Name _____ Date _____ Class _____

Weather Factors ▪ *Skills Lab*

Heating Earth's Surface

In this lab, you will develop and test a hypothesis about how quickly different materials absorb radiation.

Problem

How do the heating and cooling rates of sand and water compare?

Materials

2 thermometers or temperature probes

2 beakers, 400 mL

water, 300 mL

metric ruler

string

ring stand and two ring clamps

sand, 300 mL

lamp with 150-W bulb

clock or stopwatch

graph paper

Procedure

Review the safety guidelines in Appendix A in your textbook.

1. Which do you think will heat up faster—sand or water? Record your hypothesis. Then follow these steps to test your hypothesis.
2. Use the data table to record your data.
3. Fill one beaker with 300 mL of dry sand.
4. Fill the second beaker with 300 mL of water at room temperature.
5. Arrange the beakers side by side beneath the ring stand.
6.  Place one thermometer in each beaker. If you are using a temperature probe, see your teacher for instructions.
7. Suspend the thermometers from the ring stand with string. This will hold the thermometers in place so they do not fall.
8. Adjust the height of the clamp so that the bulb of each thermometer is covered by about 0.5 cm of sand or water in a beaker.
9. Position the lamp so that it is about 20 cm above the sand and water. There should be no more than 8 cm between the beakers. **CAUTION:** *Be careful not to splash water onto the hot light bulb.*
10. Record the temperature of the sand and water in your data table.
11. Turn on the lamp. 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.

12. Which material do you think will cool off more quickly? Record your hypothesis on a separate sheet of paper. Explain why you think your hypothesis is correct.
13. 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

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

Heating Earth's Surface *(continued)*

Analyze and Conclude

Write your answers on a separate sheet of paper.

1. **Graphing** Draw two line graphs to show the data for the temperature change in sand and water over time. Label the horizontal axis from 0 to 30 minutes and the vertical axis in degrees Celsius. Draw both graphs on the same piece of graph paper. Use a dashed line to show the temperature change in water and a solid line to show the temperature change in sand.
2. **Calculating** Calculate the total change in temperature for each material.
3. **Interpreting Data** Based on your data, which material had the greater increase in temperature?
4. **Drawing Conclusions** What can you conclude about which material absorbed heat faster? How do your results compare with your hypothesis?
5. **Interpreting Data** Review your data again. In 15 minutes, which material cooled faster?
6. **Drawing Conclusions** How do these results compare to your second hypothesis?
7. **Developing Hypotheses** Based on your results, which do you think will heat up more quickly on a sunny day: the water in a lake or the sand surrounding it? After dark, which will cool off more quickly?
8. **Communicating** If your results did not support either of your hypotheses, why do you think the results differed from what you expected? Write a paragraph in which you discuss the results and why they differed from your hypotheses.

Designing an Experiment

Do you think all solid materials heat up as fast as sand? For example, consider gravel, crushed stone, or different types of soil. Write a hypothesis about their heating rates as an "If . . . then. . . ." statement. With the approval and supervision of your teacher, develop a procedure to test your hypothesis. Was your hypothesis correct?