Land and Sea Breezes Lab

Name: _____ Date: _____ Period: _____

LT1: I can collect experimental data using temperature probes and a Vernier LabQuest.
LT2: I can use that data to predict the occurrence of land and sea breezes.

Part 1: Collecting Data

1. Set up the Vernier LabQuest
   a. Go to experimental set-up. Make sure that Probe 1 is in sand (land) and Probe 2 is in water.
   b. Turn on the Vernier LabQuest.
   c. Select LabQuest App from main menu.
   d. Click on Mode. Mode should be Time Based.
   e. Check to be sure you are collect 2 samples/sec and that the sample interval is 0.5sec.
   f. Change the duration to 15 min. and click DONE. Now click OK.
2. Turn light on.
3. Record the daytime data
   a. Press the record (green) button in the lower left hand corner of the screen.
   b. Record your starting temperature for each land and water in your table.
   c. Collect the data for 15 min.
   d. While waiting: finish Newsela, Graphing the Atmosphere or any other science related assignments.
   e. When the run ends turn off the lamp.
   f. Select Graph → Store run
   g. Record ending daytime temperature in your table.
   h. Find the overall daytime temperature increase by subtracting the starting temperature from the ending temperature and record this in your table.
4. Record the nighttime data
   a. Press the record (green) button in the lower left hand corner of the screen.
   b. Record the starting temperature for each land and water in your table.
   c. Collect the data for 15 min.
   d. Select Graph → Store run
   e. Record ending nighttime temperature in your table.
   f. Find the overall nighttime temperature increase by subtracting the starting temperature from the ending temperature and record this in your table.
5. If there is time spend some time looking at the graph and analyze options on the LabQuest.

Data Table: The Effect of Time on Temperature for Land and Water

Surface Type	Starting Daytime Temperature	Ending Daytime Temperature (highest temp)	Overall Daytime Temperature Increase	Starting Nighttime Temperature (right after light is turned off)	Ending Nighttime Temperature	Overall Nighttime Temperature Decrease
Land (sand)						
Water						

Part 2: Data Analysis

Directions: Use the data collected on the Vernier Labquest to answer the following questions.

1. According to your data, which surface type was **warmed faster** by the sun, land or water?

_____

2. As surface materials are warmed by the sun, they in turn warm the air above them. As the sun shines during the day, is the air above the beach or the water warmer?

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3. Use Figure 1 (below) to complete the following tasks.

    a. Based on your answer to Question 2, and knowing that warm, less dense air rises and cool, denser air sinks, **place arrowheads** on the two vertical lines in Figure 1 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 the wind in this convection current.

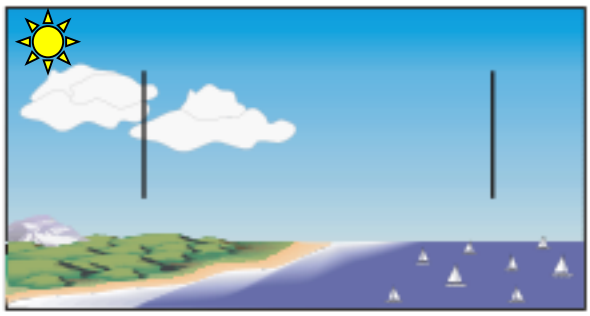

Figure 1

4. Imagine yourself standing on the beach in the diagram above. According to the arrows you drew, where would the breeze be coming from?

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5. Knowing that winds are named for the place that they originate, is this a sea breeze or a land breeze?

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6. According to your data, which material **cooled faster**, land or water?

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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 land or the water warmer?

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8. Use Figure 2 (below) to complete the following tasks.

    a. Based on your answer to Question 7, and knowing that warm, less dense air rises and cool, denser 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 the wind in this nighttime convection current.

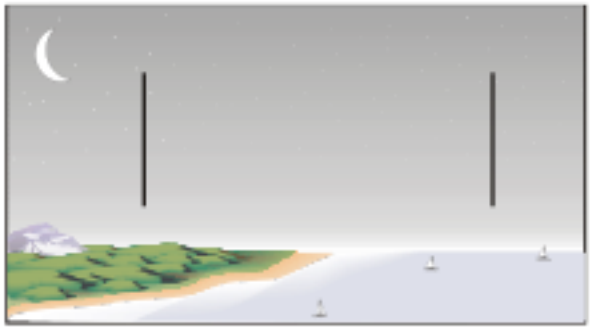

Figure 2

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?

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10. Imagine there are two coastlines. One has a large beach and then bare rocky desert land above the beach. The other has a forest above a small beach. If you stood on each beach, which beach would you expect to have more extreme winds? **Explain your reasoning.**

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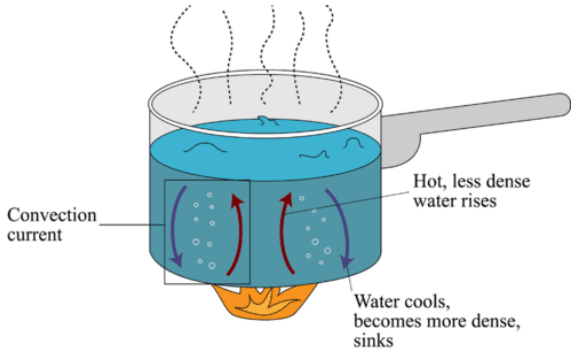
Heat Transfer by Convection

Source: Brainard, Jean. "Convection." *CK-12.org*, CK-12 Foundation, 20 Nov. 2019, www.ck12.org/physics/convection/lesson/Convection-MS-PS/.

Remembering our reading about the transfer of heat through the atmosphere, there are three ways that heat is transferred – radiation, conduction and convection. Convection is the transfer of thermal energy by particles moving through a gas or a liquid.

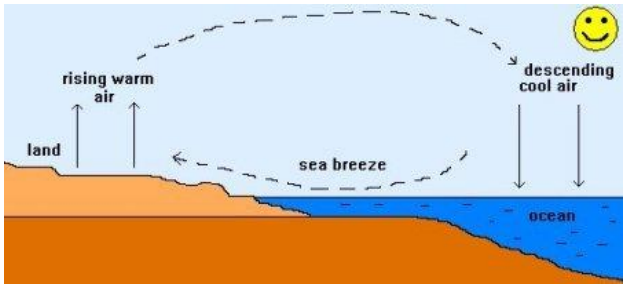
The figure below shows how convection occurs, using hot water in a pot as an example. When particles at the bottom of the pot are heated up, they move more quickly, have more collisions, and spread farther apart. This decreases the density of the particles, so they rise up through the fluid. As they rise, they transfer their thermal energy to other particles of the fluid and cool off in the process. With less energy, the particles move more slowly, have fewer collisions, and move closer together. This increases their density, so they sink back down through the fluid. When they reach the bottom of the fluid, the cycle repeats. The result is a loop of moving particles called a convection current.

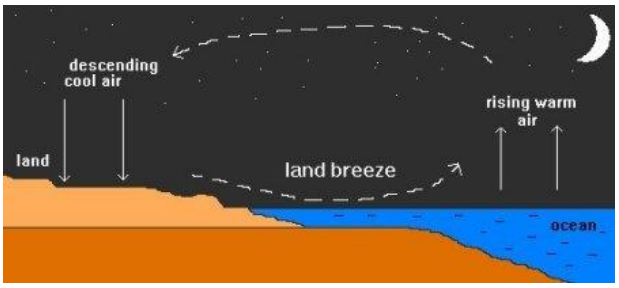


Convection currents transfer heat through several fluids, not just water. For example, convection currents transfer thermal energy through molten rock below Earth's surface, through water in the oceans, and through air in the atmosphere. Convection currents in the atmosphere create winds.

Land and sea breezes refer to winds that often occur near an ocean or lake. These breezes are convection currents. Land breezes blow from the land to the water, whereas sea breezes blow from water to the land. These breezes are both due to uneven heating of the Earth's surface.

<u>What is a sea breeze?</u> On a warm summer day along the coast, the sand gets extremely warm, while the water stays comparatively cool. The difference in heating of land and sea leads to the development of local winds call sea breezes. As the air above the sand is heated, the molecules spread out and begins to rise. The warm air rises because is less dense than the surrounding air. To replace the rising air, cooler denser air is drawn in from the surface of the water. This sea breeze can offer a cooling influence on hot summer afternoons.





<u>What is a land breeze?</u> A land breeze occurs at night when the land cools faster than the sea. In this case, it is air above the warmer surface water that gets heated and rises, pulling in air from the cooler land surface.