ARM

CLIMATE RESEARCH FACILITY

Education and Outreach Lesson Plan

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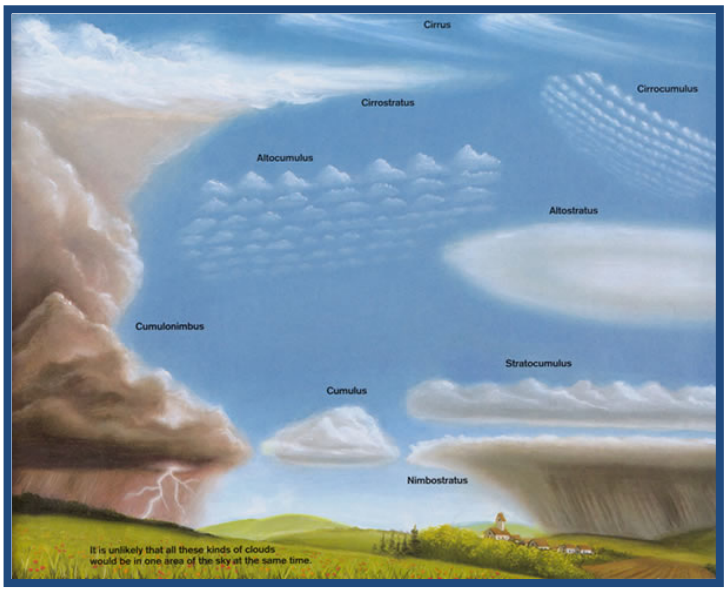
Grade levels 6–8

Making Clouds

Making Clouds



Approximate Time

1 hour

Objective

The objective of this activity is to investigate the conditions that must be present for clouds to form.

Key Points to Understand

- Three things are necessary for cloud formation: cooling of air, water vapor, and condensation nuclei.
- Water vapor must have something to condense on to form the droplets that compose clouds.
- Many things can serve as condensation nuclei. Some of the most common include dust, pollen, salt from ocean spray, and smoke.

Key Vocabulary

- **Aerosol**: Tiny particles suspended in the air are called “aerosols.” It is not unusual for there to be 10,000 aerosols per cubic centimeter (160,000 per cubic inch) of air. These come from many sources, both natural and man-made: the soil, salt from the ocean, plants, and the burning of fossil fuels or vegetation. Aerosols can be solid, liquid, or a mixture of both. Even though this sounds like “pollution,” aerosols are very important for the formation of clouds. Virtually all cloud droplets initially form around an aerosol. The more aerosols there are, the easier it is for clouds to form. After they are produced, aerosols typically only last a few days before they are washed out of the atmosphere by rain systems.

- **Cloud condensation nuclei**: Cloud condensation nuclei (CCN) are aerosols that act as the initial sites for condensation of water vapor into cloud droplets or cloud ice particles. Virtually all cloud droplets or ice particles originate around some sort condensation nuclei, which tend to “attract” water.

- **Vapor**: Water vapor is water in its gaseous state—instead of liquid or solid (ice). Water vapor is totally invisible. If you see a cloud, fog, or mist, these are all liquid water, not water vapor.

Cloud Definitions and Information

Name	Height	Description	Remarks
stratus	0–1500 feet	Whitish, grey layer, often covering hills.	May give drizzle.
cumulonimbus	1500–6500 feet	Huge towers of heavy dense clouds. The tops are flat, usually spreading.	Often bring showers and thunder.
cumulus	1500–6500 feet	Detached dense clouds with sharp outlines and rising domes, mounds, or towers.	Associated with sunny weather and scattered showers.
stratocumulus	1500–6500 feet	Grey or white rolling patches or sheets.	Bring dull weather, sometimes with drizzle.
nimbostratus	3000–10,000 feet	Dark grey cloud layer, usually diffused by rain or snow.	Ragged patches of stratus may occur below the layer.
altostratus	3000–10,000 feet	Flat, thick blue-grey sheet.	Indicates rain or snow if associated with cirrostratus.
altocumulus	6500–23,000 feet	White or grey rounded clouds.	Usually break up leaving good weather.
cirrostratus	16,500–45,000 feet	A transparent milky veil which can be fibrous or smooth.	Indicates rain later.
cirrocumulus	16,500–45,000 feet	Thin rippled sheets of rounded clouds.	Form on the edge of unsettled weather.
cirrus	16,500–45,000 feet	Fibrous or hairlike clouds with a silky sheen.	An indication of bad weather to follow with strong winds at the cloud level.

Materials

Each student or group of students will need the following:

- 1 liter (or larger) clear glass jar with lid (large-mouth jars work best)
- Ice cubes or crushed ice
- Hot water
  Caution: Even very warm water will do. Do not use water that is hot enough to burn your skin.
- Matches (NOTE: **To be used under adult supervision**)
- Can of aerosol spray (air freshener is suggested)
- Black construction paper
- Safety goggles
- Flashlight (optional)

Preparation

- Before the lesson begins, discuss cloud formation with the class to determine the students' ideas on how clouds form. Ask students what they think a cloud is made of, and then ask them how it forms. This information can be input on a chart or on the document camera to be revisited in the future.
- Be sure that all materials are either centrally located or already distributed to the groups of students. Perhaps the students could bring clear glass jars, such as mayonnaise jars, pickle jars, canning jars, etc., from home. The jars do not have to be the same shape, but clear glass works the best. The larger the mouth of the jar, the better the experiment.

Management Tip: VERY IMPORTANT!

Depending on the students, the teacher may choose to light all matches for them to reduce the risk of accidents and the temptation for horseplay. Be careful: Flames and aerosol cans are an explosive combination. Holding a lighted match in front of an aerosol can makes a very effective flame thrower. Students **must never** have access to both the matches and the aerosol at the same time. If, in the teacher's opinion, this represents too great a risk for his or her students, it is strongly recommended that the aerosol not be used at all. *The important points of this activity can still be made using only smoke.*

Each trial in this experiment (Control and Match) will be conducted three times. The final trial is done once with an aerosol. This will make a total of seven trials.

Procedure

1. Fill the jar with hot water. Do not use water that is hot enough to burn your skin.
2. Pour out most of the hot water, but leave about 2 centimeters of water in the bottom of the jar. Hold the black paper upright or prop it up against some books behind the jar.
3. Turn the lid of the jar upside down and fill it with ice. Now place the lid on the jar. Observe the jar for 3 minutes. If you have a flashlight, darken the room, and shine the flashlight on the jar while you observe it. Record your observations in the table, under "Control."
4. Pour the water out of the jar and repeat steps (1) and (2). Record additional observations.
5. Prepare the lid so that you can immediately cover the mouth of the jar during the next step.
6. Move all loose papers away from the jar, put on your safety goggles, then strike a match and drop the burning match into the jar. Cover the mouth of the jar immediately (with the ice-filled lid). Record your observations in the table, in the box marked "Match." Be extremely careful with the matches as they may still be very hot.
7. Pour out the water in the jar and repeat steps (5) and (6). Record your observations in the table, under "Match."
8. Spray a very small amount of the aerosol in the jar and immediately cover the mouth of the jar with the ice-filled lid.
9. Observe what happens in the jar for 3 minutes and record your observations in the table in the box marked "Aerosol."

Closure and Evaluation

Ask students:

1. In all the trials of this experiment, the jar contained water vapor and cooled air. Where did each come from?
2. Did a cloud form the first time you put the lid over the mouth of the jar? How about the second and third times?
3. Define *aerosol*.
4. Based on the definition of aerosol, would you classify smoke as an aerosol?
5. Based on your observations and your answers, what is the other condition besides moisture and cool air necessary for cloud formation?

Students will complete student worksheet including data table, graph, and several questions. The above questions may be used as a class discussion or for individual assessment.

Suggested Follow-Up Activities

- Using what you learned on this activity, write a paragraph about the effects of condensation nuclei/aerosols and cloud formation. What do you think makes the best nuclei?
- Research the aerosol industry. What aerosols are currently being removed or improved? What is the environmental impact of human use of aerosols globally or where you live?

Name:_____

Date:_____

Title:_____

Making Clouds

Research Question: What conditions must be present for clouds to form?

Hypothesis

_____
_____
_____
_____

Materials

- 1 liter (or larger) clear glass jar with lid (large-mouth jars work best)
- Ice cubes or crushed ice
- Hot water
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- Can of aerosol spray (air freshener is suggested)
- Black construction paper
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- Flashlight (optional)

Data

Trial	Observations:
Control	Trial 1: Trial 2: Trial 3:
Match	Trial 1: Trial 2: Trial 3:
Aerosol	

Conclusion

Based on your hypothesis, recorded data, and findings from the experiment, write a conclusion.

_____
_____
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_____

Answer the following questions using the data collected.

1. In all the trials of this experiment, the jar contained water vapor and cooled air. Where did each come from?

   _____
   _____
   _____
   _____

2. Did a cloud form the first time you put the lid over the mouth of the jar? How about the second and third times?

   _____
   _____
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   _____

3. Define *aerosol*.

   _____
   _____
   _____
   _____

4. Based on the definition of aerosol, would you classify smoke as an aerosol?

   _____
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   _____

5. Based on your observations and your answers, what is the other condition besides moisture and cool air necessary for cloud formation?

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