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How can clouds form?

Teaching and Learning Focus

In this investigation, your students will begin to develop their concept of clouds based upon three basic observations:

- Warm air can contain more water vapor than cold air.
- When air loses heat, some of the water in the air turns to liquid.
- As air loses heat, droplets of water collect and become visible on solid surfaces.

Materials Needed

For each student group:

1. Large clear glass or plastic jar with lid, without label
2. Supply of small ice cubes
3. Quart-size zip-closing plastic bag
4. Water at room temperature
5. Wooden safety matches
6. Small flashlight (observations work best if the viewing area is dimly lit)

Safety

Most of this investigation is considered generally safe to do with students. However, one part of it involves the use of a lit match. YOU need to demonstrate this step for the students. Review safety precautions with them carefully. To ensure all students clearly observe this event, conduct a separate demonstration at each table. You students can participate with each step except the one involving flame.

Setting the Scene

You might want to set the scene for this investigation by telling the students about this fascinating experience. (*Alternatively, you could use it at the end as a way of assessing what your students have learned. They should be able to explain what happened in the cave.*)

Dr. Vincent J. Schaefer (1891-1993) is known for writing several handbooks on climate and weather. He once described an interesting experience when he and a companion were exploring a cave. They slipped through a small opening and entered a large cavern where their flashlights revealed a clear pool of water. The air felt cool, their skins felt moist and clammy, and the cave walls were wet--typical conditions for a cave. They decided to take a swim. Schaefer's friend suggested saving flashlight battery power by lighting their lanterns instead. He struck a match, and, suddenly, the whole room was filled with a dense fog. They had created an underground cloud!

You can also begin by showing the students pictures of clouds. These may be photographs, or they may be art in books or that the children themselves have drawn. Have the students share their ideas about where clouds come from, and whether they can ever disappear. Given the possibility that some will offer that clouds from out of air, the question arises: How can clouds form?

Presenting the Investigation Question

Introduce your students to the investigation question: "*How can clouds form?*"

Have your students discuss the question in pairs, then in groups, and then as a whole class. Record their answers on the flipchart.

Have your students brainstorm ideas about how this investigation question could be investigated.

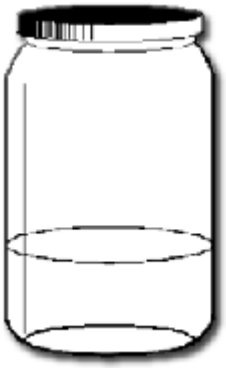
1. Design an experiment that could be used to test the investigation question.
2. What materials would be needed?
3. What would you have to do?
4. What would be measured?
5. How long would the experiment take?

Assessing What Your Students Already Know

From the last investigation, your students will have a beginning understanding that air can contain water as a gas. They may, or may not be able to describe this as water vapor. Some may know that water vapor is an invisible gas. Some students may not think of the role of water vapor in cloud formation, but will believe that clouds simply travel from one place to another, so that the clouds they see simply floated in from someplace else. Keep in mind that young children respond to concrete observations and, in so doing, can misunderstand parts of scientific phenomena.

Exploring the Concept

1. Ask each group of students to carefully pour water to the depth of about an inch (2.5 cm) in the bottom of the jar. Replace the lid. (*They can use a ruler to measure the water depth.*)



2. Have your students next examine the jar and its contents as they shine the flashlight. (*Water and jar should be at the same temperature. If the water temperature is too warm, or the jar too cold, condensation may form on wall of the jar. At this point, there should be no sign of a cloud or condensation.*)

3. Now, have a student shake the jar so that the air inside is well exposed to water.
4. Ask this question for review: Does air hold water? (*Yes. We concluded that after the first activity when we saw water condense on the side of the tumbler.*)
5. Ask your students to observe the jar as they shine the flashlight. Is there any sign of a cloud inside? (*No*)
6. Ask one student in each group to fill the plastic bag with ice. Remove the jar lid, and quickly place the bag of ice over the container. Ask the students to observe as they shine the flashlight. Now is there a cloud inside? (*No*)

7. Tell the students that YOU will do the next step. Tell them that you will come around to each group in turn.

   While the bag of ice stays on top of the container, strike a safety match. Remove the bag of ice and lower the lighted match into the container. (*Be careful to hold it in a horizontal position so that you don't burn your fingers.*)

8. Blow out the flame, so that the match begins to give off smoke, some of which will go into the jar. After a few seconds, let the match drop into the water and quickly replace the bag of ice over the top. Ask the students to observe carefully as they shine the flashlight on the jar. Now is there a cloud inside? (*Yes!*)
9. Next, have each student group review what has happened. Ask them to think about the observations they have made and try to find an explanation for the "cloud" forming. These questions may help:
   - What did shaking the container do to its contents - water and air? (*It allowed the water and air to mix, thereby causing more water vapor to form in the air - or evaporate.*)
   - What did the ice pack do? (*Cooled the air to the point where some of the water vapor is ready to change from a gas state into a liquid state - or condense.*)
   - What did the smoke from the match do? (*The smoke produced from the match contains tiny particles upon which water vapor can condense into tiny water particles - just like it did on the side of the glass tumbler in Investigation question 1.*)

   Some students might say that they are only seeing smoke from the blown-out match. You can ask them how that possibility might be eliminated. (*Light a match, put it out so that it produces smoke and drop it into a jar of water--both jar and water at room temperature--without the previous shaking and without the bag of ice.*)
10. Ask your students if the experiment helped anyone to explain the cave story. Have them consider at what point our container was most like the cave chamber before the cloud appeared. (*The jar was most like the cave after the jar of water was shaken to mix water and air and after the air was cooled with the ice pack. The smoke from the match put thousands of tiny particles into the air above the water. These acted like the wall of the cup. Each one gave liquid water a place to gather when the air was cooled*).

Applying Students' Understanding

To assess how your students' understanding, ask them what they think will happen when you place warm water in your metal cup. (*Empty and dry the cup before filling it with warm water. This time, air will not be cooled, and it will not form liquid condensation on the surface.*)

Revisiting Investigation Question 2

Complete this investigation question by asking your students to reflect on "How can clouds form?" and how their answers may have changed as a result of this investigation.

Weather Unit Sections

Introduction
Air
Temperature
Wind
Clouds
How can we see if water is in the air?
How can clouds form?
Revisit the concept of Clouds
Weather
