Leslie's cube investigation

Apparatus

- An infra red sensor with range set to irradiance range.
- Temperature sensor
- Leslie's cube or large can painted in quarters with matt and shiny versions of same colour.
- Foil covered card shutter.
- Ruler
- Kettle
- Heatproof mat (insulated).

Data recording setup.

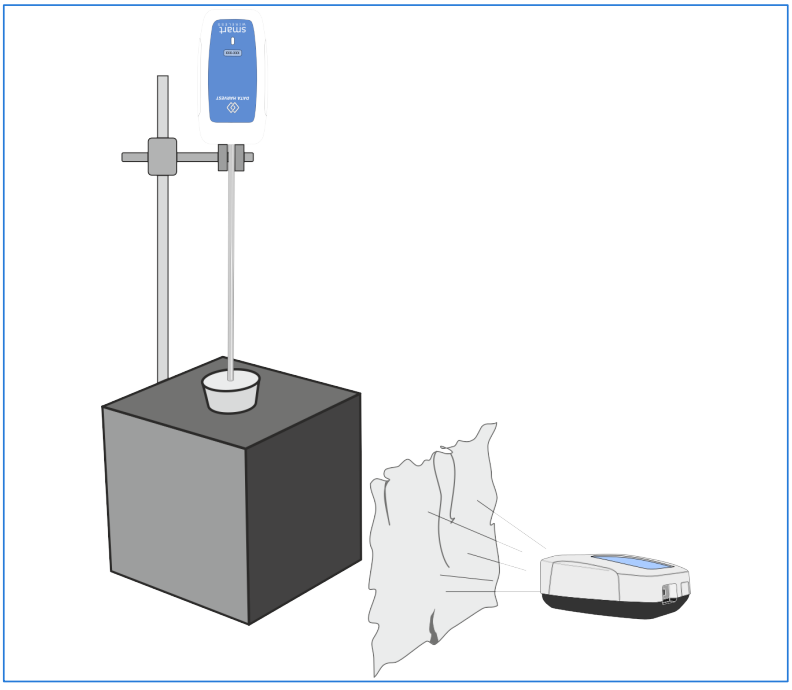
Setup Snapshot to record data as bars.

The Scottish scientist Leslie studied how the loss of energy from a surface was influenced by the texture and colour of the surface.

Using a cube shaped copper can Leslie studied the ability of surfaces to radiate energy, and how the finish of the copper altered the radiant ability.

Anecdotal evidence suggests that dark clothing makes you feel hotter in summer because it absorbed the sun's heat and white or pale clothing lets you feel cool as it reflected the sun's heat. This can be a point worth following up; it is definitely a point of conflict between science and belief. There is no real supporting evidence for pale colours creating a cooler environment in hot conditions.

Method



1. Set up the apparatus as shown in the diagram. Place the Infrared sensor about 5 cm from the can surface - at this distance the sensors will detect from an area of about 2 cm in diameter (the test surface of the can must, therefore, be more than 2 cm in diameter).
2. Place the can on a heat proof mat, which will be used to rotate the can easily and safely once it is filled with hot water. Once started you need to be able complete the investigation fairly quickly as the can will cool down, which will influence the energy being lost from the can. Place the Temperature sensor inside the can.
3. Place a foil covered card shutter between the sensor and the cube; this will stop the sensor becoming 'warmed' between readings. Keep the shutter in place when readings are not being taken, and then move it away when you want to take a reading.
4. Start the software and connect the Infrared and Temperature sensors to the software. Select irradiance as the infrared range.
5. Setup a snapshot data recording.
6. Fill the can with hot water (at about 90˚C). Leave the apparatus to reach an even temperature; this should take about 3 - 4 minutes.
7. If possible, stir the hot water and then select Start. Remove the shutter from between the sensor and the can

and click in the graph area to record the value. Place the shutter back between the sensor and the can.

8. Rotate the can so the next surface faces the sensor, check the distance from the sensor to the can is the same and remove the shutter to record the next value.
9. Repeat for all the surfaces you have prepared on the can. You may wish to repeat this several times more to enable averages to be calculated.

Questions

1. Which surface radiated out the most heat?

2. How did the temperature of the water change?

3. Did the colour of the surface have as much or less of an effect than the shininess of the surface?

4. Why do they line the inner surface of a vacuum flask with “silver”?

5. From this experiment which would matter most when painting radiators at home, the colour or the finish?

6. With evidence from the experiment does it make a difference which colour clothing you wear on hot sunny days or which colour you paint the house?

7. Use this investigation to create a coating for a cup that will keep the drink inside it hot longer (or stop a cold drink from warming up).

8. Does the theory work the other way around? Do dark objects warm up quicker than pale objects? Devise an experiment to test your ideas.