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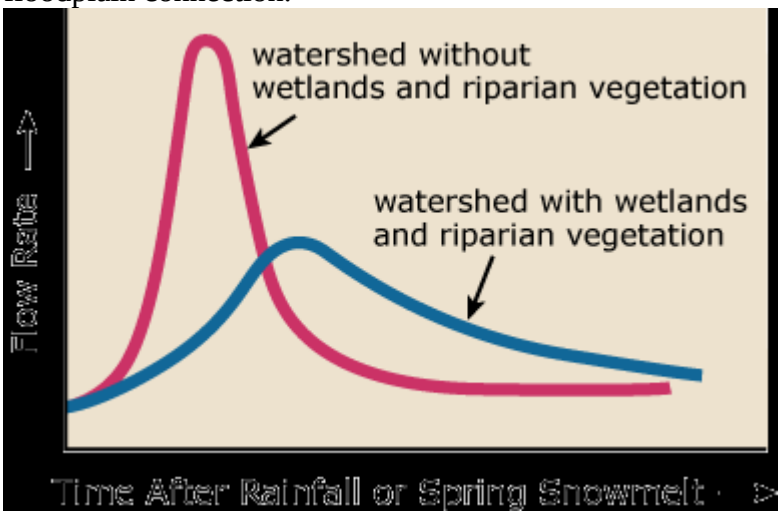
Hydrology and Stream Morphology

Grade Level	5^{th} – 8^{th} grade
Subject Areas	Water
Skills	observation, math skills, graphing
Duration	You may want to pre - flag stream or river banks where students will map morphology and take stream measurements. This can be done in one to several classroom periods depending on the number of measurements taken.
Setting	stream or river
Vocabulary	Velocity Floodplain Stream morphology
Standards Addressed	National Science Education Standards 5-8: Content B – Physical Science (motions and forces), Content D –Earth and Space Science (water, erosion), Content F – Science in Personal and Social Perspectives (resources, changes in environments)
Objectives	**Students will:** ● Record steam flow, velocity and volume of water. This can be measured throughout the year. Different sections of streams or streams with varied stream to floodplain connection can be compared. ● Survey the stream bottom and the floodplain and stream bank to measure the stream to floodplain connectivity. ● Learn about stream morphology and how a complex stream creates diverse stream functions and habitats. ● Could apply Newton's Third Law of Motion (for every action, there is an equal and opposite reaction) to water's most rapid flow pattern within a stream which creates point bars and cut banks.
Materials	● Measuring tapes to cross the stream. ● Measuring sticks to record the water depth ● Ball ● Stopwatch ● Science notebooks or observation recording sheet ● Contour map and cross section map for an introduction/background. ● Optional: watering can
Background	Estimating the amount of water in a stream or river is necessary to predict available water for the many uses for the area (fish needs, agriculture, drinking, hydroelectric). Surveying a stream bank and floodplain connectivity also helps to predict the flow

rate after rainfall or spring snowmelt.

This graph demonstrates typical flow rate models of streams/rivers with and without floodplain connection.



Source: Dunne and Leopold, Water in Environmental Planning.
http://www.mt.nrcs.usda.gov/technical/ecs/watersheds/galsourcebook/gscbk5wet.html

Streams and rivers are always changing and moving in their form. A diversity of stream morphology features allows for a diversity of stream characteristics and habitats. Cut-banks are concave sections of the creek or outside banks of the bend in the stream, receive the greatest amount of energy from the stream, and are locations of stream erosion. Point bars are convex sections of the creek or the inside of the bend, receive the least amount of energy from the stream, and are locations of deposition. Pools provide habitat. Gravels bars, boulders, and/or coarse woody debris can stir up water to increase dissolved oxygen and create more habitat.

Many urban creeks are forced into a narrow single channel which causes the water to deeply incise the channel and disconnects the stream to the floodplain. The floodplain or adjacent wetland has the potential to serve as a sponge/ water storage during heavy flows and to enhance water quality.

Procedure

Optional: flag off the stream length for students to take measurements.

1. Sketch the stream. Note the stream morphology: cut banks, point bars, pools, gravel bars.
2. Place two measuring tapes tightly across the stream from the sides of the stream bank. These tapes will be used to survey the stream bank and make water flow calculations. Note the distance between the two tapes.
3. Divide the class into groups.
4. Measure the depth of the water along the measuring tapes in increments (choose increments depending on the width of the stream). Sketch the cross section of the stream bank. Estimate the cross-sectional area of water from these measurements (add each incremental area measured).
5. Drop a ball at the upstream tape, record the time it takes to travel to the downstream tape. Measure velocity = distance/time. Repeat. Calculate an average.

	6. Determine the amount of flow based on the velocity and cross section area of the stream. Quantity (m^3/s) = velocity of water (m/s) x cross-sectional area of water (m^2). Calculate an average. 7. Note any man-made structures that alter the steam/river. OPTIONAL: If a sandy beach or a sandbox exists, a stream channel can be dug into the sand and water can be poured into the stream, to model water flow and morphology.
Assessment	How are these measurements used in practical life and management? How will these measurements change over the year? How does the different stream morphology features aid in creating diverse stream characteristics and habitats? What size rocks are in the cut bank and point bar? Are they different sizes? If yes, why? Compare measurements to another stream. Calculate how much electric energy this water flow can produce.
Extension	water quality, water cycle, watershed, land management, water conservation survey and compare macro invertebrates in the different morphology features in the stream measuring snow water equivalent in the winter as part of stream flow prediction
Resources	USGS Montana Water Science Center has water data http://mt.water.usgs.gov/ Natural Resources Conservation Service http://www.nrcs.usda.gov/ Project Wet! http://www.projectwet.org/