

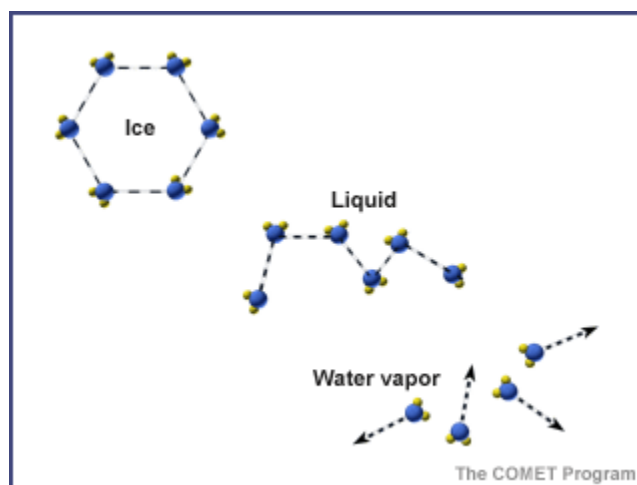
## The Water Cycle

In this activity, students will build a model to simulate parts of the water cycle. They will be able to recognize and explain the essential elements of the water cycle.

### Background

Water, in its different forms, cycles continuously through the lithosphere, hydrosphere, atmosphere, and biosphere. Water evaporates into the atmosphere from the land and the sea. Plants and animals use and reuse water and release water vapor into the air. Once in the air, water vapor circulates and can condense to form clouds and precipitation, which fall back to earth. At one time or another, all of the water molecules on earth have been in an ocean, a river, a plant, an animal, a cloud, a raindrop, a snowflake, or a glacier!

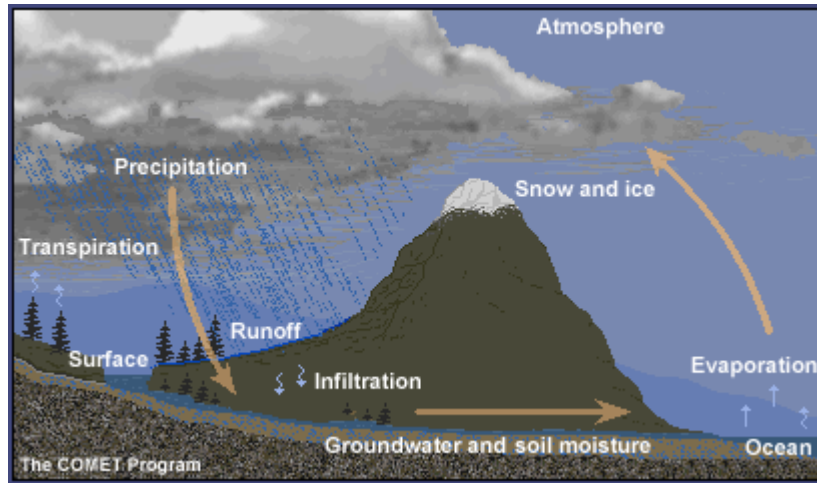
As far as we know, earth is the only planet with water in three phases: solid, liquid, and gas. The phase of water is determined by its temperature and pressure.



Water is essential for life on earth. It is recycled through the **water** or **hydrologic cycle**, which involves the following processes:

- **Evaporation**, the changing of water from a liquid to a gas
- **Condensation**, the changing of water from a gas to a liquid
- **Sublimation**, the changing of water from a solid to a gas
- **Precipitation**, the process by which water molecules condense to form drops heavy enough to fall to the earth's surface
- **Transpiration**, the process by which moisture is carried through plants from roots to leaves, where it changes to vapor and is released to the atmosphere

- **Surface runoff**, the flowing of water over the land from higher to lower ground
- **Infiltration**, the process of water filling the porous spaces of soil
- **Percolation**, groundwater moving in the saturated zone below the earth's surface



Through these processes, the amount of water on earth remains nearly constant and is continually recycled through time. Water molecules may remain in one form for a very long period of time (for example, water molecules can be locked in Antarctic ice for thousands of years) and in other forms for very short times (for example, water molecules in desert rainstorms spend mere minutes as surface water before evaporating into vapor again).

## Learning Goals

1. Students will appreciate that scale models can be an important tool to use to help understand global processes.
2. Students will be able to recognize and explain the essential elements of the water cycle.

## Alignment to National Standards

### *National Science Education Standards*

- Unifying Concepts and Processes, Grades K to 12, pg.117: "Models are tentative schemes or structures that correspond to real objects, events, or classes of events and that have explanatory power."
- Earth and Space Science, Grades 5 to 8, Structure of the Earth System, pg.160, Item #6: "Water, which covers the majority of the earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the "water cycle." Water evaporates from the earth's surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans, soils, and in rocks underground."

- Common Themes, Models, Grades 6 to 8, pg. 269, Item #1: "Models are often used to think about processes that happen too slowly, too quickly, or on too small a scale to observe directly, or that are too vast to be changed deliberately, or that are potentially dangerous."
  - The Physical Setting, The Earth, Grades 6 to 8, pg. 69, Item #7: "The cycling of water in and out of the atmosphere plays an important role in determining climatic patterns. Water evaporates from the surface of the earth, rises and cools, condenses into rain or snow, and falls back again to the surface. The water falling on land collects in rivers and lakes, soil, and porous layers of rock, and much of it flows back into the ocean."
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## Grade Level/Time

- **Grade level:** 6 to 9
  - **Time:**
    - Introduction to the water cycle: 30 minutes
    - Activity as demonstration: 30 minutes
    - Activity as group project: 45 minutes
    - Discussion: 20 minutes
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## Materials

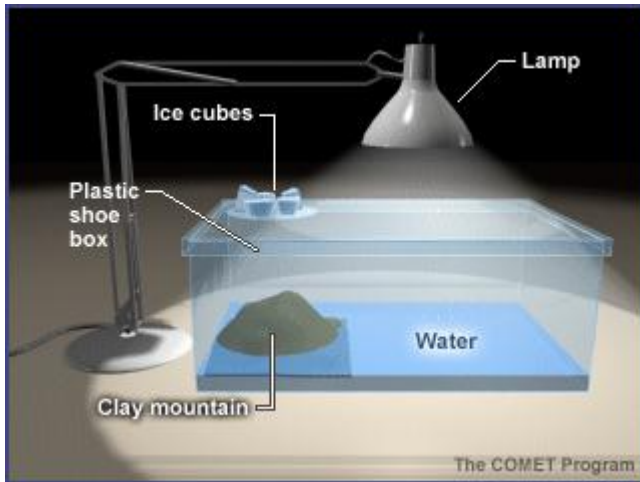
- Artist's clay or plastic mountain model
  - Plastic shoe box with cover
  - Petri dish
  - Lamp
  - Water
  - Crushed ice
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## Procedure

If you have a large aquarium, you can do this activity as a demonstration, allowing the students to study and observe the phenomena and develop their own ideas and conclusions for class discussion. With sufficient materials, you can also do it as a group project, with teams of three to five students responsible for setting up the model and drawing conclusions from their own work. The activity is described below as if it were a demonstration. As always, if done by students, it's important not to overly explain what is "supposed" to happen, but rather let them discover the model cycle for themselves.

1. Discuss the water cycle with students. Show the graphic of the water cycle and explain the various parts.

- Using the clay, shape a mountain.
- Place the mountain on one side of the shoe box with the sloped side facing the interior of the box where the "ocean" will be.



- Pour water into the "ocean" basin until about one-fourth of the mountain slope is covered.
- Replace the lid of the shoe box.
- Place a petri dish on top of the shoe box over the mountain (as shown).
- Place crushed ice into the petri dish.
- Position the lamp over the ocean. Turn on the lamp. CAUTION: THE LAMP WILL GET HOT. DO NOT TOUCH THE BULB OR SHADE.
- Have students observe the container carefully and note any changes that they see. It might help to add a little smoke to the aquarium to help them see the circulation. (A few matches lit, then blown out and quickly dropped into the box will work).

### Observations and Questions

Observation Questions	Answers
1. Which part of the activity simulated evaporation?	Evaporation was simulated as the 'ocean' was heated by the lamp.
2. Which part simulated condensation?	Condensation occurred as the water vapor from the ocean cooled on the lid of the shoe box near the petri dish of ice.
3. Which part simulated precipitation?	The drops of water falling from the lid of the shoe box simulated precipitation.
4. What is the energy source and what does it represent?	The energy source was the lamp, which represented the sun.
5. What elements of the water cycle are not represented?	Transpiration, infiltration, sublimation, and percolation were not represented.

6. How could we demonstrate transpiration in this activity?	We could demonstrate transpiration by adding live plants to the shoe box.
7. Would condensation occur in the box without the ice? Why or why not?	Condensation might occur over the mountains but not as quickly. The ice provided a greater temperature difference, forcing the vapor to condense.
8. After observing this activity, explain why water is considered a renewable resource.	Water is continually recycled through the various parts of the water cycle.
9. The system you observed/constructed is a model of the way the actual water cycle works. Why might scientists use a model like this in their research into the water cycle in the real world? Can you think of any reason that using such models might be a problem?	

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### Assessment Ideas

- Have students answer some or all of the questions in lab notebooks for collection and evaluation.
- Challenge the students to use their understanding of the water cycle to explain a related phenomenon. Example:
  - Put 1/2 inch or so of sand or gravel in a re-sealable plastic bag.
  - Add 1/4 cup of water (color the water blue for easier visibility).
  - Put it in a sunny window or under a bright light.
  - The students should see evaporation/condensation/precipitation and infiltration take place. They should identify that transpiration was not part of the system.

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### Modifications for Alternative Learners

- Students with language difficulties should be encouraged to rely on labeled diagrams to help answer the assessment questions.

**When you're finished with the activity, click on To Student Guide or Back to Activities List at the top of the page to return to the activity menu.**

