Light and Temperature - Does Material Matter?

Introduction

When the sun is shining on the water and the sand at a beach, is the temperature of the water and the sand the same? Have you had any experiences that can help you answer this question? In this investigation you will study how light affects the temperature of substances, namely water and sand.

NGSS

MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

Guiding question:

When light shines on water and on sand/soil does the temperature of each substance change equally?

Materials:

2 thermometers, (-10°C - 110°C)
2 non-paper cups of the same size (6 - 8 oz.)
stopwatch
water, at room temperature
sand (dry soil may be substituted), at room temperature
desk lamp with flexible neck
60W or higher bulb (Safety note: Check wattage limit of desk lamp.)

Safety precautions:

- Wear protective eyewear.
- Handle glass thermometers with care to avoid breakage. In case of breakage, do NOT pick up broken pieces of glass. Use a dustpan and brush to collect pieces carefully and dispose of them in a box that you tape shut and label: CAUTION - BROKEN GLASS.
- The lamp will become hot during the investigation. Do not touch the lamp during or soon after its use. Allow the lamp to cool completely before moving it. (The lamp should be left to cool for at least the same amount of time that it had been turned on.)

Plan your investigation:

Using the materials provided, plan an experiment to determine how light affects the temperature of water and sand.

1. Keep these questions in mind as you plan your experiment:
A. How can you be sure that your experiment is a fair test? That is, what conditions (variables) do you need to keep the same between the two cups? What is the only way that the two cups should differ?
B. When you measure the temperature of the water and sand, how will you position the thermometers?
C. When should you measure the temperature of each cup’s contents?
D. How long will you measure the temperatures during the experiment?

2. In the space provided below, write the steps of your procedure. Prepare a data table for your results.

3. Write your hypothesis (prediction) about how light will affect the temperature of the water and the sand. Include your reasoning.

4. Ask your teacher to review your procedure and data table. Your teacher will sign when your procedure has been approved.

**Hypothesis and Reasoning:**

**Procedure:**

**Data Table:**

**Teacher signature:** ______________________________________________________________
Do Your Investigation:

Once your teacher has approved, carry out your investigation and record your data in your data table.

Analysis and Conclusions:

1. Examine the results in your data table. How could a graph of your data help you to analyze your results? In the space below, prepare a graph of your data.
2. Based on the results of your experiment, how would you answer the Guiding Question of this investigation, *When light shines on water and on sand/soil does the temperature of each substance change equally?*

3. What specific evidence do you have from your experiment that supports your explanation about the effect of light on the temperature of water and sand? Explain *how* that evidence supports your explanation.

**New Questions:**

What new questions have come to mind by doing this experiment?