

Humans and the Hydrologic Cycle

Reflect

The last time you took a shower, did you think about where the water came from? Sure, it came out of the showerhead, but what about before that? The water you used to wash could have spent time in the South China Sea. Or maybe it was part of an ancient glacier at the South Pole.

The water in your shower could have come from anywhere in the world, because all of Earth's water is recycled in a process called the **hydrologic cycle**. So just how does water from a glacier halfway around the world find its way to your bathroom?

What drives the hydrologic cycle?

Water is the only substance on Earth that exists in all three states of matter naturally. Water can be solid ice, a flowing liquid, or a gaseous **vapor**. When water moves through the hydrologic cycle, it changes among these states of matter over and over again. The Sun's energy and Earth's **gravity** move water among land, ocean, and atmosphere by driving different processes in the hydrologic cycle. The Sun's energy drives melting and evaporation, and Earth's gravity drives precipitation, groundwater penetration, and downhill flow.

gravity- a force pulling two objects toward each other



The **hydrologic cycle** has no beginning or end. Water moves continuously from one stage to the next.



vapor- the invisible gas form of water

What are the different components of the hydrologic cycle?

A cycle is like a circle—it has no beginning and no end. However, we'll start by looking at the hydrologic cycle in the ocean. About 70% of Earth's surface is covered by ocean water. When water at the ocean's surface is heated by the Sun it gains energy. With enough energy, the molecules of liquid water change into water vapor and move into the atmosphere. This process is called *evaporation*. Ocean water is *salt water*, a mixture of salt and water. When evaporation occurs, only the water evaporates, and the salt is left behind.

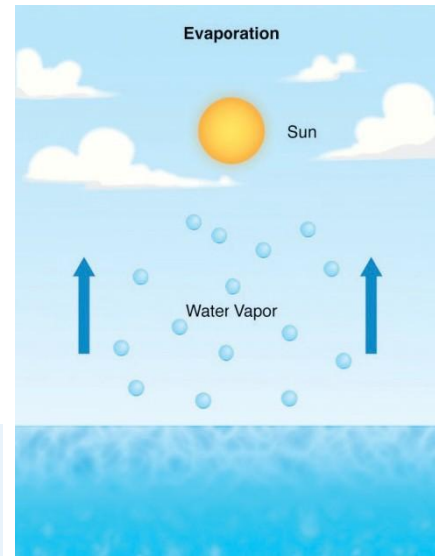
Wherever water is heated by the Sun, evaporation can occur. Water evaporates from lakes, rivers, puddles, soil, and even your body. When sweat dries on your skin, it is because the water in your sweat has evaporated into the air. You might have noticed that when sweat evaporates off you, your skin feels rough and tastes salty. Similar to the ocean, sweat is comprised of salt water. The water evaporates and the salt is left behind on your dry skin.

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After water evaporates from the surface of the land, it rises in the **atmosphere**. The higher it rises, the more energy it loses, because of the lower temperatures. As water vapor loses energy and cools, the molecules change state from gas to liquid and form small droplets of water. This process is known as *condensation*. Condensation is the opposite of evaporation.

atmosphere- the layer of gases that surrounds Earth, commonly called “the air”

Energy from the Sun causes water in the oceans to evaporate. The water vapor rises into the air and the salt remains behind.



Try Now

When the Sun's energy interacts with ocean water, evaporation takes place. Take a moment to model how this part of the hydrologic cycle works. For this activity, you will need the following items:

- Plastic bowl, clear or colored, but not white
- Salt, 8 grams
- Water, 250 milliliters
- Plastic spoon



1. Add the water and the salt to the bowl. Mix them together well with the spoon so they form salt water.
2. Set the bowl in a warm, sunny place, like outside in the Sun or on a windowsill.
3. Check the bowl after several hours or the next day. How warm the bowl of water will get effects how long you leave it in the sunlight. The warmer the area, the less time you will need to let it sit.
4. What happened to the water in the bowl? What happened to the salt in the bowl? How does this experiment model what happens in the ocean? Is the water from your bowl part of the hydrologic cycle? Where is it now? What is driving this process?

Look Out!

Fluffy, white clouds in the sky look like they are giant puffs of vapor floating in the air. Because they float high above the ground, many people think clouds are made of gas. Clouds are actually small droplets of liquid water that have condensed on bits of dust floating in the atmosphere.



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If the now liquid water molecules continue to lose energy and cool further, they will eventually change into a solid via **crystallization**. Crystallization is the process by which the liquid molecules form a highly ordered solid. Snow, hail, and sleet all form from this process.

crystallization- process in which liquid particles arrange into a highly-ordered solid

As water droplets or ice in the atmosphere become larger, they get heavier. When they become too heavy, gravity pulls them from the cloud. They fall back to Earth as **precipitation**. There are many types of precipitation, including rain, snow, hail, and sleet.



Water that falls onto Earth's surface can take many pathways. Much of the water returns to the ocean and the hydrologic cycle begins again. Some water may infiltrate the ground to help replenish groundwater and aquifers.

When this happens, there is a good chance that a living organism will use it. For example, a plant might absorb water from the soil or an animal might drink from a stream. Living things take in water and can release it as well. Plants release water into the atmosphere through their leaves, which is a process known as **transpiration**. Animals release it through sweat and urination. In both cases, the Sun's energy causes the water to evaporate, and the hydrologic cycle continues.



transpiration- evaporation of water through openings on the leaves of plants

Another pathway precipitation might take when it reaches the surface is running off along the land, moving via **downhill flow**, and collecting in lakes, rivers, and puddles. These pathways are driven by Earth's gravity constantly pulling water down. The Sun warms these bodies of water as well, leading to **evaporation**, and the hydrologic cycle continues.

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Plants impact the hydrologic cycle through absorbing water and by transpiration. Humans and animals impact the hydrologic cycle through drinking water and by sweating and urinating. Humans, however, also impact the hydrologic cycle through activities such as burning fossil fuels, deforestation, and changing the flow pattern of groundwater.



Burning fossil fuels releases chemicals such as sulfates and nitrates into the atmosphere. Organic particles, fly ash, and mineral dust are also released. These particles or aerosols remain suspended in the air.

Incoming sunlight reflects off the particles and returns to space. This reduces the amount of sunlight that reaches Earth's surface. A reduction in the amount of thermal energy reaching the surface can result in less water evaporated into the atmosphere.

The building of dams, roads, towns, and cities changes the flow pattern of water through the hydrologic cycle. When dams are built along a river, less water continues downstream to the ocean. More water is stored in a man-made reservoir. Removing water from underground aquifers to supply water for cities and towns also changes the natural flow. Less water is being stored deep underground and more is being used by humans and other organisms.



What Do You Think?

Looking to the Future: Changes to the Hydrologic Cycle

Many scientists agree that the average temperature on Earth is increasing. What does this mean for the hydrologic cycle? Rising temperatures mean an increase in evaporation, which leads to an increase in condensation in the atmosphere. Scientists predict that this will increase the overall cloud cover, humidity, and precipitation across the globe.

Higher air temperatures also mean that more precipitation will fall as rain. Snow, sleet, and hail result from low air temperatures. Increases in rainfall can cause rivers to overflow and put areas in greater danger of flooding. How else could rising global temperatures affect the hydrologic cycle?

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The Sun's energy and Earth's gravity power the hydrologic cycle. Water changes state; its temperature increases and decreases as it moves through different stages of the hydrologic cycle. Look at the scene from nature shown below. The numbers represent different parts of the hydrologic cycle. For each number, describe what is happening in the hydrologic cycle and how the Sun's energy or Earth's gravity is contributing. Then, draw arrows to show how water moves in a continuous cycle through each process.

