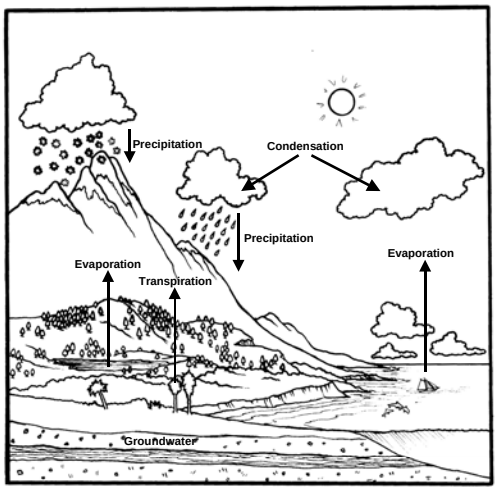
Days 3 & 4

Student Investigation: Evaporation

BACKGROUND INFORMATION



Water can change from solid to liquid to gas—all states of matter that occur in the water cycle. When it evaporates, the liquid water in a lake, a stream, or the ocean changes to water vapor and rises into the air. Depending on temperature and other weather conditions, the water vapor will eventually condense into clouds and fall again to Earth as a liquid (rain), a solid (snow, sleet, or hail), or it may condense on surfaces as dew.

Several different factors can affect the rate of evaporation, including heat, wind, relative humidity, and surface area. The rate of evaporation increases as the heat from the Sun increases, the wind strengthens, the relative humidity decreases, and the surface area expands.

THE BIG IDEA

Water moves continuously through evaporation, condensation, and precipitation as heat is added or taken away.

OVERVIEW OF ACTIVITY (2 class periods)

Students conduct an experiment to explore changes in the rate of evaporation using a measured amount of water and paper towels. They test variables that may affect the rate of evaporation and relate these variables to weather conditions.

SCIENCE STANDARD

3.b. Students know when liquid water evaporates, it turns into water vapor in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water.

PERFORMANCE OBJECTIVES

Students will be able to:

1. identify independent, dependent, and controlled variables in an investigation.

2. predict an outcome of an evaporation experiment.

3. explain that the rate of evaporation is affected by a number of different variables, including the intensity of heat and strength of the wind.

RECOMMENDED ASSESSMENT STRATEGY

Use the ***CONCLUSION*** section and the **LINE OF LEARNING** discussion to assess conceptual comprehension and investigation strategies.

MATERIALS (included in kit)*

- ❑ Parent Letter
- ❑ Overhead projector
- ❑ *Water Cycle* transparency*
- ❑ Science Notebook transparencies (optional)
- ❑ (1) Set of Science Notebook pages per student
- ❑ Brown paper towels
- ❑ Water
- ❑ Cups to hold water*
- ❑ Watches or timers
- ❑ Eyedroppers*
- ❑ Towels to mop up spills
- ❑ Desk lamps
- ❑ Different wattage light bulbs
- ❑ Portable fans
- ❑ Hair dryers
- ❑ Cardboard to make fans
- ❑ Shirt to use for demonstration
- ❑ Plastic plates*
- ❑ Rulers

ADVANCE PREPARATION

1. Make copies of the Parent Letter (see **Resource** section) to send home with the students asking for lamps, different wattage light bulbs, fans, and hair dryers.

2. Make one copy of the Science Notebook sheets for each student.

3. Make transparencies of the Science Notebook pages. **(Optional)**

4. Set up overhead projector and get out transparencies.

5. Set out two pieces of paper towels, the eyedropper, a ruler, a cup of water, and a towel for each investigation team. Have the lamps, hair dryers, fans, and cardboard available for student use.

6. Divide the class into their seven investigation teams.

ELL MODIFICATIONS

Before beginning the investigation, review the Science Notebooks. Pay particular attention to how to make a prediction, how to control an investigation, and how to identify variables. You may wish to add *dependent variable*, *independent variable*, and *controlled variable* to your Word Wall. (See the ***ELL MODIFICATIONS*** section for more information on Word Walls.) In addition, make sure that ELL students have their bilingual buddy on their investigation team.

TEACHING TIPS

1. Since this is the first investigation in which the students will use their Science Notebooks, you may need to conduct it over two days. Students can design their investigation on the first day and gather data and analyze their data on the second day.

2. Send the Parent Letter home with the students asking parents to send desk lamps, different wattage light bulbs, hair dryers, or portable fans. Remind the parents to label the materials that they send.

3. Students should decide, as a class, how much water will be used (we recommend five drops or less) and how they will distribute the water on the paper towel (all in one spot or spread around the paper). They should control the type of material (i.e., paper towels) and the amount of water used. Make sure that the students do not use too much water because it will take too long to dry.

4. If students bring desk lamps from home, use different wattage bulbs in the different lamps so students will not need to change hot light bulbs.

5. Use the plastic plates to hold the paper towels or as fans. Students may wish to tape the towel to the plate.

6. Please remind the students to use caution if they choose to use a lamp—the light bulbs can get very hot.

PROCEDURE (2 class periods)

1. Use the *Water Cycle* transparency or your water cycle poster to review the water cycle with the students. Make sure that they are familiar with the concepts of evaporation, condensation, and precipitation. **(Day 1: 5 minutes)**

2. Spill some water on a shirt. Ask the students to explain how they can make the shirt dry. Discuss their ideas. Ask the students if all of their suggested methods will dry the shirt at the same rate. Ask the students if the rate of evaporation can be changed, and if so, how. Students should identify the controlled, independent, and dependent variables in this example. (***Controlled variables*** *include the amount of water, the type of material, the time of day during which the investigation is carried out, and the way that the water is spilled on the shirt. The* ***independent variables*** *are the methods students suggest to change the rate of evaporation. The* ***dependent variable*** *is the amount of time it takes for the shirt to dry—the rate of evaporation.)* **(Day 1: 5 minutes)**

3. Hand out the Science Notebook sheets to each student, and put the corresponding transparencies on the projector. Tell the students that they will follow the directions to conduct their investigations. They should record their prediction on the lines provided in their Science Notebooks. Review the rest of the steps in the investigation as a class. **(Day 1: 15 minutes)**

4. As a class, decide how much water to use as well as how the water will be distributed across the paper towel. Make sure students record this information in the ***DATA AND OBSERVATIONS*** section in their Science Notebook. **(Day 1: 5 minutes)**

5. As you review the steps in the investigation, have the students choose one of the independent variables to demonstrate how to conduct the investigation. Show the students how to write and follow their procedure and record their data **(Day 1: 15 minutes)**

6. Have each of the teams discuss possible ways to change the rate of evaporation and decide on the method they plan to try. Remind them to record their method and the step-by-step procedure they will follow in their Science Notebooks. **(Day 1: 10 minutes)**

7. After obtaining your approval—based on safety, available materials, and variation from other team proposals—have the students gather their materials, follow their procedure, and collect and record data. Student procedures should include the amount of water they will use, the type of paper towel they will use, the way that the water is distributed on the paper towel, the method they are testing, and how far from the paper towel they will place their heat or wind source. **(Day 2: 40 minutes)**

8. After the investigation teams have completed their initial tests, have them record their results on the class data chart on the Science Notebook transparency or whiteboard. Review the data with the class.

9. Have the investigation teams work together to answer the questions in the ***CONCLUSION*** section. **(Day 2: 20 minutes)**

    - Identify the variables in your investigation. (*The **controlled variables** include the type of material used, the amount of water used, the way the water was distributed on the material, and the distance from the material and the heat and/or wind source used. The **independent variable** is the method used to evaporate the water. Answers will vary depending on what method each team used. The **dependent variable** is the amount of time it took for the water to evaporate, or the rate of evaporation.)*

    - Was your prediction correct? Explain why or why not. *(Answers will vary depending on each student's prediction. They should come to the conclusion that heat and wind do affect the evaporation of water. The more heat and wind, the faster the evaporation rate will be.)*

    - What was the method that you used to evaporate the water? What does it represent in nature? *(Answers will vary. Fans are like the wind, light bulbs give off heat and light like the Sun, and hair dryers are like the wind and the Sun combined.)*

    - Under what conditions on Earth will the evaporation rate be the greatest? *(A hot day with strong winds would increase the evaporation rate.)*

    - What further testing would you like to do? *(Answers will vary.)*

10. **Line of Learning**: As a class, discuss the answers to the ***CONCLUSION*** questions. Remind the students to record any additional questions that are generated or information that is learned below the ***LINE OF LEARNING*** in their Science Notebook. You can use this section to assess student progress. **(5 minutes)**
11. **Looking Ahead:** What else, other than heat and wind, might affect the evaporation rate of water? How does the water cycle affect weather patterns?

EXTENSION

Hold an evaporation race.

1. Have student teams use one or a combination of methods to make 50 mL of water in a container evaporate. See which team can do it the fastest.

2. Have student teams conduct a race between a shallow container with a large surface area (a pie pan) and a deep container with a small surface area to explore the effect of how the water is distributed in a container.

3. Provide the student teams with various shaped containers and run the race by having the students use the same method to cause evaporation. This will help them to explore the effect of surface area on evaporation rates.

RESOURCES

Books

Stop Faking It! Air, Water, & Weather. Robertson, William C. NSTA Press. 2005.

Water Precious Water. Book A. AIMS Education Foundation. 1988.

Web Site

University of Illinois: WW2010 (The Hydrologic Cycle)
http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/hyd/home.rxml

Evaporation

A. Scientist:_____
Date:_____
Time: _____ *(include AM or PM)*

B. INQUIRY QUESTION

How does the weather affect the rate of evaporation of water?

C. TESTABLE QUESTION

Do heat and wind affect the rate of evaporation of water?

D. PREDICTION

I predict that…

_____

_____

E. MATERIALS

- ❑ Brown paper towels
- ❑ Water in a plastic cup
- ❑ Watch
- ❑ Eyedropper
- ❑ Ruler
- ❑ Plastic plate

Testing Equipment

- ❑ Portable fan
- ❑ Lamp with different wattage light bulbs
- ❑ Cardboard fan
- ❑ Hairdryer

F. PROCEDURE

1. As a class, identify the variables you need to control, and decide how you are going to control each of them. Record this information in the ***DATA AND OBSERVATIONS*** section.

2. As a team, decide on the equipment that you are going to use to simulate a weather condition. (For example, you might use a fan to simulate wind.)

3. Review your prediction. Write the procedure you are going to follow to test your prediction.

4. After getting your teacher's approval, follow your procedure. Make sure that you record your start time, your end time, and the total time it took to evaporate the water. Draw a picture of the equipment set-up for your investigation.

5. Complete the class chart so that you can compare the rate of evaporation for each piece of equipment.

G. DATA AND OBSERVATIONS

Controlled Variables

1. Material onto which you will drop the water: _____

2. Amount of water you will drop: _____ drops of water

3. Distribution of water on your material (for example, spread out or all in one spot): _____

4. Distance between material and your heat and/or wind source: _____

Independent Variable

List the equipment that you will use to evaporate water:

_____

Procedure

1. Put your material onto the plastic plate.

2. Measure out the amount of water you plan to use.

3. _____.

4. _____.

5. _____.

6. _____.

7. _____.

8. _____.

9. _____.

10._____.

Teacher Approval:

Draw a picture of the set-up of your investigation.

Dependent Variable: Evaporation Time

Start Time: _____ End Time: _____

Total Evaporation Time: _____ -- _____ = _____
(End Time) (Start Time) (Evaporation Time)

Class Data:

Record the data from each team.

Team #	Amount of Water (Controlled Variable)	Method Used (Independent Variable)	Evaporation Time (Dependent Variable)

H. CONCLUSION

Today I learned that…

Be sure to include the answers to the following questions.

1. Identify the variables in your investigation.

   Controlled: _____

   Independent: _____

   Dependent: _____

2. Was your prediction correct? Explain why or why not.

   _____

   _____

   _____

   _____

3. What was the method that you used to evaporate the water? What does it represent in nature?

   _____

4. Under what conditions on Earth will the evaporation rate be the greatest?

   _____

   _____

   _____

   _____

I. LINE OF LEARNING

J. NEW VOCABULARY

List any new vocabulary words you learned from doing this investigation. Use the glossary to write the definitions of each word.

Evaporation – The process of a liquid changing to a gas when heat is added.

Variable – A factor or condition that is capable of changing.

Independent variable – The factor in an investigation that is changed in order to see what happens.

Dependent variable – The factor in an investigation that is observed to determine any effect of the independent variable.

Controlled variable – The factors in an investigation that are kept constant, or identical, each time you conduct the investigation.