High School Erosion Unit

Stream Table Lesson Plan

This lesson plan includes instructions for building your own stream table out of inexpensive materials likely to be available in rural Alaska communities. You will, however, need to collect local materials (sand, gravel, dirt, etc.) before freeze-up of streams and rivers and formation of ice along shorelines. If you aren't able to do this, you can order soil materials from a gardening supply company.

If you have limited time and/or materials to construct a stream table, consider engaging your students in the concepts with this interactive online Interactive Erosion Lab https://www.youtube.com/watch?v=ZNJe6hrdL3M. This short video (approx.8 mins.) uses models to demonstrate the action of water and wind on the movement of different types of materials (sand and small rocks to represent boulders) on stream and ocean beach shorelines, on the sides of mountains, and down river channels. A final demonstration places toothpick "trees" on mountainsides to show how they slow the rate of erosion. Instructions to "pause" the video are included so students can draw "after" pictures. The models are constructed within a rectangular plastic tub and can be easily duplicated using readily-available materials.

Key Concepts:

1 Streams naturally meander, or form bends, because the faster water flows as gravity draws it downhill, the more cutting power it has. When it flows a little faster on one side than the other, it erodes the bank on that side. In slower areas it deposits sediment

2. Meandering means that more water can be stored per straight distance ("as the crow flies") of the stream.

3. Allowing streams to meander prevents extreme flooding events because the stream itself is holding more. Meandering also limits the energy of the water and it carries less sediment.

Alaska State Standards (NGSS):

HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes HS-ESS2-5

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

Lesson plan developed by Marilyn Sigman, Alaska Sea Grant, and Anne Garland, ARIES, Inc. 2019.

Background information

Definitions:

Meander = length of actual stream / crow flies distance
Load = The sediment carried by a river

Streams are natural flood regulators. They naturally form sinuous curves and hold more water because the length of the river is longer. The more curves the more water a stream can hold. When streams and rivers can hold more water in their banks, less water is available to flood out onto the flood plain. The curves also create longer but less severe flood events because the water doesn't arrive at the same place at the same time.

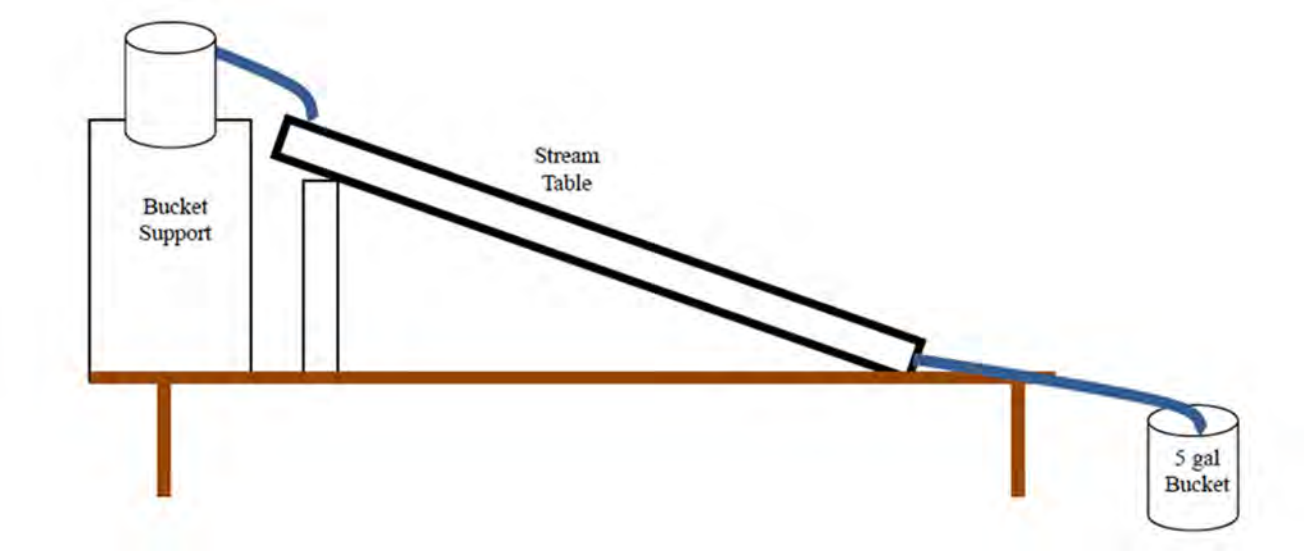
Meandering rivers also have slower water which cannot hold as much sediment. The faster water moves, the more sediment it can hold. Meandering rivers reduce the amount of erosion and the amount of sedimentation downstream. Debris and plans along the banks and in a river also slow the water and reduce erosion.

Preparation and Materials

D-I-Y Stream Table #1
Materials:
4 disposable baking pans 9” X 11”X 3” (e.g., lasagna pans)
Scissors
Coffee filters
Duct tape
Plastic drinking straw,
Hole punch or a nail
2-liter bottle
3 yard sticks or other rigid-wood supports at least 1/4" thick
A stack of books about 5" tall
Large pan to catch water
Sand or dirt (e.g., potting soil), enough to fill the stream table to a depth of one inch.
Add: fake plants, rocks, toys, and other cool things to use as: “dams” “erosion control structures” “fun stuff”

See how a teacher builds this stream table in about 15 minutes:
https://www.youtube.com/watch?v=X0xTSNASG

D-I-Y Stream Table #2



Materials:

1. Stream table Kit (all re-usable)
a. Main Plastic Table Piece
b. 2 Rubber tubes (one for water entering, one for exiting)
c. 5 gallon buckets (two) (one for water going into table, one to catch water leaving table)

d. Sand or ground nut shells for water to flow through
e. Clamp to change water flow through entering tube

3. Towels to dry hands and other wet surface.

4. Toys to change water flow in sand and add interest

5. A support for the bucket that is at the top of the table so a siphon flow can be established

6. 5 Gallons of Water (re-useable)

Set up instructions:

1. Take large plastic piece and find the output hole.
2. Put one piece of rubber tubing into the hole and put a bucket under the output tube (to catch the water).
3. Prop the table up so that the output hole is lower than the input hole.
5. Fill table with either sand or crushed walnut shells and spread out substrate so that it is flat and at least 2 inches below the sides of the table.
6. Fill another bucket with water and create siphon with another rubber tube so the water will flow into the higher portion of the stream table.
7. Add fake plants, rocks, toys, and other cool things to use as: "dams" "erosion control structures" "fun stuff"

Other materials that can be used to extend learning about stream flow dynamics:

- **Kleenex® tissues (single and multiple layers)** can be placed along the shoreline to model the effects of land cover (e.g., tundra and grasses). Tooth picks can model the effect of trees and shrubs on buffering erosion (e.g., green engineering solutions to reduce erosion rates).

- **Crushed ice cubes** (to be added at the "headwaters" of the stream to demonstrate ice jams and flooding impacts during spring melts.)

- **Sources of warm water and cold water** to allow students can test the effect on water temperature on snow melt, ice jamming, flow, and coastal flooding.

  See: https://earthobservatory.nasa.gov/images/81227/ice-jam-on-the-yukon-river-floods-galena-alaska

  https://earthobservatory.nasa.gov/images/85905/flooding-of-dalton-highway

- **Crushed small wood chips, cat litter, or mulch (absorbent material)** can be added to demonstrate a muddy slurry at the head waters to demonstrate volcanic lahar flows after an eruption or of the addition of large amounts of vegetation debris or slash in streams.

  See: **https://volcanoes.usgs.gov/vhp/lahars.html**

  https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2007GC001900

Requirements of the Demonstration Area

a. No electricity needed
b. Acess to water (5 gal) and waste water disposal area
c. Table/flat space
d. Preferably water proof/resistant floor in case of spills

Demonstration/Inquiry Procedures: (20-30 mins.)

1. Set out toys and stream equipment for participants to experiment with as water flows down the stream table.

2. Encourage participants to try different strategies to change the river flow and bank erosion.

3. Change the flow of the water to allow participants to experiment.

4. Change the slope of the stream table to allow participants to experiment

Extensions:

Use a fan to simulate wind.
Add rocks along the channel or crushed ice to the headwaters of the stream.
Compare the effects of warm and cold water on glacier and snow melt (crushed ice cubes) and ice jamming downstream.
Add crushed small wood chips, cat litter, or mulch (absorbent debris) can be added to demonstrate a muddy slurry that would result from a volcanic lahar flows after an eruption or of the input of large amounts of vegetation debris in streams, e.g., from timber harvest or land clearing.

Discussion Questions:

1. How and why do streams form meanders? What's the role of gravity?

2. Where in the stream will the most erosion occur? Why? (Erosion is highest where the materials in the streambank are smallest in diameter and lighter in mass, thus more erodible. Vegetation along the stream bank will slow the velocity of the flow. The velocity of the water is highest on the inside of a bend because the distance is shorter.)

3. What times of the year would the volume of water be largest in the rivers? (This will depend on whether or not the rivers have glaciers at the head and whether rain falls on frozen ground. Glacially-fed rivers in Alaska have the highest flow in late summer or fall after maximum melt while those without glaciers usually peak in the summer after snow melts at higher elevations. Storm events that involve rain falling on frozen ground during the spring or fall can cause floods

and peak runoff. For example, the majority of water runs off the North Slope of Alaska in the spring. Ice jams in the rivers like the Yukon or Kuskokwim during break-up can also cause flooding but this may not be the period of maximum flow for the year.)

4. How would changes in the rate of glacial melting or snowmelt affect the rate of streambank erosion? (Increased rates of glacial melt and changes in the timing of snowmelt patterns could affect the timing and magnitude of flooding and erosion.)

4. Does flooding cause erosion or deposition? (In general, flooding deposits eroded materials because the velocity of the water is slowed as the channels overtop their banks. Rising levels of higher-velocity water within the channel, however, can erode materials from the banks.)

4. What happens to water velocities at the mouth of a stream where it empties out into the ocean? (Stream flows interact with the tidal cycle which can slow them down when the tide is coming in and with storms that push fresh and brackish water back upstream.)

5. How do human activities affect erosion rates, for example:
a. the removal of plants and trees along shorelines next to building or for roads and 4-wheeler trails,
b. straightening streams so more land can be developed,
c. building erosion protection structures along banks (In many cases, this accelerates the velocity of the water "downstream," and can cause more erosion in a different place.)

6. For communities located near or on a river: How does the natural pattern of stream meandering affect the location of erosion threats near our village?