Science Objectives

- Make a model that demonstrates storm water run-off.
- Analyze the relationship between local water turbidity and storm water run-off.

Vocabulary

- exponential function
- light intensity
- particle
- run-off
- soil
- turbidity

About the Lesson

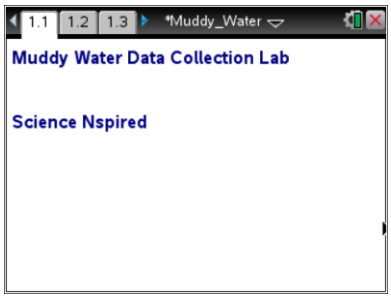
- This lesson involves using a light sensor to analyze the effect of soil run-off on the turbidity of water.
- As a result, students will:
  - Measure the light intensity through a container of water with various amounts of soil in it.
  - Analyze the exponential relationship between storm water run-off and water turbidity.

TI-Nspire™ Navigator™ System

- Send *Muddy_Water.tns* file.
- Monitor student progress using Screen Capture.
- Collect *Muddy_Water.tns*.
- Use Live Presenter to spotlight student data.

Activity Materials

- TI-Nspire™ Technology
- Vernier® EasyLink™ or TI-Nspire™ Lab Cradle
- TI Light Probe
- Clear 1000 mL container
- 50 g of dirt
- Spoon or scoop
- Stirrer
- Flashlight



TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Grab and drag a point

Tech Tip:

Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

Student Activity

- Muddy_Water_Student.pdf
- Muddy_Water_Student.doc

TI-Nspire document

- Muddy_Water.tns

Data Collection Set-Up

To save class time, put 10 g of dirt into small cups. Prepare 5 cups of dirt for each group. Pour 1000 mL of water into a separate, clear container for each lab group. If possible, use the same kind of flashlight for each group.

> **Tech Tip:** You may demo this activity using the Teacher Software so that the entire class can see the process. For demonstration purposes, you may add dirt one spoonful at a time to the water (instead of measuring out 10 g quantities). If you have only one light sensor, have each group individually perform this activity. If you have enough light sensors units, have students work in small groups.

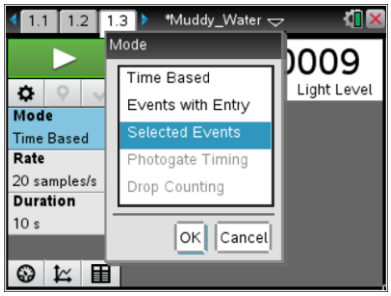
Discussion Points and Possible Answers

1. Have students align the flashlight, container of water, and the light sensor so that the light passes through the container of water directly into the light meter.

2. Have students turn on the flashlight.

Move to page 1.3.

3. Instruct students to plug the light sensor into the Vernier EasyLink or TI-Nspire Lab Cradle and connect to the TI-Nspire technology.
4. Have students select **Mode: Selected Events**. Then, select the **Start** button.



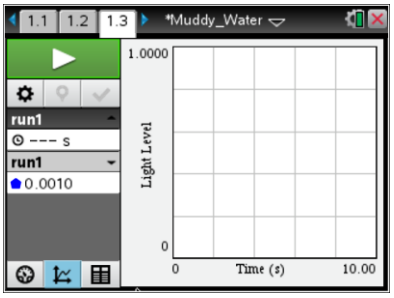
5. When the light intensity reading is steady, students should select the **Keep** button. The value is collected.
6. Then, have students add 10 g of dirt to the water and stir.
7. When the dirt is dissolved in the water and the light reading is steady, students should select the **Keep** button to collect the reading.
8. Have students repeat steps 6 and 7 until 50 g of dirt have been added to the water.

9. After students have added all of the dirt and collected the last light reading, they should select the **Stop** button. A scatter plot is displayed showing the light reading for each test. Students should click **Table View** to display the data table on the handheld and record the values in the table below.

NOTE: The data in these tables are simulated. Actual data will be slightly different.

Amount of Dirt (g)	Intensity of Light Passing Through Water
0	1.95
10	0.76
20	0.23
30	0.06
40	0.05
50	0.04

10. Have students draw and label the graph of their data on the axes provided.



Move to pages 1.4 - 1.9.

Have students answer questions 1 - 6 on their student activity sheets and/or in their .tns files.

Q1. Describe the shape of the graph.

Sample Answer: It forms a curve; it decreases exponentially.

Q2. What does the *y*–intercept represent in this situation?

Answer: The *y*-intercept is the intensity of light passing through the water when there was no dirt in the water.

Q3. What did the flashlight represent?

Answer: sunlight

Q4. Between which amounts of dirt did the intensity of light change the most?

Answer: between 0 g and 10 g

Q5. Between which amounts of dirt did the intensity of light change the least?

Sample Answer: Answers will vary. For the sample data given, between 30 g and 40 g, and also between 40 g and 50 g.

Q6. Describe how storm water run-off affects local water turbidity. When will the most devastating effect on water clarity occur?

Answer: Water clarity will decrease the most with the initial-run off. The turbidity will continue to increase as the run off continues, but it will do so with less of an impact.

Wrap Up

After the students have finished the lab, have students think about how the lab is similar to and different from an actual storm water run-off model. For example, have them think about the different types of run-off that might enter a local body of water (soil, fertilizers from farms, gasoline from roads, cleaning chemicals). Have students think about how they could redesign the experiment to observe the effects of some of these different factors.

Extension

Have students set up an experiment to test the run-off from different types of land surfaces as illustrated. Have students place materials in the carton such as dirt, gravel, or rooted grass. Then, instruct them to create a rainstorm on their carton. Have them set up the flashlight and light sensor as before to test the turbidity of water. Students should write up the results in a report.