Name_____ Date_____

Determining Flow Rate

Based on your knowledge of how water moves through a stream, choose two small sections (called "reaches") of the stream equal in length (3 to 10 meters long). One of these should be a stretch that you think will have a lower (slower) flow speed, and one should be a section you believe will have a higher (faster) flow speed. The speed is determined by timing how long it takes for an object to float from one point to another, along a measured stretch of stream; and then dividing the time it took by the distance the object traveled, to get a rate in meters per second (meters/second).

Hypothesis: What do you predict is the speed of each section?

Faster section: _____ meters/second
Slower section: _____ meters/second

Materials per group:

- 1 clipboard, pencil and set of student sheets
- 1 small floating object
- 1 stop watch
- 4 tent stakes
- 1 measuring tape
- Calculators or scrap paper

Procedure:

1. **Divide into groups** of at least 4 students per group. **Assign jobs** to the members of your group (some may need to have more than one job):
    - Measurer(s)
    - Stake Installer(s)
    - Floating Object Dropper
    - Timer
    - Floating Object Retriever
    - Floating Object Observer
    - Data Recorder
2. **Mark off two lengths of stream**:
    - Choose the two lengths of stream: One length should include a section of slow moving water. The other length should include a faster section of water.
    - Measurers: You may choose for the sections to be any length between 3 and 10 meters long. The two reaches of stream should be of equal length.
    - Installers: You will use two tent stakes to mark each length of stream. One stake will be the starting point of the measurement and the other stake will be the ending point that is the chosen length (3 to 10 meters) downstream on the SAME side of the bank.

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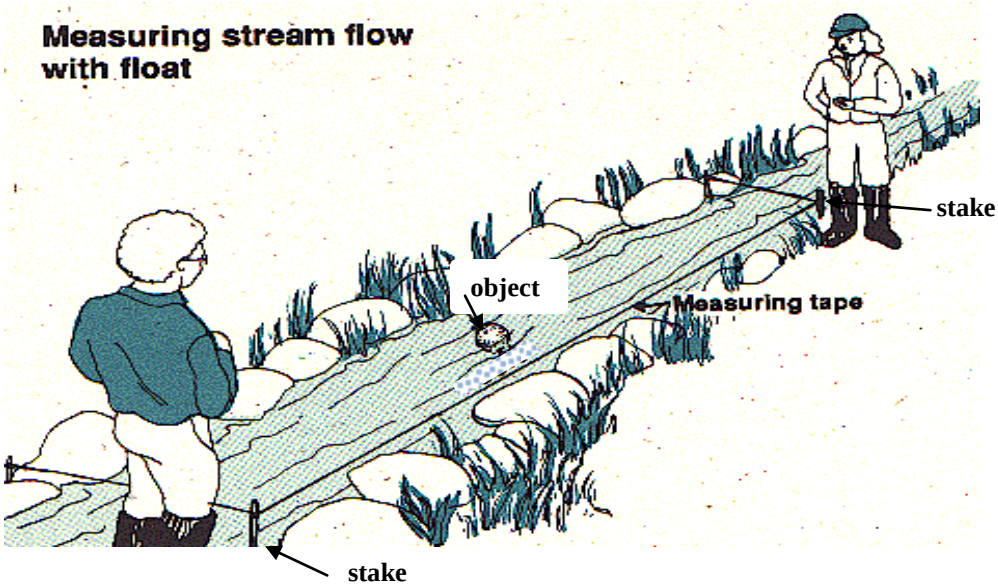
3. **Measure the flow**:
    a. Dropper: One student from each group should stand at the up-stream point of the stream section. When everyone is ready to begin, this student will drop a small floating object slightly upstream of the first tent stake in the FASTEST part of the current.
    b. Timer: Another student from each group should time how long it takes in seconds for the object to float down the section of the stream. They should begin timing IMMEDIATELY when the object passes the first tent stake and STOP when it passes the second tent stake.
    c. Retriever: Have the third student in each group stand down-stream at the end of the section they are measuring and catch the object when it arrives (a dip net may be helpful).
    d. Observer: Have a student from each group walk along the bank to keep an eye on their floating object and write down the data.
    e. Recorder: Record the time for each length of stream in the table provided on the next page.

4. **Repeat the procedure 3 times** each in the faster section and 3 times each in the slower section. Record your data in the data table provided.

5. **Calculate the flow rate**: Determine the speed of the water in each section using the formula provided on the next page. This is the flow rate for these parts of the stream.



http://www.ecy.wa.gov/programs/wq/plants/management/joysmanual/5float.html

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Results:

(1) What was the length of your stream reaches (distance the object traveled)? _____

(2) Record your data in the table:

Trial Number	Time in **seconds** it took for the object to float the **slow** section	Time in **seconds** it took for the object to float the **fast** section	**Example**
1			12 seconds
2			9 seconds
3			11 seconds
Add the seconds recorded for all 3 trails and write the **total** here:			32 seconds
Divide the total # above by 3 to get an average time for the 3 trials. This is the **average** number of seconds the object took to travel the reach.			10.67 seconds

(2) Calculate the speed of the water or the flow rate:

Distance (or length) divided by Time equals Rate. Rate is the flow rate or speed of the water, using the unit "meters per second. "

Distance (in meters) **÷ Time** (in seconds) **= Rate** (in meters/second)

For example: The object travels a 5 meter length of stream in 8 seconds. Divide 5 (length traveled) by 8 (time it took to travel the distance) for an answer of .625 meters/second.

Use your data to fill in the blanks and complete the calculation below.
Because you did 3 trials, you will use the average time for the calculation.

Slow Reach:
Distance _____ meters ÷ Time (Average) _____ seconds = Rate _____ meters/second

Fast Reach:
Distance _____ meters ÷ Time (Average) _____ seconds = Rate _____ meters/second

A little more math…The water at the surface of a stream moves faster than the water at the bottom of the stream. There is more friction on the bottom because the water flows across rocks, gravel or sand, which slows it down. On the surface, there is less friction, so the water moves faster. In order to calculate a more accurate flow rate overall for the stream, biologists adjust for this difference. You can do this by multiplying your average speed for each section by **.85** to get your final answer. Rate (from above) x .85 = Final Flow Rate (meters/second). Record it here:

Final Flow Rate – Slow Reach: _____ Fast Reach: _____

Drawing conclusions:

1. What affect do you think the flow rate of a stream has on the animals that make their home in the stream?

   _____

   _____

   _____

2. What physical and chemical properties of the stream may be affected by the speed of the water?

   _____

   _____

   _____

3. Where does the water in your stream come from? Consider all possible sources.

   _____

   _____

   _____

4. What do you think would happen to the flow rate in the stream when it rains? Why?

   _____

   _____

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