LAND EROSION

Does Vegetation Matter?

How does vegetation affect erosion?

ACTIVITY

Activity Overview

Erosion is the process by which the earth's surface is worn away by natural elements such as wind and water. Water that moves over the earth's surface and erodes or carries away soil and other particles is called runoff. As runoff flows into lakes, ponds, and other water supplies, it deposits these particles as sediment. Too much sediment can severely harm aquatic habitats. Lake Alajuela at the Panama Canal, for example, has lost some of its capacity to store water because it is partly filled with sediment.

In this activity, you will collect runoff from two simulated sites: 1) a tray with soil, 2) a tray with grass covered sod, to see how vegetation affects erosion. You will use a Turbidity Sensor connected to a TI CBL 2™ or Vernier LabPro and a TI-73 Explorer™ to compare and examine the runoff from the sites.

Can the effects of runoff on erosion be slowed? How does vegetation affect erosion? Can vegetation reduce erosion?

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Part A — Vegetation

In Part A you will examine the runoff from two simulated sites: 1) a tray with soil, 2) a tray with grass covered sod.

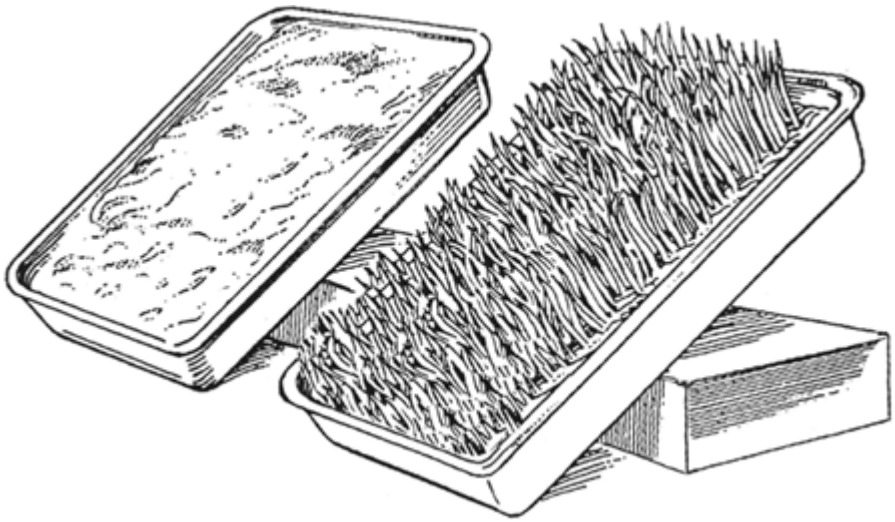
Procedure

1 Label each pan (1, 2).

2 Fill Pan 1 completely with potting soil. Pat the soil down.

3 Fill Pan 2 completely with grass covered sod.

4 Use blocks or books to prop each pan up on one side creating an incline on the surface of the soil and the grass, as shown below. **Important: Both pans must have the same incline.**



5 Place the bottom of each pan on a cafeteria tray to collect the runoff. Label each cafeteria tray (1, 2).

6 Fill both spray bottles with the same amount of water.

7 Turn the nozzle of each spray bottle to the stream position. Start spraying the soil in Pan 1 and Pan 2 evenly with water. The water represents rainfall.

8 Continue spraying until about one cup of runoff has collected in either of the cafeteria trays.

9 Carefully pour the runoff from each cafeteria tray into a sampling bottle. Stir the runoff in each tray before you pour it in a beaker in order to collect any soil particles. Close the lids and label the bottles; Runoff 1, Runoff 2.

10 Complete the Data analysis section. Answer the questions in your journal.

Materials*

- TI-73 Explorer™
- TI CBL 2™ or Vernier LabPro
- TI-73 DataMate
- Turbidity Sensor
- 2 sampling bottles with lids
- Empty Turbidity Cuvette (comes with sensor)
- Turbidity standard (StableCal® Formazin Standard 100 NTU) (comes with sensor)
- Soft, lint-free cloth or tissue
- 1 bag of potting soil (medium size)
- Grass covered sod (enough to fill one large pan)
- 2 clear spray bottles with measurements marked
- 2 large aluminum pans
- Blocks or books to prop up pans
- 2 large cafeteria trays
- Rubber gloves

TI-73 Explorer™

* This activity has been written for the TI-73 Explorer™ but you can easily substitute the TI-83 or TI-83 Plus.

Adapted from "Experiment 3 — Turbidity," Water Quality with Calculators, written by Johnson, Robyn L., Holman, Scott, and Holmquist, Dan D., published by **Vernier Software & Technology**, 2002.

Data Analysis

1. How much water did you spray on the soil of Pan 1?
2. How much water did you spray on the grass covered sod of Pan 2?
3. Which cafeteria tray had more runoff?
4. What does the amount of runoff in each pan suggest about vegetation?
5. How does the runoff in each pan look? (Hint: Is one darker than the other? Do you see soil particles in it?)
6. What does the color of the runoff in each pan suggest about how much soil erodes?
7. What does the color of the runoff in each pan suggest about vegetation?

Turbidity Sensor

Part B — Clarity of Runoff

In Part B you will examine the clarity of the runoff from each pan by measuring its turbidity using a Turbidity Sensor.

Procedure

1. **Connect the Turbidity Sensor to the CBL 2™or Vernier LabPro and TI-73 Explorer™.**
   a. Plug the Turbidity Sensor into Channel 1 of the CBL 2™ or Vernier LabPro.
   b. Use the link cable to connect the TI-73 Explorer™ to the interface.
   c. Firmly press in the cable ends.
2. **Set up the TI-73 Explorer™.**
   a. Turn on the TI-73 Explorer™ and start DATAMATE. (For instructions on DATAMATE see Appendix A.)
   b. Press [CLEAR] to reset the program.
   c. If CH 1 displays TURBIDITY (NTU), proceed to Step 3. If it does not, continue with this step to set up your sensor manually.
   d. Press [1] to go to the SETUP SCREEN.
   e. Press [ENTER] to select CH1.
   f. Select TURBIDITY (NTU) from the SELECT SENSOR MENU.
   g. Select OK to return to the MAIN SCREEN.

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3 Calibrate the Turbidity Sensor.

First Calibration point

a. Press [1] to go to the SETUP SCREEN.
b. Select CALIBRATE, then CALIBRATE NOW.
c. Rinse the empty turbidity cuvette with distilled water, and then fill it with distilled water so that the water level is equal to the level in the 100 NTU standard bottle. Place the lid on the cuvette. Gently wipe the outside with a soft, lint-free cloth or tissue.
d. Check the cuvette for air bubbles. If you see air bubbles, gently tap the bottom of the cuvette on a hard surface to remove them.
e. Holding the cuvette by the lid, place it in the Turbidity Sensor. Make sure that the mark on the cuvette is aligned with the mark on the Turbidity Sensor. Close the lid.
f. When the voltage reading is stable, press [ENTER].
g. Enter "0" as the turbidity of the water.
h. Remove the cuvette from the sensor. Set it aside for use later in Step 5.

Second Calibration point

i. Obtain the cuvette containing the Turbidity Standard (100 NTU) and gently invert it four times to mix in any particles that may have settled to the bottom. **Important: Do not shake the standard. Shaking will introduce tiny air bubbles that will affect turbidity**.
j. Wipe the outside with a soft, lint-free cloth or tissue.
k. Holding the standard by the lid, place it in the Turbidity Sensor. Make sure that the mark on the cuvette is aligned with the mark on the Turbidity Sensor. Close the lid.
l. When the voltage reading is stable, press [ENTER].
m. Enter "100" as the turbidity of the standard.
o. Select OK to return to the SETUP SCREEN.

4 Set up the TI-73 Explorer™ for data collection.

a. Use [▲] and [▼] to select MODE and press [ENTER].
b. Select SINGLE POINT from the SELECT MODE MENU.
c. Select OK to return to the MAIN SCREEN.

5 Prepare your runoff for data collection.

a. Gently invert the bottle with Runoff 1 four times to mix in any particles that may have settled to the bottom. **Important: Do not shake the sample. Shaking will introduce tiny air bubbles that will affect turbidity.**
b. If the cuvette you used to obtain your first calibration point contains distilled water, empty it. Rinse the cuvette with runoff, and then fill it so that the water level is equal to the level in the 100 NTU standard bottle. Place the lid on the cuvette. Gently wipe the outside with a soft, lint-free cloth or tissue.
c. Check the cuvette for air bubbles. If you see air bubbles, gently tap the bottom of the cuvette on a hard surface to remove them.
d. Holding the cuvette by the lid, place it into the Turbidity Sensor. Make sure that the mark on the cuvette is aligned with the mark on the Turbidity Sensor. Close the lid.

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6 **Collect your turbidity data.**

a. Select START to begin sampling.
b. After 10 seconds, the turbidity value (in NTU) will appear on the screen. Record the turbidity for Runoff 1 (soil without vegetation) in your journal. Round to the nearest 1 NTU.
c. Press ENTER to return to the MAIN SCREEN.

7 Repeat Steps 5 and 6 to measure the turbidity of Runoff 2 (grass covered sod).

8 Complete the Data Analysis section. Answer the questions in your journal.

Data Analysis

1 Which runoff sample had the highest turbidity? Why?

2 Turbidity is an indication of the clarity — or lack of clarity — of your runoff samples. Is the runoff sample with the highest turbidity the one that has the darkest color?

3 What does turbidity tell you about the amount of soil removed from each pan?

4 Based on your data and the research article, how does vegetation affect erosion?

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