Infiltration Arroyo Walk

Infiltration in the Arroyo Unit, Lesson 1

Lesson Summary: Students do a walk through the arroyo to investigate infiltration.

Suggested Timing: One hour, including time to walk to and from the arroyo.

New Mexico State Standards

Performance Expectation(s):
MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Constructing Explanations and Designing Solutions: Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future.	ESS2.A: Earth's Materials and Systems: The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. ESS2.C: The Roles of Water in Earth's Surface Processes: Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.	Scale Proportion and Quantity: Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Evidence Statements:

- MS-ESS2-2 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)
- 6.EE.B.6: Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS2-2)
- 7.EE.B.4: Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS2-2)

Content Objectives and Daily Learning Targets	**Objectives**: ● I understand that different soils allow for infiltration at different

	rates. ● I can use evidence to identify where water flows and where it pools. ● I can connect what I know about infiltration to the arroyo investigation site.
Focus Question	How does water interact with geological features to recharge our aquifers? What evidence can I find of infiltration and infiltration rates?
Language Objectives	● Students can share their observations verbally and in writing. ● Students can use scientific vocabulary to explain their thinking.
Vocabulary	● **Infiltration** - the downward entry of water into the soil. ● **Infiltration rate** - how fast or slow water will move into the soil. ● **Infiltration capacity** - the maximum rate at which a soil can infiltrate water before overland flow occurs. ● **Impermeable** - not allowing water to pass through. ● **Permeable** - allowing water to pass through. ● **Pore spaces** - the space between earth materials in the ground, can be filled by air or water. ● **Percolation** - the process where water moves down into and through pore spaces in the groundwater system. ● **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.
Materials	● Lab notebook (or lab sheet with a clipboard) ● Pencil ● Water bottle for engage demonstration ● For each lab group: ○ 1 cup measuring cup ○ Water bottle (with at least 3 cups water) ○ Can with both top and bottom removed ○ Timer or stopwatch
Preparation before class	● If you are not using the lab sheets, have students write the lab in their notebooks. ● Collect materials.
Assessments (Formative/ Summative), Rubrics, Success criteria	● Lab report ● Reflection questions Success Criteria ○ Students can describe the process of infiltration clearly. ○ Students can explain that the infiltration rates vary, depending on the type of soil. ○ Students begin to make connections between water infiltrating and running off and how that impacts stormwater.

EL Supports	• Think-pair-share allows students to practice what they want to say before sharing with the whole class.
Culturally Relevant Strategies	• Students are working in small groups, practicing social and academic skills. • Students are learning about the local environment, helping validate the experience of the students.
Special Education Modifications	• Follow student IEP. • Think-pair-share allows students to practice what they want to say before sharing with the whole class.

Lesson Plan Details

ENGAGE (~10 min):	• Review rules for being in the arroyo. • Walk to the arroyo. • Find a sandy place in the arroyo and have the students observe while water is poured onto the surface. Ask students to describe what they observed. Where do they think that the water that soaks into the ground goes?
EXPLORE (~5 min):	• Give students five minutes to look for evidence of where water pools and where it flows. Ask them for what evidence they can look for if it hasn't rained in a while. For example, are there lower areas that are at a slope, where water would flow? Look for different types of soil on the floor of the arroyo, which might indicate different flow speeds. Have them record what they notice in their science notebooks. Have them identify some permeable and impermeable surfaces and discuss why it flows in some areas and soaks into the soil in others.
EXPLAIN (~10 min):	• Get together with the whole group. Introduce the term "infiltration" and have students record the definition in their journals. Ensure they understand the terms *permeable* and *impermeable*. • Discuss that the infiltration rate is how fast or slow water will move into the soil. Determined by soil texture (percentage of sand, silt, clay) and clay mineralogy. Water moves more quickly through the larger pore spaces of sandy soil and more slowly through the small pore spaces of clay soil. • Discuss that the infiltration capacity is the maximum rate at which a soil can infiltrate water before overland flow occurs. This is an important concept because once overland flow begins, the process of erosion can occur. This can be contrasted with Infiltration Rate which is a measure of water moving through the soil surface (i.e. depth/time). An impervious surface such as asphalt or concrete will basically have an infiltration capacity of 0-inches/hour and thus stormwater runoff will occur. A sandy soil might have an infiltration capacity of 2-inches/hour which means that a moderate intensity storm (e.g. 0.5-inches/hour) will sink straight into the sandy soil without runoff and erosion occurring).

	• Have students walk the arroyo together and point out what they noticed. • Review soil types and how to assess these using the graphics in the student lab sheet (soil types and soil triangle). Also, explain that students can determine soil texture using the Ribbon Method.

ELABORATE (~20 min):	• Conduct the infiltration experiment. (For a very specific method of measuring infiltration download these Step-by-step instructions using a 6-inch diameter ring which may be available from local Natural Resource Conservation Service.)
	  ○ Students will choose three different soil textures to test.
	  ○ They will place the can in the soil so the bottom edge is dug about half an inch into the soil to avoid having water run out to the side.
	  ○ Have one student time how long it takes for a cup of water to infiltrate into the soil. They should start their stopwatch when their partner pours the water. They should stop the time when there is no longer water pooled in the can.

EVALUATE (~15 min):	• Have students in lab groups answer the reflection questions. • Together, discuss what they noticed and how this related to the erosion and deposition exploration (if conducted). • Discuss where they think the water goes after it infiltrates into the soils. • Walk back to the school.

Additional Sources:

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