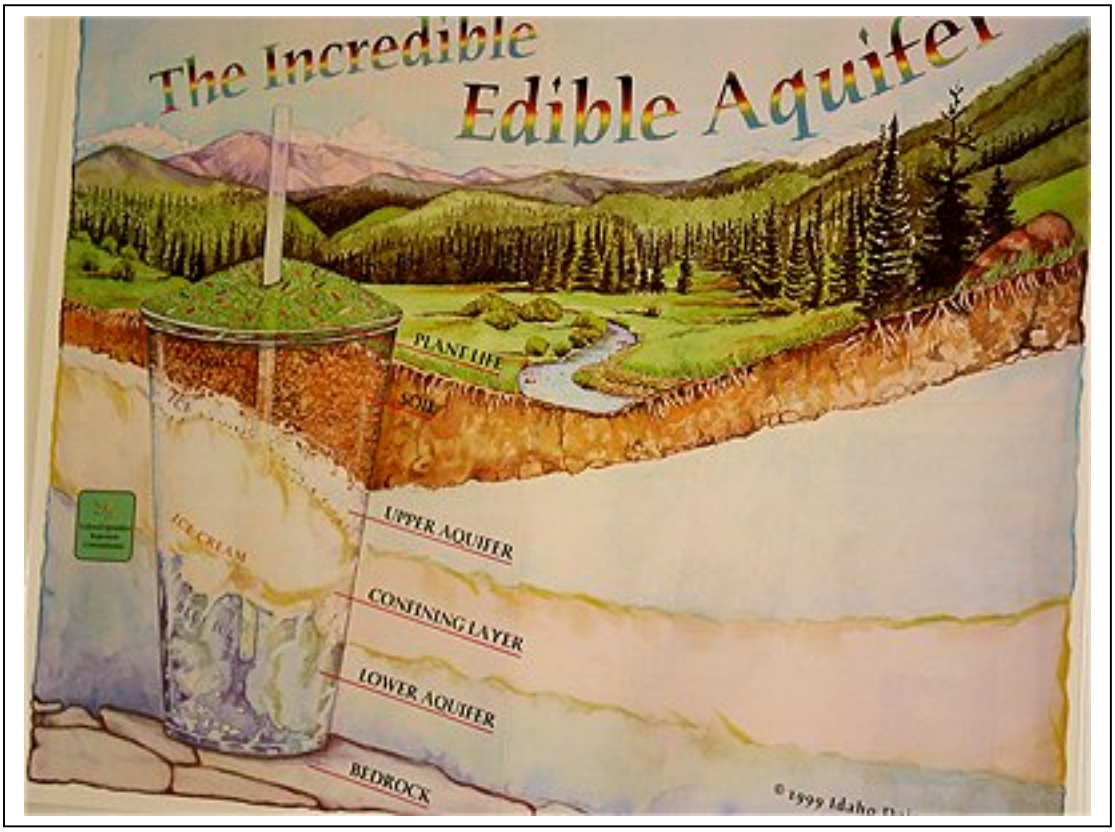
The Incredible, Edible Aquifer

Adapted from the Orange County Water District



Background:

On a hot summer day, Austinites flock to the soothing, cool water of Barton Springs. The three-acre pool, known as Austin's "crown jewel," receives over 350,000 visitors per year and sustains unique species like the endangered Barton Springs salamander. In addition to being a recreational institution, Barton Springs is the fourth largest spring in Texas and the major discharge point for the Barton Springs segment of the Edwards Aquifer.

The Edwards Aquifer is the sole source of water for more than 1.7 million people in central Texas. The Edwards is divided into three subregions that are hydrologically distinct and separated by groundwater divides: the northern Edwards, the Barton Springs segment, and the San Antonio segment. The northern Edwards extends from the Colorado River in Austin to Bell County. The Barton Springs segment is located between the Colorado River and a groundwater divide near the City of Kyle in Hays County. The San Antonio segment extends from the groundwater divide near Kyle to Del Rio in Kinney County. Major outflows in the San Antonio segment include three of the most significant springs in Texas: Comal, Hueco, and San Marcos Springs.

The story of the Edwards Aquifer began around 100 million years ago when a warm, shallow sea covered most of Texas. This sea contained marine creatures similar to today's coral and shellfish. When these creatures died, their skeletons accumulated with other sediments and were compacted, buried, and eventually hardened into what are now the various limestones of Central Texas, including the Edwards limestone. Millions of years later, faulting and subsequent erosion exposed these hidden rock layers at the land's surface and created cracks where water could enter the Edwards limestone. Over time, dissolution and additional erosion enlarged the cracks into caves and conduits capable of transmitting water very quickly.

Much of the water that fills the Barton Springs segment starts out in the rolling hills west of Austin. During heavy rains, the shallow soils of the area quickly reach their saturation point, and the rain begins to run off and flow downhill into smaller creeks that eventually flow into larger contributing waterways like Barton Creeks and Onion Creek. These contributing waterways flow east until water reaches the exposed Edwards limestone of the recharge zone. Here water enters into the aquifer through infiltration and recharge features like caves and sinkholes. Further east, the Edwards limestone dips below the surface, and groundwater becomes "confined" by overlying layers of less permeable chalk, shale, and limestone. This area is known as the artesian zone, and groundwater generally flows to the northeast until it emerges at Barton Springs or Cold Springs.

However, not all the water destined for Barton Springs will reach it; over 50,000 people depend on the Barton Springs segment of the Edwards Aquifer for their sole source of water. An ever-growing number of private residences and public supply companies use water derived from wells drilled into the Edwards limestone.

The health of Barton Springs is tied to the quality of water entering the aquifer. Growing urbanization in the contributing and recharge zones has led to increases in sedimentation, fertilizers, pesticides, herbicides, and other contaminants that can threaten water quality. Because water moves through the aquifer very rapidly (as fast as 4 to 7 miles per day), there is little time for these contaminants to break down. In addition, increased use of the aquifer (high rates of pumping), especially during a drought, threatens spring flow unless the aquifer is responsibly managed.

For more information on Barton Springs and the Edwards Aquifer and what you can do to protect them, please visit the following websites:

The Barton Springs/ Edwards Aquifer Conservation District
www.bseacd.org

The City of Austin: Barton Springs Pool

http://www.ci.austin.tx.us/parks/bartonsprings.htm

The Edwards Aquifer Authority:
http://www.edwardsaquifer.org

University of Texas – Environmental Science Institute (Archived Webcast)
http://www.esi.utexas.edu/outreach/ols/lectures/Mahler/

The United States Geological Survey:
http://capp.water.usgs.gov/gwa/ch_e/E-text8.html

Edible Aquifer Activity from
www.deq.state.id.us/water/educ_tools/edible_aquifer_lp.pdf

Rocks of the Austin Area:
http://www.lib.utexas.edu/geo/ggtc/ch2.html

Materials (for a class of 25):

- 1 Clear plastic cup per student (12 oz. or 16 oz.)
- Vanilla ice cream (1 gallon will work per class)
- Crushed graham crackers
- Ice cubes (3 or 4 per student)
- 4 liters of 7-Up
- Green and brown cake sprinkles
- 1 butter knife
- 1 straw for each student

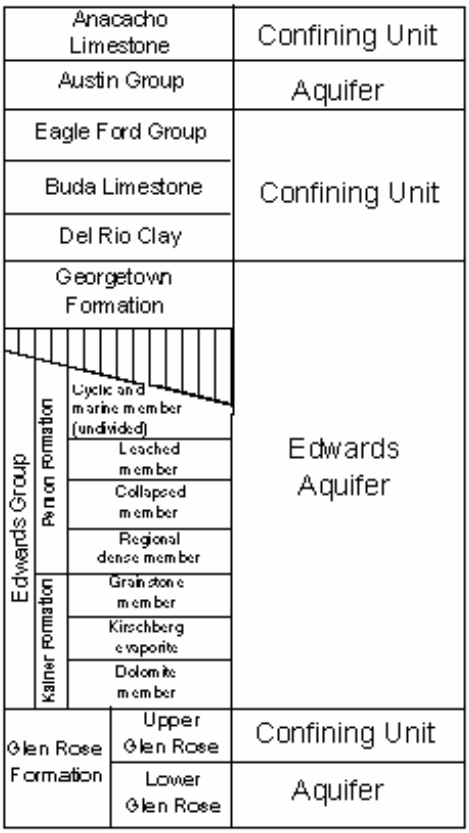
(Note: Teachers, please try this activity at home with several different ingredients. You will quickly find what works for you or you might even hit upon a better ingredient to illustrate a rock layer.)

Before the Activity:

Review with your students:

- Where do we get our drinking water? City of Austin residents get their water from the Colorado River. Barton Springs flows into Barton Creek, which empties into the Colorado River at Town Lake. However, some Hays County residents have wells in the Edwards.
- What is the difference between groundwater and surface water?
- What is an aquifer? Name two aquifers in your area.
- How does water get back into aquifers? How does water get out of aquifers?

Procedure:



1. Pass out a cup to each student.

2. Have each student cover the bottom of his or her cup with a layer of an "impermeable" substance like crushed ice or graham crackers. (It will be difficult to find anything that won't leak at all, but try to use something that won't show the water layer if water leaks into it later.) This represents the Glen Rose limestone under the Edwards. Ask the students what it means to be confined? This layer is a confining layer for the Edwards Aquifer.

3. Next add a substance that will be permeable, like blocks of ice. If possible, show an example of porous rock. What do the students notice about the rock and the ice? Where did the rock go that was dissolved out of the holes? This layer of ice represents the Edwards limestone.

4. Next, have your students add confining layers over the "Edwards limestone". These layers can be ice cream, graham crackers, and/or sprinkles. These layers represent Del Rio Clay, Buda limestone, and Eagle Ford.

5. Now that their aquifers are complete, ask the students what is missing. Water, of course! Ask them how rainwater gets into the aquifer. Show pictures of caves, sinkholes, and faulting. Have an adult walk around the room and make a "sinkhole" down into each student's "aquifer" with a butter knife. Next, have an adult come around and "rain" some water (7-up soda) into each "sinkhole".

6. Ask students how water gets out of the aquifer. Show some pictures of springs and wells. Hand each student a straw to serve as his or her "well". Have the students "drill" their wells straight down into the "aquifer". Now have them "pump" or drink water from their "aquifer".

7. Now that their aquifers are dry, ask them how they might recharge their aquifers. Before passing around more “rainwater” (7-Up soda), have the students add some dry, colored Kool-Aid to the surface of their aquifers. Let the students know that the Kool-Aid represents pollution. Ask the students to brainstorm some different things that could pollute their “aquifers”.

8. Next, have an adult rain 7-up into each student’s cup again. Talk about the dissolution of the Kool-Aid and see if it makes its way down into the “wells”.

9. At about this point, the aquifers will begin to melt. Have your students enjoy eating their “aquifers”.

After the Activity:

Review with your students:

- What results surprised you?
- Did your neighbor’s aquifer look like yours? Did it behave the same way?
- Do you think aquifers can experience drought?
- What do you think might happen if you insert more straws (or pumps) into your aquifer?
- How do you think we can clean up an aquifer once it has been contaminated?
- What can we do around the house to cut back on aquifer contamination?
- What can we do around the house to cut back on water use?