
**Exploring Aquifers Introduction:
“Exploring Aquifers”**

Academic Question: What is groundwater?
Where are the major Texas aquifers located?
Why are these aquifers located where they are?

Objective(s):

- To identify the location of 9 major aquifers in Texas

Key Terms: substrate, porosity, permeability, groundwater, zone of saturation, water table, and dissolution

[Click here for definitions to Exploring Aquifers vocabulary.](#)

Process (Activities):

1. Before you begin this lesson you will need the following supplies. (Note: These materials will be used throughout the different lessons.):
 - A large road map of Texas
 - A map of the major and minor aquifers of Texas and a geologic map of Texas. You can find these maps online at the University of Texas Online Library website.
Major Aquifers map: <http://www.lib.utexas.edu/Libs/GEO/Major.gif>
Minor Aquifers map: <http://www.lib.utexas.edu/Libs/GEO/Minor.jpg>
Texas Geologic map: <http://www.lib.utexas.edu/geo/texas92a.jpg>
 - Large beakers or two liter plastic bottles cut in half (three per group)
 - Graduated cylinders (one per group)
 - At least three different types of substrate, such as sand, clay, and gravel
 - Food coloring (optional)
2. Introduce the “Exploring Aquifers” activities by asking the following questions:
“Where does our drinking water come from?”
“Does our drinking water come from a groundwater or surface water source?”

Allow students enough time to research these questions. Depending on the geographic distribution of your students, there may be several correct answers to these questions. If you are having difficulty answering these questions contact your local water utilities. Once the students can appreciate their source of drinking water, they are ready to explore the different sources of drinking water in the state of Texas.

3. Explain to students that Texas relies on two sources of drinking water: groundwater and surface water. First, ask students to review a standard road map of Texas to identify 10 above ground sources of water. Second, ask students to review maps of the major and minor aquifers of Texas. Have students estimate the percentage of drinking water from surface water and the percentage of people that rely on groundwater for their drinking water. (Answer: Approximately 51% of Texans rely on groundwater as their source of fresh drinking water.)

4. Allow students to explore the concept of groundwater by conducting the following groundwater experiment. Before students begin the experiment, share the following background information:

Each day Texans use 7,000 to 15,000 million gallons of groundwater. So what is Groundwater? Groundwater is water that is found underground in cracks and spaces in soil, sand, and rocks. The area where water fills these spaces is called the saturated zone. The top of this zone is called the water table. The water table may be found only a foot below the ground's surface or it may be hundreds of feet down. Why is there groundwater? The presence of groundwater in the Earth is caused two main factors. The first is gravity. Gravity pulls water toward the center of the Earth. That means that water on the surface will try to seep into the ground below it. The second reason is the geology under the surface of the Earth. The rock below the Earth's surface is the bedrock, and is referred to as substrate.

Present the student with the different types of substrate. Ask them to predict which material will hold more water. Ask students to test their hypothesis using the following steps:

- a. Fill three beakers three fourths full of a different substrate.
- b. Pour a measured amount of water into each beaker. You might allow students to add a small amount of red or blue food coloring so that they can see the water movements and locate the water table.
- c. Continue pouring water into each beaker until the water table is at the surface of the substrate. Be sure to keep a running total of the amount of water poured into each beaker.

Product/Application: Ask students to record their findings and discuss the following questions: Did the substrate that held the most water also allow the water to seep in quickly. Why or why not? What characteristics of the substrate are most important in order to hold large amounts of water?

After students have recorded and discussed their findings, share the following explanation about groundwater and aquifers.

The ability of the substrate to allow water to pass through it is called permeability. The size of the particle and the density of the substrate influence the porosity and permeability of the rock. Some substrates, such as granite, consist of very dense material. Even gravity would have a hard time pulling water downward into this type of rock. But Earth's layers also consist of less dense, porous rock, such as gravel, sand, sandstone, and limestone. These substrates have varying amounts of spaces in them. Gravity pulls water into these spaces.

Gravity doesn't pull water all the way to the center of the Earth. There are rock layers made of dense material, such as granite, or material that water has a hard time penetrating, such as clay. These layers may be underneath the porous rock layers and, thus, act as an impermeable layer to prevent the water from sinking deeper into the Earth. Since water cannot go any deeper, it pools in the porous layers. These underground storages of groundwater are called aquifers.

Texas is served by 9 major and 20 minor aquifers. Some, like the Edwards Aquifer, have crevices and caverns formed by the dissolution of the limestone base over time. Other types of aquifers contains sand and gravel layers. Other aquifer types are formed by cracks and fractures that develop in harder formations like granite. Aquifer waters are used for drinking and crop irrigation. Aquifers are very important in Texas, where the average rainfall diminishes away from the coast. These 29 different aquifers in Texas supply Texans with about 51% of all the water they use each year. About 80% of Texas land is on top of an aquifer, although not all people living on top of an aquifer use the aquifer as a source of drinking water. Austin, Texas is a good example. Austin sits on top of the Barton Springs segment of the Edwards Aquifer's middle segment, yet it relies on the surface water of the Colorado as the city's source of water.

Assessment/Evaluation: Allow students to once again look at the maps of the major and minor aquifers and the geologic map of Texas. Ask students to discuss the relationship between geology and the location of these aquifers. (Students should immediately discover that the aquifers follow major geologic formations.) Have the students record the geology of the areas where the aquifers are located. If time permits, students can research the different formations to determine the composition of the bedrock. As an extension activity for older students, ask the students to explore the geologic history of Texas and how this history has contributed to the formations of aquifers around the state.

Resources:

Cyberways and Waterways website has links to several good resources on Aquifers and Recharge Zones at:

<http://www.cyberwaysandwaterways.com/en/realWorldIssues/issues/index.xml>

In addition, on the Cyberways and Waterways website, check out Exploring Aquifers Helpful Web Links at:

<http://www.cyberwaysandwaterways.com/en/tryThisAtHome/aquifercurric.xml>

Texas water development board "Texas Aquifer Maps" allows students to see city boundaries and county boundaries overlaying the aquifers:

http://www.twdb.state.tx.us/mapandphotos/mp_twdbmaps/aquifer_maps/aquifersindex.htm

The USGS Aquifer Basics web pages contain very helpful information about the rock types found in principal aquifers:

<http://capp.water.usgs.gov/aquiferBasics/index.html>

The USGS Ground Water web pages include information on how groundwater occurs, the quality of groundwater, and the nation's groundwater resources:

http://capp.water.usgs.gov/GIP/gw_gip/index.html

The USGA description of the major and minor aquifers in Texas:

http://sr6capp.er.usgs.gov/gwa/ch_e/E-text10.html

The Bureau of Economic Geology of the University of Texas has very inexpensive maps of Texas Geology, River Basins, Land Resources of Texas, Energy Resources, Mineral Resources, Geological Highway Map, and a Structure Map of the San Antonio Segment

of the Edwards Aquifer and Balcones Fault Zone. For further information or to order, please contact Publications Sales Office at 1-888-839-4365 or (512) 471-7144.

Time Frame: Two 45-minute class periods.

Grade Level: 6th- 12th

TEKS Correlation:

Science

Grade 6 6.1, 6.2, 6.3, 6.4, 6.14

Grade 7 7.1, 7.2, 7.3, 7.4

Grade 8 8.1, 8.2, 8.3, 8.4

Aquatic Science 4.B

Environmental Science 5.A,B,C,E,F

Geology, Meteorology, and Oceanography 10.A,B,C

Mathematics

Grade 6: 6.1, 6.8, 6.11, 6.13

Grade 7: 7.9

Social Studies

Grade 6: 6.21, 6.22, 6.23

Grade 7: 7.8, 7.9, 7.21, 7.22, 7.23

Grade 8: 8.10, 8.30, 8.31, 8.32

English

Grade 6: 6.1, 6.2, 6.5, 6.13, 6.17, 6.20, 6.22, 6/24

Grade 7: 7.1, 7.2, 7.5, 7.13, 7.17, 7.20, 7.22, 7.24

Grade 8: 8.1, 8.2, 8.5, 8.7, 8.10, 8.13, 8.17, 8.18, 8.20, 8.22, 8.24

English I: 1, 4, 6, 8, 13, 15, 16, 21

English II: 1, 4, 6, 7, 8, 13, 15, 16, 21