

Organizing Topic Investigating the Effects of Seasonal Changes

Overview Students focus on the effects of weather and seasonal changes, as well as the vocabulary related to these changes.

Related Standards of Learning 2.1a, h; 2.7a

Objectives

The students should be able to

- identify growth and behavioral responses of plants and animals to weather and seasonal changes. Examples of responses that are adaptive include migration, hibernation, and dormancy;
- identify animals that migrate, hibernate, or show other changes throughout the seasons or in the presence of adverse environmental conditions;
- evaluate the usefulness of camouflage in an animal's habitat (for example, coloration patterns in frogs);
- compare and contrast the responses of plants and animals to weather and seasonal changes.

Materials needed

- Chart paper
- Blank booklets — one for each student (construction paper folded in half as the cover and three sheets of plain paper folded in half as pages)
- A photo or picture of a duck
- A half or quarter piece of poster board for each group of three students
- "Habitat Cards" (index cards or strips of paper with the name and a picture of familiar habitats, such as Football Field, Soccer Field, School Cafeteria, Library, Playground, Art Room, Movie Theater, Skating Rink, and/or other familiar places)
- Art materials, such as crayons, markers, and scraps of construction paper

Instructional activity

Content/Teacher Notes

Make certain that the students know the meanings of the following vocabulary terms:

- *migration:* the seasonal movement of animals from one place to another
- *hibernation:* a sleep state for survival during cold months
- *camouflage:* blending into the surrounding environment
- *dormancy:* in plants, a period of no growth
- *adaptation:* ways plants and animals change to survive in their habitats

Introduction

1. Display a wall chart with five columns and at least 20 rows. Begin the group of lessons with a brainstorming session. Have the students name the four seasons, and list these on the chart at the top of columns two through five.
2. In column one on the second row, write the word *squirrel*. Ask students what squirrels do in each of the seasons and why. Record shortened versions of their replies under each season.
3. Encourage students to name other animals and plants, continuing to fill in the chart. Be sure the students include a variety of animals (mammals, birds, insects) and plants (trees, flowers) as well as people's clothing and people's activities.

4. Encourage use of the terms *migration, hibernation, camouflage,* and *dormancy* to describe the seasonal changes/activities of the items listed on the chart.

Procedure

The procedure is divided into several different sessions, each of which may take more than one class period to complete.

Session 1

1. Explain that *adaptations* are changes that plants and animals have gone through in order to survive. Explain that these adaptations can be ways they look or ways they behave. Have the students pick out the four terms *migration, hibernation, camouflage,* and *dormancy* on the chart created in the introductory activity, highlighting the terms as they are pointed out.
2. Distribute a blank booklet to each child. Have them title their booklet "Adaptations," making a title page as well as the cover.
3. Have students write one of the four terms on the back of the title page and write a brief definition of the term underneath. On the page opposite, have them draw an animal or plant displaying that form of adaptation. The picture should show the animal's or plant's surroundings.
4. Continue in this way until all four terms have been listed, defined, and illustrated.

Session 2

1. Review the definition of the term *adaptation* and the four adaptations already studied. Discuss that these are not the only adaptations that happen. Show a picture of a duck, and discuss how the duck's feathers, webbed feet, and bill are adapted to its environment. Tell the students that other animals also have specific adaptations, and allow students a few minutes to brainstorm some of these (e.g., a beaver's teeth, a mole's paws, an anteater's sticky tongue).
2. Divide the class into groups of three. Give each group one poster board, art supplies, and a "Habitat Card," and tell them that they should create an animal or plant that can survive in that habitat. Invite them to be creative in their adaptations. Use the term *adaptation* frequently.
3. After students have completed their posters, have them share them with the group, explaining the adaptations shown by the animal or plant they created.

Observations and Conclusions

1. From Session 1, students should understand adaptations and that these adaptations are there to help plants and animals survive the changing seasons and weather. From Session 2, students should understand that animals and plant adapt to the seasons and weather in their habitats in a variety of ways. Some of these ways are in the way the act, and other are in the ways they look.

Sample assessment

- Informally assess student definitions and drawings in their "Adaptation" booklets and on their poster presentations.
- Have students fill in the following blanks, using the four terms *migration, hibernation, camouflage,* and *dormancy*:
    - A tree frog has patterns and colors that match the leaves on a nearby tree. This is an example of _____. (camouflage)
    - A whale travels hundreds of miles to mate and then returns to his usual area. This is an example of _____. (migration)

  - A frog burrows under the leaves and mud at the bottom of the pond during the cold winter months. This is an example of _____. (hibernation)
  - A tree loses all its leaves and stops growing during the winter months. This is an example of _____. (dormancy)
- Have students write the names of plants and animals that use the adaptations studied.

Follow-up/extension

- Have students use the last pages of their booklet to list other specific animal or plant adaptations.
- Have the students create murals showing each of the seasons and ways various plants or animals adapt to them.
- Create lists of animals that display the various adaptations discussed.

Resources

- *Outstanding Science Trade Books for Students K–12*. National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.

Organizing Topic — Investigating Solids, Liquids, and Gases

Related Standards of Learning

2.1 The student will conduct investigations in which
- a) observation is differentiated from personal interpretation, and conclusions are drawn based on observations;
- b) observations are repeated to ensure accuracy;
- c) two or more attributes are used to classify items;
- d) conditions that influence a change are defined;
- e) length, volume, mass, and temperature measurements are made in metric units (centimeters, meters, liters, degrees Celsius, grams, kilograms) and standard English units (inches, feet, yards, cups, pints, quarts, gallons, degrees Fahrenheit, ounces, pounds);
- f) pictures and bar graphs are constructed using numbered axes;
- g) unexpected or unusual quantitative data are recognized; and
- h) simple physical models are constructed.

2.3 The student will investigate and understand basic properties of solids, liquids, and gases. Key concepts include
- a) mass and volume; and
- b) processes involved with changes in matter from one state to another (condensation, evaporation, melting, and freezing).

Essential Understandings, Knowledge, and Skills	Correlation to Textbooks and Other Instructional Materials
The students should be able to	
• classify materials as to whether they are liquids, solids, or gases;	_____
• measure the mass of solids and the volume of liquids in metric and standard English units;	_____
• design an investigation to determine basic factors that affect the evaporation of water;	_____
• examine and describe the transformation of matter from one state to another, i.e., solid water (ice) to liquid (water) to gas (steam);	_____
• conduct an investigation to observe the condensation of water;	_____
• describe and identify example of condensation, evaporation, melting, and freezing of water;	_____
• identify the uses of water in the home and at school.	_____

Water Cycle

Organizing Topic Investigating Solids, Liquids, and Gases

Overview Students use a water-cycle model to understand the liquid and gas phases of water.

Related Standards of Learning 2.1a, b, c, d, e, h; 2.3b

Objectives

The students should be able to

- examine and describe the transformation of matter from one state to another, i.e., solid water (ice) to liquid (water) to gas (steam);
- identify the uses of water in the home and at school;
- conduct an investigation to observe the condensation of water.

Materials needed

Per student:

- Two clear 9-oz beverage cups
- A 3-1/4-oz. plastic condiment cup
- Small rock that fits in the bottom of the 9-oz. cup
- Ice
- Water
- Permanent marker
- Masking tape
- Metric ruler
- "The Water Cycle" student activity sheets (see. p. 37)
- "The Water Cycle Song" sheet (p. 38)

Instructional activity

Content/Teacher Notes

The sun's energy heating the Earth causes water to evaporate. The resulting water vapor rises in warm air and eventually meets a cooler air mass. Warm air holds more water than cool air; therefore, as the warm air mass cools when it meets the cooler air mass, water molecules come together —they *condense* — and form water droplets. These droplets fall as precipitation. This unceasing process is called the *water cycle* or the *hydraulic cycle.*

In this activity, the environment in the plastic container simulates the water cycle on the Earth. The sun or lamp, which represents the sun, heats the water in the cup. The water in the cup, which represents the ocean, evaporates and then condenses when it hits the cup of ice, which represents the cooler air masses in the upper atmosphere. After some time, the condensed water vapor falls to the rock, which represents the Earth, and eventually makes its way back to the "ocean." Once the water cycle has begun to flow, the water level should remain about the same in the cup. The water in the Earth's environment is constantly recycled. This activity may be done as a class demonstration, in small groups, or as individuals.

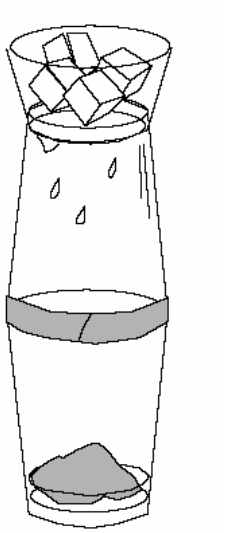
Introduction

1. At the beginning of the day on which you do this activity, or the day before, ask students what they think will happen if you put a wet paper towel on the windowsill in the sun. (If you do not have a sunny window or if it is cloudy, you can use a lamp to create "sunshine.") Have them explain what

they think will happen, and then put the paper towel on the windowsill. When you are ready to begin the activity, revisit the paper towel; it should be dry or much drier than it was in the beginning. Ask students what they think happened to the water.

Procedure

1. Have the students place the rock in the bottom of one of their 9-oz. plastic cups.
2. Let them add water so the rock is half covered. (Warm water will make the evaporation process start sooner.)
3. Tell them to place the second 9-oz. cup on top of the cup with the rock and water in it, making a dome.



4. Have them use masking tape to seal the two cups together tightly at the seam where the they meet. Students may need help with this step. The resulting container represents a closed water-cycle model.
5. Distribute ice into the 3-1/4-oz. cups, and have the students place them on top of their models.
6. Have the students place the models in a sunny location on the windowsill or under a lamp, and watch closely to find out what happens.
7. Have students complete the "The Water Cycle" student activity sheet.

Observations and Conclusions

1. Ask students the following questions, and discuss their responses:
   - What happens in the model? What role does the sun play?
   - In this activity, what does the lamp (if used) represent? The cup of ice? The rock?
   - What causes the water droplets to form? How do they get there?
   - Was any water lost in this activity? (Have students make a hypothesis.) How can this hypothesis be tested?
   - How does evaporation occur in the Earth's water cycle?
   - How does condensation occur?
2. Ask students what they think would happen if you put a cold can of soda on your desk. (This works best on a warm, humid day.) They will probably say that the can will sweat. But does it really sweat? When we sweat, water comes from the inside of our bodies out to the surface of our skin. Is the water really coming from the inside of the can? No, the water is coming from the air! The water condenses on the can and eventually drips down on the table. Why does this happen?

Warm air holds more water than cool air. The cold temperature of the can cools the air close around it. This cooler air cannot hold as much water as the warm air, so the water is deposited on the can as condensation.

Sample assessment

- Assess "The Water Cycle" student activity sheets.
- Have students draw a picture of the water cycle.
- The next time it rains, ask students to explain what is happening.

Follow-up/extension

- Display "The Water Cycle Song" sheet on the overhead (or copy it on chart paper), and sing it with the class. Keep it on display to sing at various times during study of this topic. You may also wish to sing "The Itsy Bitsy Spider" (see http://www.enchantedlearning.com/rhymes/Spider.shtml)
- Make a larger version of the water-cycle model, using a large, clear plastic container. A container from a salad bar works well. Measure the depth of the water before sealing. Then set up a second large version of the water cycle in which a small section of the lid has been cut away. Make sure that the water in the second model is exactly the same depth as that in the first. Leave the models in place for about a week. Have the students measure the two water levels daily. How do the results compare?

Resources

- *Physical Science SOLutions: Grade K–6.* Science Museum of Virginia, Virginia Department of Education. http://www.smv.org/pubs/PSSolutionsTOC2.pdf. This lesson is adapted from this source.
- *Outstanding Science Trade Books for Students K–12.* National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.

Scientist's Name: _____ Date: _____

The Water Cycle

Materials:

masking tape	2 larger plastic cups	1 rock
1 small plastic cup full of ice	metric ruler	water

Observations:

How deep is the water in my container? _____ cm

After 24 hours, how deep is the water in my container? _____ cm

What happened in my container?

What does the rock represent?

What causes the water droplets to form on the cup?

Was any water lost in this activity? _____ How do you know?

Conclusions:

How does evaporation occur in the Earth's water cycle?

How does condensation occur?

The Water Cycle Song

(Sung to the tune of "Oh My Darlin' Clementine")

Evaporation,

Condensation,

Precipitation all the time...

This is called the

water cycle,

And it happens all the time.

Mix It Up: It's Refreshing

Organizing Topic Investigating Solids, Liquids, and Gases

Overview Students identify all three states of matter as they prepare a refreshing drink.

Related Standards of Learning 2.3b

Objectives

The students should be able to

- classify materials as to whether they are liquids, solids, or gases.

Materials needed

Per student:

- Clear cup
- Pitcher of juice or flavored drink mix — enough for the whole class
- Three or four small pieces of dry ice
- Spoon
- Plates

Instructional activity

Content/Teacher Notes

This activity uses dry ice, which is carbon dioxide (which we exhale when we breathe) in its solid state. Dry ice is extremely cold — about -80^{o} Celsius or -112^{o} Fahrenheit. When dry ice warms up, it does not follow the typical steps of becoming a liquid and then a gas. Under normal atmospheric pressure, carbon dioxide goes straight from a solid state to a gaseous state. This process is called *sublimation* and will be illustrated in this activity. Sublimation can happen with water in dry climates. When there is low humidity, snow and ice seem to disappear, forming very little water. This is because the snow and ice are actually becoming water vapor and dissipating without melting into liquid. Because of this, if you fall in snow in a dry climate, your clothes will not get wet.

Safety Note: Dry ice can cause burns if it touches skin. Instruct the students never to let dry ice touch their bare skin, but always to use insulated gloves when handling dry ice.

Dry ice can be kept for several hours in a closed cooler. To find dry ice in your area, look up "Dry Ice" in the Yellow Pages of the phone book.

Procedure

1. If necessary, go through a review of the states of matter. Ask the students to think of instances in which they have seen a material change from one state of matter to another. Good examples include water freezing or melting. Remind the students that such changes often depend on temperature: if ice is heated, it becomes a liquid (water); if it is heated even more, it becomes a gas (water vapor, or steam). Tell the class that in this experiment, they are going to get a chance to see a solid turn directly into a gas, a process called *sublimation.*
2. Pass out a cup of juice to each student. The cups should be no more that two-thirds full.
3. Add three or four small pieces of dry ice to each student's cup. Have students observe what is happening.

4. Once the bubbling has completely stopped, have the students stir the liquid, drink it, and enjoy! Ask: Is it any different from what you are used to?

Observations and Conclusions

1. Lead a class discussion, using the following questions:
   - What happened when the solid (dry ice) was dropped into the liquid (drink)? (The dry ice warmed up and became a gas. This gas, carbon dioxide, was seen in the form of bubbles.)
   - How did the dry ice change the drink? (The drink became carbonated, like a soda. It also became cooler.)
   - Name some other carbonated drinks. How are all these drinks similar? (All of them have gas bubbles in them — that is, all are mixtures of two states of matter.

Sample assessment

- Give students a list of familiar things, and have them classify these items as solids, liquids, or gases.

Follow-up/extension

- Demonstrate a liquid changing to a solid by making ice cream or gelatin.
- Demonstrate matter changing from one state to another with the following activity:
  - Demonstrate a solid changing to a liquid by melting ice. Have the students draw a picture of this process.
  - Then demonstrate a liquid changing to a gas by boiling the water. Have the students draw this.
  - Capture some of the steam in a plastic bag, seal the bag, and have the students watch closely as the steam cools. Point out that the liquid condensing in the bag shows the gas changing back to a liquid. Have the students draw this.
  - Freeze the condensed water to show the liquid changing back to a solid. Have the students draw this.
  - Complete this exploration of the states of matter by having the students arrange their pictures in order in a circle. You may wish to make a circular water-cycle display, using some of the students' pictures.

Resources

- *Physical Science SOLutions: Grade K–6.* Science Museum of Virginia, Virginia Department of Education. http://www.smv.org/pubs/PSSolutionsTOC2.pdf. This lesson is adapted from this source.
- *Outstanding Science Trade Books for Students K–12.* National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.

Disappearing Water

Organizing Topic Investigating Solids, Liquids, and Gases

Overview Students investigate where the water goes when puddles dry up and disappear.

Related Standards of Learning 2.1e; 2.3b

Objectives

The students should be able to
- measure the mass of solids and the volume of liquids in metric and standard English units;
- describe and identify examples of condensation, evaporation, melting, and freezing of water;
- design an investigation to determine basic factors that affect the evaporation of water.

Materials needed

Per group:
- Three plastic lids or plastic plates of the same size
- Three different colored sponges of the same size
- Water
- Balance
- Measuring cup
- Permanent marker

Per student:
- "Disappearing Water" activity sheet (p. 44)

Instructional activity

Content/Teacher Notes

Evaporation is happening around us all the time. Water evaporates from lakes, rivers, puddles, and the ocean. It evaporates from the bathtub after we bathe and from our skin when we sweat. *Evaporation* takes place when a liquid that is at a temperature below its boiling point changes into a gas. When the sun or other heat source warms a liquid like water, some of the molecules at the liquid's surface vibrate fast enough to escape into the surrounding air. These molecules form a vapor. The warmer the temperature, the faster the liquid will evaporate. Wind also speeds up the evaporation process. Evaporation slows down and may stop when the air can no longer absorb molecules from the liquid. This is the reason that on a very humid day, a puddle will evaporate more slowly than on a less humid or dry day.

In this activity, students experiment with water turning into water vapor as it evaporates. Water vapor is an invisible gas that is around us all the time. In the experiment, students compare the evaporation rates of three plates of water — one placed outside, one in a closet or cabinet, and one on the windowsill. The water should evaporate fastest in the warmest place. Most of the time, the plate placed outside will lose water fastest because both the sun and the wind speed up evaporation. However, if it is very cold or very humid outside, the plate on the windowsill may lose water the fastest.

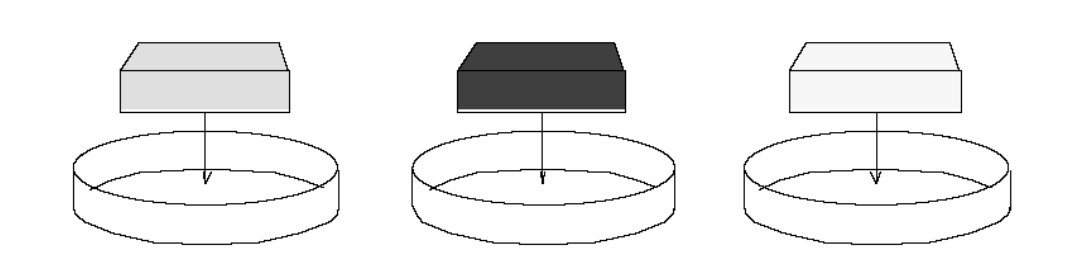
Mass is a measure of the amount of matter (stuff) in an object. Mass is different from weight. *Weight* measures the pull of gravity on an object and changes when the gravitational pull changes. For example, if you were standing on the moon, which has a weaker gravitational pull than Earth, you would weigh less (1/6 of your weight here on Earth), but you would still have the same amount of matter in your body as you do on Earth. Your mass would be the same.

Introduction

1. Before beginning this activity, cut all the sponges so they fit on the plates and are the same size. To ensure that students use the correct volume of water for the size of their sponge and plate, make sure you test this step before doing the experiment with the class.
2. Ask students what happens to puddles outside after it rains. Tell them that they are going to make their own puddles and find out what happens!

Procedure

1. Have the students observe the weather outdoors and record the information on their "Disappearing Water" activity sheet.
2. Assign each group a letter of the alphabet, and have them write this letter on each of their plates where they can see it when the sponge is on the plate.
3. Have each group choose a different color of sponge for each of their three plates. Have each group designate a specific color for each of three locations — outdoors, in a closet or cabinet, and windowsill — and record this information on the activity sheet.



4. Have the students use a measuring cup to measure a volume of water and then pour this volume of water on one of the sponges. Then have them pour *the same volume* of water on each of their other two sponges and record on the activity sheet this volume for each of the three sponges.
5. Direct each group to measure the mass of each of their wet sponges and plates, using a balance, and record this information on their activity sheet. These measurements should be approximately equal.
6. Then let the student place their sponges and plates in the three designated locations according to the colors they have chosen. (If the temperature outside is very cold or if there is rain in the forecast, place the outdoor plate indoors near a heat source, such as a heating duct or radiator.)
7. Have the students check their plates after 24 hours. Which sponge looks the wettest? Which looks the driest? Ask how they can prove that the one that looks the wettest really is the wettest.
8. Direct the students to find the mass of each sponge and plate after 24 hours, again using the balance. Have them compare these new weights to the original weights. By subtracting the mass after 24 hours from the original mass, they can find out how much water was lost. The higher the number, the more water was lost and the drier the sponge should be.

Observations and Conclusions

1. Discuss with the students the fact that the evaporation process occurs continuously, but that we do not notice because water vapor is invisible. In fact, if all the water vapor in the air became liquid all at once, it would flood the entire Earth to a depth of three feet!
2. Ask the students the following questions:
   - Where did the water go?

- Why do you think this happened? (Hint: What was the weather like in each of the locations?)
- How could you provide data that would back up your answer?

Sample assessment

- Assess the students' "Disappearing Water" activity sheet.
- Have the students measure the mass and volume of other things.

Follow-up/extension

- Put a thermometer in each location, and have the students check and record the temperature periodically. Have them use this data to make some predictions about why things happen the way they do.

Resources

- *Physical Science SOLutions: Grade K–6.* Science Museum of Virginia, Virginia Department of Education. http://www.smv.org/pubs/PSSolutionsTOC2.pdf. This lesson is adapted from this source.
- *Outstanding Science Trade Books for Students K–12.* National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.

Scientist's Name: _____ Group:____ Date: _____

Disappearing Water

Materials per group:

3 plastic plates 3 different colored sponges measuring cup
water balance

Weather observations:

Temperature: _____
☐ Sunny ☐ Partly Cloudy ☐ Cloudy ☐ Raining
☐ Windy ☐ Calm

Other observations:

_____

Data Collection Chart:

Measurements	Outdoors Sponge (color: _____)	Windowsill Sponge (color: _____)	Closet Sponge (color: _____)
Volume of water added			
Mass of wet sponge and plate			
Mass of sponge and plate after 24 hours			

Make observations!

Which sponge and plate looks like it lost the *most* water? _____

Which sponge and plate looks like it lost the *least* water? _____

Disappearing Water

continued

Be a scientist!

How much water was lost from each sponge after 24 hours? (To find this answer, you will need to do some subtraction, using the numbers on your Data Collection Chart.)

mass of wet sponge and plate originally
— mass of sponge and plate after 24 hours
mass of water that evaporated

	Outdoors Sponge	Windowsill Sponge	Closet Sponge
Mass of Water Lost			

Conclusions:

Which sponge and plate lost the *most* water? _____

Which sponge and plate lost the *least* water? _____

Where did the water go?

Why do you think this happened? (Hint: What was the weather like in each of the locations?) Think about how you could provide data to back up your answer!

Organizing Topic — Investigating Magnets and Metals

Related Standards of Learning

2.1 The student will conduct investigations in which
- a) observation is differentiated from personal interpretation, and conclusions are drawn based on observations;
- b) observations are repeated to ensure accuracy;
- c) two or more attributes are used to classify items;
- d) conditions that influence a change are defined;
- h) simple physical models are constructed.

2.2 The student will investigate and understand that natural and artificial magnets have certain characteristics and attract specific types of metals. Key concepts include
- a) magnetism, iron, magnetic/nonmagnetic, poles, attract/repel; and
- b) important applications of magnetism, including the magnetic compass.

Essential Understandings, Knowledge, and Skills	Correlation to Textbooks and Other Instructional Materials
The students should be able to	
• predict which materials will be attracted to magnets, test their predictions, and create a chart that shows the results, classifying materials as to whether they are attracted to magnets or not;	_____
• compare natural magnets (lodestone or magnetite) and artificial magnets;	_____
• identify the north and south magnetic poles of magnets;	_____
• conduct an investigation to determine how the different poles of magnets react to the poles of other magnets;	_____
• use magnetic compasses to determine the directions of the north and south poles;	_____
• identify important applications of magnets in everyday life, such as	
° refrigerator magnets and chalkboard letters	_____
° toys	_____
° door latches	_____
° paper clip holders;	_____
• create a new application for using a magnet.	_____

Which Way Is North?

Organizing Topic Investigating Magnets and Metals

Overview Students discover something interesting about the poles of a magnet as they investigate compasses.

Related Standards of Learning 2.2b

Objectives

The students should be able to

- use magnetic compasses to determine the directions of the north and south poles.

Materials needed

- Posters for the four compass directions (see pp. 50–53)

Per student:

- Piece of masking tape
- Writing instrument
- Student compass
- Bar magnet

CAUTION!

Keep magnets at least two feet away from computers, TVs, VCRs, computer discs, videotapes, audio tapes, video cameras, watches, and credit cards.

Do not store magnets near compasses! Magnets may damage your compasses.

Store bar magnets in their boxes, north pole to south pole. Do not throw them randomly into a box. Improper storage may weaken the magnetic fields of bar magnets.

Do not drop magnets. Sharp impacts may cause magnetic field strength to weaken.

Instructional activity

Content/Teacher Notes

About 1,000 years ago, explorers began to use magnetic compasses for navigation. The first compasses were thin pieces of lodestone — naturally occurring magnets composed of magnetite — that floated on water. Since the lodestone always pointed in the same direction, travelers were able to navigate even when it was cloudy and they could not see the stars. Today's compasses use the same magnetic property as the compasses of 1,000 years ago. We use a man-made magnetic needle that has the north end marked with a special color or symbol. We use compasses to navigate in airplanes, ships, cars, and on foot when hiking in the woods. Compasses work because the Earth acts like a giant magnet. The magnetic North Pole (which actually has a south magnetic field) attracts the colored north pole on the compass needle (which has a north magnetic field).

When a magnet is brought near a compass, the magnet's magnetic pull on the compass needle is stronger than that of the Earth, so the needle is attracted to the magnet. For this reason, always keep compasses away from magnets or anything made of iron, nickel, and cobalt if you do not want to get lost!

Practice using the compass yourself before using it with your class. Compasses can be tricky for adults who are not used to working with them.

You may need to go outside to get the compasses to point north if there is too much metal in your classroom or in the building. Test the compasses in the area you are going to use before doing the lesson with your class.

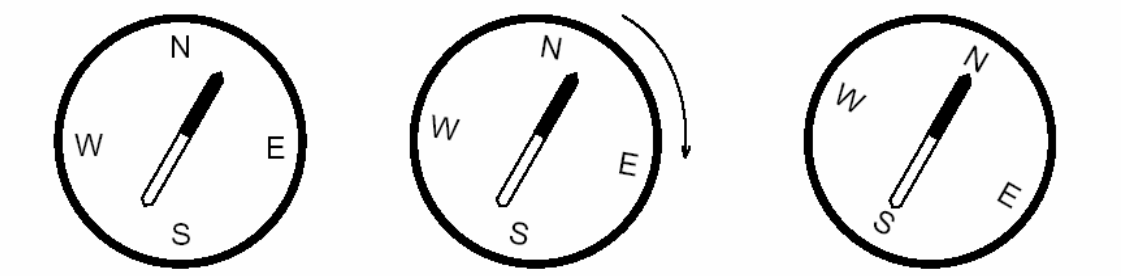
Students can damage the compasses by demagnetizing or reversing the poles of the needle, or by scratching the compass face with the magnets. Remind them to be careful!

Introduction

1. Put a short length of masking tape down on each student's desk, and tell each student to draw an arrow on the piece of tape.
2. Ask the students to think about which direction they believe is north. Tell the students to commit to their prediction by repositioning their tape so that the arrow points north.
3. Ask the students why they think they are correct. Ask them if they know of any way they could test their hypotheses.
4. Show them the large, liquid-filled compass, and ask them if they know what it is.

Procedure

1. After the students make their predictions, distribute the student compasses.
2. Tell students that the colored part of the needle should be pointing north. While the compass is sitting on the desk, the base of the compass should be turned so that the colored part of the needle is pointing directly to the "N" (which stands for north) on the compass.



3. Let students check the accuracy of their earlier predictions with the compasses. If necessary, have them correct the positions of their pieces of tape.
4. Ask the students to point in the direction of south. Of east. Of west.
5. Use the posters to label the north, south, east and west directions in your classroom.
6. Ask students if they have any idea how the compass works. Discuss their ideas.
7. Pass out the bar magnets, and allow your students to experiment with the compasses and magnets. Remind them to be careful not to scratch their compass faces. Also, spinning the needle too fast or dropping the compass can reverse the needle's magnetic field.

Observations and Conclusions

1. Tell students that there are many more applications for magnets. Show them the magnet on an electric can opener, and demonstrate what it does. Brainstorm, and make a list of other uses of magnets.

Sample assessment

- Have the students use the compass to find north. Have each student position an arrow made of tape to a desk so that it points north. Have the students identify the north and south magnetic poles of magnets.

Follow-up/extension

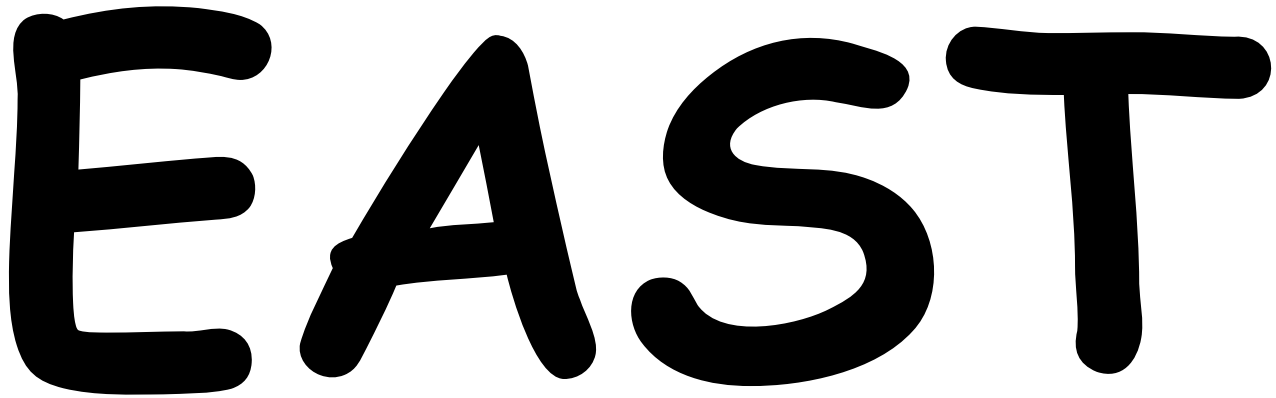
- Have students create a fictional country and make a map of it. Have them label north, south, east, and west on their map. You might make this into an art activity.

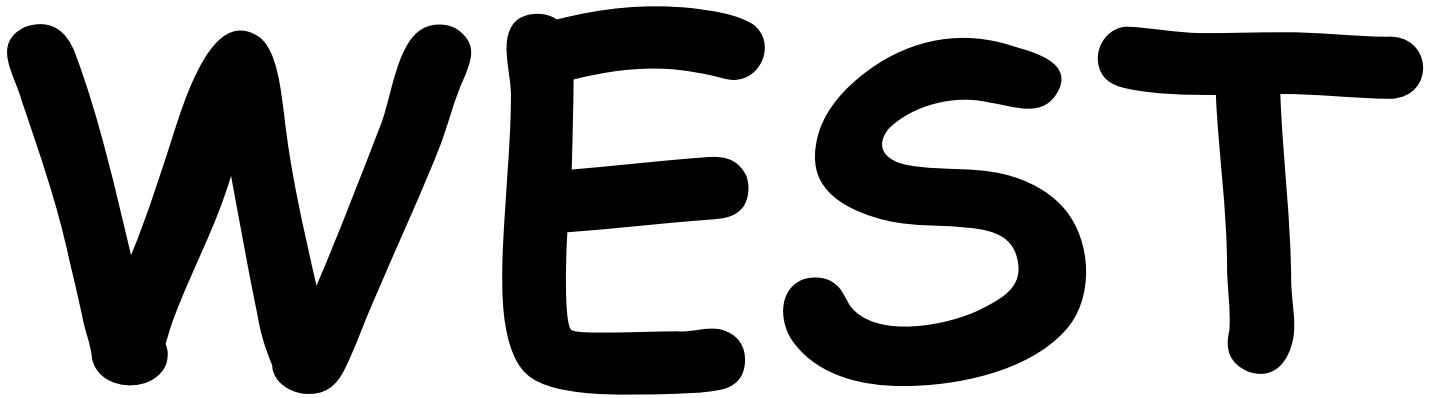
Resources

- *Physical Science SOLutions: Grade K–6.* Science Museum of Virginia, Virginia Department of Education. http://www.smv.org/pubs/PSSolutionsTOC2.pdf. This lesson is adapted from this source.
- *Outstanding Science Trade Books for Students K–12.* National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.

NORTH

SOUTH


EAST


WEST

Magnetic Barbershop

Organizing Topic Investigating Magnets and Metals

Overview Students discover the effect a magnet has on iron filings as they construct and use a toy.

Related Standards of Learning 2.2a, b

Objectives

The students should be able to

- identify important applications of magnets in everyday life, such as
  - refrigerator magnets and chalkboard letters
  - toys
  - door latches
  - paper clip holders;
- create a new application for using a magnet.

Materials needed

Per class:

- Glue gun
- Glue gun sticks
- One-quarter teaspoon measuring spoon
- Permanent marker

Per student:

- Disposable plastic petri dish
- Face cutouts (p. 57)
- Glue sticks
- Small bar magnet
- One-quarter teaspoon of iron filings
- Scissors

CAUTION!

Keep magnets at least two feet away from computers, TVs, VCRs, computer discs, videotapes, audio tapes, video cameras, watches, and credit cards.

Do not store magnets near compasses! Magnets may damage your compasses.

Store bar magnets in their boxes, north pole to south pole. Do not throw them randomly into a box. Improper storage may weaken the magnetic fields of the bar magnets.

Do not drop magnets. Sharp impacts may cause magnetic field strength to weaken.

Instructional activity

Content/Teacher Notes

In this activity, students glue faces to the bottoms of petri dishes. Iron filings are put into the dishes, which are then sealed. Students move the filings around with magnets to put "hair" in just the right places on the faces. This activity is fun, but there are several pitfalls to watch out for. Read all of the following before beginning this activity.

The activity is divided into three parts: 1) cutting and gluing the faces into the dishes; 2) adding the filings and sealing the dishes; and 3) experimenting with the finished toys. Students can easily do the first part of the activity. Older students may be able to help add the iron filings and fit the petri dish bottoms into the tops, if they are very careful. However, a teacher or adult volunteer must seal the dishes with the hot glue gun. You may want to do Part 1 of the procedure before lunch, seal the dishes while the students work on another activity, and then experiment with the completed toys after lunch. Sealing the dishes will take at least 30 minutes.

After the students use glue sticks to attach the faces, let the glue dry for 10 minutes before adding iron filings. To make sure that the iron filings will not leak out of the sealed petri dish, check carefully for gaps in the glue seal. Do not color the faces with crayons. The iron filings will stick to the wax. If your

students want to color the faces, art markers will work very well. It is easier to move the filings around by dragging the magnet along the *bottom* of the petri dish where there is less space between the filings and the magnet. Remember, magnetic force weakens as distance from the magnet increases. If you are working with an older class, you can even make this a teaching point. Ask: How far away can you hold the magnet before the filings stop responding?

Introduction

1. Show students examples of things that rely on magnetism to work, such as a
   - floppy disk
   - VCR tape
   - audio tape
   - hair dryer
   - paper clip container
   - remote control car
   - anything with an electric motor
   - electric can opener
   - magnetic screw driver
   - refrigerator magnet
   - Magnadoodle.
2. Tell the students that they are going to make their own toys that use magnetism. They may be familiar with the kind of toys they are going to make because similar toys are available commercially.

Procedure

Part 1

1. Pass out one petri dish bottom (the piece with the smaller diameter) to each student. Have the students write their names on the bottoms with a permanent marker.
2. Pass out a rough-trimmed face cutout to each student. Ask students to describe the shape of the petri dish and the shape the face should be to fit into the dish exactly. Have them carefully trim the faces to the right shape and then glue it into the bottom of their dish, using a glue stick.
3. Allow the glued face to dry for at least 10 minutes before proceeding. If liquid glue is used, allow more time for drying.

Part 2

4. Lay out all the petri dish tops on a table, and put one-quarter teaspoon of iron filings into each. Fit the bottom sections that the students have prepared into the tops so that the cutouts are facing down. Older students may be able to help with this step.
5. The teacher or an adult volunteer should handle this step. Heat up the glue gun, and put a glue seal around each petri dish. Allow the glue to set for at least 10 minutes before moving the dishes. This process will take at least 30 minutes.

Part 3

6. Pass out the finished toys. Tell the students that the filings are tiny pieces of iron, and ask them what would help them pick up the iron filings and place them in the right places on the faces. Pass out the small magnets, and give the students time to play with the toys.

Observations and Conclusions

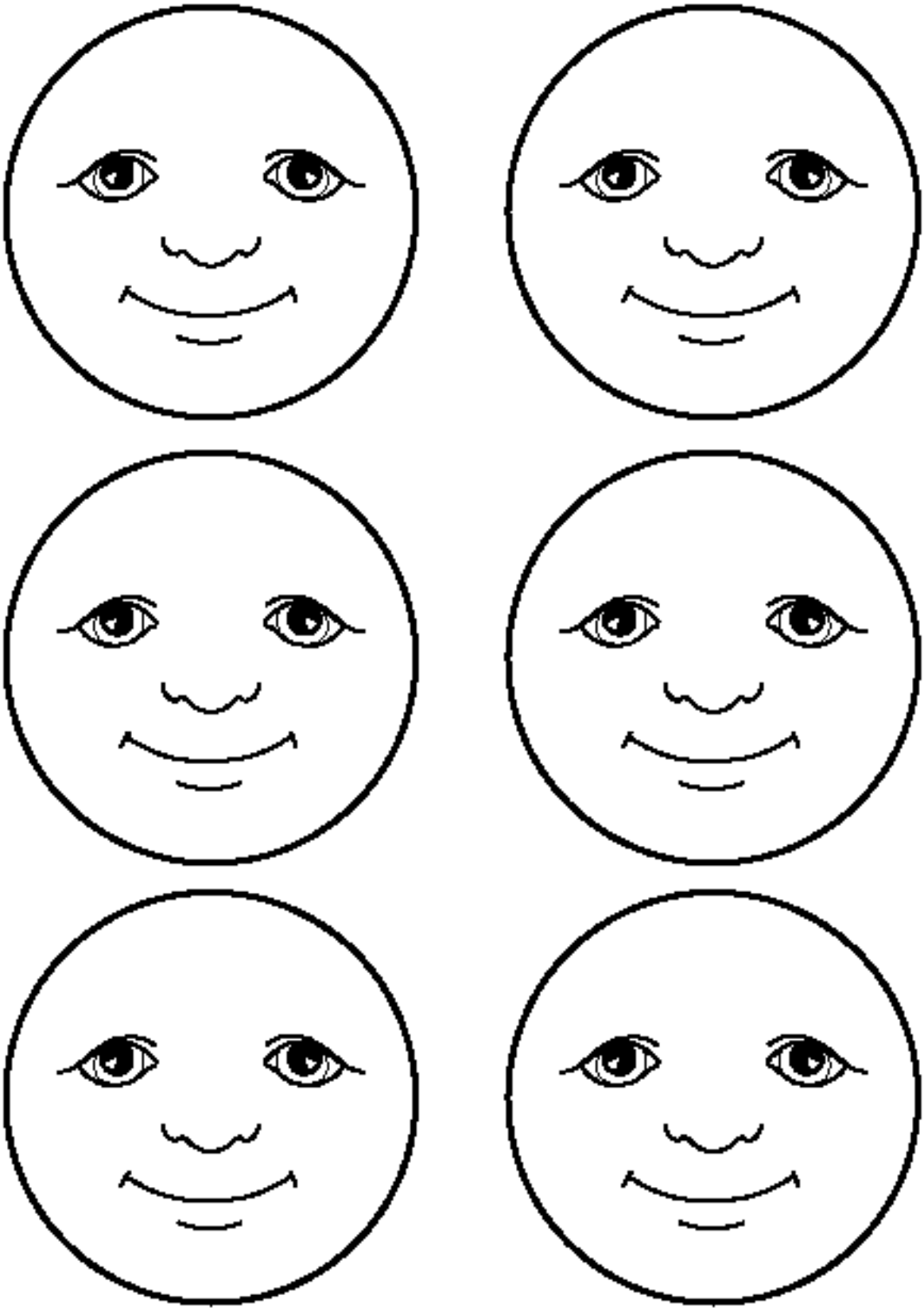
1. Ask students if there were certain techniques that worked better for moving the iron filings around.
2. Have students place the magnet on the top of the toy and turn the whole thing upside down. What happens? Why?

Sample assessment

- Have the students explain how the iron filings are moving around in the toy by answering a series of teacher-prepared questions.

Resources

- *Physical Science SOLutions: Grade K–6.* Science Museum of Virginia, Virginia Department of Education. http://www.smv.org/pubs/PSSolutionsTOC2.pdf. This lesson is adapted from this source.
- *Outstanding Science Trade Books for Students K–12.* National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.



Magnetic Fishing

Organizing Topic Investigating Magnets and Metals

Overview Students "catch" as many fish as they can during a "magnetic fishing expedition."

Related Standards of Learning 2.2a, b

Objectives

The students should be able to

- predict which materials will be attracted to magnets, test their predictions, and create a chart that shows the results, classifying materials as to whether or not they are attracted to magnets.

Materials needed

Per class:

- Assortment of magnetic and nonmagnetic objects

Per group:

- Fifteen commonly found small magnetic and nonmagnetic objects
- Make-believe pond
- Make-believe boat
- String
- Popsicle sticks
- Block or ring magnets with holes in the middle
- "Magnetic Fishing" data sheets (p. 60)

CAUTION!

Keep magnets at least two feet away from computers, TVs, VCRs, computer discs, videotapes, audio tapes, video cameras, watches, and credit cards.

Do not store magnets near compasses! Magnets may damage your compasses.

Store bar magnets in their boxes, north pole to south pole. Do not throw them randomly into a box. Improper storage may weaken the magnetic fields of the bar magnets.

Do not drop magnets. Sharp impacts may cause magnetic field strength to weaken.

Instructional activity

Content/Teacher Notes

All objects that are attracted by a magnet contain one or more of three metals — iron, nickel, or cobalt. Some objects, like a plastic-covered paper clip, may look nonmagnetic but prove to be magnetic when tested. Other objects — including U.S. coins — look magnetic, but turn out to be nonmagnetic when tested. (Some countries, including Canada, still use magnetic material in some of their coins.) An appropriate conclusion for your students to reach after this activity is that metallic objects are more likely to be magnetic than nonmetallic objects, but further tests of the metallic object are necessary to be sure that they are attracted by magnets.

Procedure

1. Divide the students into groups of two to four students, and provide each group with the materials needed to go on a magnetic fishing expedition.
2. Have the students place the teacher-selected magnetic and nonmagnetic objects in their "pond."
3. Tell the students they are going to go fishing with a magnetic fishing pole. Ask them to predict which objects in their pond they will be able to catch with a magnet. Have them sort the objects into two piles: those they think they will catch (magnetic) and those they will not catch (nonmagnetic).
4. Have students record this information on their data sheets under "Predictions."
5. Pass out the magnets, string, and popsicle sticks, and have the students make "fishing poles."

6. Tell the groups to go fishing. Tell them to put the objects that they catch into their boat and leave the ones that they could not catch in the pond.
7. Have students record their results on their data sheets under "Experiment."
8. Discuss the results as a class. Are the results different from those they expected?
9. Add some math! Make sure they count both the magnetic and nonmagnetic things.

Observations and Conclusions

1. Ask the students: Do the things that are attracted to the magnet have anything in common? Discuss their responses.
2. In their groups and then as a whole class, have the students come up with a general rule to explain what kinds of things are attracted to magnets.

Sample assessment

- Assess the "Magnetic Fishing" sheets.

Follow-up/extension

- Give each group some additional things to put into their ponds, making sure to provide objects that are metal yet nonmagnetic. Have them follow the same procedure as before: predicting, testing, and discussing the results. This should help students come to the conclusion that not all metallic things are magnetic and that things need to be tested with a magnet before you can tell if they are magnetic. Tell students that the most common ingredient needed to make something magnetic is iron. Depending on the ability of your class, you may want to tell them that nickel and cobalt are the other two magnetic metals. Iron, nickel and cobalt are *elements*, that is, they contain only one kind of atom. We use the word *nickel* to mean both the element nickel and the U.S. five-cent coin, which originally contained much of the element nickel. The coin is actually a mixture of metals, but the mixture has changed over the years and no longer contains enough nickel to make the coin respond to a magnet.

Resources

- *Physical Science SOLutions: Grade K–6.* Science Museum of Virginia, Virginia Department of Education. http://www.smv.org/pubs/PSSolutionsTOC2.pdf. This lesson is adapted from this source.
- *Outstanding Science Trade Books for Students K–12.* National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.

Name: _____

Magnetic Fishing

Predictions:

Magnetic	Nonmagnetic

Experiment:

Magnetic	Nonmagnetic

Magnetic Fishing

continued

Conclusions:

1. **Do the things that are attracted to the magnet have anything in common?**

2. **Were your predictions correct? _____ Explain.**

3. **As a group, come up with a general rule that explains what kind of things are attracted to magnets. Write it below.**

North and South Poles

Organizing Topic Investigating Magnets and Metals

Overview Students discover that magnets have a north and a south pole, and that opposite poles attract one another and like poles repel one another.

Related Standards of Learning 2.2a, b

Objectives

The students should be able to
- identify the north and south magnetic poles of magnets;
- conduct an investigation to determine how the different poles of magnets react to the poles of other magnets.

Materials needed

Per group:
- Bar magnets with poles labeled “north” and “south”
- Magnets without north and south poles labeled
- Small pieces of masking tape marked “N” and “S”

CAUTION!

Keep magnets at least two feet away from computers, TVs, VCRs, computer discs, videotapes, audio tapes, video cameras, watches, and credit cards.

Do not store magnets near compasses! Magnets may damage your compasses.

Store bar magnets in their boxes, north pole to south pole. Do not throw them randomly into a box. Improper storage may weaken the magnetic fields of bar magnets.

Do not drop magnets. Sharp impacts may cause magnetic field strength to weaken.

Instructional activity

Content/Teacher Notes

All magnets have two poles — a north pole and a south pole. Like poles always repel one another, whereas unlike poles attract one another. Magnets come in many shapes and sizes. Let your students explore and experiment with the properties of differently shaped magnets — bar, ring, marble, horseshoe, disk, and block). They will discover that no matter what shape a magnet has, it always has a north pole and a south pole.

Magnets that have lost magnetic field strength from being dropped, struck, or heated may not exhibit magnetic attraction and repulsion as well as strong, well-kept magnets. Always store your bar magnets north to south in their original packaging.

Introduction

1. Hold up a bar magnet, and ask students what they think it is. Ask them to describe the magnet. Ask them to explain the significance of the two colors, if the magnet is painted, or the letters “N” and “S”, if it is not. Ask them what they think will happen if you bring the “N” end of a bar magnet close to the “N” end of another magnet. Tell them that today they will be investigating what happens.

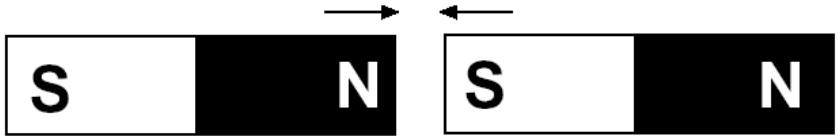
Procedure

1. Divide the students into groups of two to four students, and give each group two bar magnets.
2. Ask the students what they think will happen when they bring the two “N” ends together. Have each group discuss this question and come to a group consensus.

3. Have each group test their hypothesis. Make sure each student in the group gets to test the hypothesis individually.

Like poles repel one another.

4. Ask the students what they think will happen when they bring the "S" end of a bar magnet close to the "N" end of another magnet. Have each group discuss this question and come to a group consensus.
5. Have each group test their hypothesis. Make sure each student in the group gets to test the hypothesis individually.



Unlike poles attract one another.

6. Explain that the "S" end is the south pole of the magnet and the "N" end is he north pole. Draw two pictures on the board or on a large piece of paper that show the results of their experiments. Allow them to explore the properties of the magnets for a few more minutes to reinforce what they have just learned.
7. Ask them how they could discover and mark the poles of an unmarked magnet that has a different shape. Discuss this in groups and as a class.
8. Pass out the horseshoe, ring and marble magnets. Have the groups test the differently shaped magnets, using the bar magnets, and then label the poles appropriately. A small piece of masking tape marked with an "N" or an "S" can be used to label a pole.

Observations and Conclusions

1. Discuss the techniques the groups used to label the magnets.
2. Have students compare their results.

Sample assessment

- Give students a labeled bar magnet and an unlabeled magnet, and have them mark the unlabeled magnet's north and south poles, using masking tape marked "N" or "S."

Follow-up/extension

- Have students test the items from home or school that are magnets (can opener, Magnadoodle, refrigerator magnets, etc.) and label the poles on the magnets.

Resources

- *Physical Science SOLutions: Grade K–6.* Science Museum of Virginia, Virginia Department of Education. http://www.smv.org/pubs/PSSolutionsTOC2.pdf. This lesson is adapted from this source.

- *Outstanding Science Trade Books for Students K–12*. National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.

Organizing Topic — Investigating Plant Resources

Related Standards of Learning

2.1 The student will conduct investigations in which
- a) observation is differentiated from personal interpretation, and conclusions are drawn based on observations;
- b) observations are repeated to ensure accuracy;
- c) two or more attributes are used to classify items;
- f) pictures and bar graphs are constructed using numbered axes;
- h) simple physical models are constructed.

2.7 The student will investigate and understand that weather and seasonal changes affect plants, animals, and their surroundings. Key concepts include
- b) weathering and erosion of the land surface.

2.8 The student will investigate and understand that plants produce oxygen and food, are a source of useful products, and provide benefits in nature. Key concepts include
- a) important plant products (fiber, cotton, oil, spices, lumber, rubber, medicines, and paper);
- b) the availability of plant products affects the development of a geographic area; and
- c) plants provide homes and food for many animals and prevent soil from washing away.

Essential Understandings, Knowledge, and Skills	Correlation to Textbooks and Other Instructional Materials
The students should be able to	
• comprehend that plants produce oxygen and food;	_____
• classify and identify the sources and uses of plant products, such as fiber, cotton, oil, spices, lumber, rubber, medicines, and paper;	_____
• describe plant products grown in Virginia that are useful to people, including wood, fruits, and vegetables. List and classify plant products;	_____
• compare and contrast different ways animals use plants as homes and shelters;	_____
• construct and interpret a chart illustrating the plant consumed by different animal;	_____
• construct and interpret a model that demonstrates how plants prevent soil erosion;	_____
• model the effects of weathering and erosion on the land surface.	_____

We Need Plants!

Organizing Topic	Investigating Plant Resources
Overview	Students focus on the importance of plants and plant products and ways the types of plants available in an area affect what develops in that area.
Related Standards of Learning	2.1; 2.7b; 2.8a, b, c

Objectives

The students should be able to

- comprehend that plants produce oxygen and food;
- classify and identify the sources and uses of plant products, such as fiber, cotton, oil, spices, lumber, rubber, medicines, and paper;
- describe plant products grown in Virginia that are useful to people, including wood, fruits, and vegetables; list and classify plant products;
- compare and contrast different ways animals use plants as homes and shelters;
- construct and interpret a chart illustrating the plant consumed by different animals;
- construct and interpret a model that demonstrates how plants prevent soil erosion.

Materials needed

- An example of as many of these plant products as possible: newspaper, toothpicks, candy bar with almonds, piece of wood, tissue paper, synthetic sponge, piece of rayon fabric, baseball, pack of chewing gum, bottle cork, rubber gloves, apple, walnut, plastic comb or brush, piece of cellophane, furniture, toothpaste, shampoo, coffee filter, wig, ink, negatives, film canister, buttons, plastic toy, and soap
- Pictures of animals, such as birds, squirrels, deer, bears, mice, and raccoons
- "Agriculture Map of Virginia" handout (p. 70)
- Paper and drawing/coloring supplies

Instructional activity

Content/Teacher Notes

The information below comes from the *Virginia Naturally* Web site: http://www.vanaturally.com/guide.html.)

A wide variety and number of products we use every day are in some way derived from trees. However, many tree products are not obvious. Products are derived from all parts of the tree. Wood (lumber) is the most obvious in such things houses, furniture, doors, picture frames, floors, fences, boats, paddles, crates, spools for thread, cabinets, broom handles, toothpicks, and baseball bats. Cellulose is the major component of wood and is the source of paper and paper products, including books, cereal boxes, magazines, newspapers, food labels, toilet paper, coffee filters, stationery, grocery bags, egg cartons, and paper towels. Besides being used to make paper, cellulose is an ingredient in many other products. Paper mills use cellulose from three sources: recycled paper, wood chips, and sawdust left over from making lumber and raw logs. Cellulose can be mixed with certain chemicals and squeezed into fibers that are used to make carpets, wigs, fabrics such as rayon for clothes, and furniture.

Cellulose is also used as a key ingredient in cellophane, sausage casings, explosives, toothpaste, shatterproof glass, sponges, shampoo thickeners, imitation leather, photo film, and many other products. Cellulose may also be used to produce molded plastics for eyeglass frames, telephones, portable CD

players, buttons, hairbrush handles, steering wheels, pipes, toys, counter tops, and packaging such as bubble covers on consumer products. It would be hard to find a part of the tree that people do not use in some way. The bark of many trees is used for many different products, such as soil conditioners, fuel, mulch, and waxes for cosmetics, shoe polish, and cars.

Some trees produce saps, called gums and resins, that are used to make paint thinner, chewing gum, medicines, soaps, floor polish, crayons, perfume, printing inks, insecticides, disinfectants, and fireworks. The sap from the rubber tree was extracted for hundreds of years to make products such as rubber-soled shoes, gloves, and containers.

Maple trees produce a sap that people turn into maple syrup. Trees provide fruits and nuts, such as apples, coconuts, pecans, lemons, and olives, and spices, such as allspice, and nutmeg. Tree leaves, trunks, roots, and other parts also provide ingredients for paints, road-building materials, medicines, tea, adhesives, inks, tar, charcoal, and hundreds of other products.

One cord of wood (i.e., a pile of wood 4' by 4' by 8') can make

- 7,500,000 toothpicks or
- 1,000 pounds of paper or
- 942 one-pound books or
- 4,384,000 postage stamps or
- 61,370 business-size envelopes or
- 460,000 personal checks or
- 30 rocking chairs or
- 12 dining room tables big enough for eight people.

Introduction

1. To introduce this lesson, have students write down every *thing* they can remember using since they woke up that morning, including the bed in which they woke up. After they have completed their lists, have them circle each thing they think is a plant product. As a group, go through several students' lists, discussing which things are plant products. Most students will find that the majority of the things on their lists will be circled.

Procedure

The procedure is divided into several different activities, each of which may take more than one class period to complete.

Activity 1

1. Put examples of plant products (see suggested list under "Materials needed" above) around the room, with numbers on them for easy reference.
2. Have students work in groups to decide which products they think come from plants. In each case, they must give their reasons for their decision.
3. Go through the products, discussing how *all* of them are plant products. Explain those that the students did not know were plant products.
4. Have the students then group the products as follows:
    - Two products from the gum of trees (rubber products, chewing gum)
    - Two products from wood (furniture, toothpicks, spools)
    - Two products from fruits and nuts (cider, spices, pecan, apple)
    - Two products from resin (soap, varnish)
    - Two products from leaves or bark (cork, mulch, tea)

Activity 2

1. Provide students with the "Agricultural Map of Virginia" handout (p. 70).
2. Discuss the map, having the students name the plant products they see and coloring them as they are discussed.
3. Animals are also on this map. Discuss how plants are important for the animal products as well, e.g., as food (grains and hays).
4. Discuss how the plant products that are available in an area affect what businesses/development might also be in that area.

Activity 3

1. Remind the students that the previous two activities have concerned plant products and the fact that plant products play an important part in almost everything we do or use throughout our day. Pose the question: What are some other reasons that plants are important to us? Allow the students to brainstorm a list, prompting them, if necessary, to mention that plants provide us and other animals with oxygen, homes (shelter), and food.
2. Show pictures of a variety of animals. Discuss how each animal uses plants for shelter and food in different ways.
3. Have each student choose an animal and illustrate how it uses plants for food and shelter. Have them write a sentence or two explaining their drawings. Create a bulletin board with their drawings.

Observations and Conclusions

1. Activity 1: Students should understand the importance of plant products to our survival and to our everyday life. They should also be able to group products according to their sources.
2. Activity 2: Students should understand the types of plant products available in Virginia and how the these products help other industries develop in the area in which they are grown.
3. Activity 3: Students should understand that plants provide animals, including humans, with oxygen, a variety of shelter, and food.

Sample assessment

- Informally assess student understanding during discussions of the various topics, using questions such as the following:
  - What are some products made from the gum of trees?
  - What are some products made from the wood of trees?
  - What are some products made from fruit and nuts?
  - What are some products made from plant resins?
  - What are some products made from leaves or bark?
  - Besides food and shelter, what basic need do plants provide us with?
  - How do plants help animals?
- Use students' groupings of plant products and their drawings for assessment.

Follow-up/extension

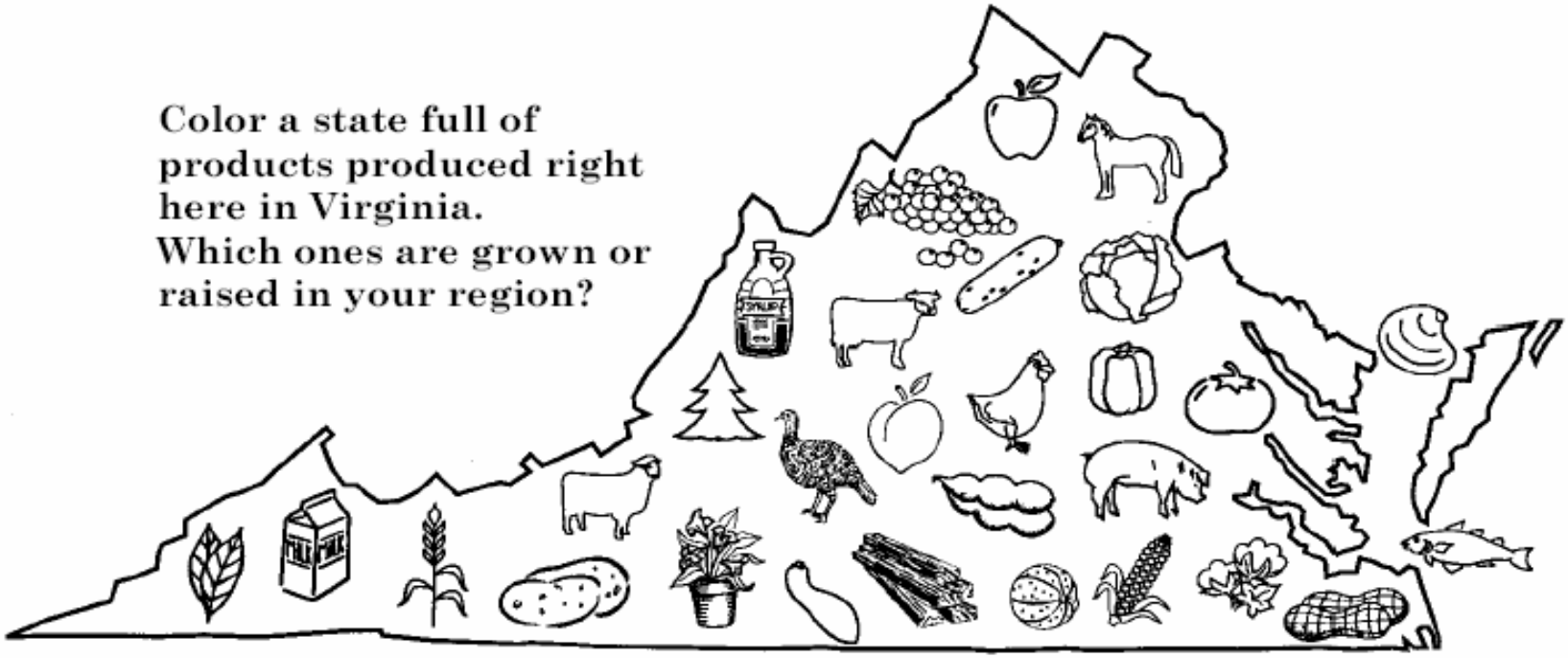
- Have students create books showing and explaining plant products.
- Hold a class contest to list as many ways as possible that plants are useful to us and other animals.

Resources

- *Agricultural Map of Virginia.* http://www.vdacs.state.va.us/teachers/agmap.pdf.
- *Outstanding Science Trade Books for Students K–12.* National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.
- *Virginia Naturally: Virginia's Natural Resources Education Guide.* http://www.vanaturally.com/guide.html. Part of this lesson is adapted from a lesson on the Virginia Naturally Web site. This site also has excellent background information, some of which is included in the Content/Teacher Notes above.

Agriculture Map of Virginia

Color a state full of products produced right here in Virginia. Which ones are grown or raised in your region?



Virginia Department of
Agriculture and Consumer Services
804-786-2373

Organizing Topic — Investigating Life Cycles

Related Standards of Learning

2.1 The student will conduct investigations in which
- a) observation is differentiated from personal interpretation, and conclusions are drawn based on observations;
- b) observations are repeated to ensure accuracy;
- c) two or more attributes are used to classify items;
- f) pictures and bar graphs are constructed using numbered axes;
- h) simple physical models are constructed.

2.4 The student will investigate and understand that plants and animals undergo a series of orderly changes in their life cycles. Key concepts include
- a) some animals (frogs and butterflies) undergo distinct stages during their lives, while others generally resemble their parents; and
- b) flowering plants undergo many changes, from the formation of the flower to the development of the fruit.

Essential Understandings, Knowledge, and Skills	Correlation to Textbooks and Other Instructional Materials
The students should be able to	
• describe changes in the life cycles of a frog and a butterfly;	_____
• identify and describe changes in a plant from flower (blossom) to fruit;	_____
• compare and contrast life cycles of a frog and a butterfly;	_____
• construct and interpret models/diagrams of animal and plant life cycles.	_____

Looking at Life Cycles

Organizing Topic Investigating Life Cycles

Overview Students focus on the changes plants and animals go through as they grow.

Related Standards of Learning 2.1; 2.4a, b

Objectives

The students should be able to

- describe changes in the life cycles of a frog and a butterfly;
- identify and describe changes in a plant from flower (blossom) to fruit;
- compare and contrast life cycles of a frog and a butterfly;
- construct and interpret models/diagrams of animal and plant life cycles.

Materials needed

- Popular children's literature about the life cycle of a butterfly from egg to butterfly
- Mealworms (available at most pet stores for about a dollar for 100)
- Clear plastic cups — one for each student
- Plastic wrap or baggies
- Rubber bands
- Oatmeal
- Small plastic zip bags (approximately 3" by 4", available in craft stores)
- Blank booklets — one for each student (construction paper folded in half as the cover and three sheets of plain paper folded in half as pages)
- Strips of paper
- Bean seeds
- Cotton balls
- Yarn
- Pictures of the frog's and butterfly's life stages
- Pictures of vegetable plants or fruit trees at their various life stages

Instructional activity

Content/Teacher Notes

Mealworms display a convenient animal life cycle for students to observe because they are inexpensive (a whole class can be outfitted with individual setups for about $3) and they go through their life cycle rapidly enough for classroom use.

The mealworm is the larva stage of the grain beetle, which goes through four stages. The first stage is the egg, which is only about one millimeter in length. Eggs hatch in about one week. The next stage is the larva (mealworm), the stage at which the students will begin their observations. This stage lasts two to three weeks. During this stage, the mealworm sheds its skin several times. The third stage is the pupa. In this stage, the mealworm transforms into its adult form, the grain beetle. The pupa stage lasts about two weeks. After becoming a beetle, it lays eggs, and the cycle begins anew. Grain beetles lay up to 500 eggs in their life times.

Frog Life Cycle: The female frog lays thousands of small, round eggs that float in the water. The dark spot in the middle of each egg becomes a tadpole. As the tadpole forms, it breaks out of the egg. It has a head, body, tail, and gills. Its gills soon begin to disappear, and back legs form. Its lungs are also

forming at this time. Then, its front legs form, its tail gets smaller, its gills disappear completely, and its lungs have developed. The tadpole must now come to the surface to breathe. Finally, the tadpole becomes a frog. Its tail is gone, and it is ready to leave the water and live on land. The female frog returns to the water to lay her eggs, and the cycle begins again.

Butterfly Life Cycle: A butterfly begins as an egg. The larva, called a caterpillar, hatches from the egg. As it grows, it sheds its skin and grows a new one. It eats a great deal in the caterpillar stage. Shedding its skin one last time, it becomes a pupa. It is covered in a hard shell, called a chrysalis. The adult butterfly breaks out of its chrysalis, lays eggs, and the life cycle begins anew.

Introduction

1. Read a popular children's book about the life cycle of a butterfly. After reading the book aloud, have the students tell the cycle. Ask what other animal life cycles they know about. (Prompt for frog life cycle.) Discuss these.

Procedure

The procedure is divided into several different activities, each of which may take more than one class period to complete.

Activity 1

1. Show pictures of the frog life cycle, and discuss the stages. Allow students time to discuss their experiences with tadpoles and frogs.
2. Show pictures of the butterfly life cycle, and discuss the four distinct stages (egg, larva, pupa, butterfly). Introduce information about the mealworm life cycle, and compare this to the butterfly life cycle.
3. Set up the mealworm experiment for each student. Give each student a cup, plastic wrap (or a baggie), and some oatmeal. Have the students put the oatmeal in their cups, and give each student three to six mealworms. Have the students cover the cup with the plastic and secure it with a rubber band. Punch two holes in the plastic.
4. Distribute booklets to students, and let them title their booklet with "Life cycle of a Grain Beetle" and make a title page.
5. Have the students draw their mealworm setup on the page after the title page, labeling the page "Mealworm Stage." They may want to measure their worms and add this information to the page. Have them put the date on this page.
6. The students should observe their mealworms everyday. Each day that they note any change (molting of skin, pupa stage developing, etc.), they should draw and write about it in their booklets. Be sure that they date the entry of each change.
7. After all the students' mealworms have transformed, place them in one larger container containing oatmeal. Over the next couple weeks, have the students observe the hatching of new mealworms!

Activity 2

1. Discuss the life cycle of a plant. Show pictures of a variety of plants, pointing out blossoms and fruits on the plants. Discuss that the blossoms develop into fruit.
2. Give each student a strip of paper. Have them draw the life cycle of a plant in sequence: seed, sprout, developing leaves, blossoms, and fruit. Discuss that the fruit is or contains the seed for the life cycle to begin again. Have students label each stage on their strip.

3. Discuss what a plant needs to grow (prompt for *water, oxygen, nutrients, space*, and *sunlight*). Discuss that while the seed is in the earth, it receives no sunlight, but it does receive heat to cause it to sprout.
4. Distribute plastic zip baggies, yarn, a cotton ball, and a bean seed to each student.
5. Have the students wet the cotton ball and place it in the baggie with their seed. Then have them seal their baggie, punch a whole near the top, tie the yarn on it, and put it around their neck with the baggie against their skin. Explain that they will provide the heat to make their seed sprout. Tell them they should wear this for the next few days and keep it under their pillow at night, *not* around their neck when they sleep. They should observe the seed often in order to notice the moment when it sprouts. They should write down the exact moment it sprouts: date, hour, minute.
6. Keep a running total of dates and times on a wall chart or the board.

Observations and Conclusions

1. Activity 1: The students should understand the life cycles of the frog and butterfly. They should be able to talk about the life cycle of the mealworm, and describe its distinct stages.
2. Activity 2: The students should understand the growth needs of plants, and be able to describe the stages in the life cycle from seed to fruit. They should be able to tell what causes the seed to sprout (heat, water), and that it initially gains its nutrients from the seed itself until it sprouts roots.

Sample assessment

- Assess the students informally during discussions, using questions, such as the following:
  - What is the frog called after it hatches?
  - Which legs develop first, the front or back?
  - What must develop before the frog can breathe air?
  - What two parts of the tadpole disappear as it develops into a frog?
  - What are the four stages of the butterfly?
  - What are the four stages of the grain beetle?
  - What causes a seed to sprout?
  - What develops first on a plant?
  - Where does the fruit on a plant develop?
  - What does the fruit eventually do, if it is not picked?
- Use students' plant and mealworm drawings for assessment.

Follow-up/extension

- Keep a class graph of where the grain beetles are in their development. This can be plotted over a period of time.
- Keep a class graph of the sprouting seeds.
- Have students write their own stories about the life cycle of a plant or animal.

Resources

- "Follow a Spider's Life Cycle." *Mathematics and Science Center*. http://www.spiderroom.info/lifecycles.html
- *Frogs at Fermilab.* http://www-ed.fnal.gov/projects/frogs/. Web site about frogs.
- *Outstanding Science Trade Books for Students K–12.* National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.

- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.
- *USGS Children's Butterfly Site.* http://www.mesc.usgs.gov/resources/education/butterfly/bfly_start.asp

Organizing Topic — Investigating Habitats

Related Standards of Learning

2.1 The student will conduct investigations in which
- a) observation is differentiated from personal interpretation, and conclusions are drawn based on observations;
- b) observations are repeated to ensure accuracy;
- c) two or more attributes are used to classify items;
- f) pictures and bar graphs are constructed using numbered axes;
- h) simple physical models are constructed.

2.5 The student will investigate and understand that living things are part of a system. Key concepts include
- a) living organisms are interdependent with their living and nonliving surroundings; and
- b) habitats change over time due to many influences.

2.8 The student will investigate and understand that plants produce oxygen and food, are a source of useful products, and provide benefits in nature. Key concepts include
- c) plants provide homes and food for many animals and prevent soil from washing away.

Essential Understandings, Knowledge, and Skills	Correlation to Textbooks and Other Instructional Materials
The students should be able to	
• classify objects as to whether they are living or nonliving;	_____
• describe the nonliving components of an organism's surroundings, including water, space, and shelter; (Shelter may be living or nonliving.)	_____
• construct and interpret simple models of different kinds of habitats, including a forest and a stream;	_____
• compare and contrast different ways animals use plants as homes and shelters;	_____
• predict and describe seasonal changes in habitat and their effects on plants and animals, for example, how trees change through the seasons and how animals respond to changes in the seasons;	_____
• describe how animals are dependent on their surroundings, for example, how squirrels and other animals are affected by the loss of forest habitat.	_____

There's No Place Like Home

Organizing Topic	Investigating Habitats
Overview	Students focus on the interdependence of living things with other living things and nonliving things in their habitats and the importance of plants to the animals in habitats.
Related Standards of Learning	2.1; 2.5a, b; 2.8c

Objectives

The students should be able to

- classify objects as to whether they are living or nonliving;
- describe the nonliving components of an organism's surroundings, including water, space, and shelter; (Shelter may be living or nonliving.)
- construct and interpret simple models of different kinds of habitats, including a forest and a stream;
- compare and contrast different ways animals use plants as homes and shelters;
- predict and describe seasonal changes in habitats and their effect on plants and animals — for example, how trees change through the seasons and how animals respond to seasonal changes;
- describe how animals are dependent on their surroundings — for example, how squirrels and other animals are affected by the loss of forest habitat.

Materials needed

- Several sheets of large paper, such as bulletin board paper
- Art materials: crayons, markers, glue sticks, construction paper
- Blank booklets — one for each student (construction paper folded in half as the cover and three sheets of plain paper folded in half as pages)
- Pictures of animals, such as birds, squirrels, deer, bears, mice, raccoons, and fish
- Two plastic or foil trays that can hold water (kitty litter trays are an ideal size.)
- Soil — enough to fill one tray half full
- Patch of grass (sod) — approximately one square foot
- Watering can

Instructional activity

Content/Teacher Notes

The *Our Living Environment: Living Systems and Life Processes*, available on the Virginia Department of Education Web site at http://www.doe.virginia.gov/VDOE/Instruction/OurLivingEnvironment.doc, is an excellent resource for background information, some of which follows:

- Plant life needs a combination of sunlight, nutrients, water, and space.
- Animal life needs air, food, water, shelter, and space in an arrangement called *habitat*.
- Organisms use different strategies to meet their life needs.
- All living things are affected by and interact with their physical (*abiotic*) environment.
- Each organism has a *niche* within an ecosystem.
- An *ecosystem* is a combination of individual habitats where animals' life needs are met. Ecosystems are usually characterized by a dominant plant community (e.g., a salt marsh, a deciduous forest).
- All forms of life depend upon nonliving components of the environment — water, oxygen, *nutrients*, space, and/or sunlight — in some combination for survival and growth.

- All living things are affected by and interact with the environment.
- All plants and animals are adapted to survive within the framework of their habitat's *abiotic* components.
- Ecosystems are comprised of living and nonliving components that interact with and are dependent upon each other.
- Changes in the nonliving components of an ecosystem have an effect on the living components of that ecosystem (e.g., decline in water quality).
- Climatic conditions can affect living systems. (Examples: Drought can alter reproduction of waterfowl. Spring rains can flood the shallow nests of rabbits, mice, and other prey species and can affect the survival of predator young.)

Introduction

1. Pose the question: What do animals need? Generate discussion, and come to a final list of food, water, shelter, air, and space. Reinforce that the arrangement of these things that animals need is called the animal's *habitat*.
2. Review how plants provide us and other animals with oxygen and that plants need sunlight, nutrients, water, and space.

Procedure

The procedure is divided into several different activities, each of which may take more than one class period to complete.

Activity 1

1. Show pictures of a variety of animals, such as birds, squirrels, deer, bears, mice, raccoons, and fish. Have the students discuss where these animals might live, or what their *habitat* might look like. Encourage them to describe the plant life, and name the type of habitat, e.g., forest, pond, river, or desert.
2. Put students into groups of two to four, depending on the size of the large paper. Assign each group a habitat to depict in a mural. Tell them to make sure that they have all the plant and animal needs included. They should create the habitat, but not yet add any animals.
3. After the habitat murals are complete, have each group choose one animal that lives in their habitat. Encourage variety. Pass out booklets, and have the students draw their animal on the first page after the title page. On the rest of the pages, have them show where in the habitat the animal finds each of its needs — food, water, shelter, and space. They should draw detailed pictures as well as write at least one sentence about each need. The students may need to do some research for this part of the project.
4. Finally, allow the students to recreate their animals from construction paper or other materials on an appropriate scale to fit into their habitat mural. They should then add the animals to the mural, along with any other needed parts, such as the animal's prey (unless this has already been added by another student). Allow time for the children to share their finished murals. Discuss what would happen if one or more pieces of the habitat were eliminated. What happens to the habitats during the various seasons? What other things could cause changes in the habitats?

Activity 2

1. Review the importance of plants to habitats.
2. Set up two trays, one containing soil, the other containing the patch of grass (sod). Position each tray so that it slants slightly. Have the watering can ready, full of water.

3. Explain to students that the two trays represent pieces of land, one with grass growing on it, the other with no grass. The watering can represents a rainstorm.
4. Have the students predict or hypothesize the effect of the rain on the two patches of land.
5. Pour water for 15 seconds on each "piece of land." Have students compare the results.
6. Introduce the term *erosion*. Discuss where more erosion occurred and why. Discuss the importance of plants to the prevention of erosion. Discuss reasons why the soil is so necessary to the habitat.
7. Repeat the experiment to make sure results were accurate. Discuss the importance of repeating experiments to check and ensure accuracy.

Observations and Conclusions

1. Students should understand the term *habitat* and the needs of both plants and animals. They should be able to discuss the interdependence of the living and nonliving things in a variety of habitats.
2. Students should understand the importance of plants in preventing erosion and reasons why the soil is so necessary to the habitat.

Sample assessment

- During discussions and project presentations, assess student's knowledge of topics informally, using questions, such as the following:
  - Why is preventing erosion important to a habitat's health?
  - What are an animal's basic needs?
  - What do plants need?
  - What is a habitat?
  - Why does changing one thing in a habitat affect so many other things?
  - What are some examples of interdependence in a forest habitat? In a desert? In a pond?

Follow-up/extension

- Have the students make a list of all the living things and all the nonliving things in each of the habitat murals.
- Play "What If": Give students a variety of situations (e.g., a fire; a drought; a long, harsh winter), and ask them to tell how they think their own habitat would respond.

Resources

- *Backyard Wildlife Habitat.* National Wildlife Federation. http://www.nwf.org/backyardwildlifehabitat/. Web site about habitats.
- *Outstanding Science Trade Books for Students K–12.* National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Schoolyard Habitats.* National Wildlife Federation. http://www.nwf.org/schoolyardhabitats/.
- *Schoolyard Habitat: Stewardship through Action.* U.S. Fish & Wildlife Service. http://www.fws.gov/r5cbfo/schoolyd.htm.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Web site with searchable database.