EXPLORATIONS

Activity 17

The Effect of Run-off on Water Turbidity

Objectives

- To model storm water run-off and its effects on local waterways
- To use data from the model to plot a graph of turbidity and interpret the graph

Materials

- TI-73
- Unit-to-unit cable
- CBL 2™
- Light sensor
- Clear 1000 ml container
- Balance (massing for 10 g)
- 50 g of dirt
- Spoon or scoop
- Stirrer
- Flashlight
- Data Collection and Analysis pages (p. 161 - 163)

In this activity you will

- Make a model that demonstrates storm water run-off.
- Use the CBL 2™ with a light sensor to determine the turbidity of the water in the model.
- Analyze the effect of storm water run-off on local water turbidity.

Problem

What is the effect of suspended dirt on the turbidity of water?

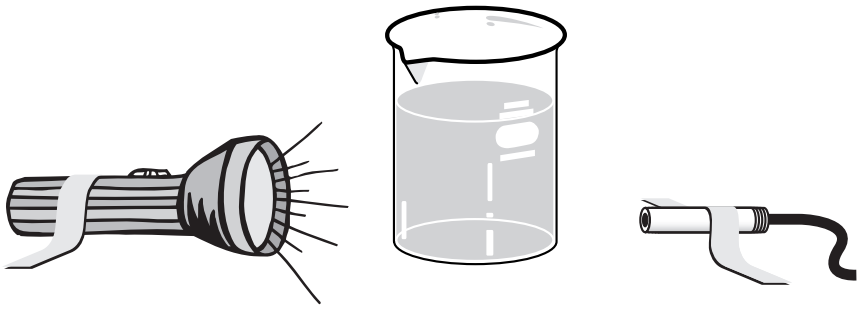
Introduction

When rain hits the land, it is either absorbed by vegetative areas and loose soil or it flows over the hard surfaces into local waterways and lakes. As rainwater runs off hard surfaces such as concrete, asphalt, and evenly packed soil, it gathers speed and is able to carry a large suspension of particles such as soil. The swiftly moving water also can erode land and dissolve pollutants such as fertilizer and motor oil. As the water moves faster and increases in volume, more erosion occurs and more pollutants and soil particles are carried into local bodies of water.

Water clarity is an important parameter in most bodies of water. Algae; phytoplankton; and plants living on the bottom, submerged aquatic vegetation (SAV) need sunlight to manufacture food through photosynthesis. If the turbidity of the water is so great that it will not allow sunlight to penetrate to the necessary depth, plant life will begin to die. Since plants are the basis of the food chain, other animals are soon affected.

Hypothesis

Before testing, complete the **Hypothesis** section on the **Data Collection and Analysis** page to predict how dirt affects the clarity of water. Complete the **Experimental Design** section on the **Data Collection and Analysis** page.



Procedure: Collecting the Data

1. Pour 1000 ml of water into your clear container.
2. Align the flashlight, container of water, and CBL 2™ light sensor so that the light passes through the container of water directly into the light meter.
3. Plug the TI light sensor into Channel 1 (**CH 1**) on the CBL 2.
4. Start the DATAMATE program.
5. The Main Screen is displayed. **CH 1:LIGHT(LX)** is displayed at the top of the screen.
6. Select **1:SETUP**.
7. Select **CH1**. Select **7:MORE** and **5:LIGHT**. Select the appropriate light sensor.
8. Select **1:OK** to return to the Main Screen.
9. If **MODE:SELECTED EVENTS** is displayed, go to step 12. If not, go to step 10.
10. Select **1:SETUP**. Select **MODE**, and then select **5:SELECTED EVENTS**.
11. Select **1:OK** to return to the Main Screen.
12. Turn on the flashlight. When you are ready to begin, select **2:START**.
13. When the light intensity reading is steady, press ENTER. The value is collected.
14. Add 10 g of dirt to the water and stir.

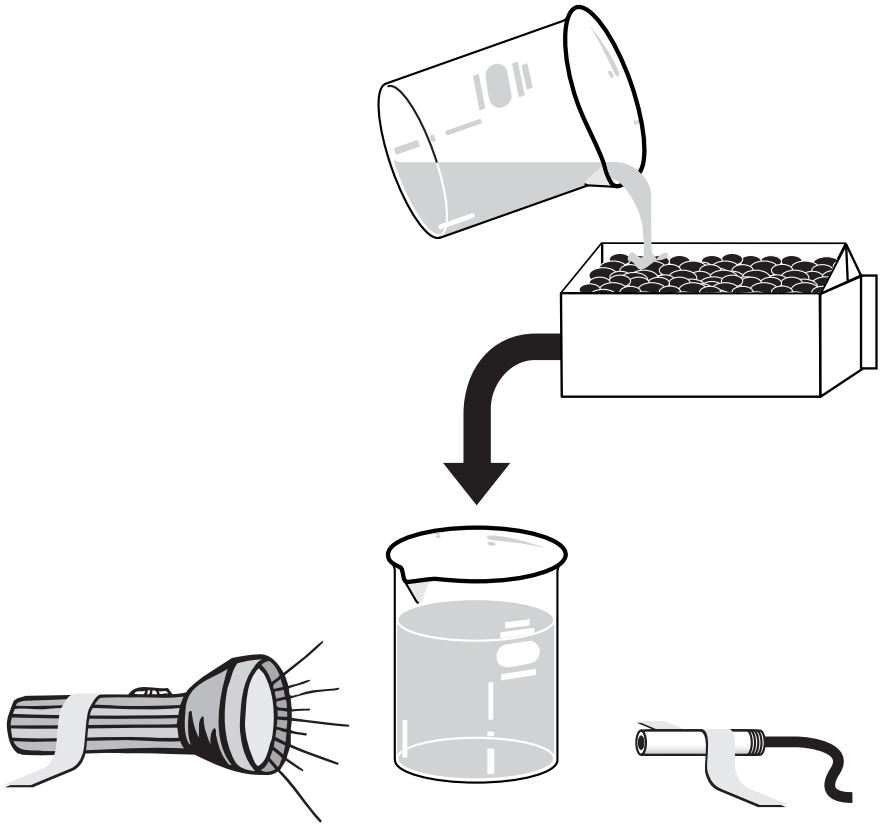
15. When the dirt is dissolved in the water and the light reading is steady, press ENTER to collect the reading from the light sensor.
16. Repeat steps 14 and 15 until 50 g of dirt have been added to the water.
17. After you have added all of the dirt and collected the last light reading, press STO▶. A scatter plot is displayed showing the light reading for each test. Use ▶ and ◀ to move to each data point. Record the values in the table on the **Data Collection and Analysis** page.
18. Sketch the graph on the **Data Collection and Analysis** page.
19. To exit from the DATAMATE program, press ENTER to return to the Main Screen. Select **6:QUIT** and press ENTER.

Data Analysis

After testing, answer the questions on the **Data Collection and Analysis** page to analyze the effects of storm water run-off on water turbidity.

Extension

Set up an experiment to test the run-off from different types of land surfaces as illustrated below. Place materials in the carton such as dirt, gravel, or rooted grass. Create a rainstorm onto your carton. Set up the flashlight and CBL 2™ light sensor as before to test the turbidity of the water.



Discuss your results. Include the following: problem, hypothesis, independent variable, dependent variable, constants, number of trials, and conclusion.

Data Collection and Analysis

Name _____

Date _____

Activity 17: The Effect of Run-off on Water Turbidity

Problem

What is the effect of suspended dirt on the turbidity of water?

Hypothesis

As the amount of suspended dirt in water increases, the turbidity of the water will

_____ .

Experimental Design

1. Independent Variable: _____
2. Treatments: _____

   _____

   _____

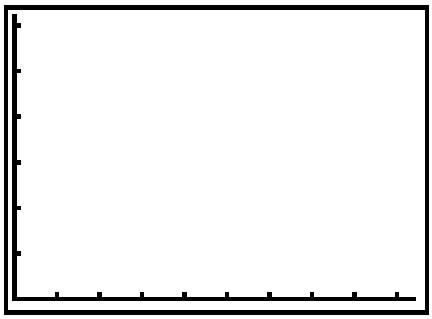
   _____
3. Dependent Variable: _____
4. Number of Trials: _____
5. Constants: _____
6. Control: _____

Data Collection

1. After testing, use the scatter plot to record the light readings corresponding to the amount of dirt in the water in the table below.

Amount of Dirt (g)	Intensity of Light Passing Through Water
0	
10	
20	
30	
40	
50	

2. Draw and label the graph of your data below or print it on the computer and attach it to this page.



Data Analysis

1. What does the shape of the graph represent?

_____

_____

2. What does the *y*-intercept represent?

_____

_____

3. What does the flashlight represent?

_____

_____

4. How does storm water run-off and the dirt suspended in this run-off affect local waters?

_____

_____

5. What is the relationship between the amount of dirt washed into the water to the turbidity of the water?

_____

_____

6. Why is this an important relationship to understand? How does this affect the food pyramid of this ecosystem?

_____

_____

_____

7. Explain how a stream or lake might be affected by a rainstorm in a paved area and a dirt field.

_____

_____

_____

_____

8. How is this different from what you might expect in a forested area?

_____

_____

_____

_____

Conclusion

As the amount of suspended dirt in water increases, the turbidity of the water will

_____ .

Teacher Notes

Activity 17

The Effect of Run-off on Water Turbidity

Objectives

- To model storm water run-off and its effects on local waterways
- To use data from the model to plot a graph of turbidity and interpret the graph

NSES Standards

- Science as Inquiry: Abilities necessary to do scientific inquiry
- Science as Inquiry: Understanding about scientific inquiry
- Science in Personal and Social Perspectives: Populations, resources, and environments
- Science in Personal and Social Perspectives: Natural hazards
- History and Nature of Science: Nature of science

Preparation

- To save class time, put 10 g of dirt into small cups. Prepare five cups of dirt for each lab group.
- If possible, use the same kind of flashlight for each group.
- Tell the students if there is something they should put the flashlight and light sensor on to line them up or if they can just lay them on the table.
- This experiment can be done as a qualitative demonstration using spoonfuls of dirt rather than measuring the dirt. It still makes the point that the relationship of the amount of suspended particles in water to the water's turbidity is exponential. The initial run-off has the most devastating effect on water clarity.

Management

- Assign these student jobs for this lab:
  - Materials/setup person (sets up samples, sensor)
  - Tech person (operates CBL 2™ and TI-73)
  - Data recorder (reads light intensity readings from the TI-73 at each collection interval)
  - Runner (brings CBL 2 and TI-73 to the computer to print graphs with TI-GRAPH LINK™ or TI™ Connect and brings **Data Collection and Analysis** pages to the teacher)

- Clear covered plastic shoeboxes will hold a CBL 2, pH sensor, cups, rinsing bottle, and other equipment neatly at each station. If students are sharing one pH sensor, representatives from each lab group would bring test beverages in the cups to the sensor. Mounting the sensor on a ring stand is an option.
- Students can record light intensity readings in their lab journals as they are displayed on the TI-73. This keeps them engaged throughout the data collection period and if they lose the data/graph later, they can still write up their lab reports. Students can also access the data in the TI-73 lists after data collection. You can send the lists to all students' calculators using APPS **1:Link**:

  a. Press APPS.

  b. Press ENTER to select **1:Link.**

  c. Select **4:List** and press ENTER.

  d. Press ▼ to move the ▶ beside the list you wish to send. Press ENTER.

  e. Repeat step **d** for each list you wish to send.

  f. Set the receiving unit by pressing APPS ENTER ▶ to select **RECEIVE**. Press ENTER. **Waiting…** displays on the TI-73 screen.

  g. On the sending unit, press ▶ to select **TRANSMIT** and press ENTER.

  For more permanent storage of data, use TI-GRAPH LINK or TI Connect to save the lists in a computer folder. However, students may inadvertently lose their data or overwrite it in the next trial, so recording data in journals is a good option.
- Students can assess each other using a teamwork rubric after the lab. Provide a checklist of positive and negative behaviors. Copy these on quarter sheets of paper.
- You can enter data from each lab group into a class computer spreadsheet or manually record it on an overhead transparency. Have one student from each group responsible for recording the data during the period. This will provide repeated trials for the experiment if time does not allow each lab group to perform it more than once.

Assessment

- Students can print line graphs using TI-GRAPH LINK™ or TI™ Connect and label the horizontal axis as the amount of dirt and the vertical axis as water turbidity. Students can also paste their graphs into a word processing document and write summaries.
- Students may form conclusions about the impact of sediment run-off on water clarity based on their data.
- Students may design a lab to investigate the effect on the ecosystem of the introduction of other variables such as fertilizer or sand from run-off.

- Students can compare and contrast the data from their designed experiment to data from the original experiment using graphs to justify their results.

Selected Answers

Experimental Design

1. Independent Variable: *amount of dirt*
2. Treatments: *10 ml, 20 ml, 30 ml, 40 ml, 50 ml*
3. Dependent Variable: *turbidity*
4. Number of Trials: ——
5. Constants: *amount of water, type of dirt*
6. Control: *water with no dirt added*