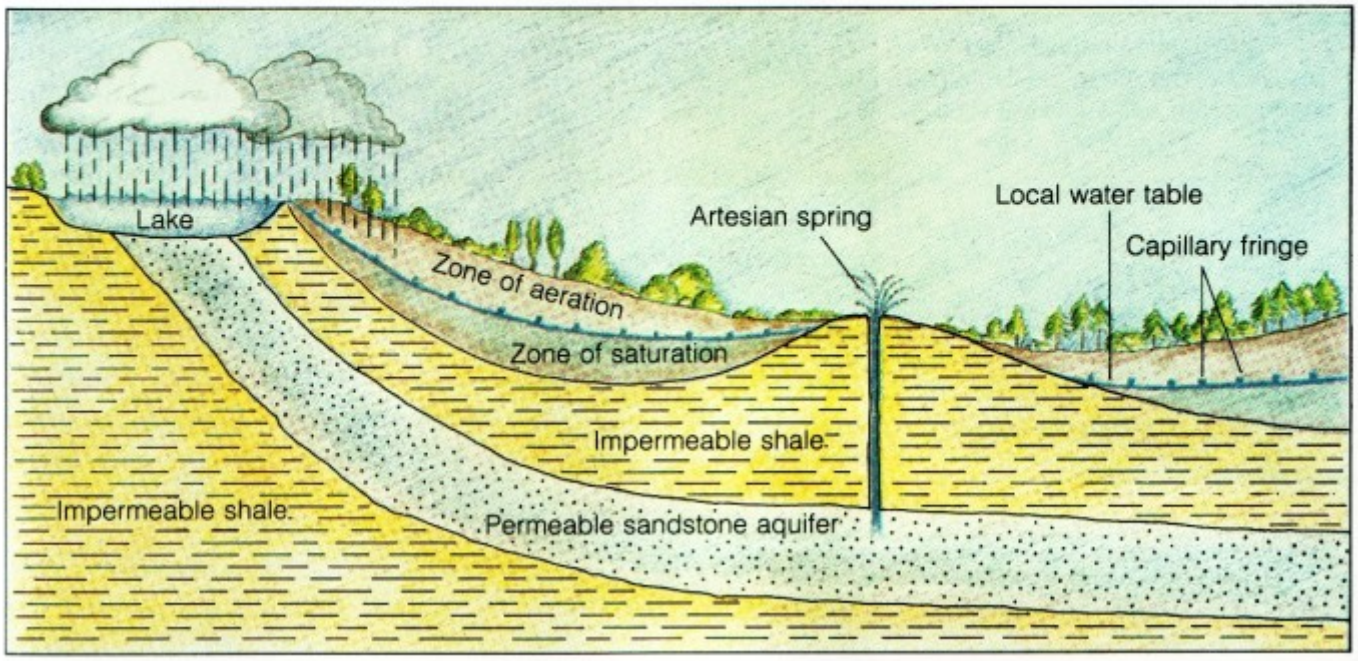

Figure 7-15. Why is the middle layer of rock in an artesian system called an aquifer?

Artesian systems. There is a type of spring that is not fed by water from the local water table. In the states of Kansas, Nebraska, Texas, North Dakota, and South Dakota, there is very little annual rain and snow to supply underground water. Yet this Great Plains region has a good water supply. Where does the water come from?

Beneath this Great Plains region and extending westward to the Rocky Mountains there is a special arrangement of underground rock layers. It is made up of three layers of rock. A middle layer of permeable rock passes between two layers of impermeable rock. This combination of rock layers is called an **artesian system.** A simple artesian system is shown in Figure 7-15. In an artesian system, the middle layer of rock is permeable. Because water passes through this layer, it is called an **aquifer.** The word *aquifer* comes from two Latin words that mean "to carry water." Aquifers are often layers of sandstone or gravel.

Water traveling through an aquifer travels through very small pore spaces in rock. Travel is therefore slow. Depending on the length of the aquifer, it may take hundreds and even thousands of years for water to travel the full length of the aquifer.

Library research

Prepare a report on artesian wells and/or the mining of water from deep in the earth. In what areas of the world is water stored deep in aquifers? (Some water dates back to the Ice Ages.) What is the danger of entering such aquifers in search of water?

The top and bottom layers of an artesian system are impermeable. These two layers of impermeable rock, between which the aquifer passes, prevent water from leaving the aquifer once the water enters it. Shale, a rock formed from particles of clay and silt, is practically impermeable. Shale is commonly found in artesian sytems.

The collecting area of an artesian system can be very far away. In the case of the sandstone aquifer (known as the Dakota sandstone) that brings water to the Great Plains, the collecting area is in the Rocky Mountains. Much of the water that enters the aquifer in the Rocky Mountains is from the snow that melts in the springtime. The water is very cool and pure.

Artesian springs. The water that enters the aquifer in the Rocky Mountains is at much higher levels than the Great Plains. The water flows downward through the aquifer because of the force of gravity. This downward flow and the weight of the water force the water in the aquifer to the surface wherever there is a crack or break in the layer of impermeable rock above the aquifer. The flow of water from an aquifer is called an **artesian spring.** Due to pressure in the aquifer, water from an artesian spring sometimes gushes up above the surface like a fountain.

What is an artesian spring?

Geysers. Sometimes water erupts from the earth in a spectacular way. In areas of volcanic activity, ground water may sink to great depths through very deep cracks. Here it is heated by hot magma or by hot igneous rocks. Because the pressure is much greater at these depths, the boiling point of water is raised well above 100°C. Suddenly, the superheated water changes to steam that forces the water resting on it out through openings in the rock above. Such a feature where water and steam are erupted out of the earth's surface is called a **geyser.**

Geysers can be found in New Zealand, Iceland, and Yellowstone National Park in Wyoming. One of the best known geysers is Old Faithful in Yellowstone National Park, which sends about 40 kL of water as high as 45 m into the air with each eruption. Old Faithful got its name because the time of each eruption used to be fairly predictable, erupting about once

Figure 7-16. A geyser is a spring of hot water and steam that gushes out of the ground. Where does the water in a geyser obtain its heat?

every 65 minutes. Most geysers, however, are very irregular in the time of their eruptions.

Check yourself

1. What causes an artesian spring to gush up out of the ground? Draw a diagram that shows this.
2. Compare an artesian spring and a geyser. How are they similar? How are they different?

Library research

Find out how the flow of streams is measured. Explain these techniques to the class. How is the speed and volume measured? Why would a scientist want to know this information?