

Activity 6.4a

Exploring moisture on the outside of a cold cup

What causes moisture to form on the outside of a cold cup?

In the previous activity, students saw the relationship between cooling water vapor and condensation. In this activity, students investigate how condensation causes moisture to form on the outside of a cold cup. To see if the condensed water vapor comes from the air, students use 2 cold cups, but limit the air around one of them by placing it in a plastic bag. Students then compare the amount of moisture that forms on the outside of both cups. They will see that more moisture forms on the exposed cup. Since students determined in the previous activity that water vapor can condense to form liquid water, they can conclude that water vapor from the air must condense to form the moisture on the outside of a cold cup.

Note: Be sure to test this experiment before trying it with students because the amount of water vapor in the air varies in different geographic regions during different times of the year. Place water and ice in a clear plastic cup and leave it undisturbed for 3–5 minutes. If moisture is readily observable on the outside of the cup, do this activity with your students. If not, do *Activity 6.4b*, pp. 362–366.

Materials needed for each group

Ice
Room-temperature water
4 Clear plastic cups
Paper towel
Zip-closing plastic bag, gallon size

Notes about the materials

- Be sure you and the students wear properly fitting goggles.
- Each group will need about 3 cups of ice.
- This activity has a take-home component. Have students empty and dry the cups used during the in-class parts of the activity. Then each student can take two of these clear plastic cups home. You may need additional cups depending on the number of students in each group.

Activity sheet



Copy *Activity sheet 6.4a—Exploring moisture on the outside of a cold cup*, pp. 359–361.

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 6.4a

Exploring moisture on the outside of a cold cup

Question to investigate

What causes moisture to form on the outside of a cold cup?

1. Discuss with students their experiences with moisture on the outside of a cold cup or other container.

Ask students if they have ever noticed moisture on the outside of a cold cup or can. Then tell students that they will do an experiment to find out where the moisture comes from.

2. Have students explore whether the temperature of a cup has anything to do with the amount of moisture that forms on the outside of the cup.

Procedure

1. Fill 1 cup with ice. Add room-temperature water until the cup is about $\frac{3}{4}$ filled.
2. Add room-temperature water to another cup until it is about $\frac{3}{4}$ filled.
3. Wipe the outside of both cups with a paper towel to be sure they are dry.
4. Allow the cups to sit for about 1–3 minutes. Look at the outside of each cup. Use your finger to test for any liquid on the outside of the cups.



Expected results: More moisture will appear on the outside of the cup with ice water than on the outside of the cup with room-temperature water.

3. Discuss student observations and possible explanations for the moisture on the outside of the cold cup.

Ask students the following questions to get them thinking about why there is more moisture on one cup than the other. It is not important that students know the correct answers to these questions at this point. They will explore these further in the next part of the activity.

- Which cup had more moisture on the outside?
- What do you think the liquid is on the outside of the cold cup?
- Where do you think the liquid could have come from?
- Why do you think the cold cup has more moisture on the outside than the room-temperature cup?

Students should remember from *Activity 6.3* that cooling water vapor increased the rate of condensation. They should use this prior observation to explain that more moisture forms on the cold cup because cooling water vapor increases the rate of condensation. The cold cup cooled the air surrounding it enough for a noticeable amount of water vapor to condense on the outside of the cup.

4. Conduct an activity to find out whether the moisture that develops on the outside of a cold cup is condensed water vapor from the air.

Tell students that one way to find out if moisture is from water vapor in the air is to limit the amount of air around one cup while leaving the other cup exposed to air.

Procedure

1. Fill 2 cups with ice. Then add room-temperature water until each cup is about $\frac{3}{4}$ full. Wipe the outside of both cups with a paper towel to be sure they are dry.
2. Carefully place 1 cup in a zip-closing plastic bag. Get as much air out of the bag as possible and then seal the bag tightly.
3. After about 1–3 minutes, observe both cups.



Expected results: The cup outside of the bag will have more moisture on it than the cup in the bag.

5. Have students discuss their results.

Ask students questions such as the following:

- Which cup had more moisture on the outside?
- What is the purpose of the bag in the experiment?
- Explain how moisture forms on the outside of a cold cup.

Students should conclude that the moisture on the outside of the cup was caused by water vapor in the air condensing on the cold outside of the cup. The cup inside the bag had less moisture on the outside of it because it was exposed to less air and therefore less water vapor.

6. Conduct an at-home activity to find out whether moisture will develop on the outside of an *empty* cold cup.

Ask students if they think that an *empty* cold cup would develop moisture on the outside of it. Then ask them what they could do to find out. The following procedure is one way to investigate this question. Have students conduct this activity at home. Send them home with 2 empty clear plastic cups and the last page of the activity sheet, p. 361. To be sure students do not have the misconception that the moisture that forms on the outside of a cold cup could be caused by water leaking through, have students conduct the following experiment with an empty cup.

Procedure

1. Place 1 empty clear plastic cup in a freezer while keeping another identical cup out. This identical cup will serve as a control.
2. Leave the cup in the freezer for at least 5 minutes.
3. Remove the cup from the freezer and place it near the control cup.
4. Look at the cups and feel the outside of each.

7. Have students report their findings.

Ask students what they observed on the outside of each cup.

Expected results: The empty cup that was in the freezer will become cloudy while the empty room-temperature cup will remain clear. The outside of the cup that was in the freezer feels wet while the room-temperature cup feels dry.