

Activity 6.4b

Exploring moisture on the outside of a cold cup: For dry environments

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

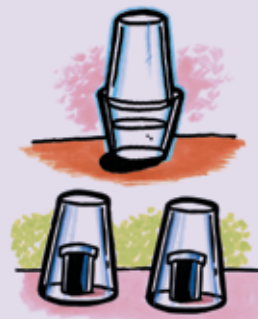
If the classroom air is not moist enough to achieve observable condensation in *Activity 6.4a*, students can conduct this activity. Regardless of the time of year or region of the country students live in, they have likely experienced moisture on the outside of a cold drink or other cold surface. In this activity, students will prepare a sample of humid air since the ambient air is too dry. Then students will place a cold container in the sample of humid air while leaving another cold container in the drier classroom air. By comparing the results, students will identify the factors that cause moisture to form the outside of a cold cup.

Materials needed for each group

Ice	1 Wide clear plastic cup
Room-temperature water	2 Film canisters with lids
Hot water	Paper towel
3 Tall clear plastic cups	

Notes about the materials

- Be sure you and the students wear properly fitting goggles.
- This activity calls for both tall and wide clear plastic cups. Be sure the cups fit together as shown.
- Use film canisters or any other small containers with lids that will fit underneath a tall clear plastic cup as shown.
- Check to see whether an ice cube will fit inside your small container. If not, use crushed ice for this portion of the activity.
- Students will need just enough ice to fill 1 clear plastic cup and the 2 small containers.



Activity sheet



Copy *Activity sheet 6.4b—Exploring moisture on the outside of a cold cup: For dry environments*, pp. 365–366.

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 6.4b

Exploring moisture on the outside of a cold cup: For dry environments

Question to investigate

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

1. Discuss with students their experiences using their breath to make a window “cloudy”.

Introduce the activity by asking students if they ever breathed on a window to make it “cloudy”. Students may mention breathing on a window in a car or in the house. Students may remember the window feeling wet as they wrote or drew on it with their fingers. They may have also noticed that they can sometimes see “smoke” when they talk or exhale in winter.

2. Conduct an experiment to see whether the temperature of a cup affects whether it becomes “cloudy” when a student breathes on it.



Distribute *Activity sheet 6.4b—Exploring moisture on the outside of a cold cup: For dry environments*. Explain to students that they will breathe on the outside of a cold cup and a room-temperature cup. Then ask them to predict what they might see on the outside of each cup.

Procedure

1. Fill a cup with ice. Add water until the cup is about $\frac{3}{4}$ full.
2. Place $\frac{3}{4}$ cup of room-temperature water in another cup.
3. Wipe the outside of both cups with a paper towel.
4. Slowly breathe warm air onto the outside of the room-temperature cup and then the cold cup.
5. Use your finger to feel the outside of each cup.



Expected results: As student breath hits the side of the room-temperature cup, the cup becomes slightly cloudy and then quickly clears. As student breath hits the side of the cold cup, the side becomes cloudy and stays that way longer. When students feel each of the cups, they should notice moisture on the outside of the cold cup.

3. Discuss student observations.

Ask students questions such as the following:

- Which cup were you able to make cloudier?
- Why do you think the outside of the cold cup became cloudier than the outside of the room-temperature cup?

Students should recognize that the moisture that forms on the outside of the cold cup is water. They may recall that in *Activity 6.3*, they were able to make more moisture form by cooling water vapor. Ask students whether they think water vapor could be in their breath. Help students understand that the moisture that appears on the outside of the cold cup is caused by water vapor from their breath condensing on the cup.

4. Conduct an activity to find out if the amount of water vapor in the air has an effect on the amount of moisture that appears on the outside of a cold cup.

Explain to students that sometimes moisture will appear on the outside of a cold cup even though no one breathes on it. Ask students if they think the amount of water vapor in the air may vary from season to season and place to place. For example in parts of the country that are often humid, moisture on the outside of a cold cup is a common occurrence. Briefly discuss the current dry conditions in your area. Explain that in the following activity students will place a cold container in a sample of *humid* air that they will make and another cold container in the *dry* classroom air.

Procedure

1. Fill a wide clear plastic cup about $\frac{3}{4}$ full with hot tap water.
2. Immediately place a taller plastic cup upside down on top of the wider cup, as shown.
3. Fill 2 plastic film canisters with ice. Add water until they are nearly full, and snap the caps on securely.
4. Wipe the outside of both film canisters with a paper towel to be sure they are dry.
5. Once the tall cup appears cloudy, take it off of the other cup and immediately place it over one of the film canisters. At the same time, place another plastic cup over the other canister. This cup will contain the normal dry classroom air. Wait 2–3 minutes.
6. Remove the tall cups and look at the outside of each canister closely. Use your finger to test for any liquid on the outside of each canister.



Expected results: More moisture appears on the outside of the film canister that is placed under the cup with a lot of water vapor in it. The film canister under the cup with the dry classroom air has less moisture on it.

6. Discuss student observations.

Ask students what they observe on the outside of each film canister. Then have students apply this observation to a different situation:

- Consider two cold cups, each in a different place. Imagine that one cup has moisture on the outside and the other doesn't. What can you say about the air in each place?

Exploring moisture on the outside of a cold cup: For dry environments

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

If you've ever let a cold drink sit out for a while, you may have noticed that water forms on the outside of the cup. In this activity, you will explore where the water comes from.

Procedure

1. Fill a cup with ice. Add water until the cup is about $\frac{3}{4}$ full.
2. Place $\frac{3}{4}$ cup of room-temperature water in another cup.
3. Wipe the outside of both cups with a paper towel.
4. Slowly breathe warm air onto the outside of the room-temperature cup and then the cold cup.
5. Use your finger to feel the outside of each cup.



1. Which cup had more moisture on the outside of it?

2. Condensation is the process in which a gas changes to a liquid. Explain how condensation might be the cause of the moisture on the outside of one of the cups.

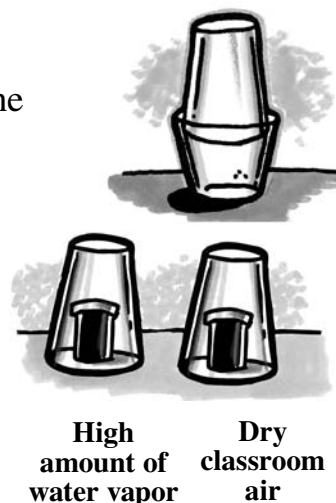
In the procedure on the following page, you can test whether the amount of water vapor in the air has an effect on the amount of moisture that appears on the outside of a cold container.

Exploring moisture on the outside of a cold cup: For dry environments *(continued)*

Does water vapor from the air cause moisture to form on the outside of a cold cup?

Procedure

1. Fill a wide clear plastic cup about $\frac{2}{3}$ full with hot tap water.
2. Immediately place a taller plastic cup upside down on top of the wider cup, as shown.
3. Fill 2 plastic film canisters with ice. Add water until they are nearly full, and snap the caps on securely.
4. Wipe the outside of both canisters with a paper towel to be sure they are dry.
5. Once the tall cup appears cloudy, take it off of the other cup and immediately place it over one of the film canisters. At the same time, place another plastic cup over the other canister. This cup contains the normal dry classroom air. Wait 2–3 minutes.
6. Remove the tall cups and look at the outside of each canister closely. Use your finger to test for any liquid on the outside of each canister.



3. Which canister had more moisture on the outside of it?

4. Why do you think there is more moisture on the outside of one canister than the other?

5. If you see a container with moisture on the outside of it, what can you say about the temperature of the container and the amount of water vapor in the air?

6. If you see a container that is completely dry on the outside, what can you say about the temperature of the container or the amount of water vapor in the air?
