

Dew Drops

Section THE CHEMISTRY OF LIFE & EARTH SCIENCES

Estimated Time ⌚ Setup: 5-10 minutes; Procedure: 15-20 minutes

OVERVIEW

Make condensation appear both on the inside and outside of a glass.

In this activity, students fill a jar first with hot water, then cold water. Depending on the temperature of the water, condensation – in the form of beads of water or fog – will appear either on the inside or outside of the glass. This activity demonstrates water changing states based on temperature and explains why we see drops of dew outside in the morning!

INQUIRY QUESTIONS

Getting Started:

🔍 What are the states of matter and how do we describe them?

Learning More:

🔍 How can matter change between states, and what are these processes called?

Diving Deeper:

🔍 How does energy and particle motion relate to states of matter and changes in states of matter?

CONTENT TOPICS

This activity covers the following content topics: states of matter, physical changes, condensation, vaporization, atomic structure, energy, temperature, heat

This activity can be extended to discuss: water collection methods, sublimation, deposition, photosynthesis, plant structure and functions, animal behavior, dew point, weather, climate, intermolecular attraction, hydrogen bonding

NGSS CONNECTIONS

This activity can be used to achieve the following Performance Expectations of the Next Generation Science Standards:

- 🔗 **2-PS1-4:** Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.
- 🔗 **5-PS1-1:** Develop a model to describe that matter is made of particles too small to be seen.
- 🔗 **MS-PS1-4:** Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

MATERIALS

For one setup:

- ✔ Clear glass jar with lid
- ✔ Ice
- ✔ Hot and cold water

ACTIVITY NOTES

This activity is good for:

- ✔ Pairs
- ✔ Small groups
- ✔ Large groups
- ✔ Demonstrations

Safety Tips & Reminders:

- ⚠ If you are having trouble getting the experiment to work, try it in a humid environment like a kitchen or bathroom.
- ⚠ Do not use boiling hot water for this activity, as it can melt the plastic cup.
- ⚠ Review the Safety First section in the Resource Guide for additional information

Fun Fact #1

Dew can be a powerful resource for farming in arid climates. If the dew can be trapped and collected, it can be used to water plants and even as drinking water!

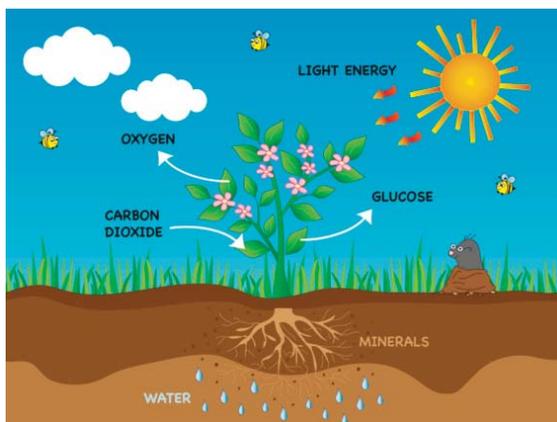
EXPLAIN  continued

In this activity, when there is hot water in the jar, the inside of the glass fogs up. This happens because the hot water releases water vapor (steam) and warms the water vapor already in the air in the glass. Those warm water vapor molecules move around the inside of the jar, and when they touch the room-temperature glass they get colder and condense from a gas to a liquid. As the water vapor condenses, it loses energy to the colder glass. The fog you see in the jar is the liquid water droplets forming as water vapor cools.

In the next phase, ice water is put into the jar. This time, you will see droplets of water forming on the outside of the jar. The ice water inside the jar cools the glass, so when warmer water molecules in the air touch the glass they condense into liquid on the outside of the cup.

If you are an early riser, you have likely experienced this phenomenon already! When the sun goes down at night and the environment cools, water vapor in the air condenses into liquid. We see this in the morning as **dew** on surfaces outside. If you live in an area that gets cold, you will see this as **frost**. As the sun comes up and provides energy through heat, the dew usually evaporates and becomes water vapor in the air, and the frost usually melts.

In places that do not get a lot of rain, the formation of dew is important because it allows plants and animals to access liquid water they need to survive. For example, in desert climates plants are known to use fog or dew as sources of water for **photosynthesis**, which is the chemical process that a plant uses to make sugars.

**Differentiation for Younger or More Advanced Students**

You can differentiate this activity for students of different grade levels by focusing on the concepts outlined below.

GETTING STARTED

For younger students, emphasize the following concepts:

- Matter exists in three states: solid, liquid, and gas.
- Each state of matter has its own properties.
- Matter can change between the states due to changes in energy, such as heat.

DIVING DEEPER

For more advanced students, emphasize the following concepts:

- Particles in each state of matter behave differently.
- As energy is added or removed from a system, matter changes state as particles gain or lose energy.

ELABORATE 

Elaborate on your students' new ideas and encourage them to apply them to different situations. The section below provides some alternative methods, modifications, and extensions for this activity.

- Set up the activity with the hot water and ice water jars at the same time so students can compare the results side-by-side
- Try the experiment with different containers: metal cans, plastic bottles, paper cups – whatever you can find! Which worked best and why?
- Connect this experiment to learning about other types of moisture that are found in the environment, including humidity, rain, snow, sleet, glaze, hail, clouds, and much more!

Fun Fact #2

Rain occurs when water vapor in the air condenses from a gas, back into a liquid form, and leaves the atmosphere, returning to the surface of the Earth in a process known as the water cycle.

CHEMISTRY IN ACTION

Share the following real-world connections with your students to demonstrate how chemistry is all around us.

Real-World Applications

Have you ever blown air onto a mirror or window to fog it up? When you do this, water vapor on your breath is condensing on the cool mirror or window surface! The same process happens in homes and buildings. On cold days water droplets might form on the inside of the windows, and on warm days if the air conditioning is water droplets might form on the outside.



Have you ever followed the path of an airplane through the sky by watching its trail? These trails are a type of cloud called a cirrus cloud. They are formed when jet exhaust from the plane encounters cold air in the sky, condenses into water droplets, and then freezes to form ice crystals.



Careers in Chemistry

- Car manufacturers have to build systems that quickly and efficiently remove moisture from car windows, since they can impair a driver's vision on the road. Car defrosters perform a variety of functions: some warm the window to evaporate moisture and remove ice, others pass dehumidified cold air that can absorb moisture from the windows.
- Sick of your cold drinks "sweating" on your tables? Double-walled cups have been designed to keep the outside of the cup at room temperature, so no condensation forms. The double wall also acts as an insulator, which keeps your hands from getting too cold or hot while enjoying your drink!
- Have you ever been on a plane and noticed the tiny "breather hole" in the window? Aerospace engineers and window manufactures have included this feature has a number of purposes: it equalizes the pressure between the cabin and the air gap between the window panes, and it also releases moisture to keep your view free of frost or fog!



EVALUATE

- Provide a scenario to students: they come home and notice that there is a glass of room-temperature water on the table, and it is sitting in a small pool of water. What do they think happened? Why? Which part of the experiment is similar to this scenario?
- Explore where condensation forms in the local community. Ask students to keep a science journal for the week and note every instance of condensation they see in their environment, either in human made or natural objects. At the end of the week they can share their findings with the class. Did anything surprise them? Where was condensation frequently found? Where was it never found? Why do they think that is?
- Can students draw the three states of water and name the processes of changing between states? See how far they can get from memory, and provide clues as needed. For more advanced learners: can they draw how particles are arranged and show their motion? Where is energy being added, and where is it being removed?

Fun Fact #3

When you take a hot shower, the mirror or bathroom window usually gets foggy. The "fog" is actually condensed water vapor.