Science Objectives

- Determine the heating rates of wet sand and dry sand
- Describe the effect of evaporation on heating rates

Vocabulary

- evaporation
- heat
- temperature
- mass

TI-Nspire™ Technology Skills:

- Open a document
- Set up a data collection

Tech Tip:

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

About the Lesson

- In this data-gathering activity, students will explore the temperature differences in two sets of sand, one dry and one wet. They will gather the data, display it in a spreadsheet, and then graph it. Then students will analyze the data and graph and draw conclusions about the temperature differences.

TI-Nspire™ Navigator™

- Send out the *Day_At_The_Beach.tns* file.
- Monitor student progress using Screen Capture.
- Use Live Presenter to allow students to show how to set up the lab.

Lesson Files:

Student Activity

- Day_At_The_Beach.doc
- Day_At_The_Beach.pdf

TI-Nspire document

- Day_At_The_Beach.tns

Activity Materials

- *Day_At_The_Beach.tns*
- TI-Nspire™ Technology
- Temperature Probe
- Two small aluminum trays
- 1000 ml sand
- Water
- Heat lamp

Discussion Points and Possible Answers

Many vacationers end up on a beach. On hot summer days, dry sand can get so hot it hurts to walk on it. But the wet sand near the water feels cool and refreshing.

Evaporation occurs when water changes from a liquid to a gas. This requires an input of energy, usually heat energy. As heat energy necessary for evaporation is transferred to the water molecules, the matter from which the heat energy is derived is cooled.

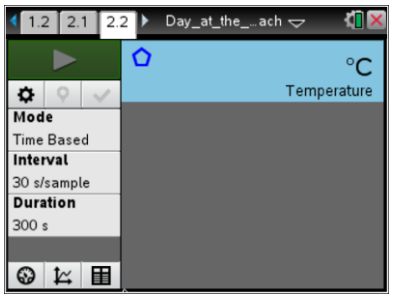
Allow students to read the background information on the activity sheet before continuing with the lab.

Set Up:

1. Students are to place 500 ml of dry sand into each of the two aluminum trays.

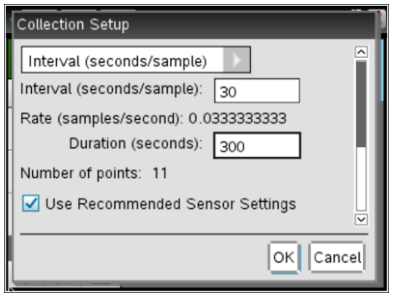
2. Make sure students add enough water to one pan to thoroughly dampen the sand. They need to use room temperature water to keep the initial temperatures of the sand in the two containers the same. It is important that the starting temperatures of the wet and dry sand be as close as possible.

3. Heat lamps with clamps designed for labs are optimal; however, student desk lamps with flexible necks and 60-/100-watt bulbs work fine. Make sure that students keep the distance from the heat source constant for both trials.



4. Students connect the Temperature Probe to the data-collection interface. Connect the interface to the TI-Nspire handheld or computer. (If they are using an EasyTemp or Go!Temp, they do not need a data-collection interface.)

5. Students are to choose **Menu > Experiment > New Experiment**. Choose **Menu > Experiment > Collection Setup**. Then they choose **Interval (seconds/sample)** from the drop down menu. Enter **30** as the interval (seconds/sample) and **300** as the experiment duration in seconds (5 minutes) and select OK.



Note: The .tns file has already set up the experiment for students.

DATA COLLECTION:

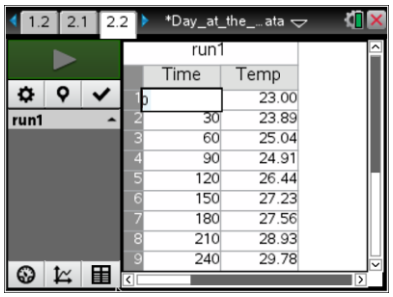
6. Now students bury the end of the temperature sensor 0.5 cm below the surface of the dry sand.

7. Students place the heat lamp 20 cm above the tray of sand.

8. When students are ready to begin, they can start the data collection by pressing . At the end of each 30 second interval, a data point is plotted on the graph.

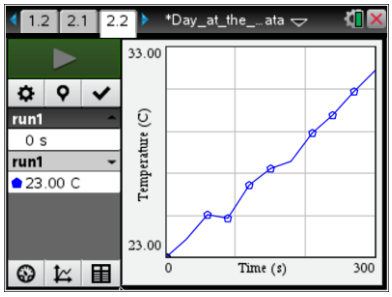
9. Students should continue to hold the sensor in the dry sand. After 11 data samples are collected from the sensor and plotted, the line graph is displayed.

10. Students can click the data table tab to see each data point and record the values in the table on the activity sheet. They can sketch the graph to the right of the table on their activity sheet.



11. Finally, students will repeat steps 1 – 5 for the tray of wet sand. They can sketch both graphs on the graph to the right of the table on their activity sheet.

Time (seconds)	Temperature of Dry Sand (°C)	Temperature of Wet Sand (°C)
0	*23*	*23*
30	*23.89*	*23.27*
60	*25.04*	*23.44*
90	*24.97*	*23.91*
120	*26.44*	*24.05*
150	*27.23*	*24.57*
180	*27.56*	*24.66*
210	*28.93*	*25.02*
240	*29.78*	*25.22*
270	*30.91*	*25.31*
300	*31.93*	*25.72*



After entering their data, students can move to pages 3.1 – 4.1 and answer questions 1 - 6 on the activity sheet, in the tns. file, or both.

Q1. What do the slopes of the lines on the graph represent?

Answer: The slopes of the lines on the graph represent the rate of heating of the sand.

Q2. What do the differences in the two slopes indicate about the heating rates of the wet and dry sand?

Answer: The positive slope indicates that the temperatures of the sand increase with time. The steeper slope of the dry sand indicates that the rate of heating is faster than the wet sand with the less steep slope.

Q3. What does the *y*-intercept represent?

Answer: The *y*-intercept represents the initial temperatures of the trays of sand.

Q4. Compare the temperatures of the wet and dry sand at the same time intervals. How does water affect the heating of the sand?

Answer: Water keeps the temperature of the sand cooler for longer.

Q5. Compare the change in temperature for the dry sand and wet sand.

Dry sand: starting temperature (____°C) – ending temperature (____°C) = (____°C)

Wet sand: starting temperature (____°C) – ending temperature (____°C) = (____°C)

Answer: Answers will vary. Answers using sample data: Dry sand 9.8°C, Wet sand 3°C

Q6. _____ sand heats faster in the sun than _____ sand.

Answer: B. Dry; wet

TI-Nspire Navigator Opportunities

Make a student a Live Presenter to illustrate temperatures changes. Throughout the lab, discuss the activity with students using Slide Show. At the end of the lab, collect the .tns files and save to Portfolio.

Wrap Up

When students are finished with the activity, retrieve the .tns file using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions using Review.

Assessment

- Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved. The Slide Show will be utilized to give students immediate feedback on their assessment.
- Summative assessment will consist of questions/problems on the chapter test.