GROUNDWATER DIAGRAMS

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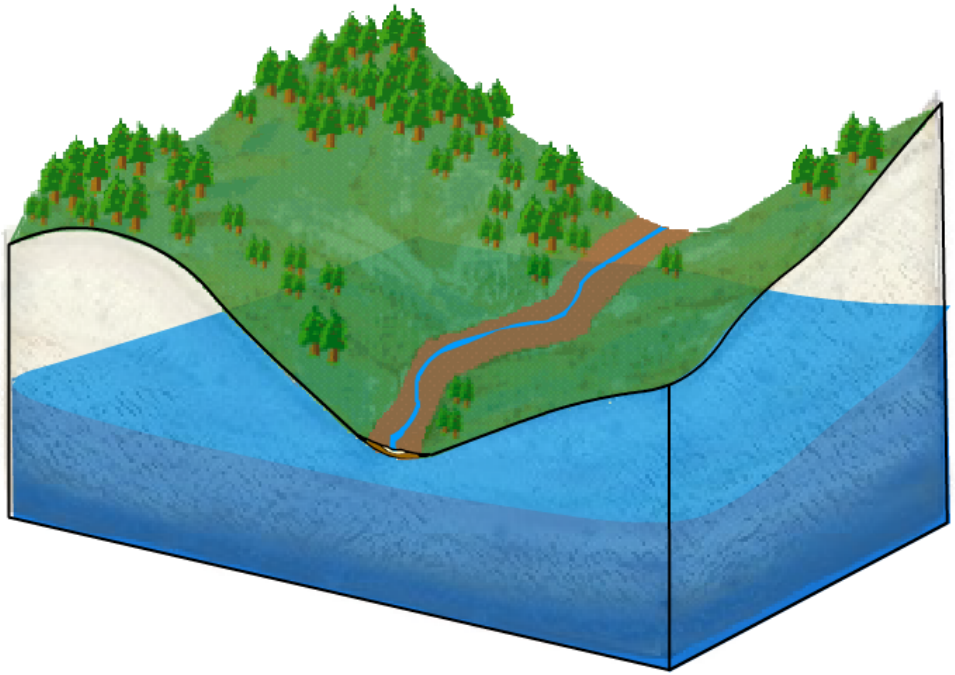
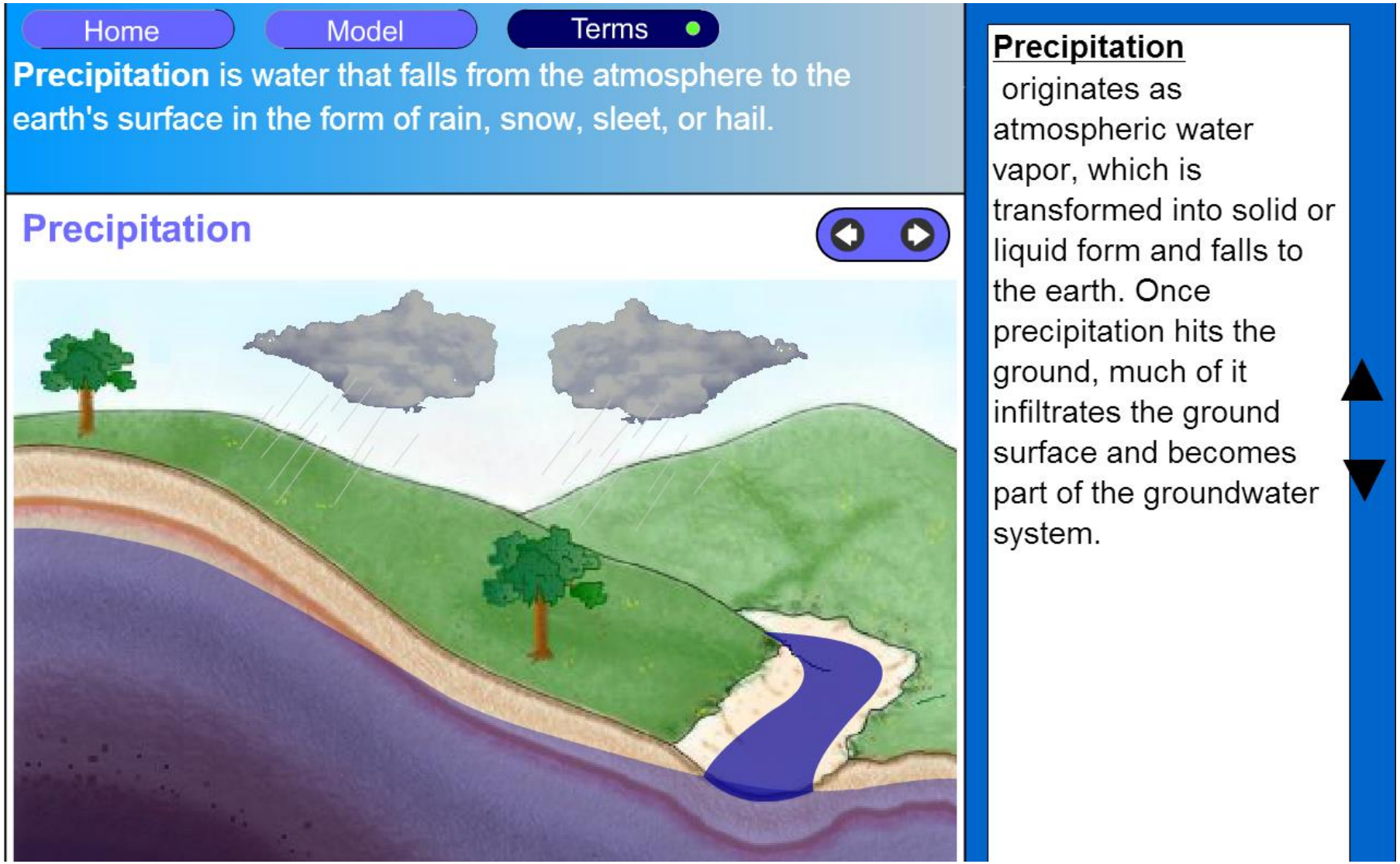
Groundwater is water that occupies pore spaces and other voids in the saturated zone. In popular usage, groundwater refers to any water found in the ground.



Groundwater can be found nearly everywhere, even in deserts. Most often one must dig or drill a well to see groundwater, but groundwater also can be seen at the surface wherever there is a spring or in many cases where groundwater discharges into streams and lakes. Of course, when you do see groundwater at the surface, it is no longer groundwater but simply "surface" water.

Dry Month - A period of dry weather, in which a lack of precipitation, combined with ongoing evaporation and transpiration, causes groundwater levels to decline.

Wet Month - A rainy period, in which enough precipitation falls to significantly raise groundwater levels.



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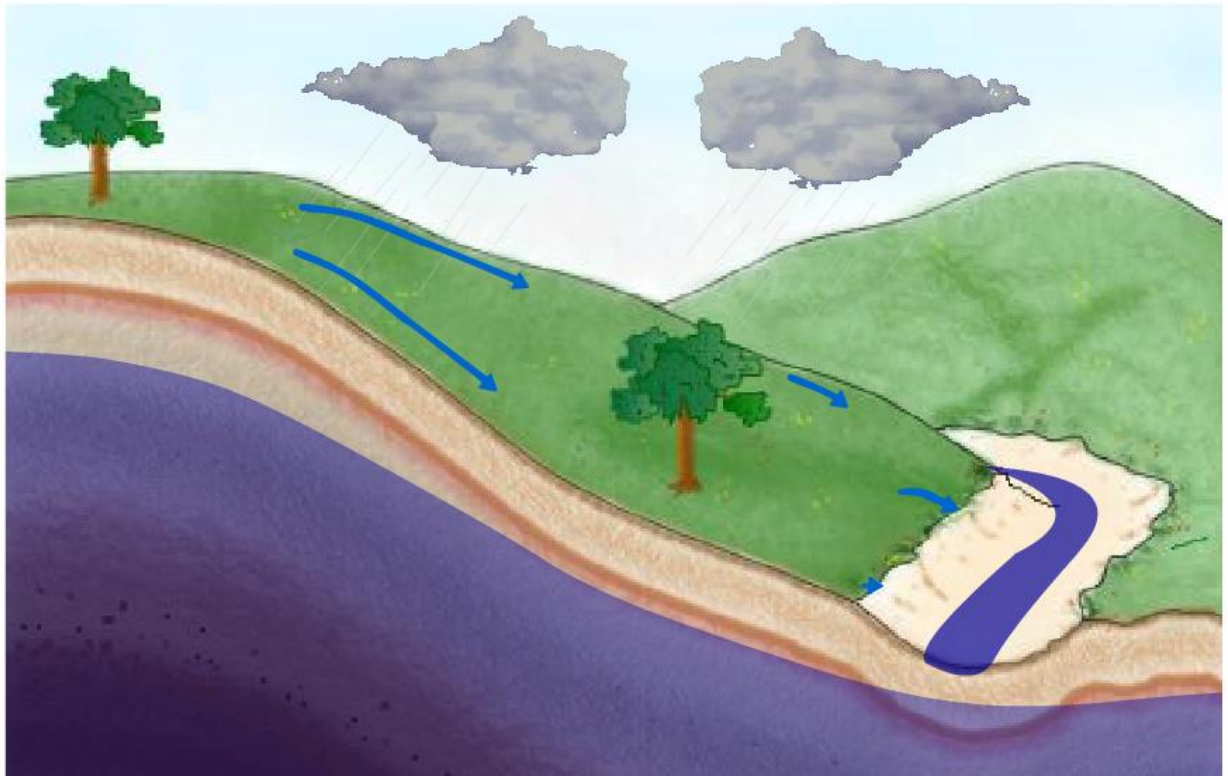
Runoff is the portion of precipitation that runs off the land surface and into the nearest body of surface water (usually lakes, rivers, or wetlands).

Runoff



Runoff is enhanced by steep slopes, impermeable soils, driving rainstorms, and soils saturated by previous rainstorms. Runoff is also enhanced by man-made structures and roads, which prevent infiltration. Thus urban and agricultural landscapes tend to have enhanced rates of runoff at the expense of infiltration; this both decreases the recharge of groundwater reservoirs and helps increase the frequency of flooding in many areas

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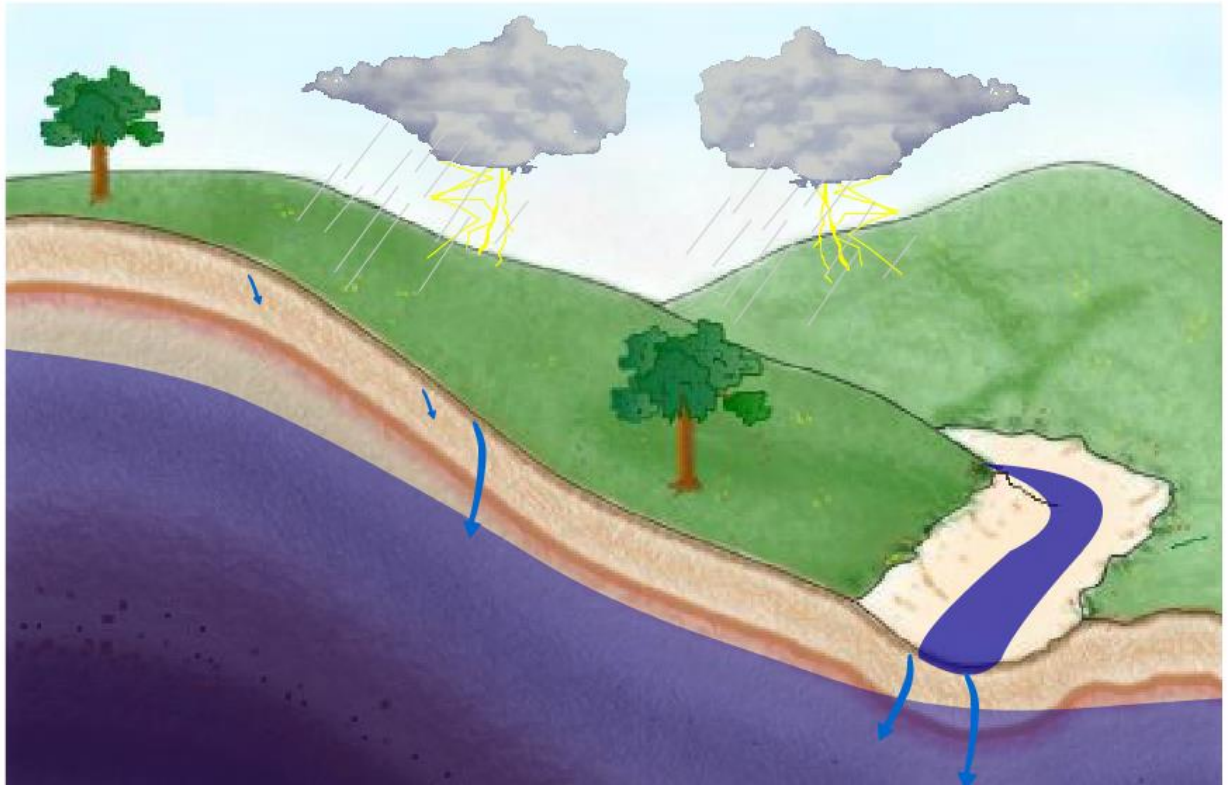
Infiltration is the movement of water from the surface downward through the unsaturated zone toward the saturated zone.

Infiltration



Infiltration

is the primary mechanism of groundwater recharge, the way in which groundwater supplies are replenished. The amount of water that infiltrates the ground is generally equal to the amount of precipitation minus the water that runs off the surface, evaporates from the surface or from vegetation, or is consumed by vegetation. Infiltration is enhanced by gentle topography, sparse vegetation, permeable soils, gentle rainstorms, and previously unsaturated soils &; other conditions lead to an increase in runoff or transpiration instead of infiltration, resulting in lower groundwater recharge rates.

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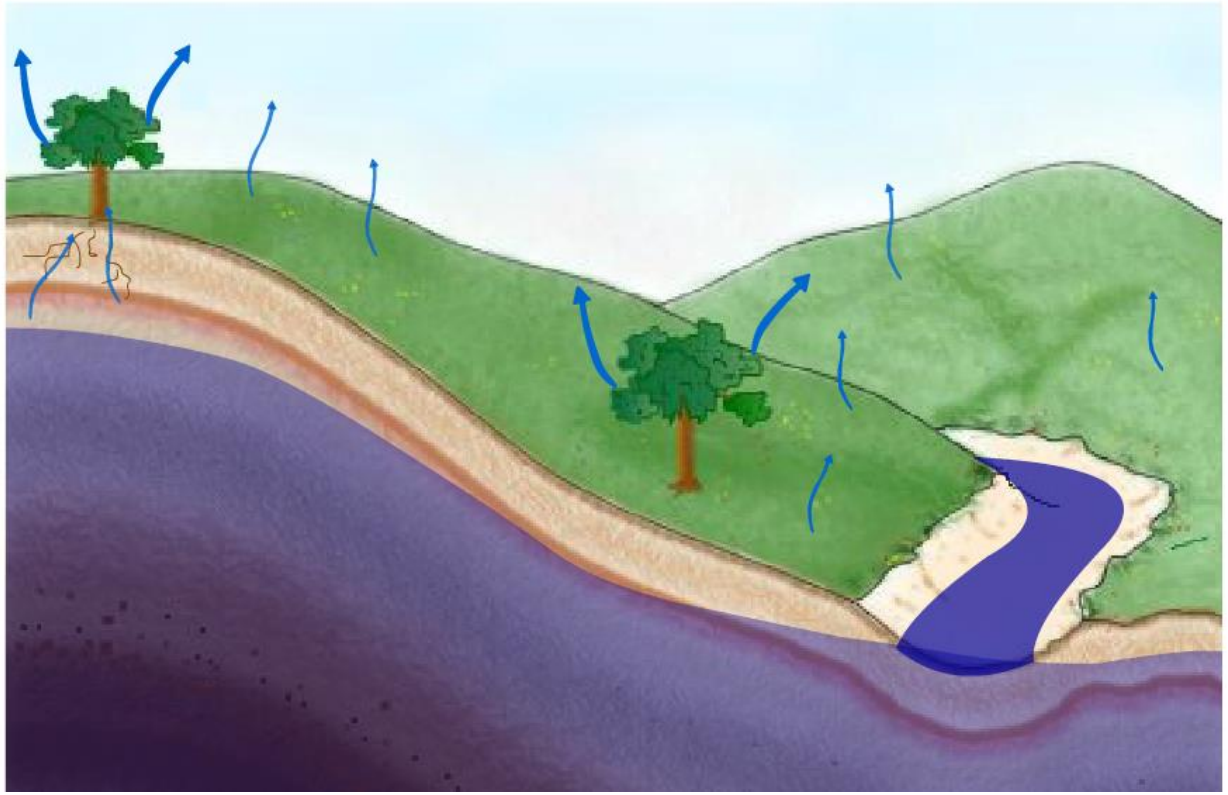
Transpiration is the process by which plants draw soil moisture in through their roots and release it to evaporation through their leaves.

Transpiration



Transpiration:

Plants can withdraw a significant amount of water from the soil before it can seep down to the water table. Transpiration, especially during periods of drought, can severely limit groundwater recharge from gentle rains. For example, envision a gentle rain falling on a suburban lawn or park covered by grass; very little of that precipitation will make it past the dense root mass to infiltrate the groundwater. Instead, the grass roots will suck up the water molecules and expel them through the leaves (via evaporation).

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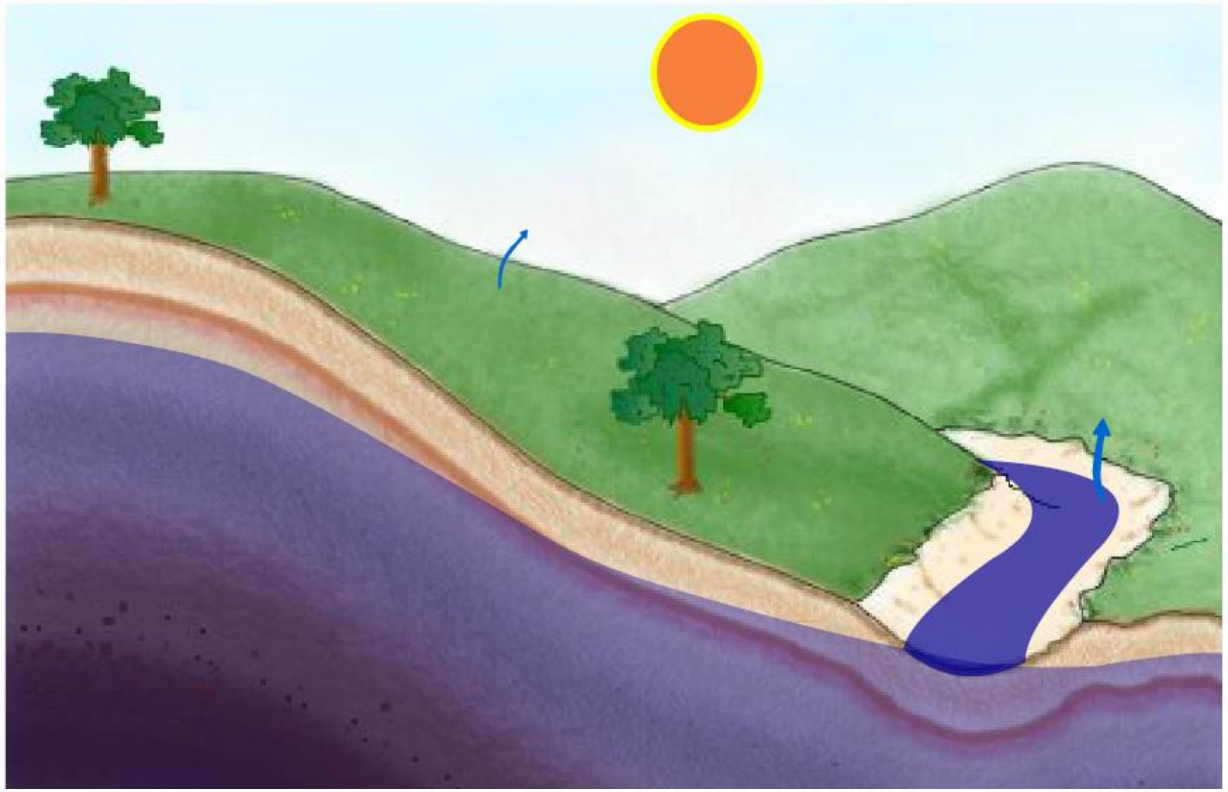
Evaporation is the conversion of liquid water to gaseous water vapor. Much of the precipitation that falls to the earth returns to the atmosphere through evaporation before it can infiltrate the

Evaporation



Evaporation:

In densely vegetated areas (like tropical rain forests) 35% or more of precipitation lands on plants and evaporates back into the atmosphere before it can reach the ground. In arid regions a significant amount of the precipitation that infiltrates the ground is later lost to evaporation - evaporation can pull water vapor right out of the ground.

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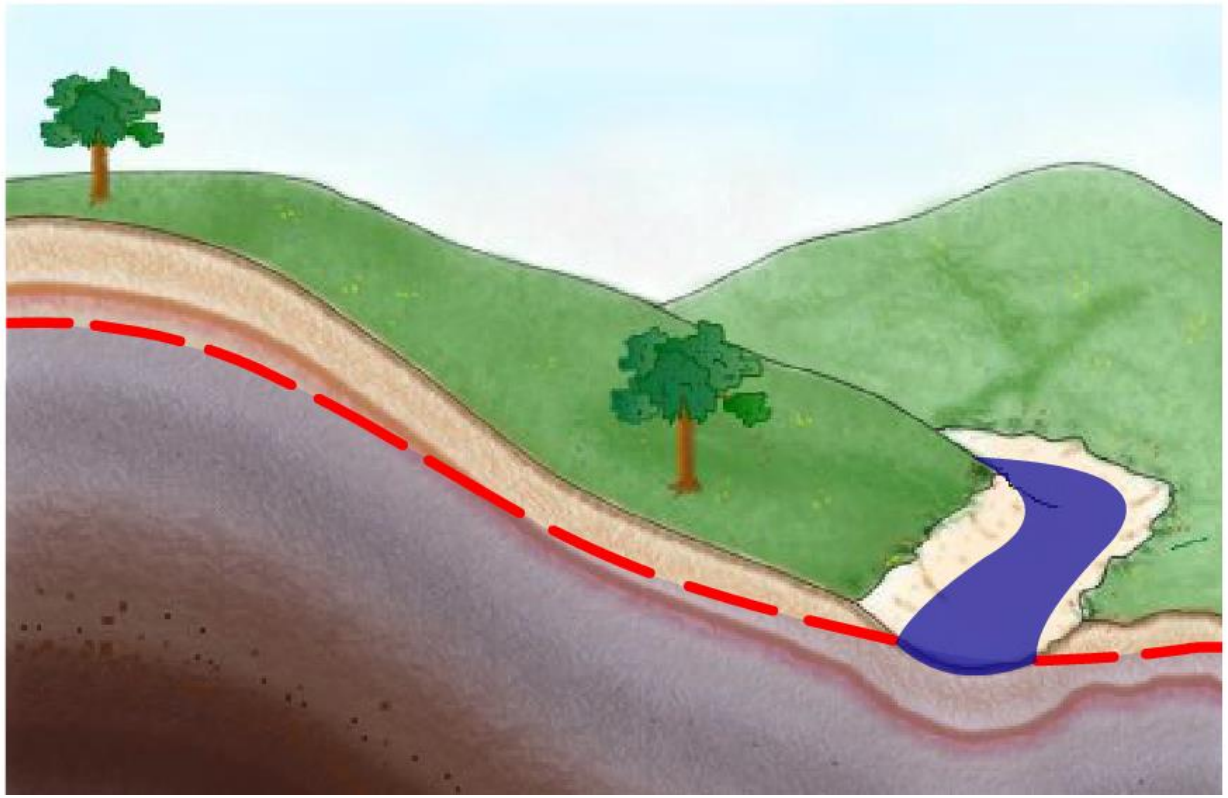
The **saturated zone** is the region of the subsurface below the water table (dashed line) where water fills interconnected pore spaces.

Saturated Zone



Saturated Zone:

The water table marks the top of the saturated zone. When something is saturated, it means completely full of something - in this case, the pores of the rock are full of water. In most areas of the world, the saturated zone of fresh groundwater extends downward for only a few tens to a few hundreds of meters. Below this, the pore spaces are full of "older," saltier groundwater. The longer groundwater stays underground, the more likely it is to become salty, which simply means that it contains ions of various minerals dissolved in it. Also called the "zone of saturation".

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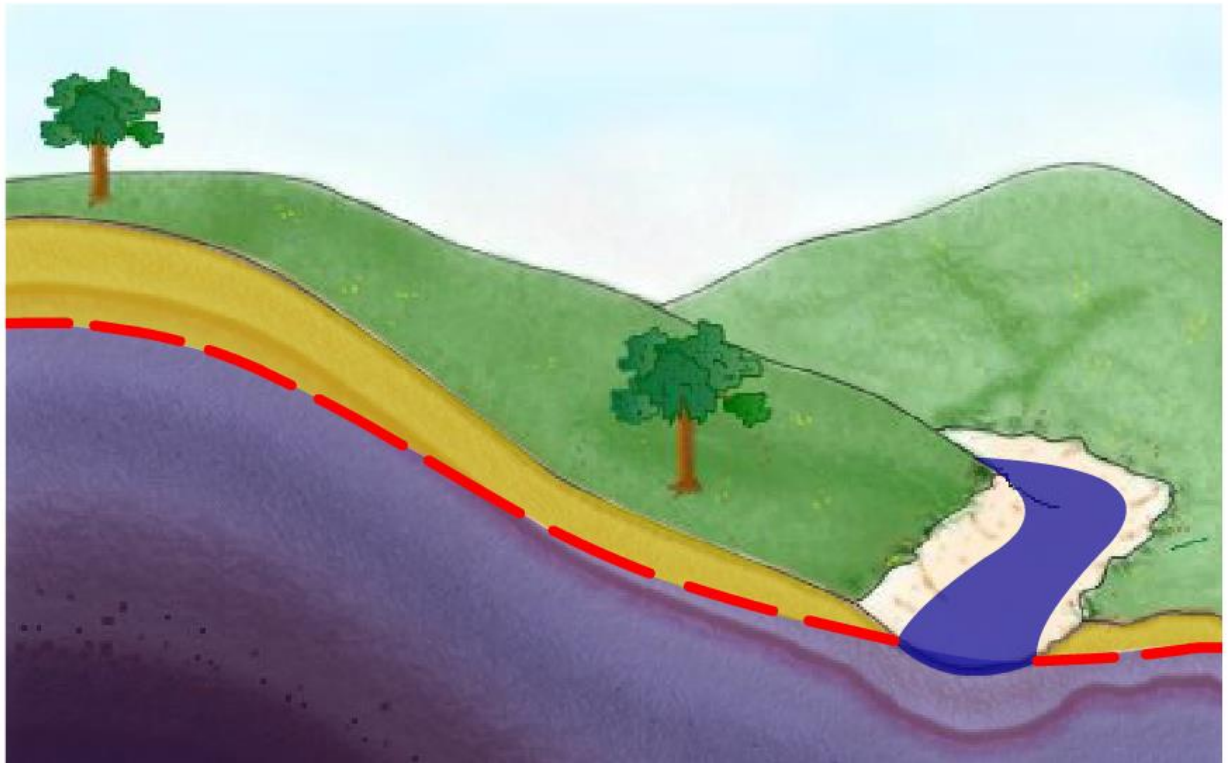
The **unsaturated zone** is the region of the subsurface above the water table (dashed line) where the pore spaces in rocks and soils contain both water and air.

Unsaturated Zone



Unsaturated Zone:

In most areas, the unsaturated zone is bounded on the top by the land surface and on the bottom by the water table. In arid regions the unsaturated zone may be tens to hundreds of meters thick. However, in areas with low-lying wetlands or near bodies of surface water, the unsaturated zone may be virtually nonexistent — the saturated zone extends right up to the earth's surface. Also called the "zone of aeration".

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The **water table** marks the "top" of the saturated zone of groundwater. It is an irregular boundary that separates the unsaturated zone and the underlying zone of saturation.

Water Table

Water Table:

The water table is almost never flat like a "table" is flat. The water table more commonly resembles a gentler version of the ground surface; the water table is typically higher in elevation beneath hills and lower beneath valleys. However, the depth from the ground surface to the water table is greater beneath hill and ridge tops than it is in valley bottoms, thus producing a subdued relief on the water table surface.

Ponds, streams, wetlands, and other bodies of water often indicate where the water table is intersecting the land surface - discharge from the groundwater saturated zone to the surface is taking place here, creating these surface water bodies.

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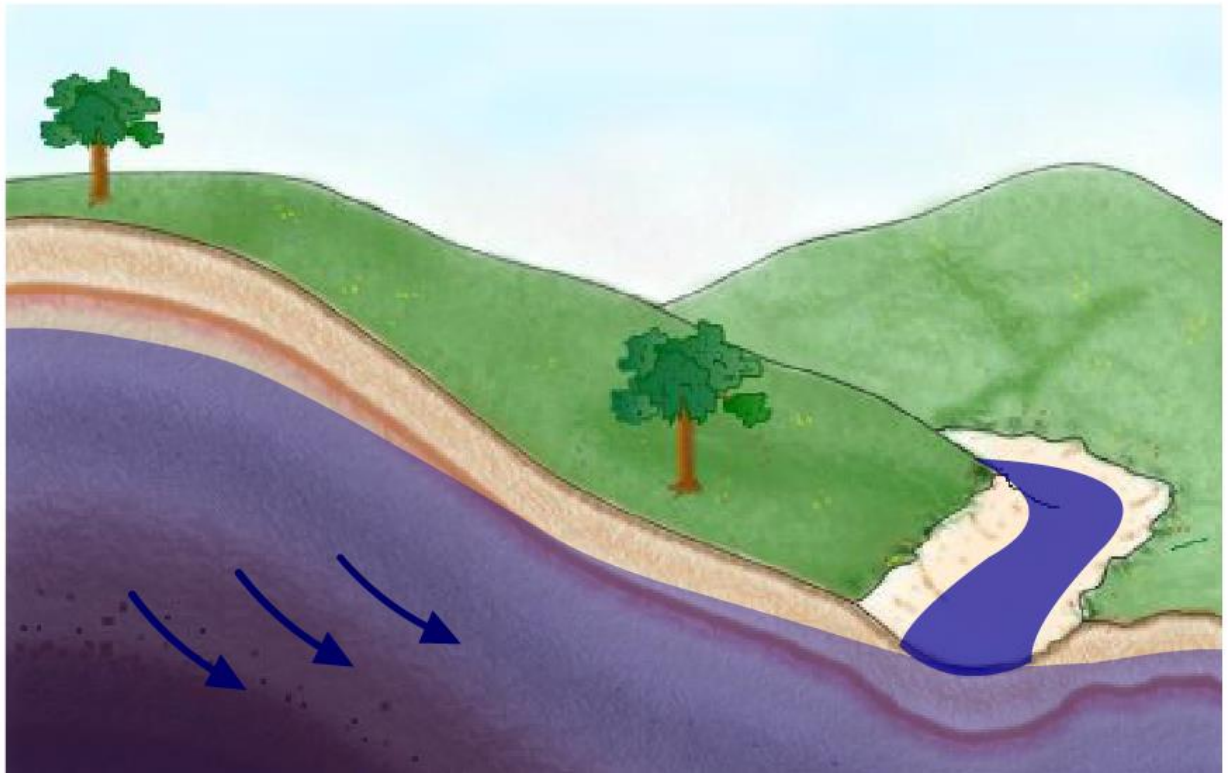
Groundwater flow is the movement of groundwater from areas of high potential toward areas of low potential, which is usually from higher elevations in the saturated zone toward lower

Groundwater Flow



Groundwater Flow:

Simply put, groundwater moves. Nearly all groundwater is moving slowly somewhere, usually from a higher elevation "recharge" area, in which infiltration is adding new groundwater, toward a lower elevation "discharge" area, in which groundwater is coming out of the rock to become surface water. Groundwater flows slowly in tiny pore spaces within the rock, moving from areas in which it has a higher

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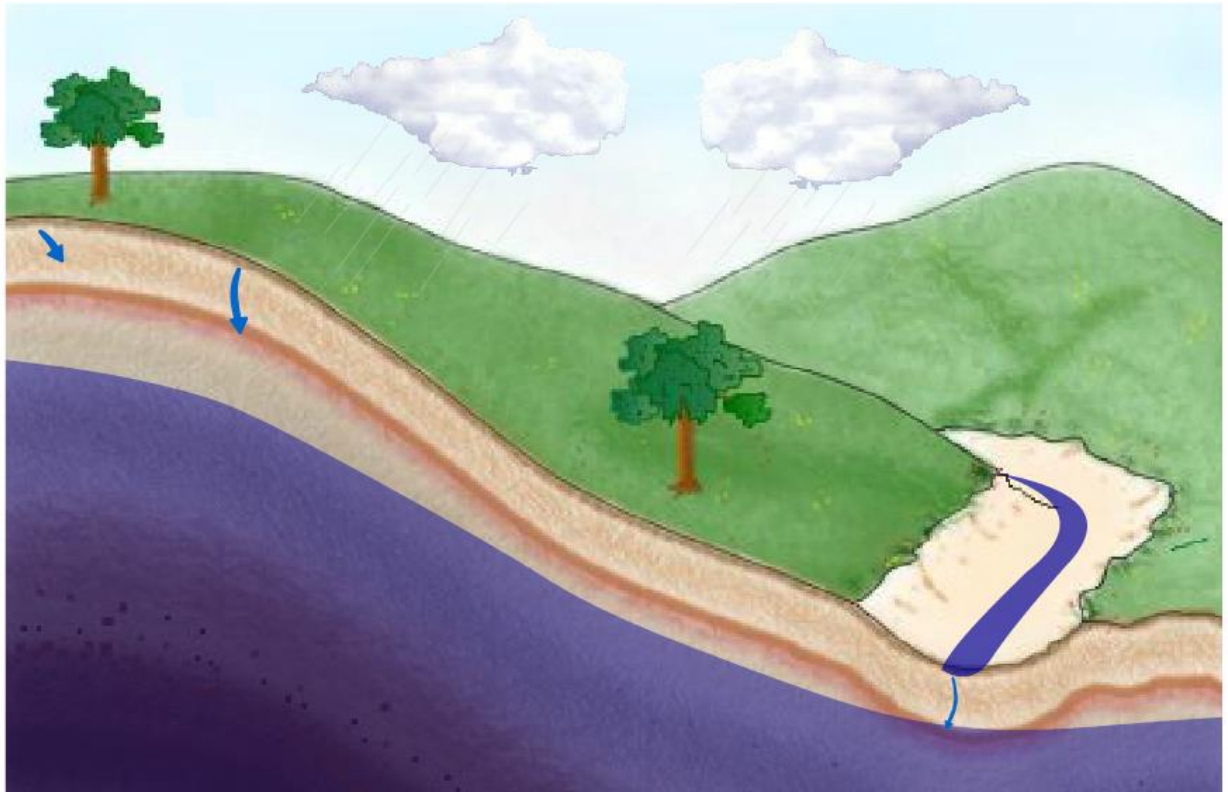
Groundwater recharge is the infiltration of water into the saturated zone. Groundwater recharge replenishes our groundwater supplies.

Groundwater Recharge



Groundwater Recharge:

Precipitation and surface water (such as streams and runoff) can contribute to groundwater recharge wherever the water table is below the surface water level. Recharge is enhanced by cool, humid climates, sparse vegetation, gentle topography, and permeable soils. Most groundwater resources are in a state of "dynamic equilibrium," losing and gaining reserves over time according to local conditions of recharge and discharge.

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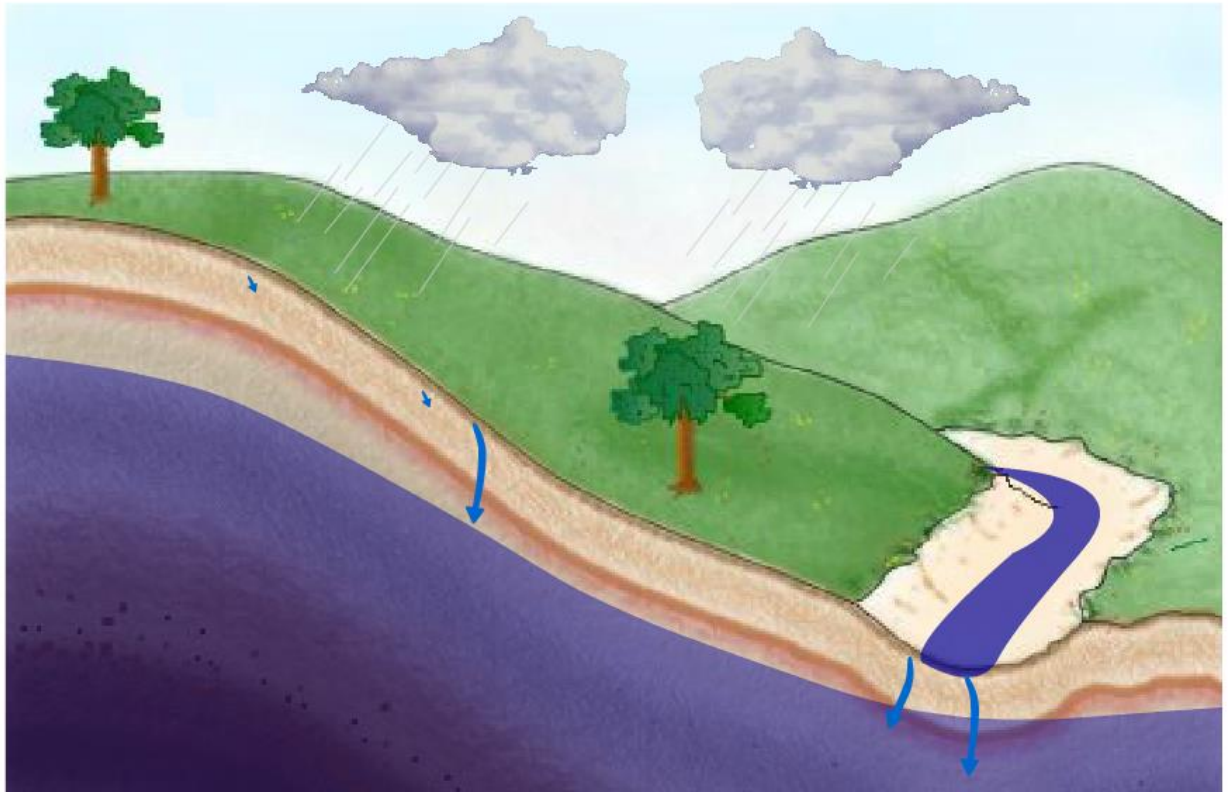

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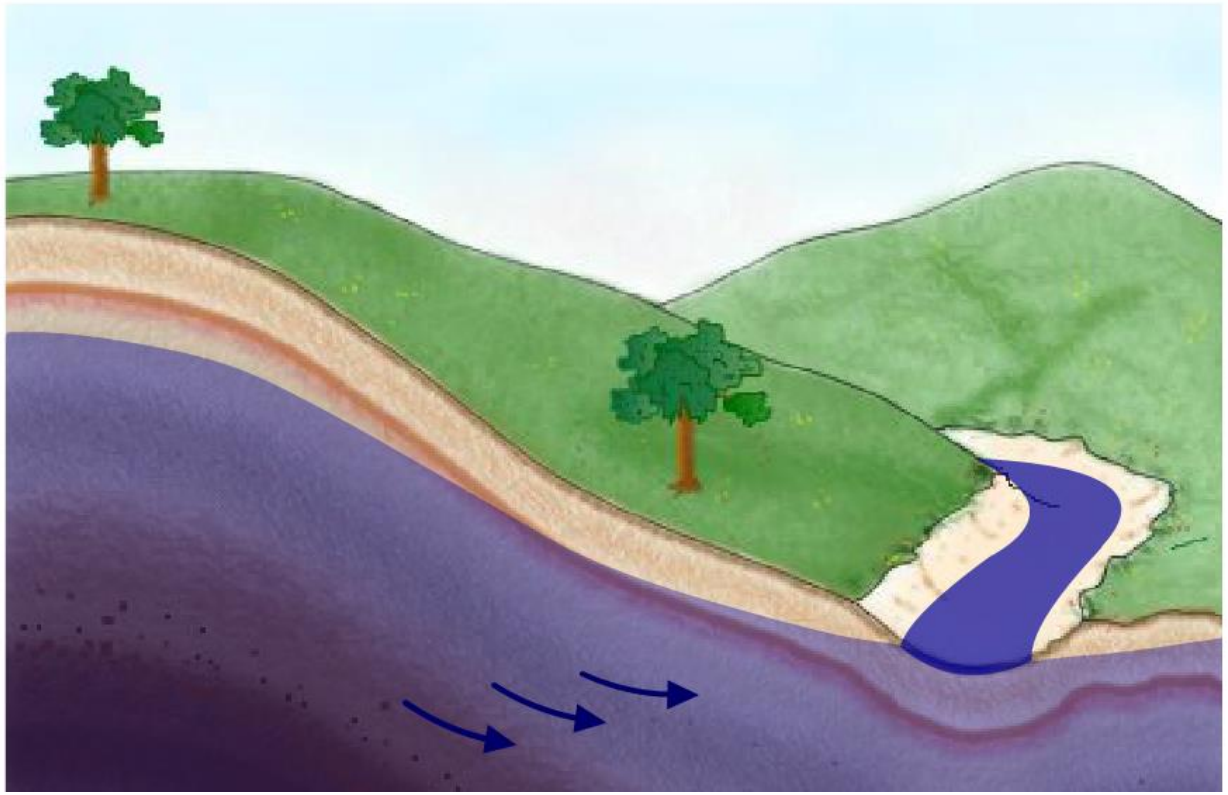
Groundwater discharge is the movement of groundwater out to surface waters, primarily through base flow into streams. Continuing discharge lowers the supply of groundwater available.

Groundwater Discharge



Groundwater Discharge:

Groundwater discharge can create or contribute to wetlands, ponds, lakes, streams, and rivers. Springs are caused solely by groundwater discharge. Because the water table drops during dry periods, many springs, streams and wetlands are seasonal, disappearing and reappearing as rainfall (and hence the underlying water table) fluctuates.