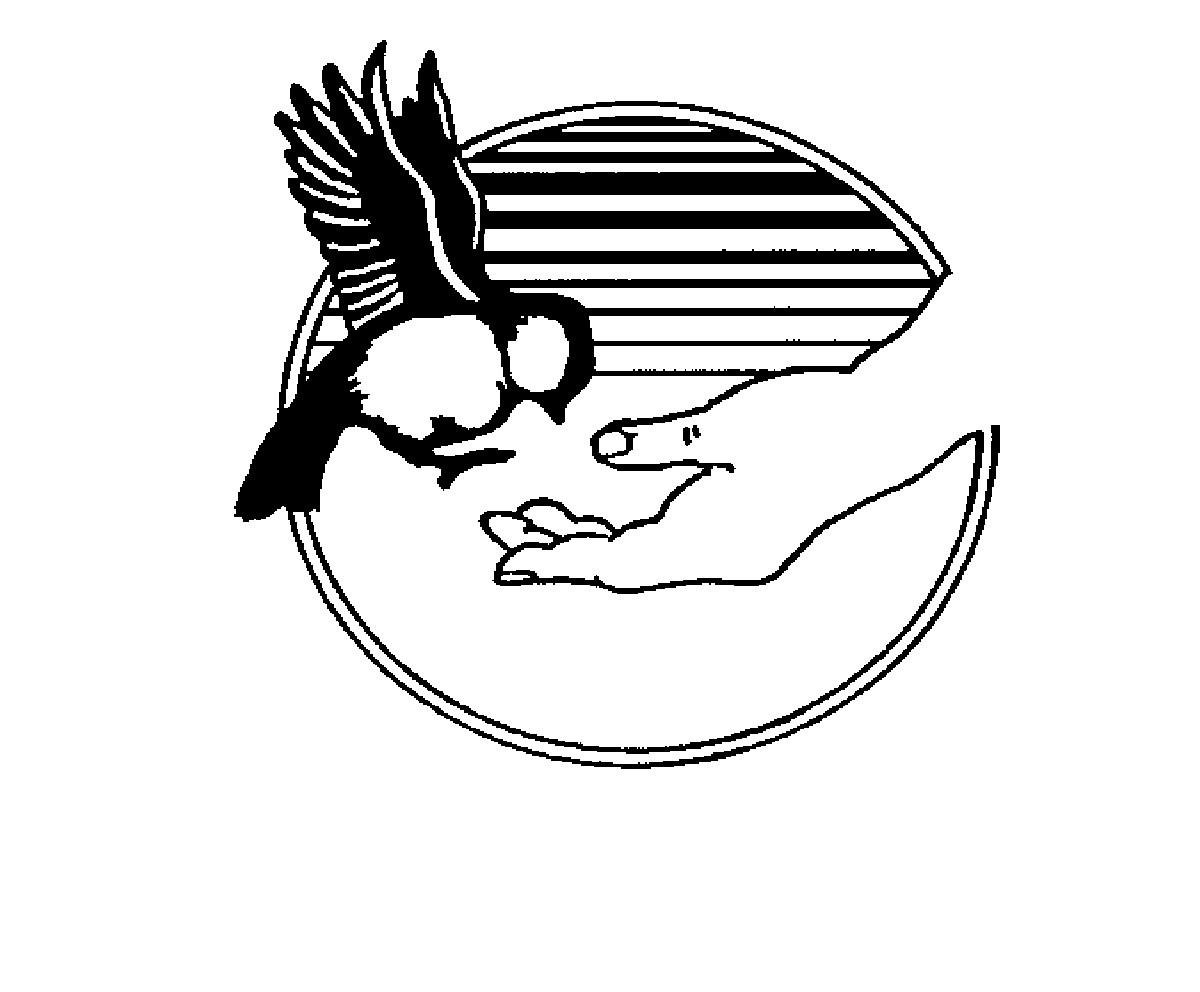
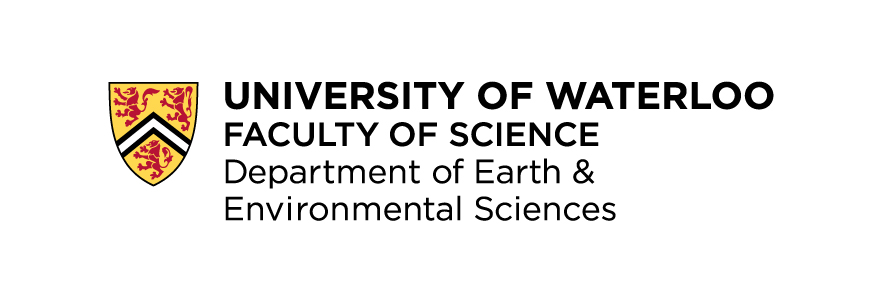
**SES4UI: Earth’s Surfaces and Processes**

**Groundwater:  
Explore, Understand, and Protect**

**Field Activity: Borehole Log, Seepage Meter, and Stream Flow Study**

**Wrigley Corners  
Outdoor and Environmental   
Education Centre**

**Groundwater Geochemistry Remediation Group**

**Borehole Log Activity Sheet**

**Sketch Description  
0m**

**Descriptive Words**

**Topsoil** – Organic material that usually contains grass, roots, leaves, and other debris

**Clay** – Dense compact material. Can have a variety of colours from brown to grey to red. Can be molded with fingers when wet. Gets very hard when dry.

**Silt** – Very fine material between clay and sand.

**Sand** – Loose granular material. Think of the beach.

**Gravel** – Loose material with particle sizes larger than sand. Does not compact very well.

**Tips for Logging:**

Don’t get too detailed! When measuring the length of a soil type, only measure to the first decimal point (i.e. 0.1 m)

**1m**

**2m**

**3m**

**4m**

**5m**

**6m**

**7m**

**8m**

**9m**

**Seepage Meter**

**Background:**A seepage meter is a device used to indicate the direction and speed with which the groundwater is flowing into or out of a stream, river, or lakebed.

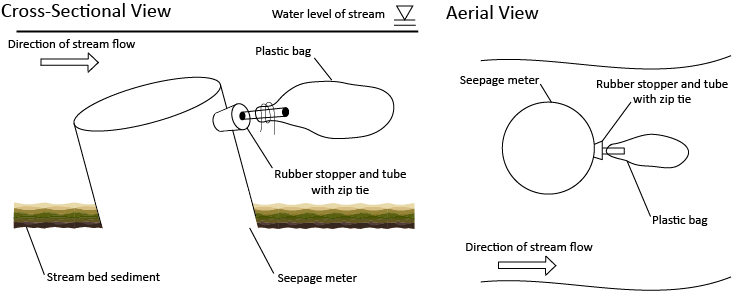
**Objective:**  
Students will use a seepage meter to find out more about the groundwater movement in their location. Calculations will be performed to aid in determining groundwater behaviour.

**Materials:**Seepage meter  
1000mL container  
Plastic bag  
Zip-tie  
Rubber stopper with tubing  
Clock or stopwatch  
Calculator

**Procedure:**

1. Firmly press the seepage meter into the bottom of the stream-bed (at least halfway down), with the hole pointing downstream (water flowing away from you). The seepage meter should be tilted slightly with the hole facing the water surface to release any gas bubbles that may come from sediments in the stream bottom. Avoid disturbing the sediment too much. See the illustration on the activity sheet for visual guide.
2. Measure 1000 mL of water from the stream, and pour it into the plastic bag.
3. Using the zip-tie, securely attach the open end of the water-filled bag to the tubing on the rubber stopper. Squeeze and remove any air that may be in the bag before tightening the zip-tie.
4. Plug the hole of the seepage meter using the black rubber stopper, submerging the bag underwater. Leave the tubing attached to the stopper – **be sure not to let any water escape down the tube!**
5. Record the starting time, and wait for at least 30 minutes.
6. After at least 30 minutes have elapsed, record the time on the activity sheet, and gently pull the plastic bag off of the tube, making sure to prevent any water from entering or exiting the bag.
7. Measure the amount of water remaining in the bag, and record in the table on the activity sheet.
8. Perform the calculations on the activity sheet, and collect data from other groups.

**Seepage Meter Activity Sheet**Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Seepage Meter Placement Illustration:  
  
  
  
­**

**Data Collection Table:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Group #** | **Start Time (hh:mm)** | **Stop Time (hh:mm)** | **Elapsed Time (minutes)** | **Volume Change (mL)** | **Seepage Flux (mL/minute)** | **Darcy Flux (mL/min/cm2)** |
| **1** |  |  |  |  |  |  |
| **2** |  |  |  |  |  |  |
| **3** |  |  |  |  |  |  |
| **4** |  |  |  |  |  |  |
| **5** |  |  |  |  |  |  |

Determine the circular area of seepage meter: \_\_\_\_\_\_\_\_ cm2  
*Note: You will need this to calculate the Darcy Flux* **Calculations:***Volume change is the difference between the original volume in the bag and the final volume in the bag.  
Seepage Flux = Volume change / Elapsed time  
Darcy Flux = Seepage Flux / Circular area of seepage meter*

**Stream Flow Study**

**Background:**In order to better understand surface water movement, we examine the discharge of a stream.

**Objective:**Students will approximate the cross-sectional area of a stream, and use a float to find the discharge.

**Materials:**Measuring tape (25 m – 50 m)  
Metre stick  
Float (Digital flow meter and data logger if possible)  
Calculator

**Procedure:  
Part I: Cross-Sectional Area**

1. Select a section of the stream to be measured (look for a section with a reasonable width, and an unobstructed length of 10 m). Make note of the direction of the stream flow – is it going straight, or curving left or right?
2. (Consider the illustrations on the instruction sheet as a visual guide.) Measure the stream width (from Point A to Point B) using the tape measure. Fasten the tape measure across the stream.
3. Use the metre stick to measure the depth of the stream in 0.5 metre intervals across the fastened tape measure, and record these values in the table on the activity sheet.  
   *Note: Ensure that all groups are travelling the same direction across the stream.*

**Part II: Determining Stream Flow**

1. (Consider the illustrations on the activity sheet as a visual guide.) Use the tape measure to measure a distance of 10 metres downstream from where the cross-sectional area was measured (Point A to Point C).
2. Be ready with the stopwatch. Carefully throw the float into the middle of the stream, and start the stopwatch.
3. Stop the stopwatch once the float has reached 10 metres downstream (to Point C) to obtain the travel time for the float.
4. Collect the float, and repeat Steps 2 and 3 twice more to obtain three trial times.
5. Complete the calculations for stream discharge on the activity sheet

**Stream Flow Study Illustrations:  
  
Cross-sectional view: Overhead view:  
(looking downstream)**

**Point ­A Point B Point A Direction of water flow 🡪**

**Point C**

**Measure depth every 0.5 m 10 m**

**along the tape measure**

**Point B**

**Stream Flow Study Activity Sheet**Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Part I: Cross-Sectional Measurements Table (Point A to Point B)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Interval (m) | Depth (m) | Interval (m) | Depth (m) | Interval (m) | Depth (m) |
| 0.0 | 0.0 | 3.5 |  | 7.0 |  |
| 0.5 |  | 4.0 |  | 7.5 |  |
| 1.0 |  | 4.5 |  | 8.0 |  |
| 1.5 |  | 5.0 |  | 8.5 |  |
| 2.0 |  | 5.5 |  | 9.0 |  |
| 2.5 |  | 6.0 |  | 9.5 |  |
| 3.0 |  | 6.5 |  | 10.0 |  |

*Note: Stream width from A to B may be less/greater than 10 m. Calculate the average (mean) depth below.*

**Part II: Stream Flow Data Table (Point A to Point C)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Travel Time (seconds)** | | | **Average (Mean) Travel Time (seconds)** |
| **Trial 1** | **Trial 2** | **Trial 3** |
|  |  |  |  |

*Note: You will need to calculate the average (mean) travel time for the table.*

**Calculations:** Record calculated values in the table below.

1. Determine the cross-sectional area (m2) by multiplying the stream width (A to B) by the average depth, and record. (You must calculate the average depth.)
2. Determine the velocity of the water by dividing the distance travelled by the float by the average travel time, and record.
3. Drag (friction) between the water and the stream results in a need to correct the velocity to account for the difference in surface velocity versus mid-water velocity. To correct, multiply the velocity from Calculation 2 by 0.85 to obtain a corrected velocity, and record.
4. Determine the discharge of the stream (m3) by multiplying the corrected velocity by the cross-sectional area.

**Stream Discharge Calculation Table:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Stream Width (m) | Average Stream Depth (m) | Cross-Sectional Area (m2) | Float Travel Distance (m) | Water Velocity (m/s) | Corrected Velocity (m/s) | Stream Discharge (m3) |
|  |  |  |  |  |  |  |