Blue- Brown River: Investigating Runoff

Grade	5th
Time	35-45 minutes
Overview	Students explore the connections among rainwater run-off, erosion, and deposition and how these processes can reduce the quality of the water in our watersheds.
Objectives	Understanding: Students connect precipitation events and water flow in rivers and the impacts that different land management strategies can have on the quantity of stormwater run-off and soil deposition. Skills & Processes: Students develop cooperation and collaboration skills and use data recording, summary, and analysis skills. Values: Students explore the importance of clean water and consider how they can help to reduce erosion.
Essential Question	When it rains, where does the water go? How can sediment get into waterways?
Primary VA SOL	Science (2018): 5.1, 5.8

This activity is adapted from the one in the Project Wet Curriculum and Activity Guide

Materials

- >1000 blue stones/beads (glass "rocks" work, too) distributed equally into 5 small containers (Such as Quart container); 1 container/tributary
- >500 brown stones distributed equally into 5 small containers (quart container); 1 container/Tributary
- One bucket (3-gallon) to hold the blue and brown stones after each trial
- Large amount of rope or flags (for watershed boundary)
- 5 laminated Signs mounted on sticks & stuck into the ground
  - "Tributary 1 or Roseville Run"
  - "Tributary 2 or Page Brook"
  - "Tributary 3 or Westbrook Run"
  - "Tributary 4 or Spout Run"
  - "Shenandoah River" (the specific river names represent the Clarke County Spout Run watershed. See map in this lesson plan)
- 4 Laminated signs that say "Light Rain", "Heavy Rain/Thunderstorm", "Erosion Event 1", and "Erosion Event 2"
- Student data sheets (one for each student)

Special Safety

Take care walking over uneven ground.

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• Stopwatch • 4-5 laminated sheets Spout Run watershed maps • Clipboards, datasheets, & pencils (one per student) • Large whiteboard and dry erase markers	

Set Up

- Choose a sloped area outdoors, if possible. Check for potential hazards before setup.
- Print data sheets
- Print and mount signs (see materials list)
- At each sign, place one container of blue beads and one container of brown beads at the "top" of each tributary--the headwaters (Roseville Run, Page Brook, Westbrook Run, and Spout Run). At the "bottom" of each tributary (where it runs into another stream or river), place an empty bucket large enough to hold hundreds of beads.
- Whiteboard and markers

Instructional Strategy	
Recommended Grouping/Instructional style	Large Group setting Movement-based instruction
Steps	1. **Engage (these questions also serve as a formative assessment to help guide instruction):** Arrange student groups so that they model a watershed with 4 tributaries and one main river. a) Ask: What type of system are you modeling? Potential answers: a river system, a watershed. If you are modeling a watershed, how do we know where the watershed begins and ends? b) Once students realize that there must be watershed boundaries, ask or select 4 students to help place the watershed boundary (the rope) around their watershed. All the space inside the rope is part of the watershed they are modeling. 2. **Explore:** a) Part 1 Blue-Brown River Trials. i. Demonstrate. Conduct a practice run of the stones flowing through the watershed. ii. Tell the students that each stone represents 10 cubic feet per second of water flowing in their stream. A blue stone represents clean water; a brown stone represents water with sediment (from soil erosion). Students at the top of each stream (headwaters) will pick up a blue stone and pass it downstream through the tributaries and into the Shenandoah River where it is dropped into the bucket. iii. *Ask*. Have you ever watched water flowing through a stream? Does the water always flow at the same speed? Conduct another practice trial, counting to three before each stone is passed to the next person.

Do this again and count to one before passing each stone.

iv. *Ask*. When we changed our count from three to one, what happened to the water flow? (It went faster).

v. Next, tell the students that they will simulate water flow through the watershed for different rainfall events. Each simulation will last for 1 minute and will be timed with a stopwatch. Instruct students who are picking the stones from the headwaters containers to ONLY pick ONE stone at a time. **Picking up several stones at once will corrupt the data and the simulation will be stopped.**

b) Event 1. Light rainfall. Hold up the Light Rainfall sign.

i. *Ask*: Do you think light rainfall will have a large or small effect on water flow in the streams? To demonstrate/simulate this:

ii. At the headwaters of each tributary, a new stone will be picked up and passed down stream every 3 seconds.

iii. Conduct this simulation for one minute.

iv. After one minute, designate students to count the number of stones in the bucket while another student writes this data on the whiteboard.

v. All students record this data in their datasheets.

vi. Return the stones to the containers at the top of the tributaries.

c) Event 2. Heavy rainfall. Hold up the Heavy Rainfall sign.

i. At the headwaters, a new stone will be picked up and passed down stream every 1 second.

ii. Conduct this simulation for one minute.

iii. Repeat steps iii-vi from B.

d) Erosion Event 1.

i. Ask students to think of land uses that could cause erosion. They need to decide whether it is raining hard, moderately, or slightly (this will determine the amount of time between the adding of beads to the river flow). Explain, in this simulation, erosion is occurring, and the brown stones represent water with sediment. Each time a blue stone is picked up, so is a brown one. Without a proper riparian buffer or other ways for rainfall to be slowed down, water (with sediment) moves more quickly than through an area with a robust/proper riparian buffer.

ii. Conduct this scenario simulation for one minute.

iii. Repeat steps iii-vi from B.

e) Erosion Event 2.

i. Ask students to think of another land use that could cause erosion. They need to choose whether it is raining hard, moderately, or lightly. Change either the

	timing of the flow or the number of brown stones picked up with each blue stone (i.e., 2 brown stones per one blue stone). Conduct this scenario simulation for one minute. ii. Repeat steps iii-vi from B. f) F. Erosion Mitigation Event. i. Ask students to think of a way to reduce erosion for one of their erosion scenarios. Conduct a one-minute simulation with the number of brown stones reduced from the container. ii. Repeat steps iii-vi from B. g) Part 2 Summarize and Analyze Data. i. Totals. Instruct students to total the number of blue and brown stones for each simulation and record totals on their datasheets. ii. Ratios. For each erosion event, calculate the ratio of brown stones to the total number of stones. Write the ratios in the erosion event table on their datasheets. 3. **Explain/Reflect: Journaling Questions.** a) As time permits, have students spend some time answering the journaling questions on their datasheets. The journaling may need to be completed at school. b) Why did Spout Run have more water flowing in it than the other three streams? Because the water from the other three streams flowed into Spout Run. c) What are some things we can do to reduce soil erosion that can harm our streams and rivers? (a) Plant trees and other vegetation along river edges to catch soil that would go into the river and to keep the river banks from eroding (b) Don't remove all the plant cover before and during construction of new buildings (c) other ideas? d) What is a mathematical ratio? In mathematics, a ratio is a relationship between two numbers indicating how many times the first number contains the second. For example, if a bowl of fruit contains eight oranges and six lemons, then the ratio of oranges to lemons is eight to six. Wikipedia e) Draw or write the sequence of streams within the Spout Run watershed that flow into the Shenandoah River. See Spout Run Watershed diagram document to check.

Extensions **1. Back at School – Math Connection**

Students calculate how much water flows EACH second in a river. Remember that 1 cubic meter of water is 7.5 gallons.

Full equation: 7.5 gal water/sec X 60 sec/min X 60 min/hour = __27,000__ gallons water/hour

Equation separated into two parts:

a. 7.5 gallons water / second x 60 seconds / minute = ___450____ gallons water / minute

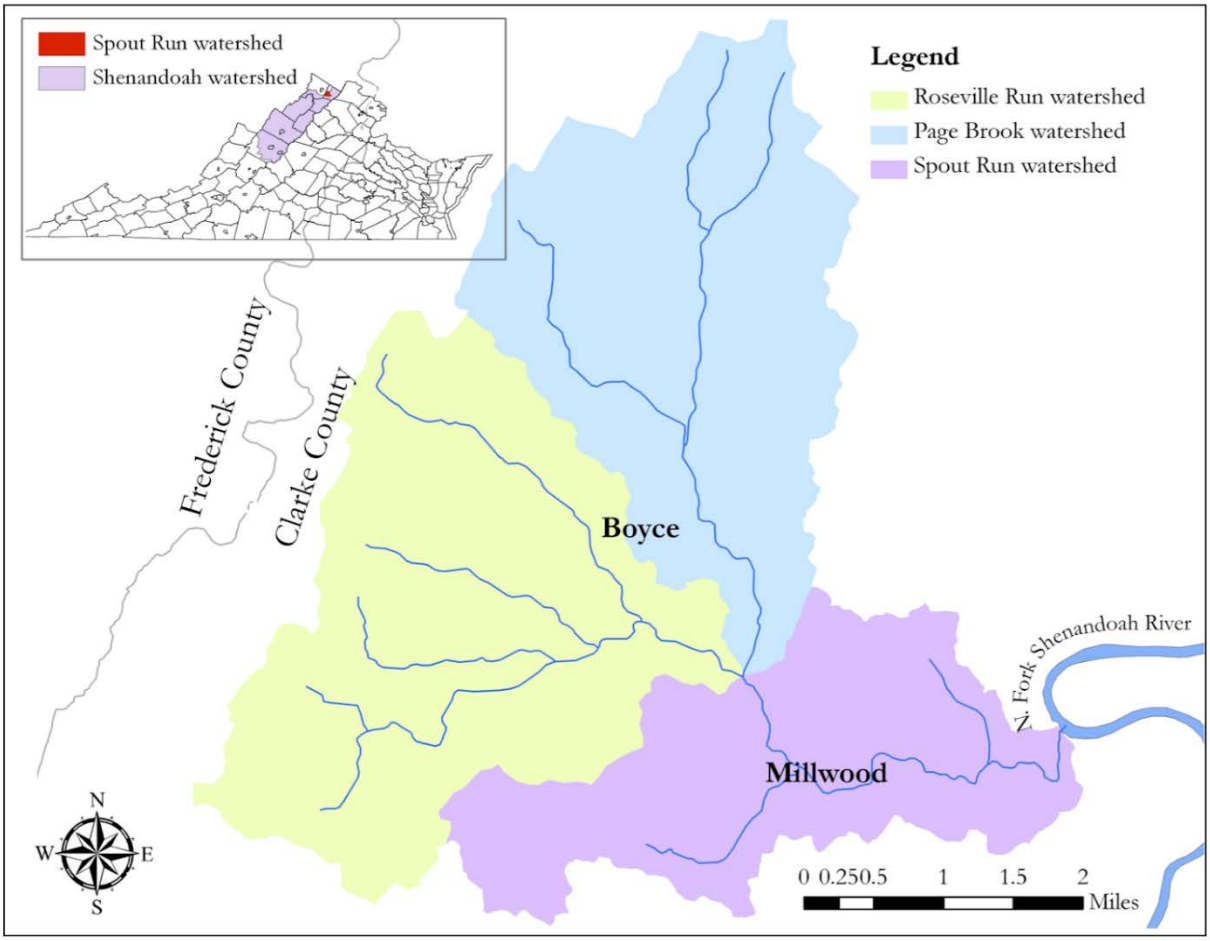
b) __450__ gallons water / minute x 60 minutes / hour = ___27,000___ gallons water / hour

Extend 2 . Back at School in Language Arts or Science Class

Give students additional time to reflect on this investigation and write responses to the journaling questions.

SPOUT RUN WATERSHED

https://spoutrun.org/wp-content/uploads/2010/06/Spout-Run-watershed-map1.png



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Blue-Brown River Investigation

Environmental Event	# of Stones		Total number of blue + brown stones	Water Flow in cubic feet per second (cfs) # of stones x 10 cfs = total cfs
	Blue	Brown		
Light rain				
Heavy rain / thunderstorms				
Erosion Event 1				
Erosion Event 2				
Erosion Reduction Event (How can we reduce erosion?)				
TOTALS				

In the erosion events, what number of the stones were brown, indicating increased sediment going into the river?

Erosion Events	# of brown	What ratio of the whole are these?
Event 1. Describe		
Event 2. Describe		

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Blue-Brown River Investigation

Journaling Questions

1. **What are some reasons that Spout Run had more water flowing in it than the other three streams?**

2. **What can we do to reduce soil erosion that can harm our streams and rivers?**

3. **What is a mathematical ratio?**

4. **Draw or write the sequence of streams within the Spout Run watershed that flow into the Shenandoah River.**

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Blue-Brown River- Back at School

1. **Calculate how much water flows in 1 minute in a river using the cubic foot per minute measure of water flow. How much water flows in 1 hour?**
   Remember that 1 cubic foot of water is 7.5 gallons.

<u>Full equation</u>: 7.5 gal water / sec X 60 sec / min X 60 min / hour = _____ gallons water / hour

<u>Equation separated into two parts</u>:

a. 7.5 gallons water / second x 60 seconds / minute = _____ gallons water / minute

b. **_____ gallons water / minute x 60 minutes / hour = _____ gallons water / hour**

2. **Make a Bar graph comparing the cubic feet / second (cfs) for the Blue River rain events.**

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