Heating Earth's Surfaces: Land Versus Water

Lab Instructions

Think about this: When you are at the beach, is there a different amount of sunlight hitting the water compared to the sand? Explain. When you walk on the sand, compared to in the water, is there a difference in temperature? Why? When do you think the sand is at it hottest?

Objective

Students will develop and test a hypothesis about how quickly different materials heat up and cool down when exposed to radiation.

Materials

thermometers (2)
lamp with heat bulb and stand
stopwatch
clothespins/clips (2)
sand/soil
beakers/cups (2)
water

Procedure

1. Fill one beaker up to the 200 mL mark with water, and the other to the 200 mL mark with sand or soil. (If using an unmarked cup instead, be sure to fill with the same amount in each.)

2. Place a thermometer in each beaker, about 1 cm below the surface. You may need a clothespin or other clip to secure the thermometer in the beaker with water.

3. Place the beakers 10-15 centimeters below the bulb of the lamp, but don't turn on the lamp yet. (Make sure the distance to each beaker is equal.)

4. Record the starting temperature of each material in your data table at "0 minutes."

5. Start the stopwatch and turn on the light simultaneously. Record the temperature of each material every minute until 10 minutes have passed.

   ➔ **CAUTION: The bulb and shade may get very hot. Be careful, and avoid touching either during the experiment.**

6. At the 10 minutes mark, turn off the light and move it away from the beakers (it will continue to generate heat even when turned off.) Continue to record temperatures every minute for another 10 minutes.

7. Plot your data on the graph. Connect the points for the two sets of data, and label one "water" and the other "land." (Or use two different colors and complete the key.)

Heating Earth's Surfaces: Land Versus Water

Objective

Students will develop and test a hypothesis about how quickly different materials heat up and cool down when exposed to radiation.

Problem (written as a question that will be answered by completing the investigation)

How will temperature change in the containers with different materials?

Independent Variable (the factor that is intentionally changed in an investigation)

This investigation is designed to see if material (land or water), the independent variable, will have any impact on the heat absorbed from radiation.

Dependent Variable (the factor that changes as a result of the independent variable; it is what is measured to determine if the independent variable has the expected effect)

The dependent variable, temperature, is measured in degrees Celsius (˚C) and may change as a result of the different materials.

Hypothesis (should be written in If [independent variable], then [dependent variable] format and should answer the question posed as the problem)

If _____ *are heated by radiation from a light bulb,*
(independent)

then the _____ *of the water will* ***increase*** _____
(dependent variable) (faster than/ slower than /at the same rate)

the temperature of the sand/soil. After the radiation is turned off, the temperature of the water will ***decrease*** _____ *the temperature of the sand/soil.*
(faster than/ slower than /at the same rate)

Data

Light Bulb On (radiation simulating daylight hours)

Time (Minute)	0	1	2	3	4	5	6	7	8	9	10
Sand/Soil (˚C)											
Water (˚C)											

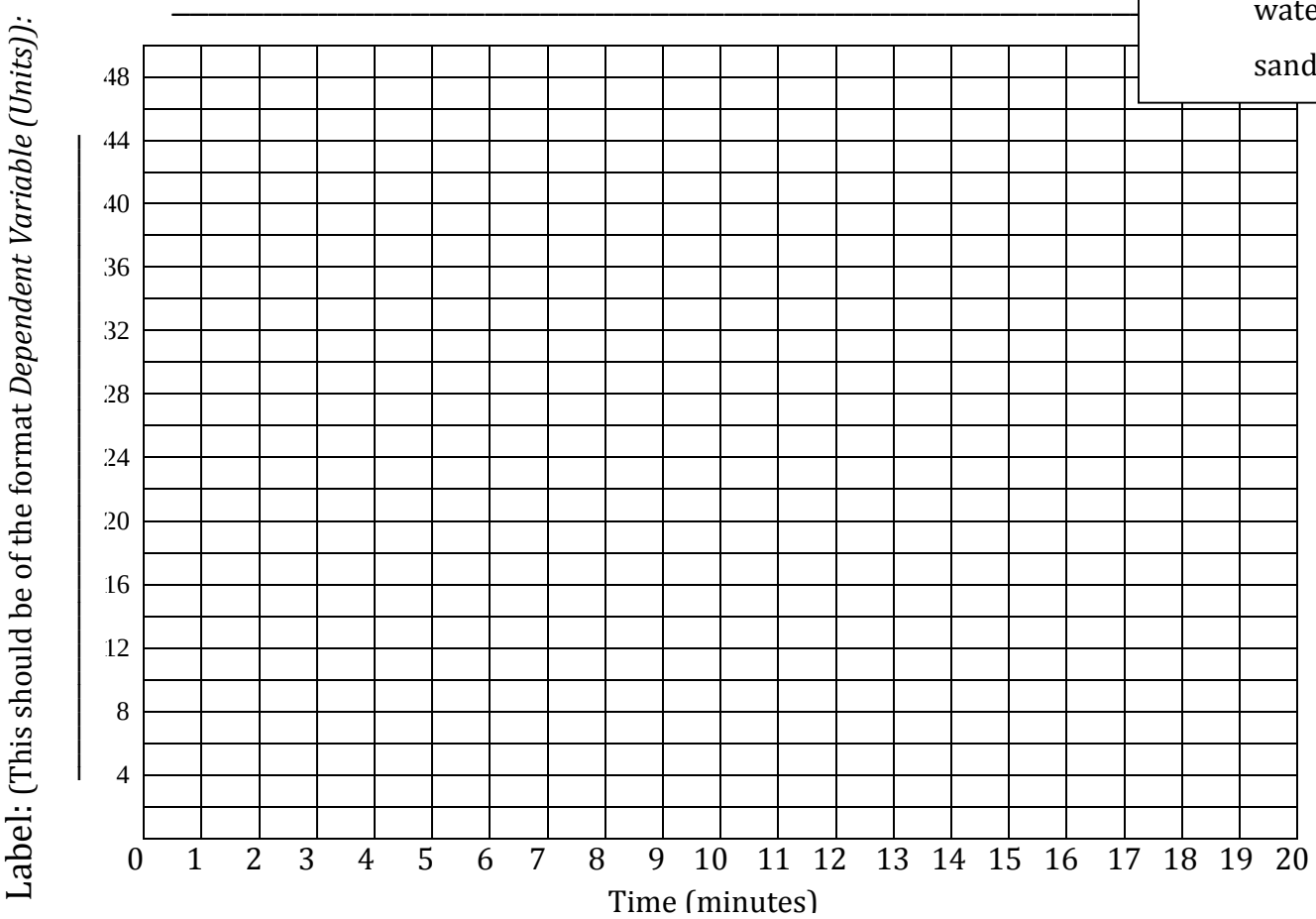
Light Bulb Off (radiation simulating nighttime hours)

Time (Minute)	11	12	13	14	15	16	17	18	19	20
Sand/Soil (˚C)										
Water (˚C)										

Graphing

Title (This should follow a format of *Dependent vs. Independent*)

Key:
water
sand/soil



Analyze and Conclude

1. Calculate the total change in temperature for each material.

Sand/Soil: heated by _____ degrees in 10 minutes; cooled by _____ degrees in 10 minutes

Water: heated by _____ degrees in 10 minutes; cooled by _____ degrees in 10 minutes

2. Based on your data, which material heated up faster? _____

Which material cooled faster when the light was shut off? _____

3. How do these results compare to your hypothesis? _____

4. Air in the troposphere (bottom layer of the atmosphere) is heated from the bottom up by heat given off by the surface and trapped by clouds and other particles in the atmosphere. If the sun shines equally on Seattle (near water) and Bismarck, North Dakota (near center of continent), which would get hotter during the day? (Hint: Think about your lab.) Explain. _____

5. Based on the results of your lab, which of the two cities, Seattle or Bismarck, would probably have a bigger difference between day and night temperatures? _____