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LESLIE CUBE
Copper, 100 mm Sides

CAT NO. PH0411B



Experiment Guide

INTRODUCTION

The primary purpose of the apparatus is to measure thermal properties as function of surface color and texture. The four vertical faces of the cube each have a different surface: blackened, roughened, varnished and polished. A hole on the top face allows the cube to be filled with water.

INSTRUCTIONS FOR HEAT ABSORPTION ACTIVITY

Required Materials: water, heat source (e.g. lamp), thermometer (or temperature logger sensor), timer.

1. Carefully fill the Leslie cube with water.
2. Insert rubber stopper into top face of cube.
3. Insert thermometer (or temperature logger sensor) into rubber stopper to measure water temperature. When inserting a glass thermometer into a rubber stopper be sure to use silicon grease, gloves, and follow all standard safety precautions.
4. Position an already warm lamp such that it points directly at one of the vertical faces of the cube. Lamp should be placed 10 – 20 cm from cube. Record this distance.
5. Start timer and record the temperature of the water as the cube is heated by the lamp. Record temperature increase in increments of one degree Celsius. Take data for an increase of several degrees.
6. Repeat step 5 for each of the vertical faces of the cube. Make sure the distance from the cube face to the lamp remains constant.

To compare the rate of heat absorption of each of the faces of the cube, students may graph the increase in temperature as a function of time. The slope of a best fit line for each cube face ($\Delta T/\Delta t$) correlates to the heat absorption for the cube face surface type.

Note: Be sure cube is completely dry at end of activity to avoid rusting of inner surface.

INSTRUCTIONS FOR EMISSIVITY ACTIVITY

All objects with temperature above absolute zero radiate energy. The power radiated by an object is given by the Stefan-Boltzmann law:

$$I(T) = \epsilon \rho T^4$$

where ϵ is the emissivity of the object, ρ is the Stefan-Boltzmann constant ($5.6703 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$), and T is the temperature of the object. Emissivities vary between 0 and 1, with a perfect blackbody has an emissivity of 1 (perfect emitter).

This activity will probe the radiated energy by measuring the temperature of the Leslie cube using an infrared thermometer.

REQUIRED MATERIALS : Hot water, thermometer (or temperature logger sensor), timer, infrared thermometer logger sensor.

1. Very carefully fill the Leslie cube with very hot water (~80 deg. Celsius).
2. Insert rubber stopper into top face of cube.
3. Insert thermometer (or temperature logger sensor) into rubber stopper to measure water temperature. Make sure to follow all necessary safety precautions when inserting a glass thermometer into a rubber stopper, including using gloves and silicone grease.
4. Wait several minutes to allow cube to come to equilibrium.
5. Point infrared thermometer logger sensor 10 cm from cube.
6. Record the temperature each of the vertical faces of the cube using the infrared thermometer. Make sure to keep the IR thermometer the same distance from the cube face for each recording. Monitor the water temperature to ensure the water temperature remains constant.

The different temperatures of each cube face reveals the fact that the surfaces do not all share the same coefficient of emissivity. Though the surface temperature of each face is equivalent (they are in thermal equilibrium with the water), the measured temperature using the infrared thermometer will yield a lower temperature.

Note : Be sure cube is completely dry at end of activity to avoid rusting of inner surface.

Manufactured by :



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