Experiment
25

Land and Sea Breezes

Land breezes and *sea breezes* refer to winds that often occur near an ocean or lake. Land breezes blow from the land to the water while sea breezes blow from the water to the land. Both of these breezes are caused by uneven heating of the Earth's surface. In this experiment, you will recreate the conditions under which these breezes form and study their causes.

In Part I of this experiment, you will expose sand and water to a light source representing the sun. You will monitor the temperature of the sand and the water and compare their warming behaviors. In Part II, you will monitor the temperatures as warm sand and water cool. This simulates the situation when the sun goes down in the evening. You will then apply your results to local weather patterns.

OBJECTIVES

In this experiment, you will

- Use Temperature Probes to measure the temperature of land and water.
- Calculate temperature changes.
- Apply your results to local weather patterns.
- Predict the occurrence of land and sea breezes.

MATERIALS

computer
Vernier computer interface
Logger*Pro*
2 Temperature Probes
2 pans
sand
water
ruler
lamp with a 100 W (or greater) bulb
2 test tubes
2 one-hole stoppers
beaker
warm water
test-tube rack

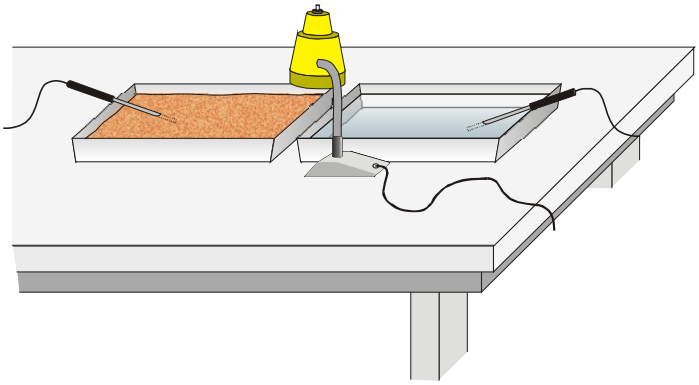

Figure 1

PROCEDURE

Part I Heating Sand and Water

1. Fill one pan with sand 1.0 cm deep. Fill another pan with water 1.0 cm deep.

2. Plug two Temperature Probes in Channels 1 and 2 of the Vernier computer interface. Lean Probe 1 in the pan with sand as shown in Figure 1. Lean Probe 2 in the pan with water. The probe tips should be at the centers of the pans.

3. Position a light bulb directly over the boundary between the two pans and about 10 cm above the pans as shown in Figure 1. The bulb should be the same distance from both probe tips.

4. Prepare the computer for data collection by opening the file "25 Land and Sea Breezes" from the *Earth Science with Computers* folder.

5. Click Collect to begin data collection, then switch on the light bulb. Record the initial temperature measured by each probe in your data table. Note: Do Steps 9 and 10 of Part II while waiting for your Part I data to be collected.

6. When data collection is complete after 20 minutes, turn the light bulb off.

7. Determine the minimum and maximum temperature values by clicking the Statistics button, . Record these values in your data table.

8. Print copies of the graph as directed by your teacher.

Part II Cooling Sand and Water

9. Fill one test tube 2/3 full with sand. Fill another test tube 2/3 full with water.

10. Place both test tubes in a beaker of warm water for several minutes.

11. Place a one-hole stopper onto each Temperature Probe as shown in Figure 2. Carefully place Probe 1 in the sand. Tilt the test tube to loosen the sand and prevent damage to the probe. Suspend Probe 2 at the same depth in the water.

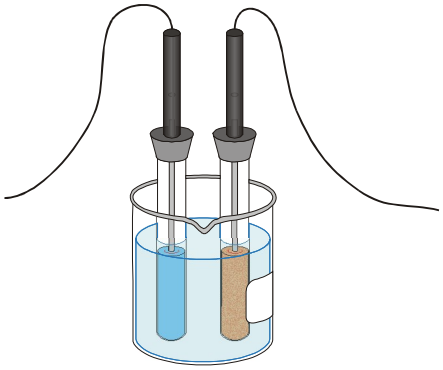

Figure 2

12. Begin data collection.
    a. Note the temperature readings displayed in the meters. When the temperatures stop rising and are nearly the same, click Collect to begin the 20 minute data collection.
    b. Remove the test tubes from the warm water and stand them in a test-tube rack to cool.

13. When data collection is complete, determine the minimum and maximum temperature values by clicking the Statistics button, , then click OK to display a Statistics box for each probe. Record these values in your data table.

14. Print copies of the graph as directed by your teacher.

DATA

	Part I		Part II	
	Probe 1 Sand	Probe 2 Water	Probe 1 Sand	Probe 2 Water
Maximum temperature (°C)				
Minimum temperature (°C)				
Temperature change (°C)				

PROCESSING THE DATA

1. In the space provided in your data table, subtract to find the temperature changes.

Part I

2. According to your data, which material was warmed faster by the "sun", the water or the sand?

3. As surface materials are warmed by the sun, they in turn warm the air above them. As the sun shines, is the air above the sand or the water warmer?

4. Use Figure 3 to complete the following tasks.
   a. Based on your answer to Question 3 and knowing that warm air rises and cool air sinks, place arrowheads on the two vertical lines in Figure 3 indicating the general direction of air movement over the sand and the water on a sunny day.
   b. The two vertical arrows you have drawn form the basis of a circular convection current. Now draw two horizontal arrows that complete the path of this convection current.

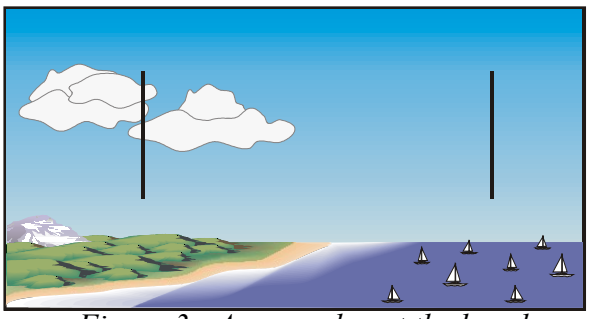

Figure 3 - A sunny day at the beach

5. Imagine yourself standing on the beach in the diagram above. According to the arrows you drew, where would the breeze be coming from? Is this a sea breeze or a land breeze?

Part II

6. According to your data, which material cooled faster, the water or the sand?

7. As surface materials cool, they in turn cool the air above them. After the sun goes down and the warm surfaces cool, is the air above the sand or the water warmer?

8. Use Figure 4 to complete the following tasks.
   a. Based on your answer to Question 7 and knowing that warm air rises and cool air sinks, place arrowheads on the two vertical lines in the diagram indicating the general direction of air movement over the sand and the water after the sun goes down.
   b. The two vertical arrows you have drawn form the basis of a circular convection current. Draw two horizontal arrows that complete the path of this convection current.

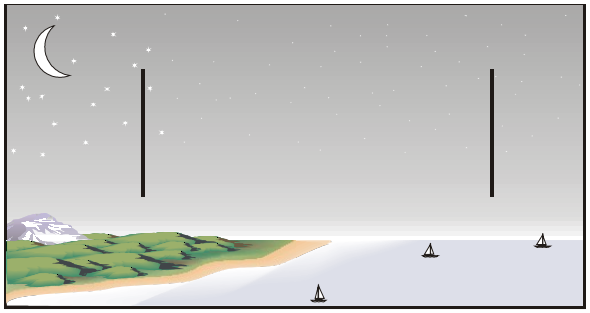

Figure 4 - An evening at the beach

9. Imagine yourself standing on the beach in the diagram above. According to the arrows you drew, where would the breeze be coming from? Is this a sea breeze or a land breeze?

10. Fill in the blanks.

    On a sunny day at the beach, the wind will usually blow from the _____ to the _____. This is called a _____ breeze. As evening falls, the wind will shift and blow from the _____ to the _____. This is called a _____ breeze.

EXTENSIONS

1. Compare the heating rates of different-colored sands or soils.
2. Compare the heating and cooling rates of dry and wet sand.