

Activity 6.2 Evaporation

Does adding heat to water increase the rate of evaporation?

This three-part activity consists of an activity that student groups develop themselves, a given procedure, and an optional demonstration. First, students discuss examples of evaporation and then design and conduct their own test to find out whether heating water has an effect on the rate of evaporation. While waiting for their results, students conduct another evaporation activity using single drops of water on 2 paper towels, one of which is heated. The optional demonstration compares the rate of evaporation of hot and cold water using a sensitive scale or balance. In each of these experiences with evaporation, students will identify variables, consider how to best control them, and use their observations to conclude that heating water increases the rate of evaporation.

Materials needed for each group

Hot tap water
Room-temperature water
2 Zip-closing plastic bags, quart-size
2 Droppers
2 Brown paper towels

Materials needed for the optional demonstration

Hot tap water
Cold water
Petri dish or wide shallow container
Sensitive scale or balance
Dropper

Notes about the materials

- Be sure you and the students wear properly fitting goggles.
- Hot tap water is sufficiently hot for the activity. Students should use care when handling hot tap water.
- The materials listed are for the provided procedure only. Student groups will need additional materials based on the evaporation experiment they design and conduct on their own.
- Use storage grade zip-closing plastic bags.

Preparing materials

- Either offer an assortment of materials for the student-designed experiments or have students bring materials from home.

Activity sheet



Copy *Activity sheet 6.2—Evaporation*, pp. 347–349, and distribute one per student when specified in the activity.

Assessment

An assessment rubric for evaluating student progress during this activity is on pp. 372–373. For this formative assessment, check a box beside each aspect of the activity to indicate the level of student progress. Evaluate overall progress for the activity by circling either “Good”, “Satisfactory”, or “Needs Improvement”.

Activity 6.2

Evaporation

Question to investigate

Does adding heat to water increase the rate of evaporation?

1. Discuss with students some of their own experiences with water evaporating.

Ask students questions like the following:

- If you forget your towel when you go swimming, you can dry off by just standing around. How does that happen?
- If you hang wet clothes up, they will eventually get dry. Where do you think the water goes?
- What are some other examples of water drying up?

Students might mention examples such as puddles drying up, dishes on a drying rack, or water in a hot pan on the stove.

Ask students what happened to the water in all these examples. Make it clear that, although you can't see the water anymore, it still exists. It changes into the gas, *water vapor*, which is a common invisible gas in air. Explain to students that when water changes from a liquid to a gas, we say that it *evaporates*. Point out that the word "evaporate" has the word "vapor" in it—water changes to water vapor.

Ask students questions such as the following:

- If you had a wet cloth or paper towel, do you think the water would eventually evaporate?
- What could you do to make the water from the paper towel evaporate faster? Students should mention some way of adding heat to make water evaporate faster.

2. Have students get into groups to design an experiment to test whether heat increases the rate of evaporation.



Distribute *Activity sheet 6.2—Evaporation*. Ask students to think about and discuss a test they could conduct in the classroom that would investigate whether heating increases the rate of evaporation. Students should record their ideas on the activity sheet. Students will continue to use the activity sheet as a guide as they plan their experiment.

As you listen to group plans, help students realize that they will need two samples of water. Students might think of putting water in containers or dampening two samples of material such as paper towels. They should realize that they will need to warm one sample but not the other. Students should mention that they will use the same amount of water in each container or on each sample of material. They should start with the same temperature of water, and the same type of container or material. You may want to suggest that students use a small amount of water so that they don't have to wait very long to see an observable difference.

3. Discuss students' experimental designs and how they plan to control variables.

Have a class discussion where groups share their experimental designs. Have students consider how each proposed experiment controls variables. Groups may modify their plans based on the feedback they get from you and other students.

4. Have student groups conduct their experiment to find out whether heating water increases the rate of evaporation.

Depending on students' experimental designs, observable results may take minutes, hours, or days.

5. Have students conduct the following procedure while they wait for their results.

Procedure

1. Add about 1 cup of *room-temperature* water to a zip-closing plastic bag. Get as much air out as possible, and seal the bag securely. Lay the bag down flat.
2. Add about 1 cup of *hot* tap water to a zip-closing plastic bag. Get as much air out as possible, and seal the bag securely. Lay the bag down flat. This bag will serve as a heat source.
3. You and your partner should each use a dropper to place 1 drop of room-temperature water in the center of 2 separate pieces of brown paper towel at the same time.
4. Allow the drops to spread for about 10–20 seconds until they don't seem to be spreading any more.
5. At the same time, place 1 paper towel on each bag.
6. Observe every few minutes. Compare the amount of water on each paper towel.



Expected results: The water mark on the brown paper lying on the hot water bag should disappear faster than the mark on the paper lying on the room-temperature water bag. This will take about 3–5 minutes.

6. Discuss the design of this experiment and the results.

While students are waiting to see which drop of water evaporates first, ask students about the design of this experiment. Ask questions such as the following:

- How will you know which sample of water is evaporating faster?
- Why do you think you used the same amount of water on each paper towel?
- What is the purpose of the bag of room-temperature water in this experiment?

Students should recognize that using different amounts of water on each paper towel could influence which sample evaporates first. Since the experiment is about differences in evaporation rates due to temperature, only the temperature of the drops of water should be different. The amount of water placed on each paper towel must be the same. Even the surface each paper towel is placed on should be the same. This is the purpose of the bag of room-temperature water.

Optional

7. Conduct a demonstration to show another way to find out whether hot water evaporates faster than cold water.



Procedure

1. Use a sensitive scale or balance that measures at least to tenths of a gram. Place a shallow Petri dish or yogurt lid on the scale.
2. Add 20 grams of hot tap water to the dish. You may use a dropper to help add or remove small amounts of water to get the mass as accurate as possible.
3. Check and record the mass. Then watch the readout on the scale or the pointer on the balance for 5 minutes. Ask students why the mass is changing.
4. Place 20 grams of very cold water on the scale for the same length of time.

Expected results: The hot water will lose more mass than the cold water.

Ask students what the results show about temperature and evaporation. Students should realize that the loss of mass was due to evaporation. Because the hot water sample was at a higher temperature, the molecules had more energy and were able to break away from the liquid and move into the air as the gas water vapor.

8. Discuss the results of the experiments designed and conducted by students.

Ask students questions like the following:

- Does the temperature of water have an effect on its rate of evaporation?
- Which evaporates faster, hot or cold water?
- How can the movement of molecules help explain why hot water evaporates faster?

Students should agree that temperature does affect the rate of evaporation. The experiments conducted show that hot water evaporates faster than cold water. Have student groups share their experiments, results, and conclusions.