Water Table Experiment

Infiltration in the Arroyo Unit, Lesson 2

Lesson Summary: Students build a groundwater system model to better understand the connection between groundwater and surface water.

Suggested Timing: 1 hour

New Mexico State Standards

Performance Expectation(s): MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

Science & Engineering Practices:	Disciplinary Core Ideas:	Crosscutting Concepts:
Developing and Using Models: Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe unobservable mechanisms.	ESS2.C: The Roles of Water in Earth's Surface Processes: Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. Global movements of water and its changes in form are propelled by sunlight and gravity.	Energy and Matter: Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.

Evidence Statements:

- MS-ESS2-4 Evidence Statements

ELA CCSS Connections:

- RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-2)
- WHST.6-8.2: Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS2-2)
- SL.8.5: Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ESS2-2)

Math CCSS Connections:

- MP.2: Reason abstractly and quantitatively. (MS-ESS2-2)

Content Objectives and Daily Learning Targets	**Objectives**: • I can explain how groundwater and surface water are connected. • I understand how aquifers are refilled.
Focus Question	What evidence can I find of infiltration and infiltration rates?
Language Objectives	• Students can accurately record their observations in writing.
Vocabulary	• **Aquifer** - an underground layer of permeable rock, rock fractures, or unconsolidated materials that hold water. • **Groundwater** - water that is found in the cracks and pore space in the rocks or earth materials below the ground. • **Impermeable** - not allowing water to pass through. • **Infiltration** - the downward entry of water into the soil.

	● **Percolation** - the process where water moves down into and through pore spaces in the groundwater system. ● **Permeable** - allowing water to pass through. ● **Pump** - noun, a mechanical device using suction or pressure to raise or move water. Verb, force water to move by means of a pump. ● **Runoff** - the flow of water occurring on the ground surface when excess rainwater, stormwater, meltwater, or other sources, can no longer sufficiently rapidly infiltrate in the soil. ● **Surface water** - water that collects or flows on the surface of the ground. ● **Water table** - the level below which the ground is saturated with water. ● **Well** - a shaft sunk into the ground to obtain water or determine the depth of the water table.
Materials	● Lab sheets or science notebooks ● For each lab group: ○ Clear plastic shoebox or similar (should be clear to see water level) ○ Course sand, white, if available, enough to fill the shoebox at least 2-3 inches deep ○ Water dropper to represent a well ○ Spray bottle ○ Water ○ Rocks, foil, plastic, or other impermeable surfaces to represent non-porous layers ○ Optional: food coloring or kool aid to represent pollution
Preparation before class	● Collect materials ● Make copies of lab sheets
Assessments (Formative/ Summative), Rubrics, Success criteria	● Lab sheet ● Reflection questions Success Criteria: ○ Students understand what groundwater is and how it is recharged through infiltration. ○ Students use the evidence they collected in their experiment to make claims about the natural environment and how it should be managed. ○ Students understand that surface water and groundwater are connected.
EL Supports	● Students work in small groups. ● Pair-share allows students to practice expressing their thinking and feel more confident when sharing with the whole group. ● Provide key vocabulary in English and the student's native language.

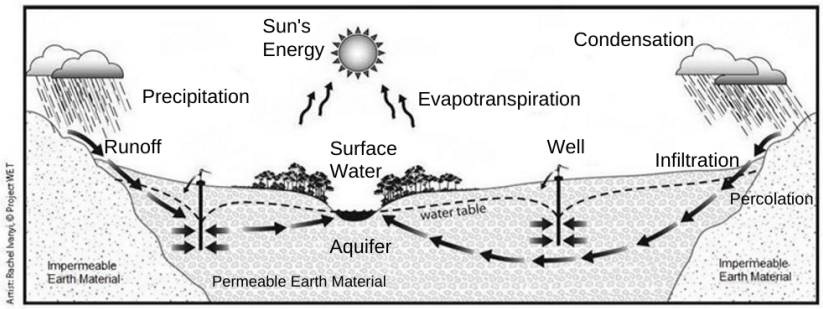
Culturally Relevant Strategies	• Students are practicing social and academic skills when working in small groups.
Special Education Modifications	• Carefully assign students to lab groups that will allow students with special needs to participate. • Follow student's IEP.

Lesson Plan Details

ENGAGE (~5 min):	• Give students the following prompt: "Some water flows on the surface of the land, but some water soaks into the ground. Imagine that we were able to cut into the soil and see a cross-section. Where would we see the water underground?" • Ask students to work in their lab group to draw a cross section that shows where and how water collects underground in their science journals. • Ensure they understand how to draw a cross section. If this is a difficult concept, compare it to slicing a layer cake. 

EXPLORE (~15 min):	• Give students instructions on how to build the model.
	  ○ Pour sand into the shoebox. Create high and low areas to model the landscape.
	  ○ Pour some water into the system and see what happens.
	• Let them explore how water flows through the system and record what they notice. Make sure they understand that aquifers are not underground lakes in caverns. Groundwater is found in the cracks and pore space in the rocks or earth materials under our feet. Some of the earth materials are small particles while others can be very large. The water slowly (over hundreds or thousands of years) moves through the spaces between these rocks.

EXPLAIN (~10 min):	• While looking at the model from the outside of the box, have students point to the top of the water. Ask them if they know what this water line represents? This is the water table. • Introduce terminology: aquifer, well, groundwater, surface water, percolation • Show students a cross section of the groundwater system, identifying the parts, and how the groundwater system is a part of the water cycle. Have students identify the parts in their own models.

	 *Cross-section illustration of aquifer (looking south) and hydrologic cycle in the San Pedro River with pumping.* ● Discuss how water is a shared resource. ● Ask students to do a pair-share activity: "How does this model connect to what you noticed in the arroyo yesterday?"
ELABORATE (~15 min):	● Ask students to follow the Guided Exploration instructions in their 2.2 handout to explore what happens when water moves through the geosphere. ● One simple method to explain the impact of wells on aquifers would be to ask students to imagine a glass of water with one straw versus a glass with many straws. Assuming that each straw sucks at the same rate, then the glass with many straws will deplete the water much faster than the glass with one straw. Now imagine the aquifer below Santa Fe. What would be the impact to the aquifer as more wells, deeper wells, and faster pumping wells are introduced to the landscape?
EVALUATE (~15 min):	● Discuss the similarities and differences between the model and the actual environment. ○ Soil types ○ Rock layers ○ Shallow and deep aquifers ○ Time scale (some of the water in our wells is more than 10,000 years old and infiltrated in the Sangre de Cristo Mountains and has been flowing slowing since then) ○ Lakes and rivers are related to and connected with groundwater. ● Point out misconceptions: ○ Aquifers are not underground lakes. ○ There is not unlimited groundwater. ○ If one well draws too much, it will impact other wells by creating cones of depression and by lowering the water table. ○ Groundwater flows underground and is interconnected. ● Have students complete the evaluate section of their handout or in their journal. ● Leave time to clean up.

Additional Sources:

- 5 Es of Science Instruction

- 5E Model of Instruction
- ISEC model of lesson sequence