Lesson Plan: Stream Table Investigation

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Target Grade: 4th

Teacher Prep Time: 1 hour

Lesson Time: 3½ hours (We recommend doing this lesson over 4 days.)

- Day 1
  - 15 min. – Beginning Thoughts
  - 45 min. – Stream Table Investigation Planning
- Day 2
  - 45 min. – Investigation Procedure
- Day 3
  - 45 min. – Carrying Out the Investigation
- Day 4
  - 60 min. – Results Analysis and Application

Lesson Overview: In this lesson students use stream tables to investigate variables that affect the way water erosion alters landforms. During the lesson, students measure and make note of the relationship between the changing variable and the amount of erosion. They will use data collected to create a cause and effect conclusion related to the variable.

Learning Objective: Students will be able to explain the cause and effect relationship between variables that affect the amount of erosion and the formation of valley and canyon landforms.

NGSS: 4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering on the rate of erosion by water, ice, wind, or vegetation.

Science and Engineering Practice

- #3 Planning and carrying out investigations
  - Planning and carrying out investigations to answer questions or test solutions to problems in 3-5 build on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
    - Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.

- **Disciplinary Core Idea**
  - ESS2.A Earth Materials and Systems
    - Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediment into smaller particles and move them around.
- **Cross Cutting Concept**
  - #2 Cause and Effect
    - Cause and effect relationships are routinely identified, tested, and used to explain changes.

Where this lesson fits in: Prior to this lesson, students have used a stream table to observe how a flow of water can cause erosion and deposition. They have identified features such as alluvial fans, plateaus, meanders, and canyons. In this lesson, students use the SciTrek format and carry out an

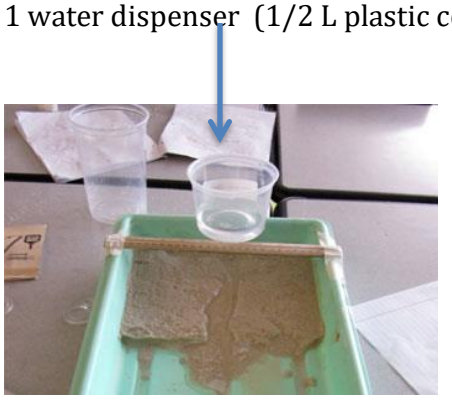
investigation to identify variables that alter the rate of erosion of landforms. If you are working with the FOSS, "Soils, Rocks, and Landforms" module, this lesson fits nicely following Investigation 2 Part 1. This video link shows students using a stream table for the previous lesson.
FOSS Investigation 2, Part 1 lesson: Stream Table Investigation video
https://www.youtube.com/watch?v=jBglF8KZn8k

General Materials for Class:

- Water source (sink, gallon containers)
- Large tub or garden hose for rinsing off hands
- Gloves (optional)
  Safety Note: Some students may be sensitive to sand/clay mixture so gloves may be needed.

General Materials for Each Group: (recommend groups of 3 or 4)

- 1 ruler to hold water dispenser
- 1 straight edge tool for arranging earth material
- 1 L water container with 50 mL graduated markings
- 1 tub with newspapers (to catch drainage)
- 1 metric measuring tape (cm)
- ~12" strip of masking tape to secure ruler for water dispenser and metric tape
- I pad or device to take pictures
- 1 stream table set-up with Earth materials (1.35 kg sand and 100g powdered clay,~1 cup water)
  - See Teacher Prep below
- 1 water dispenser (1/2 L plastic container with 1/16" hole in bottom center)



For Each Group Investigating Stream Table Elevation (Slope). Students will be able to select 3 elevations from blocks cut 10 inches long in ~½" thickness. The ½ " blocks can be stacked to the desired range of elevations. Potential elevations: ½", 1", 1½", 2", 2½", 3.
Note: (In order for water dispenser to empty do not elevate more than 3 inches. Books may also be used for elevations.) Water quantity will be limited to 100 mL.
*To determine the quantity needed, make enough material for half of the groups to stack blocks 6 inches high.

- Blocks/books to raise end of stream table (*See above)

For Each Group Investigating Water Quantity:
Students will be able to select 3 values from 6 different quantities of water.
Potential quantities: 100 mL, 200 mL, 300 mL, 400 mL, 500 mL, 600 mL

- 1,000 mL water container with 50 mL graduated markings
- standard pencil (1/4") to raise stream table slightly (as needed)

Purchasing Materials

- Sand and clay (called fire clay) can be purchased at building supply stores such as Bedrock Building Supply in Santa Barbara.
- Wooden blocks can be made from a ½" baseboard pieces from building supply stores.
- ½ L or 16 oz. plastic containers with flat bottom for water dispenser can be purchased on-line and from discount stores. Deli food containers also can be used. Note: The water dispensers will need to have the hole size drilled.
- 1 L measuring cups with 50 mL graduations can be purchased at the Dollar Store or ordered on-line. I purchased Winco Measuring Cup, Polycarbonate, 1-Quart from Amazon.

Note: You may construct inexpensive stream tables with aluminum roasting pans. For instructions go to You tube video by Derek Purdue, "Building a Stream Table".
www.youtube.com/watch?v=X0xTSNASGv8. Stream Table Construction

All stream tables, sand, clay, and water dispensers with 1/16" holes (Standard Size) can also be purchased from Delta Education website: Stream Table Materials
www.deltaeducation.com/SSIDEL/media/rpl/fossng_k5/soils_rocks_and_landforms_nextgen_rpl_2018.pdf

Teacher Prep:

- Recommend 3-4 students per stream table
- For each stream table, prepare earth materials:
    - In a gallon zip lock bag, add 100 grams of powdered clay to 1.35 kg (~3lbs) fine sand
    - Stir the clay and sand until they are evenly mixed.
    - Add up to 1 cup of water to the dry materials in the bag, close bag and mix materials well.

  Note: Sand and than clay material should have a total volume of about 1 L.
- Place earth materials at end of stream table without drain hole.
- Prepare water dispenser
    - Use a drill to make a 1/16" hole in the bottom of each water dispenser. Test to make sure water drains completely.
- Copy *Stream Table Investigation* student handout (1 copy per student)
- Copy *Standard Stream Table Set-up* directions (1 copy per group)- found at end of this lesson plan
- Copy *Materials Constraints* page (1 copy per group, 1 teacher copy) – found at end of this lesson plan

Lesson Sequence:

Day 1: 15 minutes	**Beginning Thoughts** <u>Phenomenon:</u> Place under doc cam or project pictures of a canyon and a valley on page 1 of student handout "Steam Table Investigation". 1. Ask students to carefully observe the images and identify the differences. a. ESR: The canyon is deeper, narrower, and has steeper sides. The valley is shallower, wider, and has gently sloping sides. 2. Distribute the handout, "Stream Table Investigation". 3. Review the stream table set-up and steps they used in the last investigation. 4. Have students think about the parts of the system and pair/share the following question: If the earth materials are exactly the same, what might be causing the differences in the two landforms? 5. Elaborate on specific variables students share out and have them record on their worksheets. a. ESR: rate of water flow, amount of water, amount of vegetation, etc. 6. Explain these are variables that can be changed in an experiment.
Day 1: 45 minutes	**Stream Table Investigation Planning** 1. Introduce the Focus Question: What variables affect the erosion of earth materials in a stream table? 1. Tell students that as scientists they will be able to investigate 2 variables that might affect the rate of erosion. 2. Explain that each group will select either changing the stream table elevation (slope), or quantity of water dispensed as their changing variable. They will get to choose 3 values of the changing variable to test from the Materials Constraints Page. a. **Note**: Students may select their variable values depending on blocks available, although you will need to limit elevation height to about 3-4 inches so erosion distance is measurable and water dispenses. 3. Direct students to page 2 of the **Stream Table Investigation** handout. 4. Explain the **Data Collection** requirements. Students will measure the distance in cm the earth material moved from the 20 cm starting point. 5. Allow time for the groups to fill in the **Question** with their chosen variable. 6. Hand out the *Materials Constraints Page* and read it together while showing the materials and modeling how to use them. 7. Direct each group to check the box next to the materials they will be using based upon which changing variable and three values they select. a. **Note:** Ensure at least two groups are investigating each changing variable if possible. 8. Help groups complete the Experimental Set-Up portion including the Changing Variable, Controls, and Prediction sections. 9. Collect *Materials Constraints Page* from each group in order to gather the needed materials for the investigation day.

Day 2: 45 minutes	**Investigation Procedure Writing** 1. Distribute each group's Materials Constraint Page to be used to help write the procedure. 2. Procedures are difficult for students; therefore an example step with blanks for control and changing variable values should be written, with the help of the class, for each step. Then students should copy the step with their values into their procedure before moving to the next step. 3. While writing the procedure it is helpful to look at the experimental set-up to make sure that all controls, changing variable values, and data collection requirements are included. 4. Ask students what step one should be about? a. ESR: Getting the stream table and setting up earth material. 5. Guide student to generate a step that is similar to: **Arrange stream table earth material in an even layer with an initial soil distance of 20 cm**. 6. Ask students if this will be the same for everyone. They should respond yes and all copy down Step 1. 7. Ask students what Step 2 should be about? a. ESR: Putting the table at the correct elevation. 8. Guide student to generate a step that is similar to: **Set the elevation of the stream table to _____.** 9. Tell student that they will need to put their control value or changing variable values in the blank. 10. Ask students what Step 3 should be about? ESR: Getting the water dispenser set-up. 11. Guide students to record something similar to: **Secure ruler to stream table and center water dispenser**. 12. Ask students what Step 4 should be: ESR: Pouring the water into the dispenser. Ask if this will be the same for everyone. They should respond no, guide students to write a step similar to: **Pour into the dispenser a water amount of _____.** 13. Tell student that they will need to put their control value or changing variable values in the blank. 14. Ask students what Step 5 should be about? ESR: Collecting data 15. Guide students to generate a step that is similar to: **Measure and record the distance the soil has moved and draw or take a picture showing how the stream has shaped the land.** 16. Ask students if this will be the same for everyone. They should respond yes and all copy down step 5.
Day 3: 45 minutes	**Carrying Out the Investigation** 1. Review stream table setup and remind students to measure the distance the earth material moved and to draw or take a picture of the stream table after each trial is completed. 2. Review how to record the data. 3. Show students how to drain water and reset stream table for each trial. 4. Direct students to use their procedure and Materials Constraint Page to gather their materials and conduct their experiment.

	5. Allow students time to conduct the investigation and complete the Conclusion section based upon their results data. (Students may complete drawings or print out their photographs and glue them onto their handout at this time.) 6. Direct students to clean up **Note:** Leave earth materials in stream table to dry. Dried earth materials can be returned to zip lock bags for storage as desired. Prior to next use, be sure to replace sand/clay that may have been lost.

Day 4: 60 minutes	**Investigation Analysis and Application** 1. Have groups with the same changing variable share out their results and share their conclusions. 2. Ask students the following questions: 3. What effect did the water amount have on erosion? Why? a. ESR: The higher the water quantity, the further and/or more material moved. With more water there is more energy to move the earth material. 4. What effect did the steeper slope have on erosion? Why? a. ESR: The steeper the slope, the further the material moved and the deeper the "stream" created. The water moving down the steeper slope had more energy due to gravity. 5. Discuss any unusual/unexpected results as needed. 6. Refer students to last page of Stream Table Investigation hand out. Review the questions and have them record their answers as a formative assessment. 7. Collect *Stream Table Investigation* packets.

Expected Student Work:

Name:_____

Directions: Look closely at the two pictures below. Both landforms resulted from the erosion of earth materials by running water. Discuss with a partner what factors might have caused the differences you observe.

A valley	A canyon
	

Focus Question: What variables affect the erosion of earth materials in a stream table?

Variables we think might affect the erosion of earth materials (e.m.) in a stream table. Explain.

1. Amount of water released because more water will move more material.

2. Slope of stream table because water will move down faster.

3. Type of earth materials (e.m.) – some will absorb more water than other e.m.

4. Height of water dispenser from earth materials – falling water creates deeper hole

5. Flatness of e.m. surface – water may spread out if there is a large low area.

Expected Student Work:

QUESTION: If we change the *__stream table elevation (or)__ amount of water__* ,
(Circle one of the above)
what will happen to *the distance the earth materials move?*

Experimental Set-Up

You may select 3 values from the values below. Determine the values of your changing variable and write the values for your three trials. Example: water quantity: 100 mL, 300 mL, 600 mL.

1. Stream Table Elevation Values: ½ in., 1 in., 1½in., 2 in., 2½, 3 in.
   Water Quantity – 100 mL for all values

2. Water Quantity Values: 100 mL, 200 mL, 300 mL, 400 mL, 500 mL, 600 mL
   Elevation – ¼" for all values

Changing Variable: Trial A Trial B Trial C

Water Quantity	*100mL*	*300mL*	*600mL*

Controls: Variables that will not be changed

Earth material (e.m.) amount / 4 cups

Initial earth material distance/ 20 cm

Stream Table elevation/ ¼"

Water Dispenser Opening size/___1/16" __

Prediction: We predict the earth material will move the farthest in **Trial _____**

because **more water will be able to erode more earth material.**

Expected Student Work:

Investigation Procedure: *(For water quantity investigation)*

1. Put 4 cups of e.m. in stream table with an initial distance of 20 cm.

2. Set stream table elevation to 1/4 in.

3. Measure water quantity of a) 100 mL b) 300 mL c) 600 mL.

4. Pour the water into the water dispenser, with 1/16" opening keeping the dispenser full.

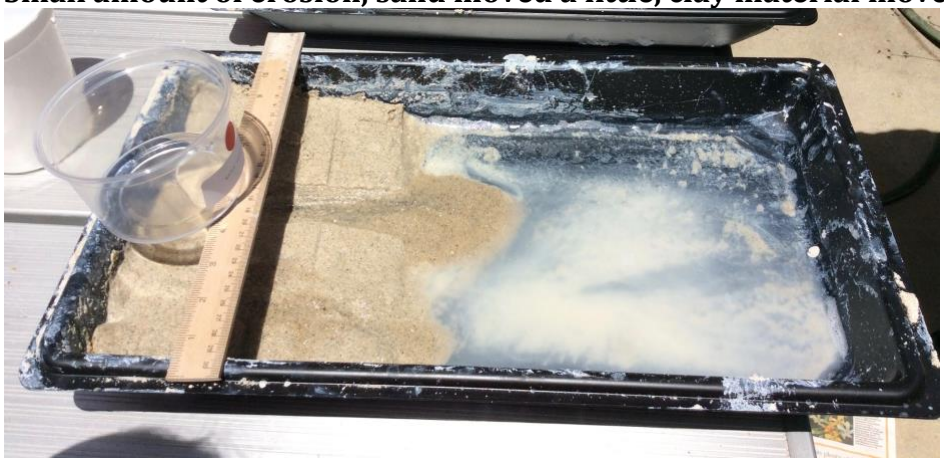
6. Measure and record the distance (cm.) the e.m. moved from the 20 cm.

7. Draw/photograph and record observations.

8. Drain all excess water and repeat steps for each value.

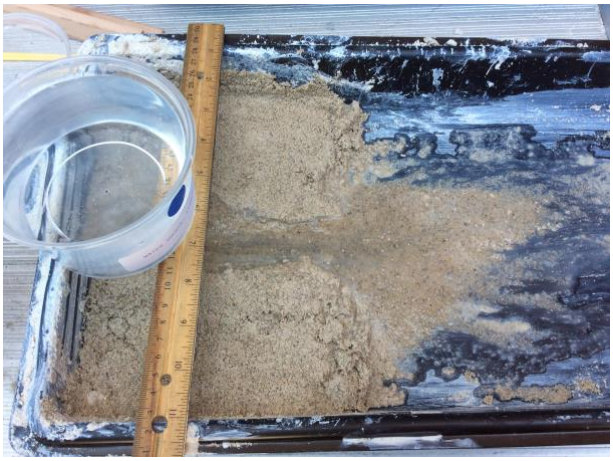
Results Data: **Stream Table Observations:**

Trial A: 100 mL
Small amount of erosion, sand moved a little, clay material moved further,



Trial B : 300 mL water quantity

Earth material moved further than Trial A, stream banks gently sloped.



Trial B: 600 mL
Earth material moved further more quickly. Banks gently sloped, wider stream width.

Stream Table Elevation:

Low Slope versus Medium Slope
E.M. moved much further, more quickly, especially heavier sand material.

Results Data: **Distance the Earth Materials Moved (cm)**

Changing Variable:

Elevation (Slope)	*1”*	*2”*	*3”*
Distance Moved (cm)	*14*	*20*	*31*

Conclusion: (A claim supported by data)

The result of the experiment shows the steeper slope caused more erosion (Claim)

because when the elevation was 1”, the earth material moved 14 cm. and when the elevation was 3” the e.m. moved 31 cm. (Data (measurement/observation))

Expected Student Answers:

Discussion:

1. What effect did the water amount have on erosion? Why?
    a. ESR: The higher the quantity, the further and/or more material moved. With more water there is more energy to move the earth material.

2. What effect did the steeper slope have on erosion? Why?
    a. ESR: The steeper the slope, the further the material moved and the deeper the “stream” created. The water moving down the steeper slope had more energy due to gravity.

3. How do erosion factors affect landforms?
   Refer back to the canyon and valley landform pictures. Based upon your investigation, predict which of these two landforms would likely result over time.
    a. A stream running down a small, low-sloped hill will likely cause *a valley* to form.

    ESR: The stream running down a low hill will remove surface earth material, but will not erode as much as the mountain because it has less energy, so a valley is more likely.

    b. A stream running down a small, low-sloped hill will likely cause *a valley* to form.

    ESR: The stream running down a steep mountain will erode more material because it have more energy due to gravity.

Teacher Background Knowledge:
1. Link to video of stream table modeling water running down a mountain side:
www.youtube.com/watch?v=IIrFDPZ_2Jo

Standard Stream Table Set-up Directions

1. Find a flat, even table surface for the stream table set-up.

2. Place newspaper on the tabletop and underneath a catching basin.

3. Place the stream table tray on the tabletop so the drain hole extends over the edge of the table and aligns to the catching basin.

4. Use a wooden ruler or angle to push the earth material to the end of the stream table at the opposite end of the drain.

5. Spread prepared earth material until it is 20 centimeters from the starting end and is evenly spaced. The earth material edge should be cliff-like. Make a slight indent down center of material.

6. Set a 30 cm ruler across the top of the tray about 6 cm from the end. Use masking or duct tape to secure it in place.

7. Set the water dispenser container on the edge of the tray and the ruler. Be sure it is stable.

MATERIAL CONSTRAINTS PAGE

Determine which variable you will change in your investigation. You will only have access to the following materials. Put a check in the box next to the materials that you need for your experiment.

General Materials per group:

☐ 1 stream table set-up with prepared earth materials
☐ 1 ruler to hold water dispenser
☐ 1 wooden angle or flat edge to arrange earth materials
☐ 1 Liter water container with 50 mL graduated measurements
☐ 1 water dispenser
☐ 1 tub for catching water
☐ 2 newspaper pages (1 under stream table, 1 under tub)
☐ 1 metric measuring tape
☐ masking tape to secure ruler for water dispenser (~12")

Changing Variable: Stream Table Elevation (Water Source End Raised)

Choose 3 from the 6 values below to raise end of stream table:

☐ 1 block ☐ 2 blocks ☐ 3 blocks

☐ 4 blocks ☐ 5 blocks ☐ 6 blocks

Changing Variable: Water Quantity (Amount of water dispensed)

☐ 100 mL ☐ 200 mL ☐ 300 mL

☐ 400 mL ☐ 500 mL ☐ 600 mL