Activity: Differential Heating of Earth’s Surface

**Problem:** How do the heating and cooling rates of water and sand compare?

**Hypothesis 1:**

Decide which surface type will **heat the fastest**. Complete hypotheses below:

1. If [sand/water] has a higher specific heat capacity than [sand/water], then the temperature of the [sand/water] will rise faster than the temperature of the [sand/water].
2. If [sand/water] has a lower specific heat capacity than [sand/water], then the temperature of the [sand/water] will rise slower than the temperature of the [sand/water].

**Hypothesis 2:**

Decide which surface type will **cool the fastest**. Complete the hypotheses below:

1. If [sand/water] has a higher specific heat capacity than [sand/water], then the temperature of the [sand/water] will decrease faster than the temperature of the [sand/water].
2. If [sand/water] has a lower specific heat capacity of [sand/water], then the temperature of the [sand/water] will decrease slower than the temperature of the [sand/water].

**Investigation:**

1. Go to the following website: <https://www.youtube.com/watch?v=SpFPOtvGjRw>
2. Watch the video of what happens to the temperatures of the soil and water when they are heated and then cooled.

**Analysis:**

1. In the space below, sketch the graph produced during the video. Specific numbers are not important. Be accurate with the shape, axis labels, and when creating an appropriate key and title.
2. Draw a vertical line on the graph indicating when the lamp was turned off. Label the correct sides of the graph “Heating” and “Cooling”.
3. For the **HEATING** period . . .
   1. Which material had the greater increase in temperature? How do you know?
   2. Was your Hypothesis 1 correct? How does the data show this?
4. For the **COOLING** period . . .
   1. Which material had the greater decrease in temperature? How do you know?
   2. Was your Hypothesis 2 correct? How does the data show this?

**Conclusions:**

1. Materials with a higher specific heat capacity require more energy to be added to raise the temperature (and more energy to be removed to lower the temperature) than materials with low specific heat capacity. **Based on your analysis, decide which material has the higher heat capacity and explain your choice below.**
2. Based on your results . . .
   1. Which would heat up more quickly on a sunny day, the water in a lake or the sand surrounding it?
   2. Which will cool off more quickly after dark?
3. Over the course of a day, week, month, and even year, the temperatures at Atlantic Beach, NC are much steadier (change less) than those of Cary, NC. Explain why in terms of specific heat.

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