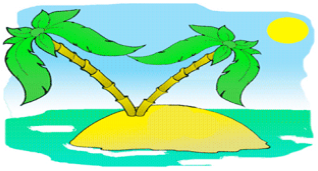

Differential Heating

Lesson Concept The Earth's land and water heats and cools differently.

Link In the previous lesson the students learned that warm air is less dense than cold air. In this lesson, they learn that the Earth's surface (land and water) heats and cools differently. In the following lessons students will use their understanding of the uneven heating of the Earth to understand the concept of convection currents.

Time

Part I Explore and Set Up 20 minutes

Part II Measurements 5 minutes every 30 minutes for 4 hours

Part III: Data analysis 20 minutes

Total time over the course of 1 day: approximately 4 hours and 30 minutes

Teacher Note: It is best to begin this lesson at the beginning of the sunny day during a warmer time of year.

Materials

Whole class

Timer (to count 30 minute intervals for 2 hours)

Per Group (groups of 6-7)

1 Beaker half full with water

1 Beaker half full with sand

1 Beaker half full with dark soil

1 Beaker half full with air (empty)

4 Thermometers

Individual

H1 Differential Heating Lab Sheet

Advance Preparation

1. Set up group materials.
2. Identify places outside in full sun where students can set up their experiment and take measurements over a 2-hour period.

3. Identify dark cool areas (with air movement so that heat will not build up) where students can set up their experiment and take measurements over a 2-hour period.

4. Duplicate **H1** Differential Heating Lab Sheet

Procedure:

Engage ***(5 minutes) The Earth's surface heats and cools differently.***

1. Ask the students to think about the beach or even being near a swimming pool. At the beach there is sand and water; at the pool there is concrete and water. In both situations, here would you rather stand if your feet needed cooling down? Warming up?
2. In a think-pair-share ask students to think about why there is a temperature difference between sand and water; concrete and water. Chart their ideas
3. Explain that today they are going to investigate how surfaces heat up and cool down.

Explore #1 ***(10 minutes set up; 5 minute measures every 30 minutes for 2 hours). Different materials (matter) absorb heat energy differently and thus heat at different rates.***

4. Divide students into groups and distribute their four beakers, thermometers and **H1** Differential Heating Lab sheet. Have students paste lab sheets into their science notebooks.
5. Have students make a prediction about which material will have the highest/lowest temperatures throughout the day.
6. Ask students to take an initial reading of the temperature of each beaker and record it. Emphasize how to properly record the temperature using the degrees symbol and F for Fahrenheit.
7. Have the groups place their beakers outside in the pre-determined full-sun places.
8. Have the students return at 30-minute intervals to record the temperature of all four beakers for two hours. They should work on other academic assignments while waiting for the intervals to measure.
9. At the end of the two-hour span, have the students discuss their data and graph it on their Differential Heating Lab Sheet.

Teacher Note: To be time efficient, do Step 9 AFTER the students have moved their beakers to the cool area (step 10) and while they are waiting to take their cooling temperature measurements.

Explore #2 ***(10 minutes set up; 5 minute measures every 30 minutes for 2 hours). Different materials (matter) release heat energy differently and thus cool at different rates.***

10. Have the students place their beakers in a dark closet or cabinet (with air circulation so that it stays cool).
11. Have the students return at 30-minute intervals to record the temperature of all four beakers for two hours. (See Teacher Note after Step 9: Ask students to discuss and graph data from the sunny location while waiting for the intervals to measure).
12. At the end of the two-hour span, have the students discuss their data from the cooling and graph it on their Differential Heating Lab Sheet.

Explain/Evaluate ***(15 minutes) The Earth's surface heats and cools unevenly depending on the type of surface material.***

13. Conduct a class discussion of the data from the heating and cooling areas. What patterns they notice? Which material heated up most quickly? Which material cooled down most quickly? How does their data relate to the questions in the engage portion of the lesson? (sand and water at beach; concrete and water at the pool?).
14. Working with a partner, ask students to think about the density lesson they just completed. Based on this lesson, would the air be more dense over land or water? Ask student to write their ideas in their science notebook.
15. Have students complete the sentence frame as an exit card*: I used to think* _____*, and now I think* _____

Name: _____

Differential Heating Lab Sheet

Prediction

I predict that the _____ will heat up more quickly than_____, because _____.
I predict that the _____ will cool down more quickly than _____, because_ _____.

Heating in the Sun

Elapsed Time	Beaker with Air	Beaker with Water	Beaker with Sand	Beaker with Soil
Initial temperature (Fahrenheit)				
30 minutes				
60 minutes				
90 minutes				
120 minutes				

Cooling in the dark

Elapsed Time	Beaker with Air	Beaker with Water	Beaker with Sand	Beaker with Soil
Initial temperature (Fahrenheit)				
30 minutes				
60 minutes				
90 minutes				
120 minutes				

Heating in the Sun Graph

100°					
90°					
80°					
70°					
60°					
50°					
40°					
30°					
20°					
10°					
	Initial	30	60	90	120

Cooling in the Dark Graph

100°					
90°					
80°					
70°					
60°					
50°					
40°					
30°					
20°					
10°					
	Initial	30	60	90	120

Follow Up Questions:

1. Were your predictions supported? _____
2. Which material heated the fastest? _____
3. Which material cooled the fastest? _____
4. What about your data surprised you most? _____
   _____