

Radiation from black and shiny surfaces

Class practical

Comparing the energy radiated from a dull black and a shiny surface.

Apparatus and materials

Copper sheet, mounted, (or use Leslie's cube, with mains immersion heater)

Thermopile

Light-spot galvanometer

Retort stand, boss, and clamp

Bunsen burners, 4

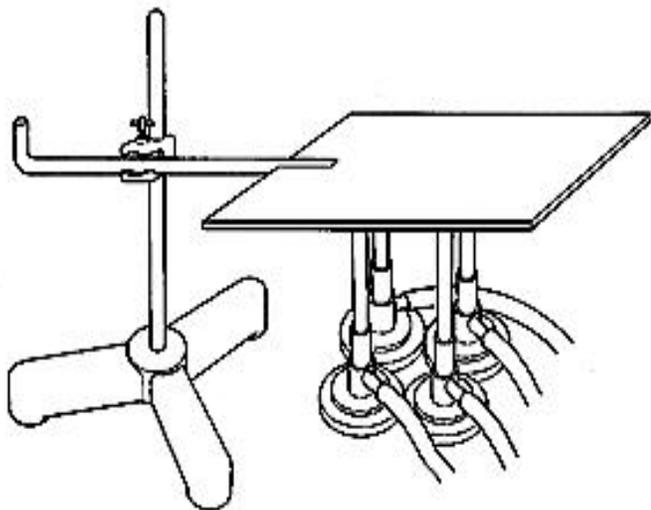
Methylated spirit

Vegetable black

Health & Safety and Technical notes

Supervise this experiment closely. Watch that students do not get too close to the hot plate.

[Read our standard health & safety guidance](#)



The mounted copper sheet is made from a sheet of 5-mm copper, blackened on one side, with 1-cm iron rod handle secured rigidly with two nuts and bolts.

Give one side of the copper sheet a coat of vegetable black mixed with methylated spirit. Allow it to dry so that it has a dull black surface. Polish the other side of the plate so that it is bright. (Tarnishing in the flame is inevitable.)

Procedure

- a** Secure the copper sheet rigidly to the retort stand, using a boss. The sheet should be horizontal with the bright side downwards.
- b** Heat it vigorously with four Bunsen burners underneath until it is as hot as possible.
- c** Remove the Bunsen burners and turn the plate so that it is vertical. Avoid burning hand when doing this.
- d** As quickly as possible ask students to hold the back of their hand first near but not touching the bright side of the plate, then the black side, and then back near the bright side. (Teacher supervision essential).

Alternatively, use a thermopile connected to a light-spot galvanometer as a detector of infra-red.

Teaching notes

- 1** The plate will need to be re-heated after every 6 to 8 students have tried it.
- 2** Radiation appears to come from hot surfaces. Copper is a good conductor and the two sides of the plate will be at the same temperature. You can bring your hand much closer to the shiny side than to the black side without burning it. More radiation is coming from the black side even though it is at the same temperature as the shiny side.
- 3** An alternative experiment is the Leslie cube, made of copper, whose four vertical faces are finished differently. Boiling water is placed in the cube and the radiation detected with the cheek as the sensitive detector. The temperature is too low for this to be impressive using the back of the hand: a thermopile or other detector is better. (The water may be kept boiling with a mains immersion heater.)

4 To make the distance comparison clear, both hands are brought up to either side of the plate. The hand on the shiny side can approach closer to the plate.

5 How Science Works extension: No measurements are taken in this experiment, but it is still possible to draw a valid conclusion about the nature of a surface and thermal radiation. You could:

- Use the experiment to illustrate the concept of valid evidence.
- Point out that, in a comparative analysis, numerical data is not always necessary.
- Ask students whether this experiment would still provide valid evidence if three or more colours were investigated. If they say it would not, ask them how the experiment could be adapted so that it did.
- Ask students to illustrate the findings of this data-free experiment in an appropriate way.

This experiment was safety-checked in August 2007

Related guidance

[Conduction, convection and radiation](#) [2]

[Note on “warming things up” and thermal energy](#) [3]

[A language for measurements](#) [4]

[Variables](#) [5]

Related experiments

[Absorbing radiant energy with different surfaces](#) [6]

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