

Energy

4. Heating and Cooling

CONCEPT 1

LESSON GUIDE

TEMPERATURE AND THERMAL ENERGY

PRECISE LEARNING POINTS

KNOW

I know what the temperature of an object is.

APPLY

I can apply my knowledge of temperature to explain the flow of thermal energy.

EXTEND

I can extend my knowledge of temperature to compare the thermal energy of different objects.

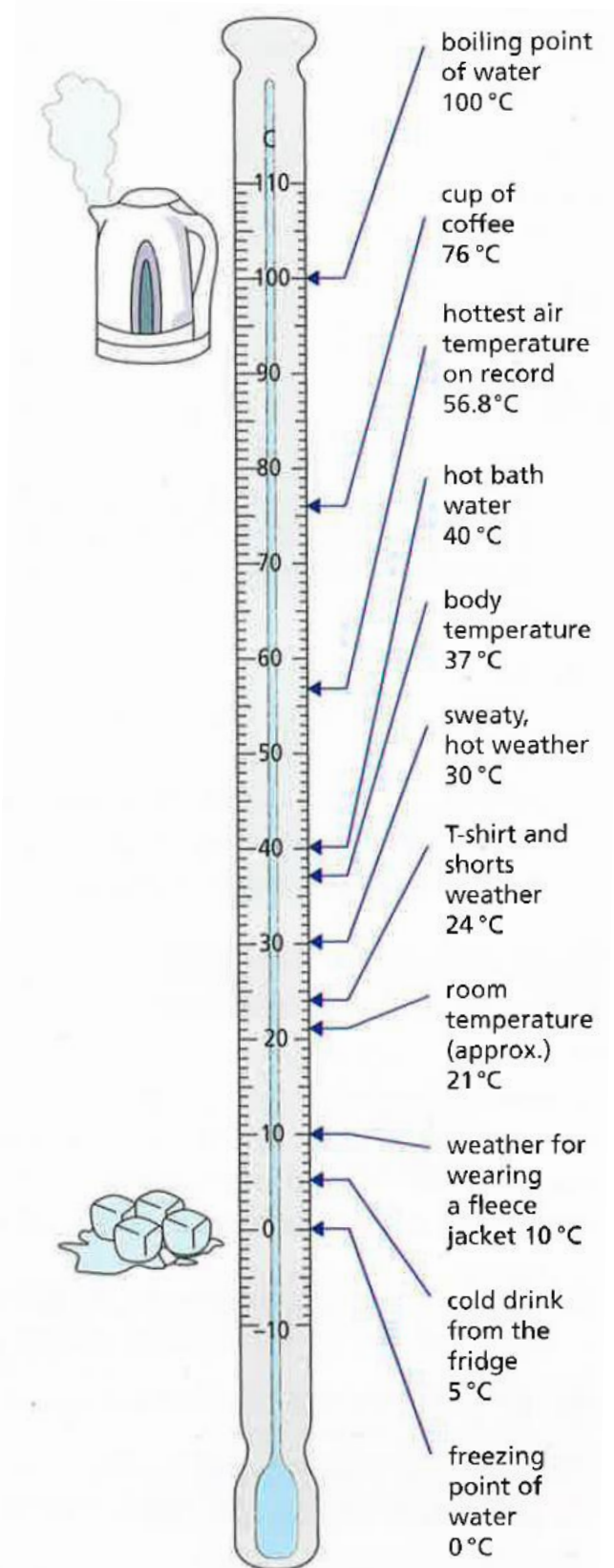
NOTES

Temperature is not heat.

We use a scale of temperature to measure how hot or how cold something is. The common unit is **degrees Celsius ($^{\circ}\text{C}$)**. The instrument we use to measure temperature is called a thermometer. Standard thermometers measure temperatures from 0°C (the temperature at which water freezes) to 100°C (the temperature at which water boils).

If there is a difference in temperature between two objects in contact, or between an object and its surroundings, there is a transfer or **flow of energy**. Energy always flows from the hotter object to the colder object. Energy will continue to flow in this direction until the two objects reach the same temperature. The greater the difference in temperature, the faster the flow of energy.

If you touch a radiator that has been heated then it feels warm to touch. This is because it will be around 45°C and your fingers are around 37°C . Energy flows from the radiator into your fingers and we describe the sensation of receiving energy as *feeling warm*.



If you pick up an ice cube then it feels cold to touch. This is because it is 0°C and your hand is around 37°C . Energy flows out of your hand into the ice cube and we describe the sensation of losing energy as *feeling cold*.

Touching something with an extremely high temperature (i.e. an iron that is on or an electric hob that is on high power) is dangerous. This is because the difference between the object's temperature and your hand is much higher – it could be hundreds of degrees Celsius. The energy flow into your hand will be extremely fast and there will be a high amount of energy. This can lead to our hands being damaged and we call this a burn.

We use this principle of energy transfer to heat and cool objects or our surroundings. If you put some food at room temperature (20°C) in a fridge (at 4°C), energy from the warmer food will transfer to the colder surroundings of the fridge. This will reduce the temperature of the food and cool it down. Meanwhile, the air in the fridge is heating up because it is receiving energy from the food. Fridges have an even cooler section at the back that allows the air to lose energy to it. This means that the food and the air in the fridge can be at the same cooler temperature.

Think about a cup of hot water (at 80°C) and a big bucket of warm water (at 30°C). You know that the water in the cup has a higher temperature. But, which **thermal energy** store is the greater?

Although the water in the cup is hotter (higher temperature), there is much less of it.

- Temperature is a way of comparing two objects and measuring how much hotter one is than the other.
- The water has thermal energy. This is the total energy of all the particles that make it up – a measure of not only how fast particles are moving but also the total number and type of particles.

