**5E Template- Science**

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| **Name: Layne Vickers** | **Date: 7/16/11** |
| **Content Area: Science** | **Grade Level: 6** | **Topic(s): Heating Earth’s Surface** |

**Standards (SOL) SOL - 6.1, 6.2e, 6.3b, 6.3c**

**Objectives (UKD’s) The student will develop hypotheses about how quickly sand and water heat and cool, measure the temperature of sand and water while they are heating and cooling, create a data table to record their measurements, and draw conclusions about their findings.**

**Materials & Resources**

2 thermometers 300 mL of sand

2 400 mL beakers lamp with a 150 watt bulb

300 mL water clock or stopwatch

Metric ruler graph paper

Ring stand and two ring clamps

**Safety Considerations**

Students will wear safety goggles. Students need to insure they don’t splash water on the light bulb.

**Engage – Time Estimate 5 minutes**

If you had to choose a time to get in the ocean, would you choose Thanksgiving Day or Memorial Day? Take a class poll. Describe a barefoot trip from the beach towel to the ocean on a 90° day. If you ever walked barefoot on the beach after dark, which felt warmer – the sand or the water?

**Explore – Time Estimate 40 minutes**

Students will be placed in groups of 4 or 5 for this lab. One student will hold the stopwatch and let the others know when it’s time to record the temperature. Another student will read the thermometer. All students will fill out their data tables each minute. When the light is turned off, the timekeeper and temperature reader may switch within the group.

Procedure

1. Do you think sand or water will heat up more quickly? Record your hypothesis. Give at least one reason why you made the hypothesis.
2. Students will be given a data table to put in their notebooks. They will fill in the minutes 1 – 15 and then 16 – 30.
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 beneath the ring stand.
6. Place a thermometer in each beaker and suspend them from the ring stand with the string.
7. Adjust the height of the clamp so that the bulb of each thermometer is covered by 0.5 cm of sand or water.
8. Position the lamp so that it is about 20 cm about the sand and water. There should be no more than 10 cm between the beakers.
9. Record the temperature of the sand and water in your data table. This will be the baseline data.
10. Turn on the lamp. Read the temperature of the sand and water every minute for 15 minutes. Record the temperature in the Light On column of the data table.
11. Which material do you think will cool off more quickly? Record your hypothesis and give at least one reason why you make that hypothesis.
12. Turn the light off. Read and record the temperature of the sand and water every minute for 15 minutes. Record in the Light Off column (16-30 minutes)

Analyze and Conclude

1. Draw two line graphs to show the data for the temperature change in sand and water over time. Label the horizontal axis from 0 – 30 minutes and the vertical axis in degrees Celsius. Draw both graphs on the same sheet of graph paper. The temperature change in water will be shown in blue and the change in sand will be shown in red.
2. Calculate the total change in temperature for each material.
3. Answer the following questions in your notebook on the page after your data table:
	1. Which material had the greatest increase in temperature?
	2. Which material absorbed heat faster?
	3. Compare these results to your first hypothesis. Were you correct?
	4. Which material cooled faster?
	5. Compare these results to your second hypothesis?
	6. Based on your results, which do you think would heat more quickly on a sunny day: the water in a lake or the sand surrounding it? Which will cool off more quickly after dark?

Students should find that the sand heats and cools more quickly than the water.

The temperature of the sun is about 5500° C on the surface. It takes light 8 minutes and 19 seconds to get from the sun to Earth. Atoms in a solid are close together and heat or cold can be transferred quickly. Atoms in a liquid are farther apart and it takes longer for heat or lack of heat to be transferred through the atoms.

**Explain -- Time Estimate 5 minutes**

Sand heats and cools more quickly than water. A refresher on the atom arrangement of solids and liquids and how the atoms in a solid are closer together will be given. There will be a discussion about reading a thermometer and how it’s important to be able to read the markings in between the numbers and to be consistent.

**Extend -- Time Estimate 20 minutes or another class period**

On a follow up lab day students in various groups may consider these variations on this experiment including testing salt water and fresh water or fluorescent versus old fashioned bulbs. They can also compare water with beakers of gravel, crushed stone, or soil. Another experiment might be to compare the temperature rise and fall of wet sand versus dry sand. Students may want to conduct the experiment by positioning the thermometer 1 cm in the beaker, 2 cm in the beaker, and 3 cm in the beaker. Another extension would be to compare temperature data from Virginia Beach, Richmond, and our home, Rappahannock County. Our high school has a weather center and data can be readily available.

**Evaluate -- Time Estimate 10 minutes**

Students will compare their charts with other groups and see how their conclusions match up with other groups. A class discussion will follow about how to extend this experiment or other alternatives and class participation will indicate how well the lesson was understood. Part of the discussion will be about who can use this data in Virginia.

**Plans for Diversity**

 *Student(s): Category/Characteristics: Accommodations:*

Special needs students (low functioning) The teaching assistant may fill in the data table if needed.

Special needs students (higher functioning) May be in a mixed ability group and have the role of timekeeper.

Gifted Students May conduct alternative experiments with various materials to compare and give results to the class.

**Connections**

There are numerous references in sixth grade science to the sun and its role in our existence on Earth. The sun is studied in various ways in the curriculum. There is also emphasis in all of science on experimentation and repeated trials. This experiment is a good fit. In reference to repeated trials and how often to take the temperature, we might have one group take the temperature every two minutes or five minutes. CTA emphasized repeated trials. In the future there could be a discussion about what if we extended the experiment to 45 minutes – when would results level out? This lesson is a good follow up on the closeness of atoms in the three states of matter.