5-8 River Erosion Activity

South Carolina Aquarium

Overview

Focus Question
How does sediment get into rivers?

Activity Synopsis
Students examine aerial photographs of rivers in South Carolina to observe the sediment that these rivers carry. Students will conduct an inquiry activity to determine how sediment gets into rivers and how it is transported.

Time Frame
One to two class periods

Objectives
The learner will be able to:

- Conduct inquiry experiments to determine why and how sediment is carried by streams and rivers.

Student Key Terms

- erosion
- sediment

Teacher Key Terms

- alluvial delta
- clay
- critical erosion velocity
- discharge
- gradient
- gravel
- overland flow
- sand
- sediment load
- settling velocity
- water table
- weathering

Standards

South Carolina College- and Career-Ready Science Standards 2021

5th Grade: 5-ESS2-1, *5-ESS3-1*
6th Grade: 6-ESS2-4
7th Grade: 7-LS2-1, 7-LS2-2, 7-LS2-4, 7-ESS3-3

***Bold standards are the main standards addressed in this activity**

2014 Academic Standards and Performance Indicators for Science

5th Grade: 5.S.1A.1, 5.S.1A.2, **5.S.1A.3**, 5.S.1A.4, 5.S.1A.5, **5.S.1A.6**, 5.S.1A.7, **5.S.1A.8**, **5.E.3A.1, 5.E.3B.1,** 5.P.5A.1
6th Grade: 6.S.1A.1, 6.S.1A.2, **6.S.1A.3,** 6.S.1A.4, 6.S.1A.5, **6.E.4A.6**, 6.E.4A.7, **6.E.4B.8, 6.E.2A.3**
7th Grade: 7.S.1A.1, 7.S.1A.2, **7.S.1A.3,** 7.S.1A.4, 7.S.1A.5, **7.E.4A.6**, 7.E.4A.7, **7.E.4B.8**, **7.EC.5A.2**
8th Grade: 8.S.1A.1, 8.S.1A.2, **8.S.1A.3**, 8.S.1A.4, 8.S.1A.5, **8.E.4A.6,** 8.E.4A.7, **8.E.4B.8, 8.P.2A. 5**, **8.P.2A. 7**, **8.E.5A.1**

*** Bold standards are the main standards addressed in this activity**

South Carolina College- and Career-Ready Science Standards 2021

5th Grade Performance Expectations
5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
5-ESS3-1. Evaluate potential solutions to problems that individual communities face in protecting the Earth's resources and environment.

6th Grade Performance Expectations
6-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.

7th Grade Performance Expectations
7-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
7-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
7-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
7-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

2014 Academic Standards and Performance Indicators for Science

Fifth Grade Performance Indicators
5.S.1A.1 Ask questions used to (1) generate hypotheses for scientific investigations or (2) refine models, explanations, or designs.
5.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
5.S.1A.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses and predictions, and develop explanations: (1) formulate scientific questions and testable hypotheses, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.
5.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.
5.S.1A.5 Use mathematical and computational thinking to (1) express quantitative observations using appropriate metric units, (2) collect and analyze data, or (3) understand patterns, trends and relationships between variables.
5.S.1A.6 Construct explanations of phenomena using (1) scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
5.S.1A.7 Construct scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.
5.S.1A.8 Obtain and evaluate informational texts, observations, data collected, or discussions to (1) generate and answer questions, (2) understand phenomena, (3) develop models, or (4) support hypotheses, explanations, claims, or designs. Communicate observations and explanations using the conventions and expectations of oral and written language.
5.E.3A.1 Construct explanations of how different landforms and surface features result from the location and movement of water on Earth's surface through watersheds (drainage basins) and rivers.
5.E.3B.1 Analyze and interpret data to describe and predict how natural processes (such as weathering, erosion, deposition, earthquakes, tsunamis, hurricanes, or storms) affect Earth's surface.
5.P.5A.1 Use mathematical and computational thinking to describe and predict the motion of an object (including position, direction, and speed).

Sixth Grade Performance Indicators

6.S.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge claims.

6.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

6.S.1A.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

6.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.

6.S.1A.5 Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) collect and analyze data, (3) express relationships between variables for models and investigations, or (4) use grade-level appropriate statistics to analyze data.

6.S.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

6.S.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.

6.S.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

6.E.2A.3 Construct explanations of the processes involved in the cycling of water through Earth's systems (including transpiration, evaporation, condensation and crystallization, precipitation, and downhill flow of water on land).

Seventh Grade Performance Indicators

7.S.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge claims.

7.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

7.S.1A.3 Plan and conduct controlled scientific investigation to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

7.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.

7.S.1A.5 Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) collect and analyze data, (3) express relationships between variables for models and investigations, or (4) use grade-level appropriate statistics to analyze data.

7.S.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

7.S.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.

7.S.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

7.EC.5A.2 Construct explanations of how soil quality (including composition, texture, particle size, permeability, and pH) affects the characteristics of an ecosystem using evidence from soil profiles.

Eighth Grade Performance Indicators

8.S.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge claims.

8.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

8.S.1A.3 Plan and conduct controlled scientific investigation to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

8.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.

8.S.1A.5 Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) collect and analyze data, (3) express relationships between variables for models and investigations, or (4) use grade-level appropriate statistics to analyze data.

8.E.4A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

8.E.4A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.

8.E.4B.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

8.P.2A. 5 Analyze and interpret data to describe and predict the effects of forces (including gravitational and friction) on the speed and direction of an object.

8.P.2A. 7 Use mathematical and computational thinking to describe the relationship between the speed and velocity (including positive and negative expression of direction) of an object in determining
average speed (v=d/t).

8.E.5A.1 Develop and use models to explain how the processes of weathering, erosion, and deposition change surface features in the environment.

Cross Curricular Standards

South Carolina Social Studies Standards

6.5.CX, 7.5.1.PR

South Carolina College and Career Standards for Math

6.EEI.9, 6.DS.1

South Carolina College and Career Standards for ELA

Inquiry (I) – 6-1.1, 6-2.1, 6-3.1, 7-1.1, 7-2.1, 7-3.1, 8-1.1, 8-2.1, 8-3.1
Writing (W) - 6-1.1, 6-2.1, 6-3.1, 6-4.1, 6-5.2, 6-6.1, 6-7-1.1, 7-2.1, 7-3.1, 7-4.1, 7-5.2, 7-6.1, 8-1.1, 8-2.1, 8-3.1, 8-4.1, 8-5.2, 8-6.1
Communication (C) – 6-1.1, 6-1.2, 7-1.1, 7-1.2, 8-1.1, 8-1.2

Common Core ELA Standards

Writing – 6.1, 6.2, 7.1, 7.2, 8.1, 8.2
Speaking/Listening – 6.1, 6.4, 7.1, 7.4, 8.1, 8.4
Language – 6.1, 6.2, 6.3, 6.6, 7.1, 7.2, 7.3, 7.6, 8.1, 8.2, 8.3, 8.6
Writing for Literacy – 6-8.1, 6-8.2, 6-8.4

Background

5-8 River Erosion Activity

Key Points

Key Points will give you the main information you should know to teach the activity.

- Streams and rivers have the ability to erode and transport **sediment**. **Erosion** is the picking up of sediment by wind or water. The higher the velocity of water, the better its ability to transport sediment.
- Because streams and rivers can erode and transport sediment, sediment is often carried by these bodies of water all the way from the mountains to the ocean through watersheds.
- Reading aerial infrared photographs
  - These photos were taken from an airplane with an infrared camera in 1999 in different parts of South Carolina.
  - The red areas on the photographs are forested places or other places with lots of vegetation.
  - The greenish-blue areas are areas of low vegetation, such as salt marshes.
  - The white and gray areas are developed areas.
  - Blue areas indicate water
  - Infrared photographs show how much sediment is suspended in the water. Bodies of water that are dark blue in color have almost no sediment suspended in them. Bodies of water that are almost white (very light blue) have a great deal of sediment in them. Depending on how blue or white the water shows up on the infrared photograph is an indication of how much sediment is in the water.
  - The photographs of the mouths of the Edisto River, the Pee Dee River and the Santee Rivers show the outlets of three watersheds in South Carolina. By looking at the coloration of the water in these photographs, students can get an idea of how much sediment is being transported in each watershed. Because the photographs of the Pee Dee and Santee Rivers have more white coloration in them than the Edisto River, this gives the indication that these bodies of water transport more sediment than the Edisto River. This makes sense if students examine a map and see that the watersheds of the Pee Dee and Santee are much larger than the watershed of the Edisto River, and therefore are receiving more water with more sediment.
  - The photograph of the convergence of the Saluda and Broad Rivers shows where two rivers in Columbia, SC come together to form the Congaree River. The Saluda River is dark blue in coloration, indicating very little sediment, while the Broad River is much lighter in color, indicating that it is carrying a lot more sediment. The differences in **sediment load** can be explained by looking at a South Carolina map. This section of the Saluda River is downstream of the Lake Murray dam and reservoir. Because the reservoir slows down the velocity of the Saluda River so much, all of its sediment will drop out, and the Saluda River downstream of the reservoir is carrying very little sediment.
  - *All aerial photographs are courtesy of the Land, Water and Conservation Division of the South Carolina Department of Natural Resources. For information on attaining aerial photographs, topographic maps and other materials contact the SCDNR Map & Information Center at (803) 734-9108.*

Detailed Information

Detailed Information gives more in-depth background to increase your own knowledge, in case you want to expand upon the activity or you are asked detailed questions by students.

South Carolina is a state covered by numerous streams and rivers. These streams perform two major functions important for natural vitality. They remove all the excess water runoff from rainfalls and other precipitation. In the process of removing rainfall, they also erode, transport and deposit **sediment**. By moving sediment, streams and rivers are the major shaper of landforms on approximately 75% of the Earth's land area.

To understand how sediment gets into rivers, one needs a basic understanding of **weathering** and **erosion**. Weathering is the processes by which rock is broken down into smaller particles either by physical or chemical processes. Erosion is the process by which these smaller particles are then transported. Transport of sediment can be conducted by wind, gravity, ice or water. When it rains, water that does not infiltrate the ground becomes runoff. This water will first collect in shallow depressions in the land. As these depressions fill, the excess water will be pulled by gravity downward along the slope of the land. This water moves in a slow disorganized fashion and is known as **overland flow**. As the overland flow moves downhill, it will begin to build in volume and velocity and this increase in power gives it the ability to erode away soil particles. This erosion is the beginning of a stream channel. If water continues to move to this channel and to erode away the sediment in it, it will eventually be deep enough to where it is below the **water table**, the boundary beneath which all of the ground is saturated with water. Being below the water table, allows groundwater to flow into the stream and gives it a source of continual water flow even during dry periods. As these streams move downhill they will eventually join together to form larger streams and rivers.

The ability of a stream to erode and transport sediment is dependent on many factors. Primarily among these is the force and friction produced by the flow of the water. The more velocity and volume water has the more friction it will produce and the more sediment it can erode and transport.

The velocity of a stream is influenced by the **gradient** of the slope it is moving down and the volume of water flowing through it. The steeper the gradient, the faster the water will flow. So a stream in the Blue Ridge Mountains will flow faster than a stream of the same size in the Coastal Plain. Increased water volume will also increase velocity. As more water enters a stream the amount of water moving through the channel increases and the rate it travels will speed up. This is known as **discharge** and is measured in cubic feet per second of water that passes a given point. Velocity is not uniform across a stream, but tends to be faster the deeper the water is, because a larger volume of water is moved in the deeper parts.

Topography and climate both affect the velocity of streams. Mountainous area with steep gradients will have faster streams than flatland areas with gentle gradients. Flatland streams can be faster though if the area receives more rainfall than the mountain area, or if the stream in the flatland has a larger drainage basin than the stream in the mountains, as a larger volume of water will be in that stream. Rainfall amounts fluctuate throughout the year, so stream volumes and velocities will vary with this fluctuation. Generally, though, the larger the drainage basin of the stream or river, the higher that stream's volume, velocity and discharge.

Vegetation also has an effect on the volume of water that reaches a stream. Plants are dependent on water to survive. As it rains, plants will intercept a large amount of the rainfall before it can become groundwater or surface runoff. The water not intercepted by the plants is more likely to become groundwater than surface runoff in these well-vegetated areas, as the soil under plants tends to be very porous. Because plants are intercepting rainwater, streams in these areas are unlikely to have sudden volume increases. The water is more likely to seep in the streams through the groundwater than to arrive as surface runoff. Erosion is low in these areas too, because the root systems of the plants hold the soil and sediment in place and prevent water from carrying it away.

Dry areas with low vegetation have much more surface runoff and are more likely to have flash floods than well vegetated areas. With no plants to intercept the water, and with dry soils tending to have low porosity, almost all of the water will run off the surface, building in volume and velocity. Because a high quantity of water can rush through these areas in a short amount of time, and because there is little vegetation roots to hold soils in place, these low vegetation areas are much more prone to erosion. This was a problem in the Piedmont region of South Carolina during the mid-century. Farming practices cleared large areas of land and with no vegetation on them a great deal of erosion took place. An average of 12 inches of soil was lost to erosion at this time.

The volume and velocity of a stream create friction on the beds they travel over. The volume, velocity and friction create the energy that allows a stream to erode and transport sediment. When the stream has the energy necessary to dislodge sediment, it has reached **critical erosion velocity**. Different sediment sizes will have different critical erosion velocities, and it gets kind of tricky. **Clay**, the smallest sediment with particle sizes under .002 mm, has a very low velocity to transport and can be suspended in water indefinitely. Because of the tiny particle size, though, clay exhibits a great deal of cohesion, (it sticks together well). For this reason, it takes a high critical erosion velocity to erode clay, about the same velocity it takes to erode **gravel**, which has particle sizes more than 500 times that of clay (2.0 to 100 mm). Gravel needs a lot of energy to erode, not because of cohesion, but because of its large size. Unlike the much smaller clay, gravel also needs a lot of energy to transport it, almost as much velocity as it needs to erode it. **Sand**, sediment with particle sizes of .06 to 2.0 mm, requires less velocity to erode than both clay and gravel. This is because it is smaller than gravel but the particles do not have the cohesive property of clay. Because of size differences, though, it requires more velocity than clay to transport and less than gravel.

All sediment sizes also have a **settling velocity**. This is the velocity of water flow at which the water no longer has the energy necessary to transport a specific sediment size. If the water flow dips below that sediment size's settling velocity that sediment size will settle out. For clay, this velocity is very low. The water would practically have to stop flowing for the clay particles to settle out. As particle size increases, the settling velocity increases with it. Rivers can transport sand, but without maintaining a certain velocity, sand will settle out and deposit. Gravel has the largest particle size. For this reason, the water would really have to be ripping to have the power to allow gravel to be transported. This is why it is rare for small rocks to be seen riding the current downstream, though at the right velocity it could happen.

Because the volume and velocity of water is dependent on rainfall amounts, sediment will go through periods of being carried and dropped. During high rainfall times, more and larger sediment can be carried because more water is flowing through the rivers. When the rainfall is low, the river velocity and volume will also lessen and some of the larger sediment will settle out. Then when the rainfall is up again, the volume and velocity will increase and the sediment is picked up again and transported a little farther downstream, until the next dry period comes. This pulsing of stream flow, the regular changes in water volume and velocity, is a normal characteristic of natural streams.

Most streams and rivers dip below their settling velocity for almost all sediments when they flow into a large body of standing water such as a lake or ocean. This causes the sediments to settle out and creates the **alluvial deltas** of places such as the Mississippi River into the Gulf of Mexico and the Santee River in South Carolina into the Atlantic Ocean. The deltas are the sediment deposits of the rivers, generally in a fan-shaped pattern. Not all rivers carry enough sediment to create deltas, but they all transport sediment and when this reaches the sea, it provides some of the sand that replenishes the beaches.

The building of dams on the rivers that has created the many reservoirs in South Carolina, have resulted in large bodies of water that intercept the sediment on the way to the ocean. The river current is slowed down when it flows into these reservoirs and much of its **sediment load** is lost. This creates a problem on the coast as little sand from the mountains can now reach the ocean to replenish the eroding beaches.

For more information on the watersheds of South Carolina and the sediment they carry, see the "Background" information in the "What is a watershed?" activity.

Procedures

Materials

- Sand
- Clay
- Gravel
- Potting soil
- Sod
- Topographic maps of South Carolina
- Map of South Carolina Watersheds
- Aerial photographs
  - PeeDee River
  - Saluda and Broad Rivers
  - Edisto River
  - Santee River
- Water table or large trays
- Measuring beakers
- Food coloring
- Funnels
- Stopwatch

Procedure

1. Students will observe infrared aerial photographs of the mouths of the Santee, Pee Dee and Edisto Rivers as well as the joining of the Saluda and Broad Rivers to form the Congaree River to examine the sediment load of each. (Sediment in the rivers will look white in the aerial photos. The whiter it is, the more sediment that is present. Clear water will be very dark blue). The teacher will pose the questions: how does sediment get into these rivers and how is it transported by the rivers? Why do some rivers have more sediment than others? The class will discuss their thoughts and write their ideas on the board.

2. Students will be broken up into small groups, with at least three members. Each group will come up with a hypothesis as to why they think sediment gets into water. Each group will be shown the materials available to them and will be told to use these to try to determine whether their hypothesis is correct or not. Each group should write their hypothesis down, list the materials they used, describe the experiments they conducted, record the data and observations they collected and write a conclusion describing whether their experiments supported their hypothesis or not.

Helping to Facilitate the Students
If students are floundering while attempting to come up with an experiment, here are some suggestions as to where the activity might go. Sediment is carried by moving water. The faster the water moves the more and larger sediment it can carry. To look into this, students can lay sediment in the middle of a tray and then continuously raise the elevation of one end of the tray. At each elevation, students can pour water on the tray and observe how increased velocity affects the amount of sediment transported. Students can conduct similar experiments with water volume. As water volume in a stream increases, the water velocity increases. Students can conduct experiments to show how increasing the volume of water in the tray will increase the amount of sediment that is carried. Different sediment sizes require different rates of water velocity to be transported. Students can be informed that most of the soils in South Carolina are made of clays and sands and can experiment by pouring water on both of these sediment sizes as well as gravel to see which is transported the easiest.
http://www.scaquarium.org/Curriculum/iexplore/sixth_eighth/units/erosion/erosion_proc.htm - top

Follow-up Questions

(Students may want to create experiments to answer these questions.)

- How do dams affect the water velocity and sediment transporting capacity of rivers?
- How does flowing into large bodies of water such as reservoirs or the ocean affect the water velocity and sediment transporting capacity of rivers?
- How do rivers bring salt to the ocean?
- How do rivers replenish the surrounding area with nutrients?
- If rivers can carry sediment, can they also carry trash and pollutants?

Assessment

Students will write a report of their inquiry experiment in which they write their hypothesis down, list the materials they used, describe the experiments they conducted, record the data and observations they collected and write a conclusion describing whether their experiments supported their hypothesis or not.

Scoring rubric out of 100 points:

Hypothesis clearly written	**20 points**
Materials listed:	**20 points**
Experiment clearly explained:	**20 points**
Data recorded and explained:	**20 points**
Conclusion describes whether their experiment supported their hypothesis or not:	**20 points**

Cross-Curricular Extensions

STEM Extension
In groups of 3, have students research the history of the St. Stephen's Fish Lift. Have them figure out why the fish lift was needed and the hardships and accomplishments that were made along the way. How can this project help us in the future? Have each group put all their research into a presentation to present to the class.

Math Extension
Students will calculate the rate of flow for a local stream or river. Students will drop a natural, biodegradable object in the water, such as a leaf or twig, at a designated start point. The students will time how long the object takes to travel five meters. This will be repeated five times. Students will graph the data and calculate the average time it took the object to travel five meters. Students will

use this to calculate rate of flow (meters/second) and compare this with the amount of sediment (the murkiness) they observe in the water.

Social Studies Extension
Students will reenact a state assembly debate in which students take opposing views on whether a dam should be licensed in South Carolina. The class as a whole will vote at the end.

Language Arts Extension
Students will create a travel brochure for a canoe trip through one of the watersheds of South Carolina. The brochure will describe the different rivers they can travel down in South Carolina and what they can expect on the trip.

Resources

Teacher Reference Books

Cvancara, Alan M. *A Field Manual For The Amateur Geologist: Tools and Activities for Exploring Our Planet,* John Wiley & Sons, Inc., New York,1995.
This field guide contains information on the physical environment.

Kovacik, Charles F. and John J. *Winberry. South Carolina: the Making of a Landscape,* University of South Carolina Press, Columbia, 1989.
This wonderful reference book provides information on the abiotic factors that determine the habitats of South Carolina.

Mitchell, Mark K. *Field Manual for Water Quality Monitoring: An Environmental Education Program for Schools,* Kendall/Hunt Publishing Company, Iowa, 1996.
This field manual offers background information on water quality as well as activities for use in the classroom.

Murphy, Carolyn Hanna. *Carolina Rocks!: The Geology of South Carolina*, Sandlapper Publishing Co., Inc., Orangeburg, 1995.
Information on the geology, topography and formation of all of the regions in South Carolina.

Plummer, Charles C. and David McGeary. *Physical Geology,* Wm. C. Brown Publishers, Iowa, 1991.
Though admittedly college textbooks are often a little too dry and in-depth, with their text, photographs and illustrations they are often the best resources for finding information on a particular subject. This college textbook is an excellent resource for anyone wanting to know more about geology.

Teacher Reference Websites

Chesapeake Bay Foundation Environmental Education
www.cbf.org/
The Chesapeake Bay Foundation has put together an exemplary watershed protection program that encompasses many states. This site includes information on what they have done in this program as well as curricula and other education related items.

EPA'S Environmental Education Center
www.epa.gov/teachers/
Provides information on water and watersheds and links to other sites.

EPA Office of Water: Office of Wetlands, Oceans and Watersheds
www.epa.gov/owow/
Provides information on watersheds, wetlands, water quality plus much more.

South Carolina Department of Health and Environmental Control (DHEC): Bureau of Water
www.scdhec.net/water
This site offers information on drinking water, water pollution control, watersheds plus much more.

Southern Appalachian Watershed Conservation Clearinghouse
http://sunsite.utk.edu/samab/proj/watershed.html
This site offers links to a number of websites related to watershed conservation in the Southeastern United States.

Surf Your Watershed: A Service to Help You Locate, Use, and Share Environmental Information about your Place
www.epa.gov/surf
This site allows you to learn specific information related to the watershed your town is located in.

U.S. Geological Survey
www.usgs.gov/
This site offers valuable earth science information on a variety of topics.

Water Science for Schools
http://ga.water.usgs.gov/edu/
Background information on water and watersheds is provided on this site.

Student Reference Books

Cone, Molly. *Come Back, Salmon,* Sierra Club Books for Children, San Francisco, 1992.
Learn how the students of Jackson Elementary School in Everett, Washington, cleaned a nearby stream, stocked it with salmon and protected it from pollution.

Eyewitness Books: Earth, Susanna Van Rose. Dorling Kindersley, London, 1994.
These very attractive books use photographs, illustrations and text to teach the reader about the earth.

Haslam, Andrew. *Make It Work! Rivers,* World Book Inc./ Two-Can, Hong Kong, 1996.
Readers will explore the rivers of the world and determine how they affect Earth.

Levete, Sarah. *Closer Look At: Rivers and Lakes,* Copper Beech Books,Connecticut,1999.
This book uses photographs, illustrations and text to teach the reader about rivers and lakes.

Taylor, Barbara. *Earth Explained: A Beginner's Guide to Our Planet,* Henry Holt and Company, New York1997.
This book uses photographs, illustrations and text to teach the reader about the earth.

http://www.scaquarium.org/Curriculum/iexplore/sixth_eighth/units/erosion/erosion_res.htm - top**Student Fiction Books**

Cherry, Lynne. *A River Ran Wild,* Gulliver Books/HBJ, San Diego, California,1992.
Follow the environmental history of the Nashua River, from its discovery to present day. Learn how it was polluted during the Industrial Revolution but has since been cleaned.

Curricula

Aquatic Project WILD
Aquatic Project WILD is an interdisciplinary curriculum for K-12 teachers on aquatic wildlife and ecosystems. The activities cover a broad range of environmental and conservation topics.
For more information click on http://www.projectwild.org/ProjectWILDK-12AquaticcurriculumandActivityGuide.htm

JASON Science: Education through Exploration
The JASON Science is an interdisciplinary curriculum for K-12 teachers focusing on the geology, climate, biology and biodiversity of specific regions in the world. The activities cover a broad range of topics.
For more information click on: http://www.jason.org/public/whatis/start.aspx

Project WILD
Project WILD is an interdisciplinary curriculum for K-12 teachers on a broad range of environmental and conservation topics.
For more information click on: http://www.projectwild.org/

Project WET
Project WET is an interdisciplinary curriculum for K-12 teachers on water. The activities cover a wide range of water-related topics.
For more information visit the website at http://www.projectwet.org/

SC MAPS
SC MAPS is a standards-based interdisciplinary curriculum for middle school teachers that focus on the geology of the regions of South Carolina using aerial photographs, images and topographic maps. Great source for good maps!
For more information visit the website at http://www.cas.sc.edu/cege/resources/scmaps/scmaps.html