STARS RESOURCES

Leslie cube

ACTIVITY

Investigate the influence of surface colour and texture on the absorption and emission of heat.

By the end of this activity students will:

- Have a preliminary appreciation for the challenges faced by engineers when designing and building space craft
- Understand the differences between absorption and emission of heat

BACKGROUND INFORMATION

Note: Modern versions generally have matte black, shiny black, white and shiny metal on the four sides of the cube.

Read about the Leslie cube:

Richard G. Olson A.M. Ph.D. (1969) A note on Leslie's cube in the study of radiant heat, Annals of Science, 25:3, 203-208, DOI: 10.1080/00033796900200111, https://www.tandfonline.com/doi/pdf/10.1080/00033796900200111

'Leslie's canisters', Chemistry World website, https://www.chemistryworld.com/opinion/leslies-canisters/4012476.article (2 October 2020)

Read more about how this experiment influences the design of space telescopes:

'James Webb telescope going through cooling process', Phys.org website, https://phys.org/news/2022-02-james-webb-telescope-cooling.html (16 February 2022)

'Why the most powerful space telescope ever needs to be kept really, really cold', NPR.org website, <u>https://www.npr.org/2021/12/21/1064183308/james-webb-space-telescope-sunshield-launch</u> (21 December 2021)

Some examples of others conducting this same experiment:

'Leslie's cube', Helen Rogerson, YouTube (1:29 mins), https://www.youtube.com/watch?v=4Pz8xcEQtMU (23 September 2015)

'AQA physics required practical 10: Leslie cube', Chemistry Science YouTube (6:50 mins), <u>https://www.youtube.com/watch?v=Li2RQX_noJA</u> (15 November 2016)

All websites accessed 17/3/2022.

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CURRICULUM LINKS

AUSTRALIAN CURRCIULUM – YEAR 9 SCIENCE

Science Understanding

Energy transfer through different mediums can be explained using wave and particle models (ACSSU182)

- Investigating the transfer of heat in terms of convection, conduction and radiation, and identifying situations in which occurs

Science as a Human Endeavour

Advances in scientific understanding often rely on technological advances and are often linked to scientific discoveries (ACSHE158)

AUSTRALIAN CURRICULUM - SENIOR PHYSICS

Science Understanding

Heat transfer occurs between and within systems by conduction, convection and/or radiation (ACSPH016)

Two systems in contact transfer energy between particles so that eventually the systems reach the same temperature; that is, they are in thermal equilibrium (ACSPH022)

Science as a Human Endeavour

Advances in science understanding in one field can influence other areas of science, technology and engineering (ACSPH011)

PRE-LAB ACTIVITY

Depending on the age of your students, you may wish to conduct some preliminary brainstorming to ascertain the base level of knowledge on this topic. Many students may already be familiar with white being a highly reflective colour (e.g. white cars sitting in the hot sun don't get as hot as black cars), or shiny surfaces being better at reflecting heat than matte surfaces (e.g. the analogy might be playground equipment).

Analogies relevant to climate and greenhouse effect may also be mentioned by students. To read more, visit 'Absorption/reflection of sunlight', University of California (Berkeley), <u>https://ugc.berkeley.edu/background-content/reflection-absorption-sunlight/</u>.



Teacher notes

Leslie cube

SUGGESTED ANSWERS

1. Which surface (or can) stayed the coolest? Which surface (or can) was the hottest?

Shiny is coolest, matte black is hottest.

2. Explain in terms of radiation why your measurements had to be taken from the same distance each time.

The radiation dissipates away from the heat source as the inverse square law.

3. Using your results, propose a reason for why vacuum flasks are shiny and silver on the inside.

Helps to prevent heat loss from the liquid by being highly reflective, and low absorbing, of heat.

