

Lesson Title: How Does Your Stream Flow?

Ohio Standards Connection:

Standard(s): Earth Science

Benchmark(s): (grades 3-5) B: Summarize the processes that shape Earth's surface and describe evidence of those processes.

Indicator(s):

- Grade(4) 8.** Describe how wind, water and ice shape and reshape Earth's land surface by eroding rock and soil in some areas and depositing them in other areas producing characteristic landforms (e.g., dunes, deltas, glacial moraines).
10. Describe evidence of changes on Earth's surface in terms of slow processes (e.g., erosion, weathering, mountain building and deposition) and rapid processes (e.g. volcanic eruptions, earthquakes and landslides).

Lesson Summary: Using a Stream Table, students will become familiar with stream features and the natural processes of erosion and deposition. They will also experiment with materials that might encourage more natural patterns of sediment movement and deposition.

Estimated Duration: class period

Background:

A River Continuum-An Imaginary Stream Tour

Upper Reaches You see several small headwater streams originating from a variety of sources--snow melt, surface runoff, a lake outlet, or groundwater that surfaces as springs. Some may be ephemeral, flowing only during periods of intense rainfall or high groundwater. Some are intermittent, only flowing during the wet seasons of the year. Others are perennial, having year-round flow.

These headwater streams are classified as first order and second order streams. You zoom into one of these small, young streams. It is no more than a few feet wide. It has a fairly steep gradient, or vertical drop over a set distance. Various logs and boulders give it a stair-step appearance. Water cascades over them to form deep plunge pools or step pools. Cobble and gravel fill in around the boulders to cover the stream bottom.

The stream valley that contains the channel is narrow and "V" shaped. The riparian zone, the area of vegetation adjacent to the stream, almost completely covers the stream with its canopy. This zone is composed of some herbs, shrubs and trees; a few deciduous trees that have broad leaves and conifers that have needles.

Very little sun gets to the stream. The plant material that enters the stream in this headwater area comes from outside of the stream. It consists of leaves, needles, and woody stems, branches and tree trunks known as organic debris and woody debris. This material supports the bottom of the food chain, providing food and habitat for the small organisms that are the primary consumers of the stream.

Middle Reaches Downstream in the middle reaches of the river system; some tributaries have entered the stream and added to the flow. It is bigger and deeper, now a third or fourth order stream. It reflects an older system; its channel has widened into a “U” shape and has eroded its stream banks laterally in some places. You can detect a flood plain, a lateral flat area along the stream banks. The stream periodically overflows onto this area, and dumps its load of sediment. The stream has begun to flow across its flood plain in curves or meanders.

The gradient of the stream has decreased. There is no longer a stair-step appearance. The stream still has logs across it, but they are farther apart and are usually accompanied by deeper areas of water called pools. In between the pools are shallower areas of faster moving water called riffles, where a few rocks break the surface. Pools and riffles alternately make up the stream in this area. The bottom substrate is composed of mostly gravel and cobble.

The riparian area is a little wider; its canopy no longer reaches all of the way across the stream. Organic debris still falls in the stream from the riparian zone to feed the primary consumers; however some sunlight gets to the stream, allowing photosynthetic algae to grow and become part of the food base. The composition of the food base changes and nurtures a slightly different community of organisms than in the upper reaches.

Lower Reaches Progressing downstream towards the stream’s mouth, more tributaries have entered and added more flow to create a mainstem river. The wider, deeper channel reflects an older, mature stage. The river flows in big, arcing meanders through a flat flood plain and broad valley.

The bottom substrate of the river may consist of sand, gravel and mud. As the river flows toward its mouth, the load of sediment grows beyond its capacity to carry it. These sediments and debris form a delta as they are deposited. The river is forced to split and follow different paths, giving the channel a braided appearance.

Side channels, sloughs, and wetlands are interspersed throughout. The riparian zone is broad and complex, with different kinds of grasses, shrubs, and trees. It only covers the sides of the river; most of the water is unshaded. The community of small aquatic organisms has changed again. Although the water is unshaded, the turbidity from suspended sediments prevents sunlight from reaching the bottom. Fine particles replace organic debris and algae as the food source for primary consumers.

At its mouth, the river empties into another body of water and carries its remaining load of sediment, debris, and other substances with it.

See Life Depends on Water <http://www.wviz.org/edsvcs/Water/> for more information on watersheds, how streams work and how they are affected by man-made features, and natural features of watersheds.

Concepts to Demonstrate:

Stream Parts:

- Headwaters and mouth
- Meanders, riffles, runs and pools
- Currents and eddies
- Floodplains and riparian corridors

Stream Erosion and Deposition:

- Stream bank (from high flow or unstable geometry)
- Headcutting (from in-stream mining)

- Sand/gravel point bars

Stream bank Protection:

- Armoring (rip, rap, evergreen revetments)
- Deflectors (log, bend-way weirs)
- Move OUT of floodplain

Stream Management:

- Effects of debris vs. habitat enhancement
- Channelization
- Watershed changes (increased imperviousness)

Stream Energy:

- Slope
- Width
- Velocity
- Bedload transport process

Slope Changes:

- Tributaries or mainstem
- Stream age

Instructional Procedures:

1. Borrow “Streamulator” or Stream Table from your local Soil and Water Conservation District. Borrowing this stream table may require a small deposit.
2. Have Streamulator set up and ready to go, but do not start the running water.
3. Begin with several questions to assess what the students already know about streams, or cover these questions through the demonstration:
 - What can you tell me about streams?
 - Where does water in streams come from?
 - What is erosion?
 - Where does the stream deposit the particles that have eroded?
 - How does erosion change the shape of streams?
 - What are some of the factors that determine the shape of streams?
 - Why are different sized particles deposited in different places in the stream?
 - How does the change of slope affect the stream?
 - How does the slope affect the size and shape of the delta?
 - What happens when rocks are placed in the channel?
 - What ways could you reduce the amount of particles, such as soil, rocks and debris being carried by the stream?
 - Why do some streams require the channel to be dredged?
 - How do a stream’s erosion and deposition patterns affect humans?
4. Have learners (may have to split class so that no more than 12-15) gather around the table and adjust themselves so that everybody can see what’s happening.
5. Tell learners that we will be “building” a stream. Cut a channel in the sand that includes at least two meanders (bends).
6. Start the water flowing slowly and steadily. As water begins to flow, discuss the stream features (source, mouth, meander, delta, erosion, riparian zone, floodplain, point bar) and

have the learners point them out on the model. As learners identify the features, have them put in feature flags.

7. Pass out clipboards and observation sheets and instruct learners to note their observations in the first block in the “observation” column. Learners can work in groups or as individuals.
8. Learners can share their observations with the entire group.
9. Ask students to predict what will happen if the slope is increased. Have them write, “slope increased” in next condition box as you raise the table slope at least 1 ½ inches.
10. Have learners observe stream dynamics and makes notes in the observation column.
11. Lower table back down to 2% (1” above crossbar). Ask students to predict what will happen if the flow rate is increased. What would cause an increased rate in a real stream? (Heavy rains, changes in land use along the stream, increase in impervious surfaces).
12. Increase the rate of flow of the stream.
13. Have learners add new condition and new observations to worksheet.
14. Depending on time, you could experiment with other conditions such as using bedrock pieces to line the channel or “vegetation” cloth to simulate cement lined channel. Discuss what channelizing a stream does to downstream areas.
15. Discuss the importance of understanding erosion/deposition factors and how researchers use them to determine the status of a stream so that they can make plans to reduce erosion or encourage more natural patterns of sediment movement and deposition.
16. Discussion could include ways in which experts try to prevent erosion, such as rip-rap, plantings, tree revetments, bioengineering, riparian setbacks, etc.
17. Discuss why or why not it is wise to use rivers as boundary lines (centerline of rivers move as rivers naturally move).
18. Other stream table ideas:
 - What happens if you dam the stream?
 - What happens if you build levees along the river?
 - What happens to houses along the edge of the stream channel during a flash flood (use examples of real floods)?
 - What happens if you build a mountain in the middle of the stream table?
 - What happens if you use two water sources instead of only one?
 - What happens if you use many water sources (like an egg carton with holes)?
 - What happens if you allow the “lake” level to rise by plugging the outlet?

Assessment: Learner understanding can be assessed in a number of ways, including, but not limited to the following. Have learners:

- Draw a “birds-eye-view” of the stream table and label the stream features.
- Write questions they would use if interviewing a stream to discover “Secret” factors that influence erosion and deposition.
- Pretend they are a stream and write several journal entries describing the changes they are going through.
- Make diagrams of the stream under several different conditions.
- Create a poem using the designated stream feature words.
- Work with a partner to develop a crossword puzzle, with definitions, using stream feature words.

Materials and Resources:

- Streamulator or Stream Table (can make one on your own as well)
- Source of water (enough to fill a 5 gallon bucket)
- Clipboards, Writing utensils, Streamulator Observation Sheet and Stream Table Experiment Worksheet (Enough for each student or group of students)

Vocabulary: Headwaters, mouth, meanders, riffles, runs and pools, currents and eddies, Floodplains and riparian corridors, headcutting, sand/gravel point bars, channelization, tributary, mainstem

“A River Continuum” taken from Streamkeeper’s Field Guide Tom Murdoch and Martha Cheo with Kate O’Laughlin. Adopt-A-Stream Foundation, Everett, WA. (425) 316-8592. Pp 7-9.

Streamulator Observation Sheet

Name _____

Condition	Observation
Slow, steady flow with meandering channel	

Stream Table Experiment Worksheet

Name:

Date:

Question: What do I want to find out? _____

Hypothesis: What do I think will happen? _____

Procedure: This is how we set up the stream table. _____

Experimental variable. The ONE condition you change to determine its effect.

Results: What actually happened? _____

Conclusions: What did I learn? _____
