# Zones of water in the ground

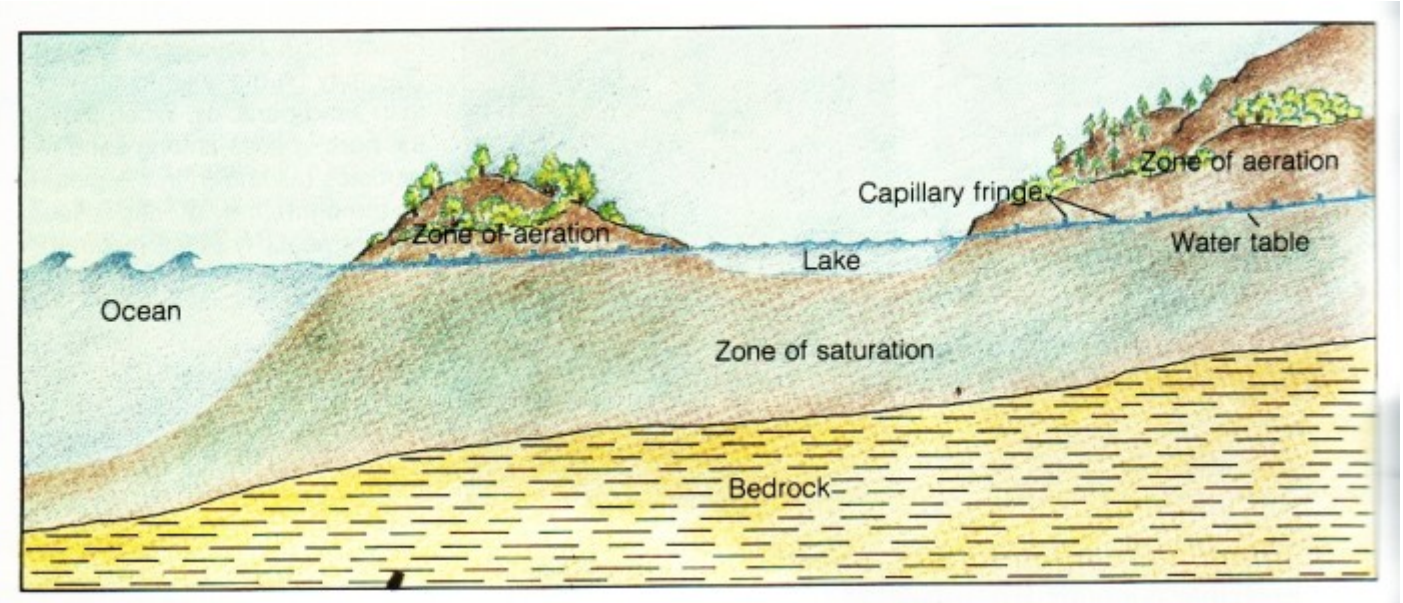


Figure 7-14. In the zone of saturation, the pore spaces are filled with water. What do the pore spaces in the zone of aeration contain?

The water that infiltrates the earth's surface becomes part of the huge supply of water stored in the ground. It is called ground water. Gravity acts on ground water, pulling it downward through the pore spaces, cracks, and other openings tithe ground.

The amount of water in soil often varies, depending on the depth of the soil below the surface. After a rain has soaked into the ground, the layer of soil near the surface is usually moist. but not soaking wet. Most of the rainwater has passed down through the pore spaces of this layer and is in a lower layer of soil. But some water does remain behind, clinging to the soil panicles at or near the surface. This layer of the soil is known as the zone of aeration (see Figure 7-14) because the pore spaces in this layer contain air as well as water.

Water clings to soil particles in the zone of aeration because water molecules are attracted to many other kinds of molecules. This attraction of water molecules to other kinds of molecules is called adhesion. It is this process of adhesion that keeps the soil in the zone of aeration damp long after it rains.

As long as the ground is permeable, gravity continues to pull ground water deeper into the earth. But at some point the ground water reaches a layer of soil or rock that is impermeable, or not (im-) permeable. It allows no water to pass through, This is known as the impermeable layer.

Once the descending ground water hits an impermeable layer (the bedrock in Figure 7-14), it begins to collect there. Ground water will fill up the pore spaces above the impermeable layer. As the pore spaces fill with water, the soil or permeable rock becomes saturated. This saturated layer of soil or permeable rock is known as the zone of saturation.

If you pour 10 ml of water into a cylinder containing 50 mL of sand, some of the water will gradually sink to the bottom of the cylinder, which is impermeable. Some of the water will adhere to the sand, making it damp. The descending water will then form a zone of saturation. After all water has descended to the zone of saturation, there will be a boundary where the water-filled zone of saturation meets the layer of particles above it. This boundary, which is the top of the zone of saturation, is called the water table.

Some water in the soil moves upward, against the downward pull of gravity. This upward movement of water in soil is called capillary action. You have probably seen examples of capillary action, but never realized what it was. Have you ever seen water soaked up by a sponge, a piece of paper toweling, or a blotter? If you have, then you have observed capillary action. You can observe capillary action at home by taking a small amount of water, placing the end of a paper to^'el in the water, and watching what happens.

Capillary action is caused by cohesion and adhesion. Cohesion is the attraction of one molecule to another molecule of [he same kind. Adhesion, as already mentioned, is the attraction of one molecule to a molecule of a

different kind. By the process of adhesion, water molecules at the top of the water table are attracted to molecules of the soil particles above. rhen, when water molecules have attached themselves to molecules of soil particles, they attract other water molecules to themselves by the process of cohesion.

In soil, these forces of adhesion and cohesion lift a little water ipward from the zone of saturation to an area called the capillary fringe, which is just above the water table. (See Figure 7-14).

The damp soil in the zone of aeration receives its moisture from water that infiltrates down from the surface. The soil particles in the capillary fringe get their moisture from the zone of saturation by capillary action. If the pore spaces in the capillary fringe are small, the water will rise higher than if the pore spaces are large. The height of the capillary fringe ranges from about 2.5 cm or less in sands and gravels to as much as 60 cm or more in silty soils

# Check yourself

1. What is found in the pore spaces in the zone of aeration? in the capillary fringe? in the zone of saturation?
2. Describe what happens as a result of adhesion and cohesion in the capillary fringe.