

How Much Water?

OBJECTIVES

Students use cobalt paper to compare the amount of water vapor in the air in different locations and over a period of time.

The students

- ▶ observe the reaction of cobalt paper to moisture
- ▶ use cobalt paper to compare the level of humidity in various locations
- ▶ use cobalt paper to compare the change in air humidity over time

SCHEDULE

Session I About 40 minutes, followed by daily observations for about a week

Session II About 20 minutes, about 1 week after Session I

VOCABULARY

humid
humidity

MATERIALS

For each student

- 1 Activity Sheet 7

For each team of two

- 1 pc cobalt paper
- 2 containers, plastic, 1-pt
- 1 container, plastic, round
- 1 sht paper, white*

For the class

- 1 pitcher*
- 1 roll tape, masking
- water, warm*

*provided by the teacher

PREPARATION

Session I

- 1 Make a copy of Activity Sheet 7 for each student.
- 2 Set up a distribution station with a pitcher of warm water and the masking tape.
- 3 If necessary, obtain permission to bring students to various parts of the school such as the bathroom, the cafeteria, the gym, and so forth, as well as outdoors.
- 4 Each team of two will need one sheet of cobalt paper, two 1-pt containers, one round container, and a sheet of white paper.

Session II

Each student will need his or her copy of Activity Sheet 7.

BACKGROUND INFORMATION

The amount of water vapor in the air at any given time and place is referred to as the **humidity**. Air containing high amounts of water vapor is said to be **humid**. The amount of water vapor in the air varies from day to day. During a rain storm, the air is very humid. On a clear, sunny day, the air is dry.

Humidity also varies with location. Even on a very dry day, the humidity in a kitchen may be

high. On a humid day, the humidity inside a building with the heat or air conditioning running will be much lower than the humidity of the outside air.

The **relative humidity** is the amount of water vapor in the air in proportion to the greatest amount that it can hold at a given temperature and pressure. For meteorologists, the relative humidity is helpful for predicting the weather.

Humidity is generally measured with a hair hygrometer or a psychrometer. Cobalt paper also can give a rough estimate of the humidity. In dry air, the paper is blue, and in very humid air, it turns pink. When the air is mildly humid, the paper will be a faint pink or violet.

▼ Activity Sheet 7

How Much Water?

- In Table 1, record the color of the special paper at each of the three times indicated.

| Color of Paper at Start | Color of Paper in Containers | Color of Paper at End |
|-------------------------|------------------------------|-----------------------|
| blue | pink | blue |

- In Table 2, write the names of the places where you will be testing the humidity level. Then record the color of the paper in those locations.

| Location | Color of Paper |
|--------------------|----------------|
| Answers will vary. | |
| | |
| | |

- In Table 3, record the color of the special paper over the next few days. Describe the weather conditions on each day that you observe.

| Day | Color of Paper | Weather Conditions |
|--------------------|----------------|--------------------|
| Answers will vary. | | |
| | | |
| | | |
| | | |
| | | |

Guiding the Activity

Session I

- Ask the students, **Where does water go when it evaporates?**

Ask, **Do you think the air always contains the same amount of water vapor?**

Tell students that, in this activity, they will use a special type of paper to find out the answer to this question.

- Give each student a copy of **Activity Sheet 7**. To each team of two, distribute two 1-pt plastic containers, a small round plastic container, and a piece of cobalt paper. Tell the students to record the color of the paper in Table 1 on the activity sheet.

Additional Information

Students should recall that it enters the air as water vapor.

Accept all answers.

Guiding the Activity

Instruct the students to fill one of the 1-pt plastic containers with about 2 cm (0.75 in.) of warm water. Have them place the cobalt paper in the small plastic container and then place that container in the container with the water. Instruct the students to place the second 1-pt container upside down on top of the first and tape the two together around the edges as shown in Figure 7-1.

- 3** Ask the students, **What is happening to the warm water in the plastic container?**

Ask, **What is happening to the air inside the containers?**

Instruct the students to watch the paper inside the containers for several minutes. Tell them to record any changes they see in Table 1 on their activity sheet.

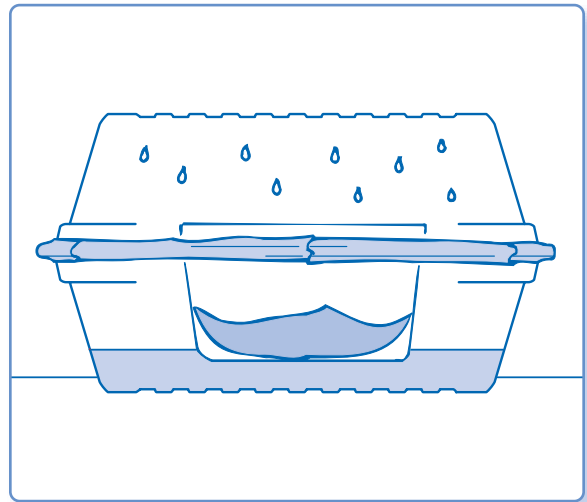
- 4** Ask the students, **What change did you notice in the paper?**

Ask, **What do you think caused this color change?**

Ask, **What could you do to test this idea?**

Have the students remove the paper and allow it to dry. Instruct them to record the color of the paper in Table 1 on their activity sheet.

Additional Information



▲ Figure 7-1. Creating a humid environment.

Some of it is evaporating, and water vapor is entering the air. Some water droplets may be forming on the insides of the containers.

It is filling with water vapor.

It changed from blue to pink.

The students should suggest that the color change was caused by contact with the water vapor in the air inside the plastic containers.

If the students do not suggest it, tell them that they can remove the paper from the containers and allow it to dry out and observe what happens to the color.

Guiding the Activity

Additional Information

5 Ask the students, **What happened to the color of the paper after you took it out of the containers?**

Ask, **What caused this to happen?**

It turned back to blue.

The students should say that the paper dried out and therefore changed from pink to blue.

6 Ask, **What color is the paper when the air is moist?**

Ask, **What color is it when the air is dry?**

Ask, **What can this special paper be used to measure?**

pink

blue

the amount of water vapor in the air

7 Write the words *humidity* and *humid* on the board. Tell the students that the **humidity** is the amount of water vapor in the air. When the air contains a lot of water vapor, it is **humid**, and it is said that the humidity is high. If the air contains little water vapor, it is dry, and it is said that the humidity is low.

Ask the students, **How can you measure humidity?**

Ask, **What color is the paper when the air is humid, or the humidity is high?**

Ask, **What color is the paper when the air is dry, or the humidity is low?**

Students should suggest using the special paper.

pink

blue

8 Tell the students that they will now test the humidity of the air in different locations around the school. Ask, **What are some locations that you could test?** Write the locations that are feasible on the board.

Distribute a piece of masking tape and a sheet of white paper to each team of two. Instruct the students to tape the square of special paper to the center of the white paper.

Decide with the class which locations they will test for humidity. Have them record these in Table 2 on the activity sheet.

Answers will vary but may include the cafeteria, bathroom, gym, outside, beside an open window, over a sink, and so forth.

Make sure the students only tape the cobalt paper along the edges.

Try to include at least one location that is likely to have a higher humidity. If the day is wet, but the heat is on in the school, the results will be different inside and outside.

Guiding the Activity

Take the teams to each location. Instruct them to bring their cobalt paper, activity sheet, and a pencil. In each location, wait several minutes. Then have the students record the color of the cobalt paper.

Back in the classroom, invite volunteers to share their results. Ask, **How can you explain the color of the paper in each location?**

- 9 Tell the students that they will keep track of the humidity over a period of several days. Have them write their names on the paper to which they taped the cobalt paper. Have them leave the paper out in the classroom for several days. Each day, have the students record their observations of the color of the paper in Table 3 on the activity sheet. They should also record observations about the weather.

Have the students dump out the water from the plastic containers and remove and discard the tape. Have them dry out their containers and return them, along with the roll of masking tape, to the kit.

Session II

- 10 Give each student his or her copy of Activity Sheet 7. Invite volunteers to share their observations of the cobalt paper over a period of several days. Have them note any changes in the weather and compare this to any color changes.

Ask the students, **How can you account for any changes in color?**

Additional Information

In dry locations, the paper remained blue. In humid locations, the paper turned pink. A light pink indicates a lower level of humidity than a dark pink.

If it is winter, and the heat is on in the building (or if air conditioning is on in hot weather), the students will see little change. You may wish to have them take their cobalt paper outside each day for better results. If it is raining, make sure that the rain does not fall on the cobalt paper. Have the students stand in a sheltered location. Try to continue the observations long enough to include both dry and wet days.

On rainy or humid days, the paper should have turned pink. On clear and dry days, the paper should have stayed blue.

Students should be able to say that the paper changed color according to the amount of water vapor in the air.

Guiding the Activity

11 To summarize, ask the students, **Does the air always contain the same amount of water vapor?**

Ask, **Does the air in different locations always contain the same amount of water vapor?**

Ask, **Under what kinds of weather conditions is there more water vapor in the air?**

As a lead-in to the next activity, ask, **Once water evaporates into the air, does it stay in the air as water vapor forever? Or does water come back out of the air again?**

Additional Information

no

no

Students should say there is more water vapor in the air around times of rainy or stormy weather.

Answers will vary. Some students may mention rain as evidence that “water comes back out of the air.” Tell the class they will further investigate these questions in the next activity.

REINFORCEMENT

Discuss with the students other indicators of a change in the amount of water vapor in the air. For example, students with curly hair may notice that their hair becomes frizzy in wet weather. When the air is humid, students may say it feels sticky or damp. In very dry weather, some students may notice that their skin dries out.

SCIENCE JOURNALS

Have students place their completed activity sheets in their science journals.

CLEANUP

Have the students discard their cobalt paper or take it home.

Connections

Science Challenge

Since the temperature of the air affects the amount of water vapor it can hold, you may want to have students continue the Science Extension below as a long-range project and have them measure and record the temperature each day as well as use cobalt paper to determine humidity. Students will find that more water evaporates on warm dry days than on cool dry days, and less on cool humid days than on warm humid days. Differences between warm humid days and cool dry days will be less obvious. (Also see Science and Math below.)

Science Extension

Let teams investigate and compare evaporation rates on humid and dry days by pouring a measured amount of water into a dish, leaving the dish in a shaded location for a specified length of time, then remeasuring the water and calculating how much was lost through evaporation. (The dishes could be placed either inside the classroom or outdoors. However, if indoor humidity is affected by heating or air conditioning, make sure the dishes are placed outdoors.) Also have each team leave a piece of cobalt paper next to the dish as a rough measure of the humidity each day. Students will find that less water evaporates on humid days. Ask students to suggest why this is so. (In general, the more water vapor already in the air, the less additional vapor it can absorb.)

You may want to introduce the term *relative humidity* and explain what it means (see Background Information). If you are doing this module during a time of year when weather reports routinely include this information, ask students to record the relative humidity reported each day and compare it with the reaction of their cobalt paper.

Science and Math

As a follow-up to the Science Challenge above, help students make a line graph showing the relationships between air temperature and the amount of water that evaporated. Tell them to label the horizontal axis *Temperature* and the vertical axis *Amount of Water Evaporated* and to plot data separately for humid days and dry days using different color lines.

Science and Health

The following activity could be done in conjunction with the Science, Technology, and Society activity below. Ask students whether their families use a humidifier during the heating season. Explain that some heating systems include a built-in humidifier, so they may have a humidifier at home but not realize it; encourage them to check this possibility. Ask students to find out why humidifiers are used. (Breathing heated air tends to remove moisture from the mucous membranes lining the nose, throat, and bronchial passages, making them more vulnerable to attack by bacteria and viruses.)

Science, Technology, and Society

Ask students whether their families use a dehumidifier at home during muggy weather and, if so, to explain why. (Reducing humidity makes the air more comfortable and also prevents the growth of mildew in damp areas.) If you have or can borrow a dehumidifier, set it up in the classroom on a humid or rainy day so students can observe its operation. (*Safety Note:* Warn students not to touch any exposed coils.) You also might want to explain that besides cooling the air, air conditioners remove water vapor from it and make it less humid. Encourage interested students to find out how dehumidifiers and air conditioners work.