

WRAP-UP

To wrap-up the investigation, bring your students together for a group discussion to help them understand why and how they achieved their results. It is important to share results so that everyone has a clear picture of what happened. To help you facilitate the discussion, review the explanation in "The Why and The How" using the Group Discussion questions as a guide.

GROUP DISCUSSION

Explain to students that scientists learn from each other through discussion, and they build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their experiments, students will now come together as a group to share their results and make conclusions about the investigations they've conducted. Have students record their final results and the explanation in their journals. Ask students:

- What did you learn about water in this investigation?
- What surprised you?
- What new questions do you have?
- What role did the ice have in this investigation?

Answer: it cooled the air inside the jar, helping the water vapor condense onto the sides.

- What do you think would happen if one part of the water cycle was left out?
- How do these investigations help us understand weather?

The "Why" and The "How"

This lesson demonstrates how water travels up into the atmosphere, and how it returns to the Earth's surface in a continual process called the water, or **hydrologic** cycle. The water cycle has no beginning and no end. During this cycle, water that has **collected** in oceans, swamps and rivers is heated by the sun. Heat causes water to escape from oceans and other bodies of water in a process called **evaporation**. When water evaporates, it rises into the atmosphere, changing from a liquid to a gas called water vapor. In the cool atmosphere, water vapor **condenses** (changes from a gas state to a liquid state) into millions of liquid water droplets that form clouds. When these water droplets get heavy, they fall to the Earth as **precipitation** -- rain, sleet or snow.

Temperature played an important role in these investigations. In the "Making a Terrarium" investigation, heat from the sun caused water to evaporate from the moist soil. In the "Rain in a Jar" investigation, warm water at the bottom of the jar represented the ocean. The warm "ocean" water evaporated inside the jar. As water vapor rose in the jar, it was cooled by the colored ice on the



terrarium set-up

lid. The ice represented the cool air in the Earth's atmosphere. The aerosol spray allowed you to see how water vapor gathers and condenses into tiny droplets forming a cloud. Water fell from the "cloud" as precipitation and collected on the sides and at the bottom of the jar. If you wear glasses, your lenses may have fogged up with small water droplets when you entered a cold room -- a common example of condensation.

When it rains or snows, precipitation falls into rivers, lakes and streams, and seeps into the soil and into underground aquifers. Water soaks into soil and is absorbed (taken in) by the roots of plants and trees. Water travels through the stems of plants and trees through a process called **capillary action**. Plant leaves eventually release water back into the air as water vapor through a process called **transpiration**. This cycle of water collection, evaporation, condensation and precipitation occurs continuously around Earth.

Curriculum Match-Up

- Use a thermometer to measure the temperature of the air inside the terrarium over a period of days.
- Create a chart of your results.
- Draw each phase of the water cycle that you observed in these investigations.
- Describe how temperature affects different forms of precipitation.
- Research and discuss ways that pollution might affect weather.
- Make a list of places you see condensation and evaporation everyday.

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References:
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NOAA

The Water Cycle

Learning Objectives

Students will:

1. List the phases of the water cycle.
2. Conduct experiments that demonstrate the phases of the water cycle.
3. Create an ecosystem.

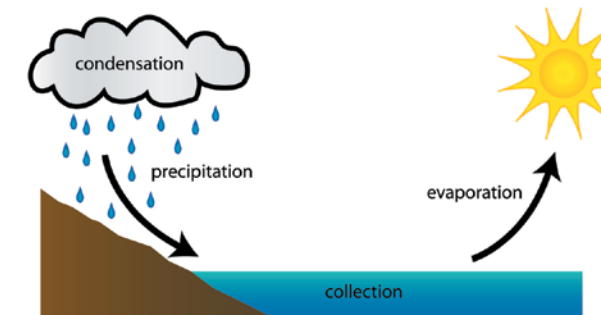
Vocabulary Ventures

aquifers
atmosphere
boiling
collection
condensation
evaporation
gaseous
hydrologic cycle
liquid
oxygen
precipitation
solid
terrarium
transpiration
water
water cycle
water vapor

There is probably no liquid that scientists have studied more than **water**. Water is constantly moving, changing, and interacting with other substances. Water is the only natural substance that exists as a solid (ice), liquid, and a gas (steam or vapor) at normal temperatures.

At average room temperature, water exists in a **liquid** state. Water freezes into a **solid** called ice at 32 degrees Fahrenheit (0 degrees Celsius). Water can absorb a lot of heat and will boil when it reaches a temperature of 212 degrees Fahrenheit (100 degrees Celsius). At this temperature, water changes from a liquid to a **gaseous** state called **water vapor**.

Did you know that the water we use today is



The Water Cycle

the same water found on Earth millions of years ago? The Earth constantly uses and recycles water in a process known as the **water cycle**.

There are four main parts to the water cycle: **evaporation**, **condensation**, **precipitation** and **collection**. The sun is the "engine" of the water cycle, heating water that has collected in oceans, lakes and puddles.

As water is heated, it evaporates (changes from a liquid to a gas) from the Earth's surface into the air. Water vapor rises into the atmosphere where it cools and condenses (changes from a gas to a liquid) and falls back to the earth as precipitation, collecting again in oceans, streams, and **aquifers** (underground layers of stone where water is filtered and stored naturally). Water continually goes through each of these changes everyday.

Time Needed to Conduct Investigations

Investigation 1: This investigation has two parts.

Organize & set up materials: 10 - 15 minutes
Introduce the lesson: 5 minutes
Conduct the investigation: 15 - 20 minutes
Student journaling / group reflection: 10 - 15 minutes
Total estimated time: 40 - 55 minutes

Investigation 2: This investigation has two parts and can be done over a period of 2 to 4 days.

Organize & set up materials: 10 minutes
Introduce the lesson: 5 minutes
Conduct the investigation: 15 - 20 minutes
Student journaling/group reflection: 10 - 15 minutes
Total estimated time: 40 - 50 minutes
5 minutes each day for observations

Investigation 1: Rain in a Jar

Materials

For groups of three or four
Student journals and writing tools

Investigation 1

Part 1

- Glass jar with lid (mayonnaise jar), or Pyrex bowl and large plate to cover the bowl
- Hot water
- 2 cups of ice made with food coloring (dark red or dark blue)

*NOTE: 240 mL equals 1 cup

Part 2

- Can of aerosol spray (air freshener)
- Lid

Investigation 2

- Small plastic container
- Clear lid to cover the container, plastic wrap or a large re-sealable storage bag
- 1 - 1½ cups potting soil
- Lima beans or sunflower seeds
- ½ liter bottle of water
- Ruler
- Marker
- Masking tape
- Small to medium-sized box to secure projects
- Thermometers (optional)

Inform students that they will conduct an investigation that creates a water cycle inside a jar.

Part 1 It's Raining in a Jar



Caution: This activity requires hot water!

GET READY!

Discuss the main parts of the water cycle with students: evaporation, condensation, precipitation and collection. Share with students that there is a limited amount of water on our planet, and that the Earth continually uses and recycles water. Remind students to document observations and findings in their student journals.

Ask students:

1. Do you think the Earth has the same amount of water today that was here when dinosaurs roamed the Earth millions of years ago?
2. How do you think water gets into the ground? The air? The oceans?
3. How does rain form?
4. How do you think clouds form?
5. Where do you think water goes after it rains?



TIP

Make sure the glass jar is clean, dry and free of condensation.

PROCEDURE

1. Have students carefully fill the bottom of the glass jar with 2 - 3 inches (10 oz - 13.5 oz) of hot water.
2. Next, have students turn the lid of the glass jar upside down so that it acts as a small bowl, forming a seal over the jar.
3. Fill the lid with the colored ice.

NOTE: The colored ice is used to demonstrate to students that condensation forms from the hot water inside the jar. The changes may take several minutes to occur. The hotter the water, the faster you will observe results.

OBSERVE

Ask students to make and discuss the following observations:

- What is happening inside the jar?
- What evidence of the water cycle do you observe?
- What do you observe on the sides of the jar?
- What role do you think heat plays in the water cycle?

Part 2 Cloudy with a Chance of Rain

Students will continue the investigation using the set-up from Part 1.

PROCEDURE

1. Holding a can of aerosol spray (air freshener, for example), have students carefully lift the lid of colored ice and spray a small amount of aerosol into the jar.
2. Students should quickly replace the lid of ice back on the jar.



adding air freshener to jar

OBSERVE

Ask students to make and diagram the following observations:

- What do you notice about the water inside the jar?
- What states of water do you observe inside the jar?

Answer: water as a liquid, and as a vapor or gas.

- How do you think the cloud was formed?
- How does this experiment demonstrate the water cycle?

Investigation 2: Making a Terrarium

GET READY!

Inform students that they will conduct another investigation that demonstrates the phases of the water cycle. Explain that students will make a **terrarium**, a container that is used to keep and observe small living plants or animals.



BRAINSTORM!

Ask students to share what they know about water and the water cycle. Make a list of the group's ideas on a flipchart or chalkboard.

PROCEDURE

1. Break students up into groups of 3 or 4.
2. Provide each group with a small plastic container that can be covered tightly with a clear, see-through lid or with plastic wrap.
3. Have students pour 1 - 1½ cups of soil into the container.
4. Next, ask students to use their fingers or a pencil to make 3-4 holes (approximately 1 inch deep) into the soil. They should then place a seed/bean into each hole and cover completely with soil.
5. Students should water the soil until well moistened and cover the terrarium with the lid or plastic wrap. Make sure that the terrarium is well sealed.
6. Have students make a label for their terrarium using the marker and masking tape.
7. Place each labeled terrarium in the box and place in a warm, sunny location. (Once the seeds sprout, they will need sunshine.)



TIP Keep the terrarium sealed to prevent water from escaping.

PREDICT

Ask students to predict what they think they will observe in the terrarium over the next few days.

OBSERVE

Over the next several days, have students make some simple observations about what is happening inside the terrarium. Students should record and diagram their observations in their journals.

Ask students:

- What do you observe happening in the terrarium?
- Is there evidence that the seeds have sprouted?
- Do you see water inside the terrarium? Where? Is the water in a liquid, gas or solid state?
- How did the water get under the cover of the lid? Which parts of the water cycle occurred?
- Remove the lid from the terrarium and rub some of the soil between two fingers. Is the soil wet? Has any of the water evaporated from the soil?



TIP Remind students to re-seal the terrarium after they have examined the soil. The terrarium will not need water for a few weeks. Replenish the water when the soil feels dry.