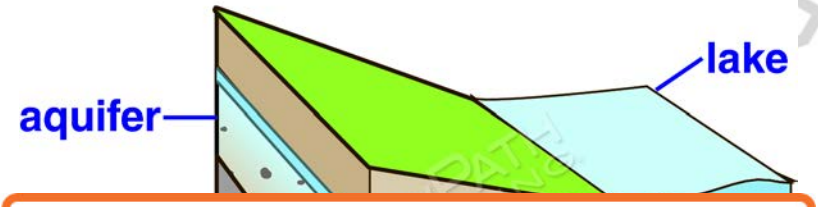
GROUNDWATER RESOURCES

Groundwater is a vital source of water for individual homes and entire communities. Some groundwater reservoirs are so large they provide water for homes and farms over hundreds of square miles.

Groundwater is fresh water stored in **regolith** and **bedrock**. (Regolith is un-cemented rock and soil.) Even though solid rock like granite or marble has no pores, it often has a series of cracks and possibly faults. Water accumulates in the cracks in solid bedrock and, at times, is a source of water. A layer of rock material that can store water and allow the movement of water through the ground is called an **aquifer**.



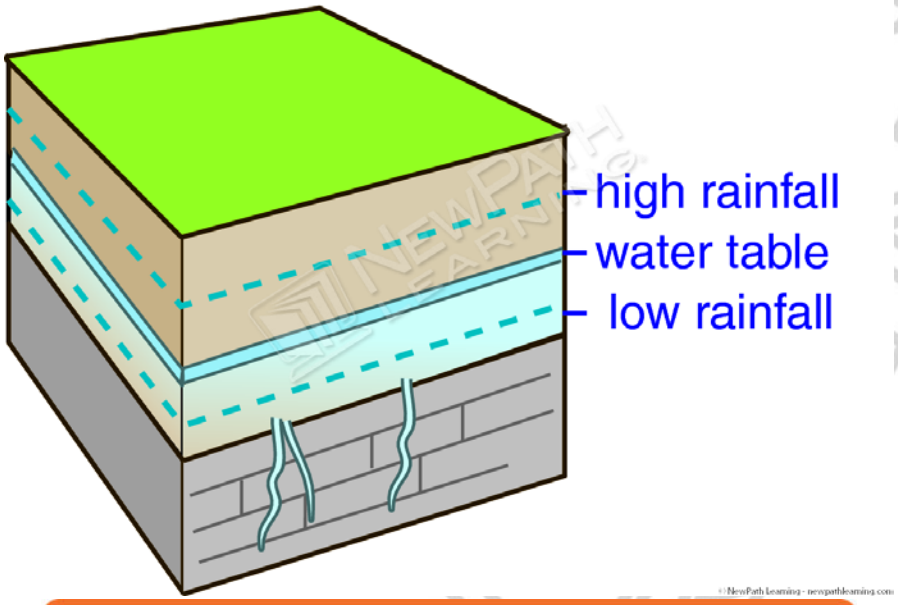
The Water Table

The top surface of the water in an aquifer is the **water table**. The water table is not a fixed surface. It rises or falls due to two factors.

- First, since aquifers are replenished by rainwater, the water table will go up or down depending on the amount of rainfall over a given time.
- Second, the water table is affected by the amount of water that is removed from the aquifer for use by people.

The water table marks the division between the **aeration zone** above and the **saturation zone** below.

WATER TABLE LEVELS



Peop eir local aquifers. drawn out of the aqui rains into the well. dry out immediate

This area around the well hole is called the **cone of depression**. The cone of depression is actually the top of the water table as it dips down toward the well shaft. If more water is taken out of the well than can be replenished the cone of depression will become so deep that the well will run dry.

The ability for water to move through an aquifer depends on the **porosity** and **permeability** of the aquifer.

- Porosity is a measure of the pore spaces between the grains in the aquifer. The porosity determines how much water can be stored.
- Permeability is a measure of how connected the pore spaces are. The permeability determines the ability of the water to move through the aquifer.

Lesson Checkpoint:
What is the cone of depression in a well?

Artesian Well

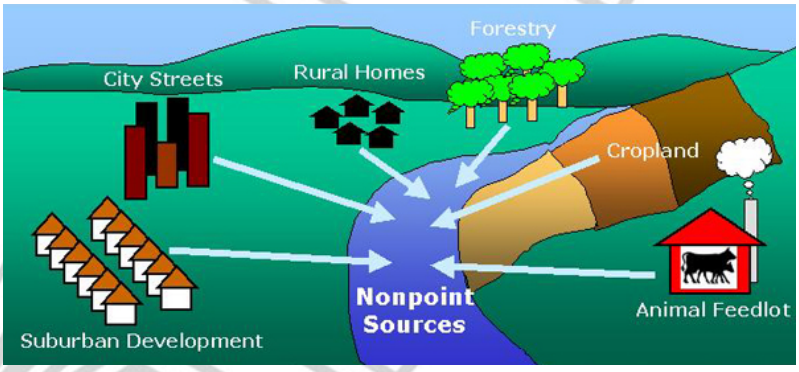
Aquifers have an impermeable bedrock underneath them. In some instances, they can also have an impermeable **cap rock** on top of them. This results in pressure on the aquifer. In breaks in the cap rock, fresh water can squirt out as a spring. This type of spring is called an **artesian spring** (also called an **artesian well**).

The difference between a well and an artesian spring is that a well is drilled or dug and an artesian spring is a natural formation.

Groundwater Pollution and Overuse

Though traditionally thought of as a **renewable resource**, overuse and unmanaged pollution can eradicate a water resource, either depleting it completely or making it unusable for very long periods of time, turning it into a **nonrenewable resource**. Consequently, water preservation and pollution management is essential.

There are two categories of pollution, **point-source pollution** and **nonpoint-source pollution**.



Nonpoint-source pollution is pollution that comes from an unidentifiable region. The pollution is transported by the runoff of groundwater. Runoffs from city streets, fertilizers from farmland, seepage from septic tanks in housing tracts are all examples of nonpoint-source pollution.

If polluted water is returned to the ground, it becomes very, very difficult to clean. In fact, it moves so slowly through the aquifer that it will take extraordinary measures to get it out of the aquifer and make the aquifer usable again. Consequently, it is preferable to collect wastewater and transport it to a water purification facility where it can be properly treated so that clean, usable water can be returned to the environment.

Caves and Other Groundwater Features

When groundwater flows through limestone, natural acids interact with the limestone. The natural acid that dissolves limestone, creating underground caves and cave features, is carbonic acid. The chemical reaction is as follows: $CO_2 + H_2O$ produces H_2CO_3 (carbonic acid). When dissolved in water, the carbonic acid ionizes into a hydrogen ion and a bicarbonate ion. The hydrogen ion chemically reacts with the limestone (which is made of calcium carbonate). This process dissolves away the limestone. This limestone dissolution creates an entire suite of features that are unique to limestone cave formations.

Unde rbonic acid in the ever, some lime-rich w evaporates Cave formations estone cave are c p from the floor of a l alactite and a stalagmite grow together they form a **column** or **pillar**.

When a large cave forms under ground, the roof of the cave can collapse. When this happens, the surface – and everything built on the surface - collapses into the depression into a giant **sinkhole**.

A sinkhole is but one example of the harsh and unique surface features created by the formation of limestone caves. The rough terrain of dramatic peaks and valleys that form on the surface of the Earth above limestone that has been dramatically dissolved away by groundwater are called **karst topography**. When karst topography forms on the surface, extensive limestone dissolution has occurred below the surface. In many cases, large caves have formed but the limestone structure is solid enough that there is no evidence on the surface that caves lie below.

Lesson Checkpoint:
What is a stalactite?