The Journey Begins

Rain and snow are the main sources of our water. When it rains or the snow melts, part of the water flows to streams, lakes, and other water bodies. This is called **surface water**. Some of the remaining water goes back into the air through **evaporation**. The rest of the water goes into the ground through the soil. The water that goes through the soil without getting used by plant roots eventually hits rock. That rock lying beneath the soil is called **bedrock**. You can also see bedrock at the surface in parts of the Rocky Mountains because soil is often thin or not there in these areas.

In many parts of the Rocky Mountains the bedrock is solid and water can only move through it by following cracks in the rock. Those cracks are called **fractures**. If you have a well at home or at school, those fractures contain the water you drink every day. Water that fills the fractures is called **ground water**.

Ground water is stored in the pore spaces or small openings in some rocks such as sandstone, and in solution openings and fractures in other types of rocks, such as granite. In the foothills west of Denver, the land is generally made up of granite, schist, and other low porosity rocks, and so the ground water is stored in fractures.

These fractures occur over time from folding and faulting of the rocks. Weathering increases the size and number of fractures. Fractures often close up at around 400 feet beneath the surface due to increased pressure from materials above.
**Mountain Water on the Move**

Water added to the ground water is called ground water **recharge**. Recharge from rain and snow occurs where the fractures in the rocks are close to the land surface. At the zone where water first enters these fractures there is both air and water. Scientists call this the **unsaturated zone**. The unsaturated zone is immediately below the land surface. The unsaturated zone includes the soil where plants get their water. There is not enough water in the unsaturated zone for a well.

As the water continues to move down through the cracks, the cracks fill up with water and there is no air left. Scientists call the location where there is no air left in the cracks the **saturated zone**. The top of the saturated zone is called the **water table**. The saturated zone is located below the unsaturated zone. The saturated zone is where wells get their water. Wells must at least be deep enough to be below the water table in the saturated zone to get water. Of course wells below the water table must cross fractures to get their water. Wells remove water from the cracks in the saturated zone.

The water table may be just below the land surface or hundreds of feet beneath. During dry years when it does not rain or snow very much, the water table can lower, making it a greater distance from the land surface. This will cause some wells to be in the unsaturated zone where there is not enough water for them to pump, causing the well to be dry.

**Ground water occurs below the land surface in two different zones, unsaturated and saturated. Water held in the unsaturated zone is not considered ground water because there are insufficient quantities to supply water to a well or to a spring. A zone in which all the fractures are full of water is called the saturated zone. It almost always underlies the unsaturated zone. The water table may be just beneath the land surface or hundreds of feet below. In the Turkey Creek Watershed of Jefferson County, Colorado, the maximum depth to water is about 520 feet and the minimum is 1 foot. This is based on over 1,100 well records from the State Engineer’s Office.**

**Ground water comes from two sources, precipitation that infiltrates through the unsaturated zone and directly from some surface-water bodies (i.e., lakes, streams, or rivers). Areas that supply ground water are commonly referred to as recharge areas. Recharge from infiltration of precipitation and surface-water bodies usually occurs where the formation containing water is close to the land surface.**

**Where the land surface intersects the top of the water table, water stored in the saturated zone can flow onto the land surface as a spring or seep. Some surface-water bodies obtain part of their water from ground water. The water level of some ponds and wetlands can be an extension of the local ground water. Locations where ground water flows or is discharged to the land surface or surface-water bodies are discharge areas. A well can also be considered a discharge area, since it pumps ground water to the surface. Water moves from recharge areas to discharge areas through the saturated zone. Recharge areas are higher in elevation than discharge areas. Recharge, ground water movement, and discharge of ground water are related to the elevation of the water table.**
How much water comes from your well depends on how much water the bedrock around your well can hold. The amount of water the bedrock can hold depends on the bedrock’s **porosity**. Porosity is a measure of the fractures in the bedrock that can fill with water. The more fractures—or cracks—the bedrock has, the more water it can store and the higher the bedrock’s porosity. The less fractures bedrock has the lower the bedrock’s porosity.

For water to move to a well in bedrock so that we can use it to drink, the fractures must be connected. If there is a good connection among the fractures and water can move freely, we say that the bedrock is **permeable**. If there is enough water in the bedrock fractures to fill them with water, and the water can flow from the fractures to a well the bedrock is called an **aquifer**.

![Permeable Not Permeable](image)

Fractures must be connected in order for water to move through rock.

Without fractures there is no place for water to go into the bedrock, so there would be no water available for a well. You can not tell by looking at the land surface where the fractures are located.

**Our Actions and Ground Water Quality**

As the water from rain and snow flows over the ground, through the soil and into the aquifer it can pick up pollution left on the surface such as oil from cars, pesticides, and fertilizers. It can flow into the fractures and **pollute** the aquifer. It is important to be careful how you and your family use pesticides and fertilizers. It is also important to dispose of certain items such as paint, used oil and some household cleaners in a safe way. Many cities and some counties have special drop-off sites where people can drop off these household products. The people working at these sites make certain that the products will not get into your ground water.

![The soils associated with the foothills’ ecosystem are thin and poorly developed. This provides for little opportunity for “cleaning” of the waters that recharge the aquifers through microbial activities and filtration. Thin soils provide for a small buffer zone between the fractures from which ground water recharge occurs, making it very important to watch what is placed on the surface. Used automobile fluids should be taken to recycling sites, and pesticides and fertilizers should be used sparingly and away from wells. The shallow soils also provide for limited purification of wastewater from septic tanks and associated leach fields. This is especially important if a well is in close proximity to the waste disposal system.](image)

**Porosity** is measured as a ratio of openings in the rock material to the total volume of rock material and is described as a percentage. Fractured rocks, such as those that provide water to the wells in Evergreen and Conifer, Colorado, have very low porosity. For that reason, ground water is relatively scarce in the area.

**Permeability** refers to the ability of a material to transmit water.

If underground rock materials are capable of storing and transmitting water in useful amounts, the rock materials are called an aquifer. Underground rock materials, such as clay or unfractured crystalline bedrock, that restrict the flow of water are not aquifers but are confining materials.

The volume of water that an aquifer can hold depends upon the volume of the bedrock materials and the size and amount of pores and fractures that can be filled with water. An aquifer may be only one yard (meter) or thousands of yards (meters) thick. It may be less than a square mile (kilometer) in area or hundreds of thousands of miles (kilometers) in area.
Water flushed down toilets or poured down drains can find its way to fractures and pollute ground water.

It is important to be careful of what you flush down the toilet or pour down the drain. These things can pollute ground water. If your home or school uses a septic tank and leach field for waste disposal, it is possible that waste can get into your well, or that of your neighbors. The liquid from a leach field can flow into the fractures in the bedrock. If that fracture supplies water to a well, that well can be polluted. In that case, your drinking water would also be polluted.

The journey of a mountain raindrop is one that begins in the sky, and could end in a variety of places. One such place could be the water glass on your dinner table. However, it doesn't really end there, because after you drink it that raindrop gets recycled once again.
**Aquifer**: An underground formation that is capable of storing and moving water. They are sources of ground water for wells and springs.

**Bedrock**: A layer of hard rock that is often thick and filled with cracks or “fractures.” In the mountains bedrock is often close to the ground surface.

**Evaporation**: The process of changing from a liquid or solid to vapor (example: when morning dew on the grass disappears, it is due to evaporation).

**Fracture**: A crack or break in a rock formation due to stress. They are often the result of the natural processes at work when the mountains were being formed many years ago.

**Ground Water**: Water found underground in spaces between soil particles and in the cracks or “fractures” in bedrock.

**Leach Field**: The part of a sewage disposal system that receives wastewater minus the solids.

**Permeable**: The property of a material (rock or other) that allows water or another substance to pass through it.

**Pollute**: to make unclean or to contaminate, as in the environment, or the water. This may make people, animals or plants unhealthy.

**Porosity**: the property of a rock, or other material that compares the amount of small open spaces to the amount of solid material. The more open spaces (holes or cracks) the greater the porosity. Porosity has to do with how much water a rock can store.

**Precipitation**: Water falling in a liquid or solid state from the sky to the earth. Examples include rain, snow and hail.

**Saturated Zone**: An underground layer in which every fracture or space is filled with water.

**Septic Tank**: the container part of a home or business waste disposal system that receives the waste pumped from the building. Bacteria break down the solids, and the liquids move on to the leach field. Tanks periodically need to be pumped out.

**Surface Water**: Water from precipitation that does not soak into the ground. It is stored in water bodies such as creeks, streams, rivers, lakes, wetlands, reservoirs and oceans.

**Unsaturated Zone**: An underground area that contains both air and water in the fractures or spaces and is not filled to capacity with ground water.

**Water Table**: The upper limit of a ground water source. It separates the saturated and unsaturated zones.