Stream Velocity

This activity will allow students to make a rough calculation of stream velocity. To determine velocity, students will toss a buoyant object into the stream and measure the time in seconds for it to pass over a stretch of stream, typically 25 or 50 feet in length.

As you will see from the doing this activity, there are a number of variables that might affect the measurement such as imprecise use of the stopwatch. Other factors provide fertile ground for extending the activity if time allows by seeing how speed is affected. These include size, shape, buoyancy and weight of the object and where the object first enters the stream such in a fast-moving current or in an eddy.

Each of these variables and other factors you may encounter make for good discussions with students about scientific method and the importance of controlling for variables. With older or more advanced students who tend to get through the activity more quickly, it is good to keep the activity extensions in mind.

Please take note of the background information regarding stream speed and its relation to discharge- the volume of water that flows by a given point over a period of time. Discharge is the more important issue in understanding the dynamics of a stream and how it affects its banks, the riparian area in which it flows and flood zones.

Although the pre and post discussions are necessary to provide important information about each topic, it is the activity that is most vital to this unit. Be sure to allow plenty of time to complete the activity.

Pre-Activity Discussion (Answers can be found in the Background Information section below)

Before beginning the activity ask students:
1) What is speed?
2) Why is stream speed important?
3) How does stream speed affect turbidity (siltiness)? Erosion? Aquatic life? Discharge?
4) How do impervious surfaces affect stream speed?

The Activity

Equipment

-Stopwatch
-Surveyor's measuring tape
-4 Marker flags
-A lot of small sticks or floats. Sticks are good; you don't need to worry about recovering them. Corncobs and pinecones also work well.
-Calculator (or ability to add and divide)
-Student data page; pencils; clipboard
-Display board
-Hip boots may be helpful but are usually not necessary

Set-up

An ideal stream speed site has a run of 25 feet or more of fairly straight stream channel of fairly uniform width. This run should be free from obstacles (logs, brush, rocks, gravel bars, etc.). Access to the water's edge at both ends of the stream section should be easy and offer good visibility. Streams do not always provide perfect sites so selection may require making do as best one can. Advance scouting is helpful for this activity. Keep in mind that water levels vary so a site that looks good one day may not be so good the next. If necessary, improvise!

1. Select a site and place a flag at the bank at the upstream end of the run. Place another flag on the opposite bank or identify a distinctive object (tree, rock, etc.) to use instead. These flags mark the starting line and should be at a point wide enough to toss a stick well into the stream and with clear visibility.

2. Mark the "finish line" similarly with flags and/or objects at a distance of 25 or 50 feet. (A small stream may necessitate a shorter run.) A measuring tape is provided.

Procedure

1. One student will toss a stick or corncob into the river a few feet upstream from the imaginary starting line that stretches between the two flags and call out "start" when it reaches the line.

2. A second student will stand by the imaginary finish line and call out "stop" when the float crosses the line.

3. A third student, versed in the correct use of the stopwatch, will operate the stopwatch, starting it and stopping it when directed to do so by the other students. Be sure the students have their communication system down well to help ensure accurate measurements. Lastly, remind students not to reset the stopwatch until it has been verified that the time has been recorded

4. A fourth student can handle the clipboard and record the data.

5. There should be time for at least four trials. If you have more than 4 students in a group, rotate responsibilities so everyone is kept as involved as possible.

6. If time allows, do more trial runs testing different variables such as: 1) Size and/or shape of the sticks being used; 2) Tossing the stick into different channels of the stream.

Using the Data Sheet to Determine Velocity

1. For each run, divide *d* (distance) by *t* (time) and record the speed of that run on the data sheet. You will then have four measurements in feet per second. Example: If the run is 50 feet and 32 seconds are required then 50 feet ÷ 32 seconds = 1.56 feet/second.

2. To determine the average speed, add the velocity for each of the trials and divide by the number of trials. Example: 1.24 + 1.43 + 1.25 + 1.51= 5.43 and 5.43÷ 4= 1.35 ft./sec.

Post-activity discussion questions:

1) Did the measurements vary? If so, why? 2) Look at the streambanks, the riparian zone and areas nearby. Are there conditions present that could affect stream speed? 3) What can be done to protect a stream from receiving too much runoff? 4) Stream speed affects discharge. Why is it important to understand discharge?

Background Information

Speed is distance traveled divided by the time required to travel that distance. The example above will look similar to your own results. Another example: If a car travels 30 miles in a half hour, here is the equation: 30 miles ÷ .5 hours = 60 mph.

Importance of stream speed: Stream speed by itself is not a critical statistic. It alone does not tell us if a stream is susceptible to damage from erosion or flash flooding. This information, however, is essential in determining discharge (the volume of water that passes through a stream). Knowing a stream's discharge rate makes it possible to predict the probability and extent of flooding in areas downstream after rain or snowmelt. This is vital to municipal planners and farmers. It also makes it possible to manage impoundments such as reservoirs and manmade lakes that are controlled by dams.

Stream speed is also of value when taken in context of bank and nearby conditions. All streams fluctuate seasonally and due to weather conditions. High water and faster flows in general will cause higher levels of erosion and turbidity than lower, slower flows, and therefore the affects on stream life are greater. When a stream's riparian zone is healthy and has a variety of flora stabilizing the ground, it is better equipped to deal with fluctuations in water levels. This is not the case if streambanks are not properly vegetated and there are impervious surfaces or farm fields nearby that quickly transfer high volumes of water to a stream. In this case, erosion, turbidity, habitat destruction, and the warming of water are much more serious problems.

Increased erosion and turbidity caused by high stream speed can: 1) Create problems with purification for water treatment facilities due to additional silt in the water; 2) Affect the health of fish and macroinvertebrates by gumming up breathing apparatus; 3) Increase water temperature above the level that some living creatures can survive in. Runoff is typically warmer than rain falling directly into a stream or that reaches the stream as ground water. It also carries more silt, which increases water opacity and allows it to heat up more readily.

High flows and increased stream speed can damage habitat for living creatures. Banks can be undercut and eroded and sediments that result from erosion can create a stream bottom not as suitable for harboring macroinvertebrates. Higher stream discharge of warmer water carrying phosphates washed from yards and farms can lead to algae blooms in lakes or reservoirs along the stream's path

Impervious surfaces and farm fields contribute significantly to high flows and high stream speed. Such surfaces result in more runoff reaching the stream and doing so much more quickly, perhaps in minutes or hours rather than in hours and days as in a natural setting. Significant amounts of runoff can make a stream “flashy”, meaning that the stream is more likely to experience flash flooding with more serious amounts of erosion.

The measurements taken in this activity are rather crude. Scientists use electronic equipment and may take 20 or more measurements across a stream. They use the measurements to determine discharge. Knowing the discharge of a stream at various depths and at various locations makes it possible to identify downstream areas that will be susceptible to flooding.

We can help prevent streams from flash flooding and causing damage to riparian zones by protecting natural vegetation in these areas and planting more when necessary; by reducing or preventing runoff through the use of retention ponds, rain barrels and proper farming techniques; and by allowing natural deadfall to remain in a stream to slow the flow of the water.

For this and all other units, advanced level information is available if desired. Contact the HRWC and request an electronic version of the unabridged manual.

Stream Speed Data Sheet

Measure the distance from the start to the finish line of the run between the two marked flags) using the surveyor's tape.

1. Distance from start to finish of float run: *d* = _______________ft.

You will make 4 trials with 4 different sticks. Toss a stick into the stream at the starting line and time its movement to the finish line 4 times.
When told, toss your stick straight out into the water.

2. Record Time in seconds for each run. Calculate Velocity for each run.

Time (Stopwatch Reading at end of run)	Velocity = Distance / Time Example: 100 ft/ 35 sec = 2.9 ft per sec
1.	1.
2.	2.
3.	3.
4.	4.

3. Stream speed = average velocity =
(Velocity 1 + Velocity 2 + Velocity 3 +Velocity 4) / 4 = _____________ft/sec

4. Now compare your stream speed to the list on the display board. Tell how your results compare with the others on the list?

5. Can you think of some reasons why different groups are getting different speeds?

<u>Stream Speed Summary Questions</u>

1. What variables did we notice in our tests?

2. How might changes in the river affect our results?

3. What is a “flashy” creek?

4. How does this affect the health of the river?

5. What can people do to improve this condition?

KEY: Stream Speed Summary Questions

1. What variables did we notice in our tests?

Answers may vary

2. How might changes in the river affect our results?

More rainfall might make the flow faster; less precipitation might make flow slower. A wider stream is slower.

3. What is a "flashy" creek?

A flashy creek is one that experiences pulses or big amounts of water following rain events.

4. How does this affect the health of the river?

Flashy creeks tear away their banks, putting more sediment into the river. They can take away streamside vegetation, making the banks more vulnerable to collapse.

5. What can people do to improve this condition?

   A. Slow down rain water, through fewer impermeable surfaces.
   B. Plant rain gardens.
   C. Plant trees next to streams
   D.

Stream Speed Sample Lesson Narrative

Intro. 5 – 8 minutes. The mission is to make these points: The water in the stream has speed. Speed can vary. When streams get flashy (change speed quickly), erosion can take place that harms the health of the stream and its organisms.

1. 1. My name is _________ and I'm a volunteer with the Stream Speed station. Please tell me your names. (Go around)
2. So when you think the idea of speed, what do you think about? (Solicit 2 or 3 answers.)
3. So we think that speed is how fast something goes. Another way to say that is how far something goes in a certain amount of time. Today we are going to see what the speed of the stream is. We are going to drop sticks in the stream and time how long it takes them to go __(50)_____ ft.
4. You are going to get to help in different ways, and we'll switch so everyone gets to help at least one or two ways.

The Activity. 10 – 15 minutes. Assign the roles. Drop one stick, time and record. Repeat, then switch roles. When you have 3 good pieces of data, change 1 variable. Repeat 1 or 2 more times. If time, change 1 more variable. Variables to test can include length of stick, width of stick, corncobs, type of throw, location of stick at starting point.

5. Go to the stopping point. Show everyone the markers or flags. Leave someone there to shout "Stop" when the stick passes that point.
6. Go to the starting point. Show the markers or flags. Have someone be the one who says, "Start" when the stick passes that point.
7. Show how to run the stopwatch to the timer, including NOT to reset until the data is repeated out loud.
8. Tell the recorder to say the data out loud after it is recorded.
9. Give someone the stick and explain where to aim. (upstream of the start marker)
10. Run the test.
11. Repeat.
12. Switch roles.
13. Repeat 1 or 2 more times.
14. Gather students together. Review the data. Ask what things might have caused differences in the results. Choose one new variable to test.
15. Run the test 2 or 3 times.

The Wrap Up: 5 minutes.

16. Gather the group back at the table/station. Ask "What variables might have affected our tests today?"
17. Explain that when people measure the speed of streams, they use special equipment to take data all across the stream, and at two different levels in order to account for more of the variables.

18. Ask what variables could affect the actual stream speed from day to day and season to season. (Amount of rainfall, vegetation near site, presence of impermeable surfaces nearby or upstream, etc.)
19. Ask or tell what effects could a pulse of fast water have on the stream? (Fast water can cause erosion.)
20. What is harmful about erosion? (Puts more dirt into the water, which clogs gills, affects water temperature, makes it more expensive to clean drinking water, etc.)
21. Ask or tell how people might improve the situation? (Limit runoff, plant trees by streams, not mow to stream edge, etc.)
22. Thanks for visiting with me today. It's time for you to go to your next station _____________.