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The Hydrologic Cycle

(more commonly known as the water cycle)

The hydrologic cycle describes how water is exchanged (cycled) through Earth's land, ocean, and atmosphere. Water always exists in all three places, and in many forms—as lakes and rivers, glaciers and ice sheets, oceans and seas, underground aquifers, and vapor in the air and clouds.

Evaporation, Condensation, and Precipitation

The water cycle consists of three major processes: evaporation, condensation, and precipitation.

Evaporation

Evaporation is the process of a liquid's surface changing to a gas. In the water cycle, liquid water (in the ocean, lakes, or rivers) evaporates and becomes water vapor. Water vapor is water in the form of a gas.

Water vapor surrounds us, as an important part of the air we breathe. Water vapor is also an important greenhouse gas. Greenhouse gases such as water vapor and carbon dioxide insulate the Earth and keep the planet warm enough to maintain life as we know it.

Define and give an example of **Water Vapor**

The energy for driving the water cycle and evaporation is the sun. As the sun interacts with liquid water on the surface of the ocean, the water becomes an invisible gas (water vapor). Evaporation is also influenced by wind, temperature, and the density of the body of water. The largest source of water vapor is evaporation from the oceans, especially those that lie in the warmer parts of the world. The Pacific Ocean is the primary source of water that falls as precipitation on Oregon and the Northwest.

Condensation

Condensation is the process of a gas changing to a liquid. In the water cycle, water vapor in the atmosphere condenses and becomes liquid.

Condensation can happen high in the atmosphere or at ground level. Clouds form as large masses of water vapor condenses into billions of fine water droplets, or becomes more concentrated (dense). Water vapor condenses around tiny particles called cloud condensation nuclei (CCN). CCN can be specks of dust, salt, or pollutants. Clouds at ground level are called fog or mist. Water vapor condensed into the form of water droplets is called dew.

Like evaporation, condensation is also influenced by the sun. As water vapor cools, it reaches its saturation limit, or dew point. Air pressure is also an important influence on the dew point of an area.

Precipitation

Unlike evaporation and condensation, precipitation is not a process. Precipitation describes any liquid or solid water that falls to Earth as a result of condensation in the atmosphere. Precipitation includes rain, snow, sleet (frozen rain) and hail. Hail is small rounded pieces of ice that sometimes fall during thunderstorms.

Fog is not precipitation. The water in fog does not actually precipitate, or liquify and fall to Earth. Fog and mist are a part of the water cycle called suspensions: They are liquid water suspended in the atmosphere.

Precipitation is one of many ways water is cycled from the atmosphere to the Earth or ocean.

Other Processes

Evaporation, condensation, and precipitation are important parts of the water cycle. However, they are not the only ones.

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Transpiration is another important part of the water cycle. Transpiration is the loss of water from plants through evaporation as a byproduct of photosynthesis. Plants release water vapor through microscopic pores called stomata. The opening of stomata is strongly influenced by light, and so is often associated with the sun and the process of evaporation. Evapotranspiration is the combined components of evaporation and transpiration, and is sometimes used to evaluate the movement of water in the atmosphere.

Runoff, for instance, describes a variety of ways liquid water drains over the surface of the land. Snowmelt, for example, is an important type of runoff produced as snow or glaciers melt and form streams or pools.

The Water Cycle Underground

Some of the water that falls as precipitation runs off the land and some soaks into the ground, filling up spaces between soil particles. The movement of water into the soil is called ground water infiltration. The movement of water through the soil is called percolation.

Water is moved by gravity through soil and rock layers until it is stopped by solid rock or saturated soil and rock material.

Define **Infiltration & Percolation**

The hydrologic cycle does not distribute water evenly around the earth. When precipitation is low in a certain area and groundwater levels drop, the condition is called a drought. When large amounts of water fall in a short time, the land cannot absorb all of it and rivers cannot hold it within their banks. Water pours over the land, causing a flood.

A well is a hole that is drilled into the earth to get ground water. An artesian well is a type of well where the water flows to the surface under its own natural pressure. Ground water can come to the surface naturally as a spring. A geyser is a special type of spring that ejects warm water under pressure into the air.

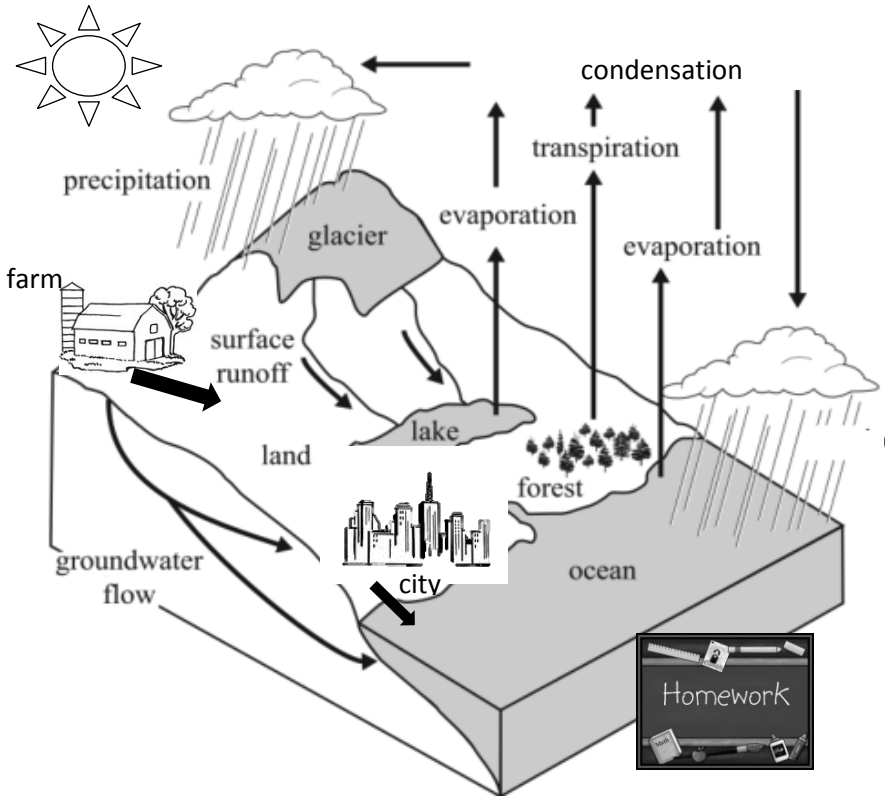
Reservoirs and Residence Time

Reservoirs are simply where water exists at any point in the water cycle. An underground aquifer is a layer of **porous** underground rock that acts as a water reservoir, holding groundwater. The top of these aquifers or saturated layers is called the water table. Water table levels usually rise and fall as water is added to or removed from the aquifer.

Define **Aquifer, Porous & Water Table**

Porous = Having small spaces or holes through which liquid or air may pass

The ocean is a reservoir. Ice sheets are reservoirs. The atmosphere itself is a reservoir of water vapor.



Residence time is the amount of time a water molecule spends in one reservoir. For instance, the residence time of "fossil water," ancient groundwater reservoirs, can be thousands of years. Some fossil water reservoirs beneath the Sahara Desert have existed for 75,000 years.

Residence time for water in the Antarctic ice sheet is about 20,000 years. That means that a molecule of water will stay as ice for about that amount of time. The residence time for water in the ocean is much shorter—about 3,200 years. The residence time of water in the atmosphere is the shortest of all—about nine days.

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Calculating residence time can be an important tool for developers and engineers. Engineers may consult a reservoir's residence time when evaluating how quickly a pollutant will spread through the reservoir, for instance. Residence time may also influence how communities use an aquifer.

States of Water
Through the water cycle, water continually circulates through three states: solid, liquid, and vapor.

Ice is solid water. Most of Earth's freshwater is ice, locked in massive glaciers, ice sheets, and ice caps. Glaciers are large accumulations of ice in the polar areas and at high elevations in the mountains.

As ice melts, it turns to liquid. The ocean, lakes, rivers, and underground aquifers all hold liquid water.

Water vapor is an invisible gas. Water vapor is not evenly distributed across the atmosphere. Above the ocean, water vapor is much more abundant, making up as much as 4% of the air. Above isolated deserts, it can be less than 1%.

The Water Cycle and Climate
The water cycle has a dramatic influence on Earth's climate and ecosystems.

Climate is all the weather conditions of an area, evaluated over a period of time. Two weather conditions that contribute to climate include humidity and temperature. These weather conditions are influenced by the water cycle.

Humidity is simply the amount of water vapor in the air. As water vapor is not evenly distributed by the water cycle, some regions experience higher humidity than others. This contributes to radically different climates. Islands or coastal regions, where water vapor makes up more of the atmosphere, are usually much more humid than inland regions, where water vapor is scarcer.

A region's temperature also relies on the water cycle. Through the water cycle, heat is exchanged and temperatures fluctuate. As water evaporates, for example, it absorbs energy and cools the local environment. As water condenses, it releases energy and warms the local environment.

The Water Cycle and the Landscape
The water cycle also influences the physical geography of the Earth. Glacial melt and erosion caused by water are two of the ways the water cycle helps create Earth's physical features.

As glaciers slowly expand across a landscape, they can carve away entire valleys, create mountain peaks, and leave behind rubble as big as boulders. Yosemite Valley, part of Yosemite National Park in the U.S. state of California, is a glacial valley. The famous Matterhorn, a peak on the Alps between Switzerland and Italy, was carved as glaciers collided and squeezed up the earth between them. Canada's "Big Rock" is one of the world's largest "glacial erratics," boulders left behind as a glacier advances or retreats.

Glacial melt can also create landforms. The Great Lakes, for example, are part of the landscape of the Midwest of the United States and Canada. The Great Lakes were created as an enormous ice sheet melted and retreated, leaving liquid pools.

The process of erosion and the movement of runoff also create varied landscapes across the Earth's surface. Erosion is the process by which earth is worn away by liquid water, wind, or ice.

Erosion can include the movement of runoff. The flow of water can help carve enormous canyons, for example. These canyons can be carved by rivers on high plateaus (such as the Grand Canyon, on the Colorado Plateau in the U.S. state of Arizona). They can also be carved by currents deep in the ocean (such as the Monterey Canyon, in the Pacific Ocean off the coast of the U.S. state of California).

Breaking the Cycle
The water cycle can change. Glacial retreat is the process in which glaciers melt faster than their ice can be replaced by precipitation. Glacial retreat limits the amount of fresh water available on Earth. We are experiencing the fastest rate of glacial retreat in recorded history.

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