



Post-festival Lesson 5 – Groundwater Connection Lesson Plan

Investigative Question:

- How does groundwater fit within the Arizona Water Cycle?
- What is the relationship between groundwater and surface water?

Summary: Students review what they learned about groundwater at the water festival and then dive deeper into how Arizona depends on groundwater. Learning more about wells and what happens when we over pump the aquifer, students explore the changes people can make to the groundwater system and our environments. Understanding the connection between groundwater and surface water along with realizing that groundwater is an integral part of our Arizona water cycle, helps students want to become groundwater guardians.

Reference: adapted from "San Pedro Connection," *Arizona Conserve Water Educator's Guide*, 2007, pg. 71-90 and staff created materials.

Time Frame: 50 minutes

Cross Cutting Concepts Demonstrated:

- cause and effect
- systems and system models
- stability and change

Science and Engineering Practices Integrated:

- analyze and interpret data
- engage in argument from evidence
- ask questions and define problems
- construct explanations

Materials Needed:

- [Arizona Groundwater Videos](#)
- [Groundwater Diagram Worksheet](#)

PowerPoint Files: [AWF Unit Slides Lesson 5](#)



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Warm Up:

Use the slides above to introduce some new facts for this lesson and review with your class what they learned about groundwater at the water festival.

1. Groundwater is the largest source of fresh water on Earth – it's kind of a big deal! In fact, there is over a thousand times more water in the ground than there is in all the world's rivers and lakes.
2. Most of Arizona's water supply comes from groundwater – 41%.
3. Ask: **What does groundwater begin as again?** Where does it come from? Precipitation (snow or rain). Then it runs off the land until it can find places to soak down through materials or adds to surface water.
4. Have students write in their notebooks **what is groundwater** – water in the ground that fully saturates or fills up the pores or cracks in soils, sand and rocks. Can they draw a picture of it?
5. **How do we get to and use groundwater?** We use **wells** to pump it up.
6. If you live in Arizona then you are probably using groundwater! But do different places in Arizona have different amounts of groundwater? Yes, just like surface water, groundwater is not distributed equally over the state.
7. **Can we just keep pumping and taking all the groundwater that we want? Why or why not?**
8. Pumping groundwater at a faster rate than it can be recharged can have some negative effects on the environment and the people who use that water. We call this **overdraft**.
 - a. **Lowering the water table** – the level below which the ground is saturated with water can be lowered. This can cause shallow wells to dry up and forcing others to dig deeper.
 - b. We also learned at the festival that if we over pump and take too much groundwater, it can **reduce the amount of water in our streams, rivers and lakes** and even cause them to dry up.
 - c. We can also cause damage to the land in the form of **sink holes, fissures, and land subsidence**. When land subsides, it loses its capacity to hold groundwater in the future.
9. What did the state of Arizona do to help control the use of groundwater? We passed the **1980 Groundwater Management Act**. It created Active Management Areas (AMAs), which introduced regulation and conservation measures in parts of the state with a history of heavy reliance on groundwater.
10. Phoenix and Tucson are both trying to achieve **safe-yield** – which means the amount being taken is the same amount being replaced annually... they are still working on this. Cities do this by **recharging** the aquifer. We usually use surface water to do this which normally comes from CAP (or the Colorado River).
11. We have made improvements, **but there is still work to do**. In the 1950s approximately 70% of the water used in Arizona was groundwater and today it is only about 41%, but if we keep having droughts this can become a challenge.



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Lesson Sequence:



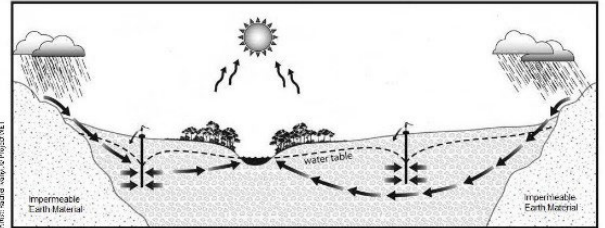
Activity: [Watch groundwater videos](#) at least episodes 1 & 2



Exploration:

Pass out the Groundwater Diagram handout and have students work in small groups to label with words and arrows with as many parts and processes as they can.

They shouldn't forget the water cycle since groundwater is a part of the water cycle. You can print a blank copy from [here](#).



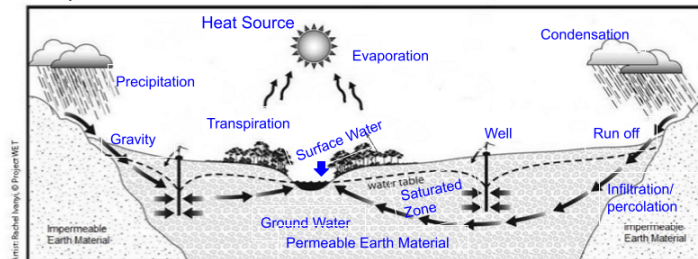
Cross-section illustration of aquifer (looking south) and hydrologic cycle in the San Pedro River with pumping.

Review as a class by first asking: **What do you see? What are the parts and processes you labeled?**

Ideas should include in any order:

- Rain in the mountains.
- Runoff from the mountains enters the ground at the mountain-front recharge area.
- Groundwater moves towards the low point in the land surface.
- **Do you see the dashed line labeled water table? What is that?** The water table is the top surface of the groundwater, or the top of where the ground is fully saturated.
- **What happens where the water table crosses the surface?** There is surface water, river, lake or pond water.
- Wells pump water from the ground. **What happens to the water table when groundwater is pumped?** If we pump too much it can cause the water table to drop.
- What process do you think the arrows pointing up represent? Evaporation
- **What do you think caused water to evaporate?** The heat from the sun.

Step 1: Select a spokesperson for your group reporting. Label with words and arrows as many parts and processes as you can.



Cross-section illustration of aquifer (looking south) and hydrologic cycle in the San Pedro River with pumping.

Step 2: Discuss these questions in your group.

What is the dashed line labeled water table? **It is the top surface of the groundwater, saturated vs. unsaturated zone**

What happens where the water table crosses the surface? **Surface water - lake, river, pond.**

What happens to the water table when groundwater is pumped? (label or represent it on your diagram)

What are the relationships between the groundwater system and the water cycle? **All connected**



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Ask: what are the relationships between the groundwater system and the water cycle?

Groundwater is part of the water cycle because its water connects to the other natural places with water, such as lakes and soil. Groundwater is a source of water that can move throughout the water cycle.

Wrap-up:

Ask students: **What have you learned about the relationships between groundwater and surface water?** They are connected. Over-use of the groundwater can impact the river and the wells that supply people water in the watershed. **How does drought, which is a natural occurrence in the Southwest, affect the availability of surface (river) water in relationship to the groundwater supply?** It can make surface water dry up faster or reduce how much surface water we have to use, which means we have to use more groundwater as a supply for our needs. **Is there anything we can do to help protect and conserve our groundwater?** Yes, many things if we prevent pollution and make choices to conserve water. **Can you be a groundwater guardian?**

Make sure students label new parts and processes on their water cycle diagrams as well.

*Students should complete the Lesson 5 section of their AWF Water Notes handout to record evidence and construct explanations based on that evidence. Students will also look at the lesson from the perspective of stability and change. Stability is a system that is balanced. Change looks at a system that is not staying the same over time.

Other Resources:

<https://www.usgs.gov/special-topics/water-science-school/science/groundwater-information-topic>

<https://asu.maps.arcgis.com/apps/dashboards/57696be87aac421f90ab2033807b7310>