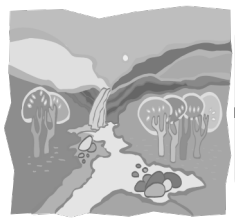


LBJWC - Sinkhole Lesson

Concept
Caves and sinkholes are major openings in the ground that recharge water to the Edwards Aquifer.

Objective - Students will:
1) identify a sinkhole, cave, fracture, fault, recharge zone, stalactite, stalagmite, Edwards Aquifer, spring, dye trace, well, karstic limestone and aquifer;
2) explain how surface water travels into the Edwards Aquifer through Recharge Features and discharges at springs.

Time 45 minute session

Materials: Earth Camp Assistant will provide materials
- Karst model
- Poster of dye trace
    1. Karstic rock (found on the trail)
    2. Calcite mineral (found on the trail)
- Teaching Photos

Vocabulary:
Sinkhole - A sinkhole is a large, bowl-shaped depression that forms on the surface when rock layers below the surface have collapsed. The bowl collects rainwater and drains underground through holes in the sink to the cave passages of the aquifer.
Recharge zone – area of land where the openings in the aquifer are at the surface, allowing rainwater runoff to drain into the aquifer below
Cave – a natural opening in the limestone big enough for a person to enter. Caves drain water into the aquifer.
Stalactite – a cave formation that looks like an icicle on the ceiling of a cave, formed by dripping water
Stalagmite – a cave formation that looks like a stalactite, but is on the floor of the cave, formed by dripping water
Fracture – a large crack in the underground rock
Fault – a large break and shift in the underground rock layers, usually caused by an earthquake
Edwards Aquifer – an underground system of limestone caves full of water
Spring – an opening on the surface where water discharges from the aquifer
Dye trace – a scientific study by hydrogeologists to determine the flow routes and times of underground water
Well - a man-made opening drilled into the aquifer that produces water
Limestone – a rock formed by the sand and seashells from a sea that was present in Austin 75 million years ago; limestone is the rock that forms the Edwards Aquifer
Groundwater – water that flows underground
Karstic limestone – limestone with holes dissolved in it

Preparation: Review map to the sinkhole

LESSON: Sinkhole

INTRODUCTION: While walking the path to the sinkhole:

Karstic limestone: Stop by examples of karstic limestone. You can tell you are in the recharge zone of the Edwards Aquifer when you see karstic limestone occurring naturally on the surface of the land. Water dissolves holes in the rock and flows into the Edwards Aquifer. One way geologists identify the recharge zone of the Edwards Aquifer is by identifying karstic limestone. Find examples of karstic limestone as you make your way to the sinkhole.

Investigating calcite: Show students the calcite crystals in a limestone rock along the trail. During the time of the shallow, prehistoric ocean that covered this area, shells and sand accumulated on the ocean floor. Over millions of years, the ocean floor turned into limestone. Limestone, a sedimentary rock, is composed of sand, seashells and the mineral calcite. Holes develop in the rock because the limestone is dissolved by slightly acidic rain water. The most common acid involved in karstification is carbonic acid, which typically forms by combining carbon dioxide with water. The calcite is redeposited by water in a more pure form, thus forming crystals. Crystals are more geologic evidence that water is traveling through the rocks in this area.

TEKS CONNECTION: The calcite in limestone is a mineral that dissolves in water. Think of sugar dissolving in water. If you let the water evaporate from the sugar water, you will have sugar crystals formed. Calcite forms crystals underground when it separates from the water.

SINKHOLE PROCEDURE

1. Sinkhole: A sinkhole is a large, bowl-shaped depression that has natural openings that drain water into the cave passages of the aquifer. They are formed where a cave ceiling collapses and the rock and soils fall into the cave passage or when closely spaced cracks underneath the rock enlarge or join together. Sinkholes can sometimes be spotted in creekbeds at the point where all of the flow in the creek sinks into the ground. Look around you and define the land that might drain water into this sinkhole. Go into this sinkhole and find the drain holes. Define the rim of the sinkhole (limestone boulders).

2. Edwards Aquifer: This sinkhole is an opening into the Edwards Aquifer. The Edwards Aquifer is a limestone system of caves and smaller passages which are full of water that flows underground and resurfaces at springs.

3.

4. Dye Trace: Show the map of the dye trace study.

Scientists know that water that enters this sinkhole flows to Barton Springs. Hydrogeologists inject non-toxic dye into caves and sinkholes in the recharge zone to determine flow paths and rates of groundwater flow. They put receptors in various wells and springs throughout the area to detect the dye.

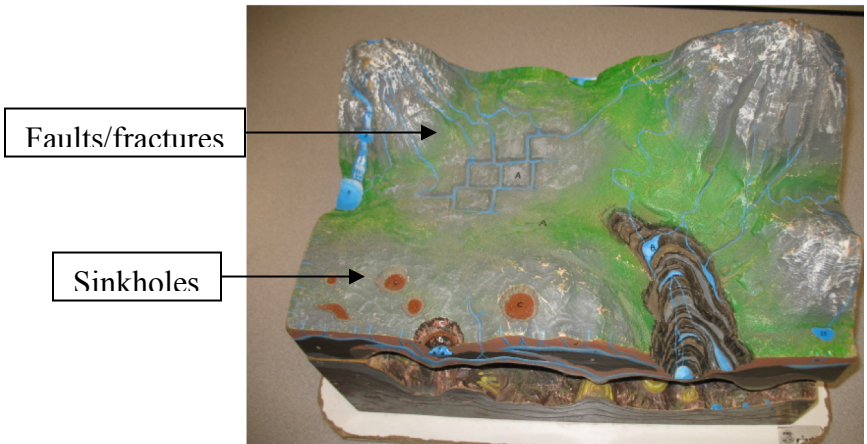
Point out the injection points at recharge features, detection of dye at wells along the flowpath and discharge at springs. Point out the injection point closest to the Wildflower Center, and discuss which spring it flows to and how fast it flows.

Scientist also discovered from the dye trace that water moves EXTREMELY fast through the Aquifer, in hours or days. In sand and gravel aquifers, water moves 1 mile in 1 year. In the Barton Springs portion of the Edwards Aquifer water can move 1 mile in 1 day!"

EXTENSION - Sinkhole Drawing: Use the whiteboards and markers to have students draw their understanding of a sinkhole and how water flows off the land into the aquifer. Discuss elements of their drawings that depict the process.

USE THE KARST MODEL FOR 3 -7

5. Sinkhole, Recharge and Cave . Locate the sinkholes on the model. Point to C and D for an example of an upland sinkhole and I for a cross-section of a sinkhole in a creek. Sinkholes collect rainwater runoff from the land surface and channel it into the underground cave system we call the aquifer. This process is called recharge. A cave is a type of sinkhole that is large enough for a person to enter.



6. Fracture, Fault. Point out fractures and faults in the model. Fractures are cracks in the rocks, and faults are where layers of rock have broken and shifted (usually the result of an earthquake). These openings also drain water into the aquifer.

7. Recharge Zone. The entire land area with sinkholes, caves, fractures and faults that lead to the aquifer is called the Recharge Zone. The water in creeks flowing across the Recharge Zone drains down into the aquifer through openings on the surface.

8. Aquifer, Groundwater: Point out the cave stream in the model. Groundwater in an aquifer is the water that is moving through the system of caves and passages that form the Aquifer underground. Groundwater can travel very quickly through the large openings of the cave.

9. Stalactite, Stalagmite: Point out the stalactites and stalagmites on the model. Inside a cave, water dripping through fractures in the ceiling can form stalactites that hang from the ceiling or stalagmites that grow up from the floor. If a stalactite meets a stalagmite, it forms a column.

10. Spring: Groundwater flows through the cave system of the Edwards Aquifer towards Barton Springs. A spring is the discharge point where the water comes to the surface again

11. Well: Some people drill a well from the surface of the land down into the water underground and pump it up for drinking

12. Human Impact: Understanding that anything on the ground or in the creeks in the recharge zone can quickly get into the groundwater and move towards Barton Springs can help you make better choices for cleaner water. Picking up litter AND PLANTING NATIVE PLANTS helps reduce polluted runoff.

Final Summary: Water flowing into this sinkhole and Wildflower Cave goes to Barton Springs. Think about this connection when you visit Barton Springs.