

SMOKE ON THE WATER (1 Hour)

Addresses NGSS

Level of Difficulty: 3

Grade Range: 6-8

OVERVIEW

In this activity, students use simple materials to produce and observe cloud formation. Students will experiment with different substances to observe their effects on cloud formation and the water cycle.

Topic: Meteorology

Real-World Science Topics

- An exploration of the condensation of water vapor
- An exploration of clouds and the water cycle

Objective

Students will gain an understanding of the factors that influence cloud formation and the effect this has on the water cycle.

NGSS Three-Dimensions

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models <ul style="list-style-type: none">• Develop a model to describe unobservable mechanisms	Energy and Matter <ul style="list-style-type: none">• Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter	ESS2.C: The Roles of Water in Earth's Surface Processes <ul style="list-style-type: none">• Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.

Background Information

What is happening in this activity?

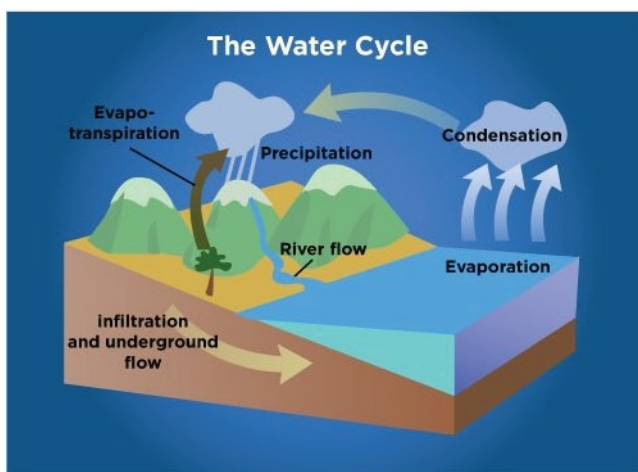
When the match is lit and dropped into the sealed container, particles of burnt wood and gas are released into the air above the water. The ice-cold surface at the top of the container rapidly cools the warm water vapor in the air, causing the vapor to condense around the particles of smoke in the container. A cloud forms that is similar to the clouds one sees in the sky. If there were not a significant number of dusty particles in the container, the water vapor would condense onto the edges of the container (the same way glass inside a warm car fogs up on a cold day).

How do clouds form in nature?

A great and very useful example of cloud formation occurs almost daily on hot summer days in the Rockies in the western United States. Known as "orographic uplift," warm air blowing west to east rises as it passes over the mountains. As the warm, moist air rises, it cools rapidly and condenses around dust and other large particles in the atmosphere, forming large puffy cumulus clouds.

What is the water cycle?

The water cycle (sometimes referred to as the hydrologic cycle) is the movement of water from the surface of Earth, through the atmosphere, and back down to Earth. Heat from the Sun and Earth warms a body of water or snow. The heat causes water molecules to evaporate into the air. This warm, moist air rises and cools as it ascends, condensing around dust particles in the atmosphere to form clouds. These water droplets remain suspended in the atmosphere until they become saturated and heavy. When this happens, the water droplets fall to Earth as precipitation, and the process repeats.



Key Vocabulary

Cloud – visible condensed water vapor

Condensation – the conversion of a substance from a vapor state to a denser state such as liquid or solid

Water vapor – water in the gaseous state

Ice – water in the solid state

Materials Needed for Activity

- drinking glass
- 5 to 7 cups hot water
- 20 to 30 ice cubes
- 1/3 cup vegetable oil
- 1/3 cup liquid soap
- tablespoon of salt
- 4 to 6 stick matches
- a transparent plastic container, such as a 2-L soda bottle
- a plastic bowl or dish with a diameter greater than the opening of the plastic container
- scissors

Teacher Preparation

If using plastic soda bottles for the plastic container, cut the top third off each bottle. (Save these as they make great funnels!)

- 1. Warm-up Activity:** Fill a drinking glass with ice cubes and pour water into it. Ask students to observe what happens. They should notice that the cold glass will become wet around the outside. Ask students to think about why this might happen. Explain that there is moisture in the air in the form of water vapor (such as steam). When air holds a lot of moisture, we say it is humid. When that moisture comes in contact with the cold glass, it forms a drop of water. This is called condensation. Have students think of other places that they have noticed condensation (such as dew on plants in the morning, fog on eyeglasses or car windows, steam on mirrors after a shower, and so on).
- 2.** Ask students to think about clouds. How might clouds form? Could they be the result of condensation? Briefly review the water cycle with students. (It may help to draw a diagram of this process.) Be sure to clarify any questions students might have about states of matter (solid, liquid, plasma, and gas).
- 3.** Explain to students that they will be investigating the formation of clouds by creating clouds in plastic containers. Model the equipment setup for this activity by placing a tall container half-full of hot water in front of the class. Light a match and drop it into the hot water. Be sure to hold the lit match inside the container for at least 5 seconds before dropping it into the water, so that a significant amount of particulate matter accumulates inside the container. Cover the container with a dish of ice, as shown below:



Basic equipment setup

- 4.** Divide teams into groups and then pass along the materials and Student Handouts to the teams.
- 5.** Review the steps for setting up the equipment, performing the activity, and making and recording observations. Explain that students will repeat the activity for the following combinations of materials:
 - Hot water
 - Hot water and salt
 - Hot water and liquid soap
 - Hot water and vegetable oil

Note: Students should test the hot water and vegetable oil combination last, as this will be the most difficult combination to clean from the plastic container

6. When groups are ready to test their setup, check their materials to be sure that they have set up the plastic container, water solution, and ice bowl correctly. Then, light the match and drop it into the plastic container. (Be sure to hold the lit match inside the plastic container for at least 5 seconds.) Have students make and record their observations. **Caution students not to light any matches themselves.**
7. As a class, discuss the results of the activity. Have students share their observations. Which materials did or did not prevent cloud formation? What might explain the different results of cloud formation? Have students answer the questions on their Student Handouts. Explain that there was moisture in the air inside the plastic container. When the match was dropped into the hot water, it released smoke and dust particles into the air in the container. Then, when the ice was placed over the top of the container, the moisture in the air cooled down and condensed on the dust particles, forming a cloud. How might this model be similar to the formation of a cloud in the sky?

Extension Activity

Have students investigate an alternate way to create clouds in a bottle. Use a 2-L transparent plastic bottle. Add approximately a cup of hot water to the plastic bottle. Light a match and insert it into the bottle. Screw on the bottle cap. Squeeze the bottle several times. Squeeze and hold the bottle to see the cloud form. Pressure on the bottle increases the interior pressure, which causes the water molecules to condense on particles released by burning the match.

Sources

National Science Teachers Association

<http://nsta.org>

National Council of Teachers of Mathematics

<http://standards.nctm.org/document>

National Educational Technology Standards

<http://cnet.iste.org/currstands/cstands-netss.html>

Name:

Date:

Data Table

Cloud ingredients	Observations
Hot water	
Hot water + Vegetable oil	
Hot water + Salt	
Hot water + Liquid soap	

Based upon your observations, answer the following questions:

1. Which combination of materials formed a cloud?
2. Which combination of materials prevented a cloud from forming?
3. What might explain the different results you observed?
4. How would the water cycle be affected if the ocean were covered with oil?