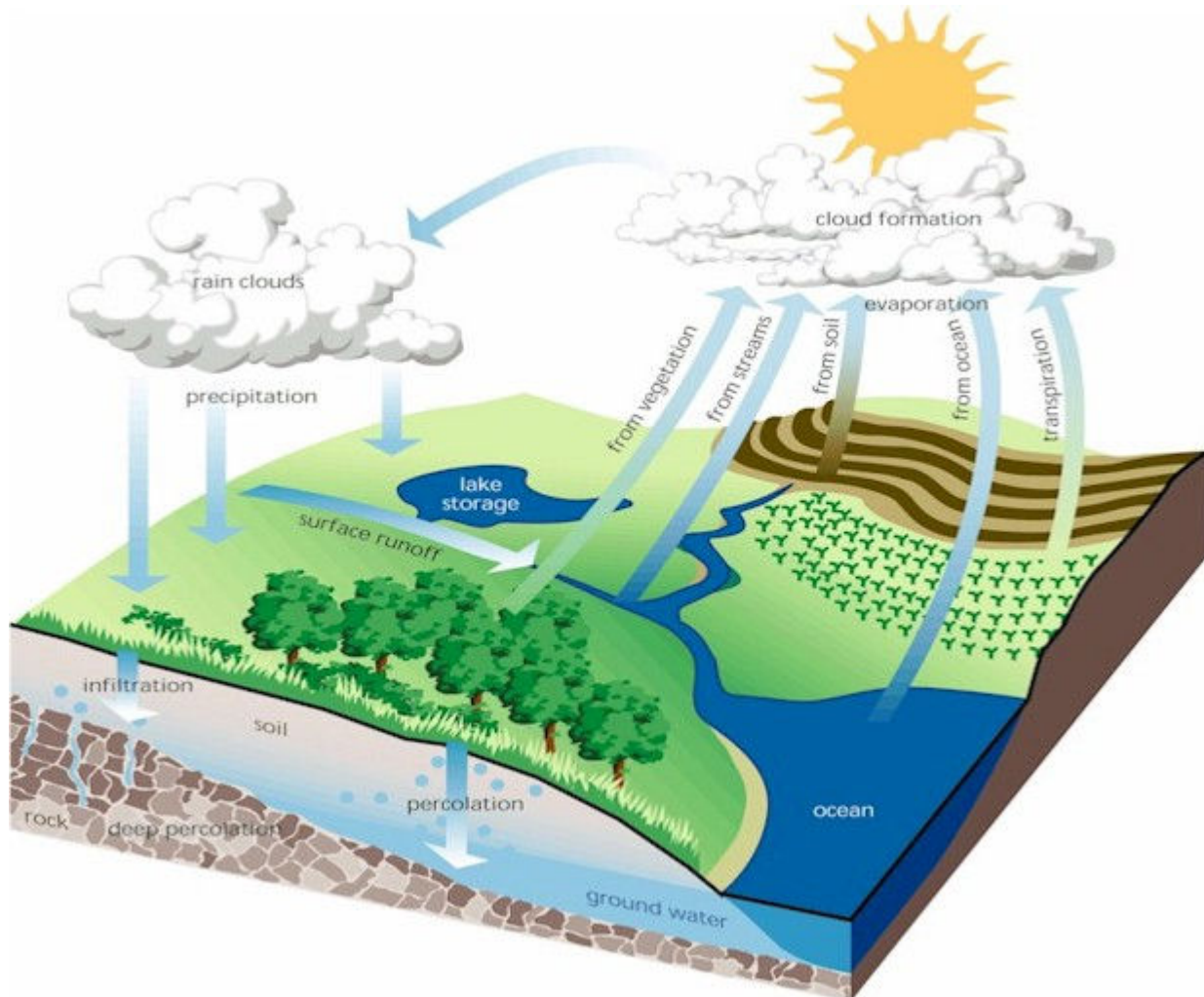




# Hydrology

Hydrology is the study of how water moves from the atmosphere to the land or ocean and back again – commonly known as the water cycle. This is a VERY simplified description of the hydrologic cycle, the movement of water is influenced by many factors .



## Evaporation

Liquid water can become water vapor when sunlight (or other energy) heats the water molecules. Water is subject to evaporation whenever it is exposed to the atmosphere, such as on the surface of a lake, river or ocean or on a plant, animal or soil.

## Transpiration

Plants move water from the soil through their roots to their leaves. This water is lost to the atmosphere as water vapor in a process called transpiration. Transpiration provides a pathway between water stored deep in the soil and the atmosphere. Water movement to the atmosphere by evaporation and transpiration is sometimes combined into the single term, evapotranspiration.

**Sublimation**

When water is frozen solid as ice or snow, it can be heated and directly converted to water vapor, without melting into liquid water.

**Precipitation**

When water vapor condenses, it forms droplets that fall to Earth as rain, snow, or hail (depending upon the temperature). Precipitation is the ultimate source for all water that flows through streams and rivers and enters lakes and groundwater.

**Interception**

Some precipitation never reaches the ground because it is captured as it falls onto the surface of vegetation, twig and leaf litter, or other above ground structures. In areas with healthy vegetation, interception can store up to 25% of the precipitation that falls.

**Infiltration**

When precipitation falls onto a permeable surface, such as soil, it can enter pores and soak into the soil. Soil pore size depends upon the inorganic particle size (sand, silt or clay) and whether biological organisms, such as plants, worms or moles, have created large holes called *macropores*.

**Runoff**

Water that cannot be intercepted, stored or infiltrate the soil will run off the soil surface. Runoff follows topography, so the streams and rivers where surface water runoff comes together are usually in valleys and geographic depressions. Urban areas have large amounts of impervious surface, such as concrete and rooftops, so a large percentage of precipitation is lost through runoff.

**Storage**

Water is stored when it isn't actively being cycled. Typical reservoirs where water is stored include the ocean, lakes, wetlands, groundwater, snow and ice. Some reservoirs of stored water are essential for sustaining stream flow during the dry summer. The length of time water is stored in one of these reservoirs may vary from hours to hundreds of years.

**Groundwater**

Water that infiltrates soil usually reaches an impermeable soil or rock barrier (called an *aquitard*). Once a barrier is met, water will fill the soil pore spaces and create an *aquifer* or an underground reservoir. The water table is the level below which the ground is saturated with water. Water can flow back and forth between surface and groundwater, depending upon how far below the soil surface the water table is.

**Climate**

Climate is defined as the long-term weather pattern of a particular area, this includes temperature, precipitation, and seasonality. It is important to consider that even in areas with high average precipitation, like western Oregon and Washington, the majority of that precipitation falls during a few months of the year. Large rain events can exceed the soil infiltration rate, and once lakes and wetlands are filled, much of the water runs off to the ocean. In areas with higher elevations, some of this precipitation will fall as snow, where it can be stored until it melts in the spring and summer.

# Geology

The Pacific Northwest has been defined geologically by a series of extraordinary dynamic geological events – **tectonic plate movement**, **volcanic eruptions** and **massive floods**.

## **Tectonic plates**

For about 35 million years, tectonic plates have been converging along the present-day Oregon Coast causing the seafloor to sink. The ocean-floor is a small, dense plate named the Juan de Fuca Plate. The Juan de Fuca Plate is being pushed under the more buoyant continental North American plate, causing the continent to buckle and rise, forming the Coast Range, between the City of Portland and the Pacific Ocean.

As the Juan de Fuca Plate plunges under the continental plate and towards the earth's center, the plate's crust heats up and becomes liquid rock, called magma. Some of the magma gets returned to the earth's inner layers, while some rises and forms volcanic mountain ranges. This is what creates the Cascade Range, and forms area volcanoes like Mount Hood. The Cascades are much taller than the Coast Range, so the precipitation they receive is often in the form of snow. The elevation of this mountain range also facilitates the storage of water in the form of glaciers.

The large Pacific Ocean Plate has been moving North and dragging the western edge of North America along. This plate has been moving 2 inches per year for the past 10-15 million years, which is evidenced by the San Andreas Fault in California, as well as the northern jog the Columbia River makes just west of Portland.

## **Volcanic Eruptions**

Long before volcanoes formed the Cascade Range, a series of volcanic eruptions from the Grande Ronde Volcano occurred in northeastern Oregon (12-17 million years ago). Copious amounts of basalt flowed west across northern Oregon, laying the foundation for the series of scenic stacks and arches now seen along the coast of Oregon (e.g. Haystack Rock). These layers of basalt, known as Columbia River Basalt, form the bedrock for most of the region and can be easily seen in the Columbia River Gorge.

## **Massive Floods**

A series of catastrophic floods deposited large amounts of gravel and sand on top of the Columbia River Basalt. The first flood deposited layers in the Willamette area were unconsolidated deposits of gravel and sand known as the Troutdale Formation.

The second major flood event, called the Bretz (or Missoula) Floods, occurred about 15,000 years ago at the end of the last Ice Age. As the ice sheets that covered most of North America were retreating towards the poles, a large glacier from British Columbia dammed the Clark Fork River in the Idaho panhandle. This glacier formed Lake Missoula, one of the largest freshwater lakes in Earth's history. When the ice dam melted, most of the 500 cubic miles of water from Lake Missoula rushed west and scoured the Columbia Gorge within a 2-day period. The floodwaters carried gravel, sand, silt and whatever else the raging river picked up in its path.