

The Water Cycle

What is water?

Water is a very unique molecule. It cannot be created nor destroyed; the amount of water we have on planet Earth is finite. Water can exist either as liquid, solid or gas at relatively moderate temperatures. Water also has a unique molecular structure and consists of one oxygen and two hydrogen atoms at a 105 degree angle. It is considered the universal solvent and has a tremendous capacity to carry other constituents either dissolved or in suspension. Water is "practically" incompressible, and therefore its density will not change due to pressure. It requires a lot of energy to break the hydrogen and oxygen bond, which would convert the water molecule into individual hydrogen and oxygen atoms. The temperature at which water decomposes is 1,000° C. In relative terms, the temperature of molten lava ranges from 700° C to 1,300° C. However, water retains its molecular structure when it evaporates due to solar energy, vapor pressure, or boiling water in a pot on the stovetop.

Water is essential for life here on Earth. Every living thing requires water to survive. Plants are almost 90% water, and humans and other animals are 60% water. Water covers approximately 70% of the Earth with 97% of it accounting for the oceans and seas; however, less than 1% of the Earth's water is available to humans in the form of fresh water. Considering that water cannot be created nor destroyed, why is it so important that we conserve water? It is important because we are depleting our static freshwater sources faster than they can be replenished over a period of time.

For more information about water and its physical properties checkout the following U.S. Geologic Survey (USGS) web site - <http://ga.water.usgs.gov/edu/>. The USGS is the federal agency responsible for studying, interpreting and explaining the geologic processes on planet Earth, which include the rocks and water. The USGS has no regulatory authority, and is strictly focused on scientific studies of the planet(s).

What is the water cycle?

The water cycle describes the existence and movement of water on, in, and above the Earth. The water on Earth is always in motion and always changing states, from liquid to vapor to ice and back again. The water cycle has been working for billions of years and is the basis of all life on Earth. Earth would look more like Mars if it weren't for water. The following diagram shows the dynamic interactions of water on Earth.

Diagram of the water cycle

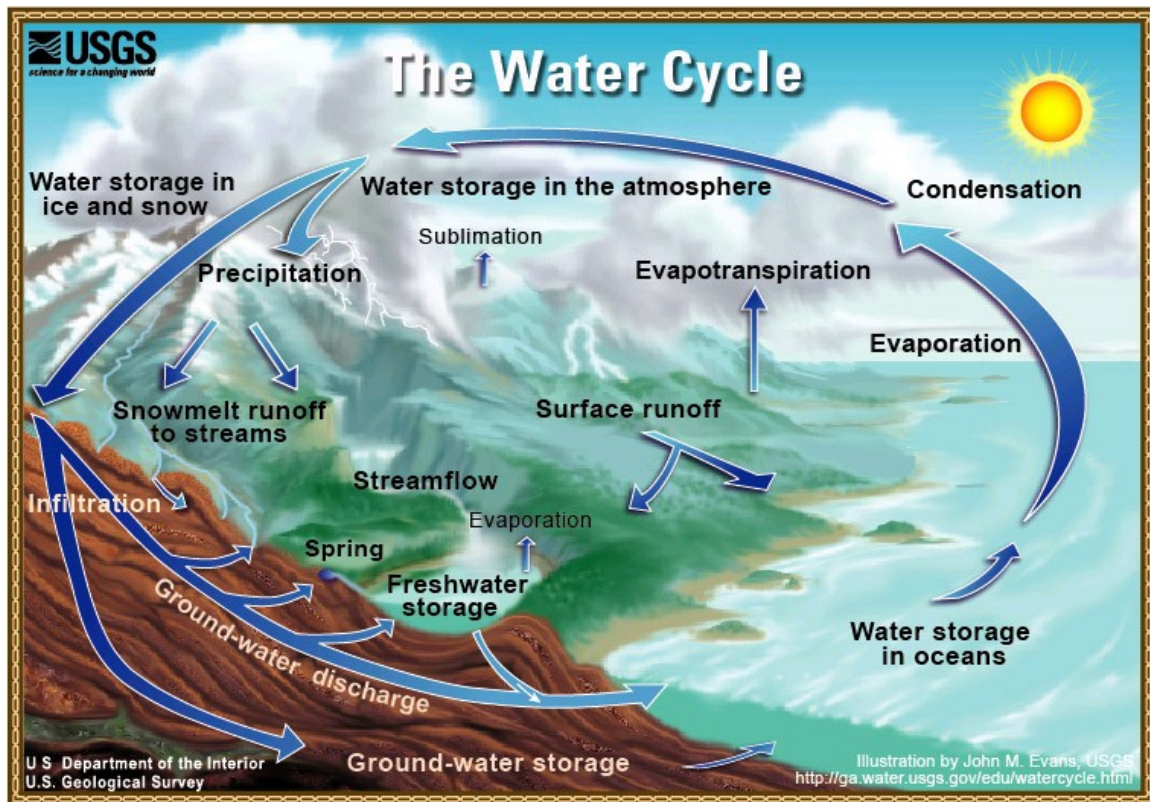


Illustration by John M. Evans, USGS, Colorado District

Source: <http://ga.water.usgs.gov/edu/watercyclehi.html>

It's All About the Cycle

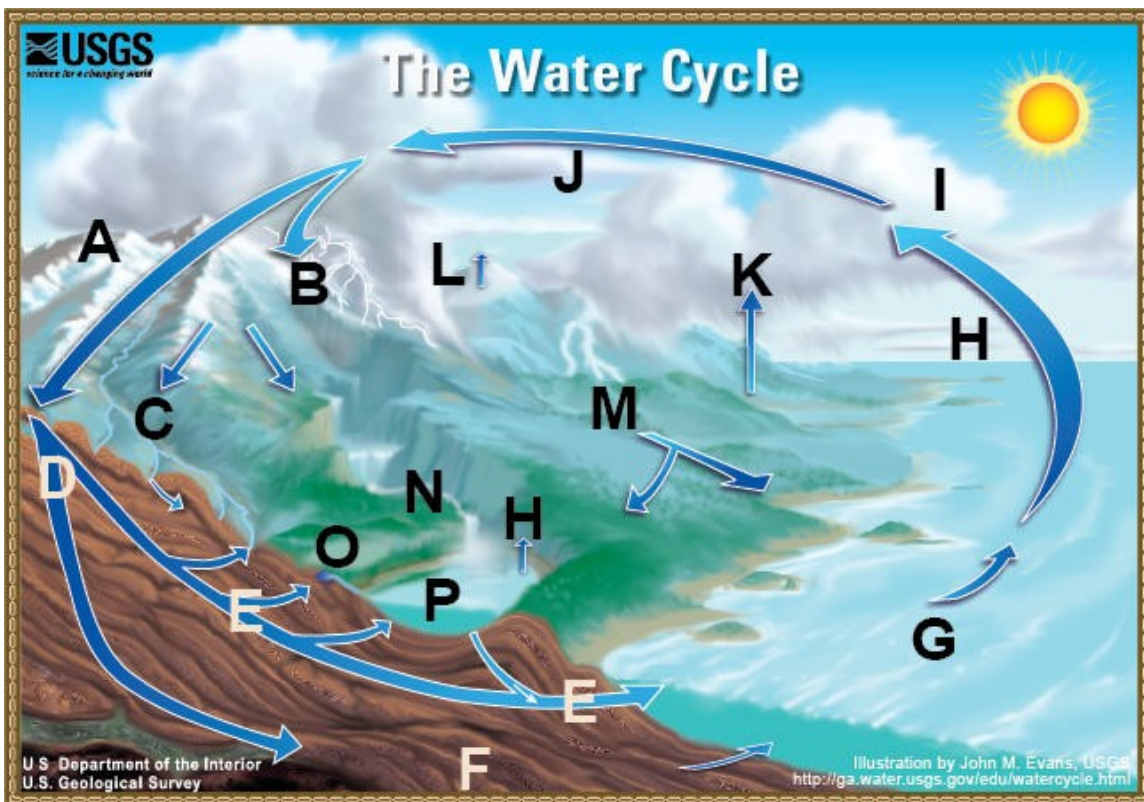
The water cycle has no starting point. But, we will “begin” in the oceans, since that is where most of Earth's water exists. The sun, which drives the water cycle through solar energy, heats water in the oceans. Some of it **evaporates** as vapor into the air. Ice and snow can sublime directly into water vapor based on vapor pressure. Rising air currents take the vapor up into the atmosphere, along with water from **evapotranspiration**, which is water transpired from plants and evaporated from the soil. The vapor rises into the air where cooler temperatures cause it to condense into clouds, the process of the water cycle known as **condensation**. Air currents move clouds around the globe; cloud particles collide, grow, and fall out of the sky as **precipitation**. Some precipitation falls as snow and can accumulate as ice caps and glaciers, which can store frozen water for thousands of years. Snow packs in warmer climates often thaw and melt when spring arrives, and the melted water flows overland as snowmelt **runoff**.

Most precipitation falls back into the oceans or onto land, where, due to gravity, the precipitation flows over the ground as surface runoff. A portion of runoff enters rivers in valleys in the landscape, with stream flow moving water towards the oceans. Runoff, and ground-water seepage, accumulate and are stored as

freshwater in lakes. Not all runoff flows into rivers, though. Some of it soaks into the ground as **infiltration**. Over long periods of time some water infiltrates deep into the ground and replenishes aquifers (saturated subsurface rock), which store huge amounts of freshwater. Some infiltration stays close to the land surface and can seep back into surface-water bodies (and the ocean) as ground-water discharge, and some groundwater finds openings in the land surface and emerges as freshwater springs. Over time, all of this water keeps moving, some to reenter the ocean, where our description of the water cycle "ends."

Test Your Skills

Here's a change to test your skills. Take a sheet of paper and divide it into three columns. Write down A through P in far left column, and put "My Answers" and "Correct Answer" in the middle and far right. Next, try and name the process or thing associated with the letters. When you are finished compare your answers to the answers in the water graphic above. By completing the Water Cycle you will have strong understanding of what drives the climate on planet Earth.



As a second task, try to identify the five most prominent processes in the water cycle and write a simple algebraic equation that describes how water interacts with the Earth. Use the formula below (hint: storage equals what).

$$\underline{\hspace{2cm}} = (\underline{\hspace{2cm}} + \underline{\hspace{2cm}}) - (\underline{\hspace{2cm}} + \underline{\hspace{2cm}})$$