Erosion Solutions

Erosion in the Arroyo Unit, Lesson 4 and 5

Lesson Summary: Students will build and test erosion control structures using the models they created in Lesson 1.2.

Suggested Timing: Two 1 hour classes

New Mexico State Standards

Performance Expectation(s):
MS-ESS2-4: Earth's Systems: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
MS-ESS3-3: Earth and Human Activity: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*
MS-ETS1-1: Engineering Design: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
MS-ETS1-2: Engineering Design: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-ETS1-3: Engineering Design: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
MS-ETS1-4: Engineering Design: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

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. Asking Questions and Defining Problems: Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.	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. ETS1.A: Defining and Delimiting Engineering Problems**:** The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.	Energy and Matter: Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. Influence of Science, Engineering, and Technology on Society and the Natural World: All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.

Evidence Statements:

• MS-ETS Evidence Statements
ELA CCSS Connections: • RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts. • WHST.6-8.8: Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. **Math CCSS Connections:** • MP.2: Reason abstractly and quantitatively. • 7.EE.3: Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

Content Objectives and Daily Learning Targets	**Objectives**: • I can explain how arroyos are created. • Using the engineering process, I can build, test, and improve erosion control devices. • I can explain how the model and the arroyo are connected. • I can explain how people can have a positive or negative impact on the world around them.
Focus Question	What are the most effective ways of slowing or stopping erosion? What are the challenges?
Language Objectives	• Students can use scientific vocabulary to describe what they notice. • Students can use accurate language to record results of an experiment.
Vocabulary	• **Energy** - the ability to do work. • **Erosion** - process in which earth materials are worn away and transported by natural forces such as wind or water. • **Flow** - (of a fluid, gas, or electricity) to move along or out steadily and continuously in a current or stream. • **Friction** - the resistance that one surface or object encounters when moving over another. • **Gravity** - the force that attracts a body toward the center of the earth, or toward any other physical body having mass. • **Kinetic energy** - the energy an object has because of its motion. • **Mitigation** - something done to reduce the impact of a hazard. • **Potential energy -** the stored energy an object has because of its position or state.
Materials	• Models from lesson 1.2 • Watering cans with shower head • Water • Sod grass seeds (choose a fast growing variety like rye)

	● Lab sheets or science journals ● Materials to build ● Projector ● PowerPoint showing how runoff is controlled using built structures and some of the challenges of each design (provided)
Preparation before class	● Ask students to collect recycled materials to build erosion solutions ● Prepare materials
Assessments (Formative/ Summative), Rubrics, Success criteria	● Lab sheets ● Report or diagram Success Criteria: ○ Students are able to clearly explain, using evidence, what erosion control device they would use in the arroyo and what their reasoning is for choosing that method.
EL Supports	● Provide key vocabulary in the student's first language.
Culturally Relevant Strategies	● Students work together to conduct the experiment. ● Students investigate the local environment, which is an important part of the local culture.
Special Education Modifications	● Students are able to express their thinking in multiple ways, allowing them to build on their strengths.

Lesson Plan Details
DAY 1

ENGAGE (~20 min):	● Have students review and share what they learned in the erosion mitigation walk in the arroyo in their lab groups. ● Ask students to look at these different approaches to erosion control and discuss what parts of these approaches worked and why if they didn't.
EXPLORE (~40 min):	● Students should use what they learned to design three different methods of erosion control they can test using their model from Lesson 1.2. ● Have them develop a procedure they will follow. ● They can begin to construct these with the materials that are available. ● Students should make a list of what additional materials they will need and decide who will bring these materials. Limit this to recycled items, they should not purchase anything. ● As they are planning, ask them to consider: ○ What volume of water is your device designed to accommodate? ○ How will your device work as sediment washes downstream? ○ How does your device use the principles of kinetic energy, potential energy, and friction?

	○ What is the goal of your device?

DAY 2

EXPLORE (~20 min):	● Students will build their erosion control devices and test them. They should be given time to iterate the design and retest. ● The success or failure should be defined and causes should be identified in their notes.
EXPLAIN (~15 min):	● Using think-pair-share, have students reflect on what worked and what didn't work. Ask them to look for patterns. ● **Present the Erosion Control Devices PowerPoint (Provided)** to students. As you discuss each erosion control method, ask them to identify any of their own inventions that followed the same principles.
ELABORATE (~15 min):	● Have students return to their models and apply what they learned. ● Clean up. ● **In preparation for lesson 2.4:** Have half of the students scatter grass seeds over their models and water them in. They will use this to explore how roots, groundwater, and infiltration are interconnected. The other half should not add grass. Keep the grass wet and watered until Unit 2 Infiltration Lesson 4.
EVALUATE (~10 min plus 30 minutes of homework):	● Explain homework: Have students create a report or draw a diagram that explains what erosion control method they would recommend to control erosion in the local arroyo. They should use evidence from their experiments and explain why they chose that particular method.

Additional Sources:

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