

B1: HEAT ENERGY AND TEMPERATURE

Overview

The energy within a system **cannot be created or destroyed**. It can only be **changed from one form to another**. This principle is known as the **Conservation of Energy**.

The **chemical energy** in a battery, for example, can be transferred into **light energy**, or into **kinetic energy** when used to make a mechanical toy move.

Heat is a transfer of energy between two bodies due to temperature difference. The temperature of a body is an indication of the direction of the flow of energy when two bodies come in contact with one another. When one body is at a higher temperature, then energy will flow from the region of higher temperature to the region of lower temperature until both bodies attain the same energy level. All of the activities in this section should provide students with opportunities to examine their understandings of heat, temperature, and the role of thermometers.

The purpose of these activities is to provide students with an introduction to heat energy and temperature. The calibration process of the thermometer in **B1 ACTIVITY 3 (II): CALIBRATING THERMOFILM** is not a rigorous one, as the purpose of the activity is only to relate measuring temperature to a visible physical change – a thermometric property. Two physical changes are used – the expansion and contraction of liquid, and colour change.

Using the smart material thermofilm (also known as thermochromatic film) shows the students that not all thermometers need to be accurate. In **B1 ACTIVITY 1: DESIGNING, CONSTRUCTING AND USING A THERMOMETER** students use the expansion and contraction of liquids resulting from the transfer of heat energy to construct a simple liquid-in-glass thermometer. In **B1 ACTIVITY 2: THE DIFFERENCE BETWEEN HEAT AND TEMPERATURE** the students examine the difference between heat energy and temperature.

B1 ACTIVITY 3: HOT VERSUS COLD introduces the students to thermofilm as another form of thermometer. Using a standard alcohol-in-glass thermometer, students calibrate the thermofilm and draw up a scale of temperature. They can then use the thermofilm to distinguish between hot and cold, and to explore the relationship between these terms and temperature.

In **B1 ACTIVITY 3 (III) VISUALISING ENERGY FLOW** the students use this film to observe the direction of heat flow with the aid of the scale they have drawn up in **B1 ACTIVITY 3 (II): CALIBRATING THERMOFILM**.

NOTE:

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Suggested approaches:

- Start with a short brainstorming session to discover what the students think 'temperature' is:
 - ① *Can they name the units it is measured in?*
 - ① *Can they name different types of thermometers, e.g. a meat thermometer, a fridge thermometer, a clinical thermometer, a strip thermometer (i.e. temperature strip held on forehead)?*
 - ① *Can they give some reasons we might need to measure temperature?*
- Another approach might be to see if students can relate physical changes to temperature change, e.g. relating the colour of a gas flame to hotness.
 - ① *Can they give you a number of examples?*
 - ① *What do they understand by the term physical changes?*
- Introduce the term 'thermometric property' and challenge the students to explain it without looking it up.
 - ① *Suggest that they 'dissect' the word, i.e. what about 'therm'? What does it suggest? The second part, 'metric' – when might the word 'meter' be used?*
 - ① *Check the spellings of 'meter' and 'metre' – do they represent the same concept?*
- Another approach might be to focus on finding out what ideas the students have about the direction of heat energy.
 - ① *Why might a table feel initially cold when I put my hand on it?*
 - ① *How long will it continue to feel cold?*
 - ① *What about walking on carpet?*
 - ① *What about walking on a tiled floor?*
 - ① *What are our five senses?*
 - ① *Could any of our senses be responsible for our responses to heat and cold?*
- Before the investigations, the following questions could be put to the students to provoke a short discussion:
 - ① *Must all thermometers be accurate?*
 - ① *What is the function of a thermometer?*
 - ① *What information are we looking for when using a thermometer?*
 - ① *Is accuracy an important feature of all thermometers?*

If the students are arranged in groups for this, have each group draw up their conclusions for reference at the end of the investigations.