Heating the Earth's Surface

Based on an activity from Prentice Hall *Science Explorer* (2004)

Focus on Inquiry

The student will develop a hypothesis to investigate how quickly sand/water heat and cool.

Lesson Overview

Students investigate how quickly land and water heats and cools.

Duration	Setting	Grouping	PTI Inquiry Subskills
2 class periods	Classroom	Cooperative groups of 3-4	1.3, 2.1, 3.1, 3.2, 3.5, 3.7, 4.2, 4.3, 5.2, 5.4, 7.2, 7.3

Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
Engage (Day 1)	5 min	5.2	None	2	Students take part in brainstorming from a series of teacher-guided questions.
Explore	40 min	1.3, 3.1, 3.2, 3.5, 3.7, 5.4	None	3	Students will set-up an experiment u sing sand and water to determine which of the two heats and/or cools faster.
Explain (Day 2)	20 min	4.2, 4.3, 5.2, 5.4, 7.2, 7.3	None	3	Students will create a graph of this data and present their findings to the class.
Expand	15 min	2.1	None	3	Students will design a test to measure the heating and cooling rate of gravel, crushed stone, or soil.
Evaluate	10 min	4.2, 7.3	None	3	Students can be evaluated on their graphs, presentations, and lab sheets.

Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

National Science Education Standards – Inquiry

Use appropriate tools and techniques to gather, analyze, and interpret data.
Develop descriptions, explanations, predictions, and models using evidence.
Communicate scientific procedures and explanations.

National Science Education Standards – Earth Science

Global patterns of atmospheric movement influence local weather. Oceans have a major effect on climate, because water in the oceans holds a large amount of heat.

Louisiana Grade Level Expectations – Inquiry

Gr. 8, Inquiry GLE#4 - Design, predict outcomes, and conduct experiments to answer guiding questions (SI-M-A2)
Gr. 8, Inquiry GLE#6 - Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations (SI-M-A3)
Gr. 8, Inquiry GLE#7 - Record observations using methods that complement investigations (e.g., journals, tables, charts) (SI-M-A3)
Gr. 8, Inquiry GLE#8 - Use consistency and precision in data collection, analysis, and reporting (SI-M-A3)
Gr. 8, Inquiry GLE#11 - Construct, use, and interpret appropriate graphical representations to collect, record, and report data (e.g., tables, charts, circle graphs, bar and line graphs, diagrams, scatter plots, symbols) (SI-M-A4)
Gr. 8, Inquiry GLE#12 - Use data and information gathered to develop an explanation of experimental results (SI-M-A4)
Gr. 8, Inquiry GLE#13 - Identify patterns in data to explain natural events (SI-M-A4)
Gr. 8, Inquiry GLE#19 - Communicate ideas in a variety of ways (e.g., symbols, illustrations, graphs, charts, spreadsheets, concept maps, oral and written reports, equations) (SI-M-A7)
Gr. 8, Inquiry GLE#22 - Use evidence and observations to explain and communicate the results of investigations (SI-M-A7)

Louisiana Grade Level Expectations Earth Science

Gr. 8, GLE#25 - Explain and give examples of how climatic conditions on Earth are affected by the proximity of water (ESS-M-A11)

Materials List (per group)

- lab sheet
- lamp/150-W bulb
- graph paper
- clock/stop watch
- 2 thermometers/or probes
- 2 400 mL beakers
- water, 300mL
- sand, 300mL

Advance Preparation

1. Obtain materials listed in the materials list.
2. Make sure the sand is dry.
3. Both the sand and water should be at room temperature.
4. You may wish to set up the equipment and measure out the sand and water.
5. Make enough student copies of the lab sheet.

Other Information

Learning Objective

The learner will:

- develop hypotheses about how quickly sand and water heats and cools.
- measure the temperature of sand/water while they are heating and cooling.
- compare the heating and cooling rates of sand and water.

Prior Knowledge Needed by the Students

- Students need to know how to properly read a thermometer, stop watch, and levels in a beaker.

Procedure

Engage (DAY 1)

1. Ask the class if they have ever walked barefoot on the beach on a hot day? What was the temperature of the sand like? (*the sand was probably hot*) When you reached the water, how did it feel by comparison to the hot sand? (*much cooler*) If you walked barefoot on the beach after dark, which felt warmer, the sand or the water? (*water*)

Explore

1. Form collaborative groups of 3-4 students.
2. Follow the procedure as outlined in **Blackline Master #1**.

Explain (DAY 2)

1. Each group can duplicate their data and present it to the class.
2. Each group can make a line graph: one for the sand and one for the water. In either case the students will answer the following questions in their presentation:
   - What was the total change in temperature of the water and the sand?
   - Based on your data, which material had the great increase in temperature?
   - What can you conclude about which material absorbed heat faster? How do your results compare with your hypothesis?
   - Which material cooled faster? How do these results compare to your second hypothesis?
   - If your results did not support either of your hypotheses, why do you think the results differed from what you expected?
   - Based on your results, which do you think will heat up more quickly on a sunny day, the water in lake or the sand surrounding it? Which will cool off more quickly after dark?
   - What does this experiment have to do with understanding how climate is affected by nearness to water bodies?

Expand

1. Ask the students: Do you think all solid material heats up as fast as sand? For example, think of gravel, crushed stone, or different types of soil.

2. Write a hypothesis about the heating rates of various earth materials.
3. Develop a procedure to test your hypothesis.

Evaluate

1. Evaluate the students' presentations of their graphs and other written work completed in the above stages of the activity, such as **Blackline Master #1**.

Blackline Master

1. Lab: Heating the Earth's Surface

Supplementary Resources

Which Gets Hotter, Land or Water
http://www.geosociety.org/educate/LessonPlans/Land-WaterTemp_Lab.pdf
This website contains a lab illustrating how dark land surfaces, light land surfaces and water all heat at different rates and the causes for weather. It includes an expansion for the lab shown in this activity as it includes different types of soil along with the water. Trackstar #267962

Heat an Agent of Change
http://genesismission.jpl.nasa.gov/educate/scimodule/heat/develop_1TG.pdf
This teacher-centered site discusses the 3 types of heat transfer.

Physics Demonstration: A Sourcebook for Teachers of Physics by *Julien Clinton Sprott*
http://sprott.physics.wisc.edu/demobook/intro.htm
Under Section 2 of this web resource's "Table of Contents," there are several different activities based on heat transfer, such as the activity "2.13 Heat Transmitter."

Name_____ **Date**_____ **Class**_____

Lab: Heating the Earth's Surface

1. Do you think sand or water will heat up faster? Record your hypothesis, and then test your hypothesis by following the steps below.

   My hypothesis is that _____ will HEAT UP FASTER than _____.

   My hypothesis is that _____ will COOL FASTER than _____.

2. Fill one beaker with 300 ml of dry sand.
3. Fill the second beaker with 300 ml of water at room temperature.
4. Place the thermometers in the water and sand.
5. Position the lamp so that it is about 20 cm above the sand and water. Do not turn on the lamp yet. There should be no more than 8 cm between the beakers. CAUTION: Do not splash the water on the hot light bulb.
6. Record the temperature of the sand and water below beside the "Starting Temperature".
7. Turn on the lamp. Then, using the clock or stopwatch, read the temperature of the sand and water every minute for 15 minutes. Record the temperatures in the Light On column in the data table.
8. Which material do you think will cool off more quickly? Record your hypothesis. Give some reasons why you think your hypothesis is correct.
9. Turn the light off. Read the temperature of the sand and water every minute for another 15 minutes. Record the temperatures in the Light Off column (16-30 minutes).

Data Table:

Starting Temperature (° Celsius): Sand _____ **Water** _____

Temperature with Light On (° Celsius)			**Temperature with Light Off (° Celsius)**		
Time (min)	**Sand**	**Water**	**Time (min)**	**Sand**	**Water**
1			16		
2			17		
3			18		
4			19		
5			20		
6			21		
7			22		
8			23		
9			24		
10			25		
11			26		
12			27		
13			28		
14			29		
15			30		

Based on your data, what conclusion can you make about the heating and cooling of sand and water? _____

_____

Were your two hypotheses correct? _____