

Heat and temperature

When we know the **temperature** of something, we know how hot it is, not how much **heat** energy (**thermal energy**) is in it.

Temperature is measured in **degrees Celsius** ($^{\circ}\text{C}$).

Heat (thermal) energy is measured in **joules** (J).

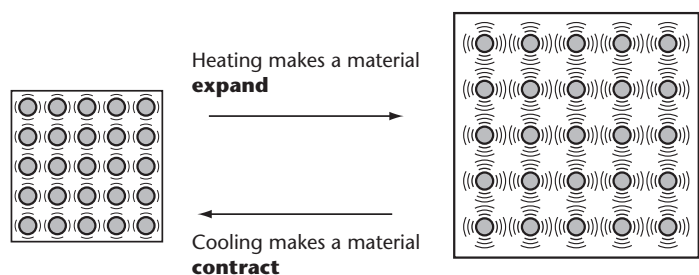
The amount of heat or thermal energy in something depends on:

- how hot it is (its temperature)
- the material it is made from
- its mass.



Transferring heat energy

The **particle model of matter** helps to explain how some forms of heat energy travel. The theory suggests that everything is made of moving or vibrating particles. When these particles are heated, they move faster and further, so they take up more room. The material expands.



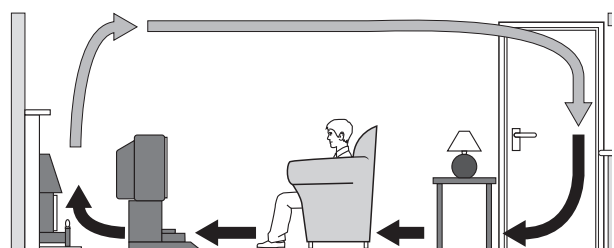
Heat energy can be transferred in three different ways.

Conduction takes place in solids and can also happen in liquids (although not very well). The particles in a solid are held together tightly. When they gain energy they vibrate faster and further, and the vibrations are passed on. Metals are the best **conductors**. Most other solids are poor conductors.

Particles are not as close in a liquid, so conduction is not very good. Particles are a long way apart in gases, so gases hardly conduct heat at all. Something that does not conduct heat very well is an **insulator**. Liquids, gases, and solids that contain a lot of trapped air are insulators.

Convection takes place in **fluids** (liquids and gases).

When the air near the fire is heated, the particles spread further apart and the air becomes less dense and rises. As it rises it meets cooler air and passes the energy on. Having passed on the energy, it cools and becomes denser. The denser air sinks, setting up a cycle or **convection current**.



Infrared radiation can transfer heat energy through empty space. Radiation does not require the movement of particles. Any hot or warm object gives off or **emits** radiation. When something takes in heat energy from radiation, it is said to **absorb** it.

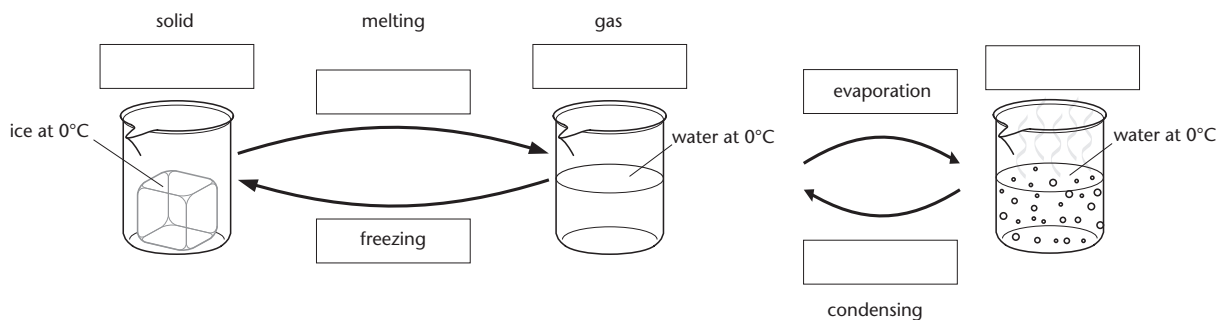
Infrared radiation is similar to light. It can be absorbed or **reflected**, and it can also be focused.



You can start a fire by focusing the infrared radiation from the Sun.

Changes of state

Substances can change state when they are heated or cooled. The three states of matter are solid, liquid and gas.



The melting point and the freezing point of a substance are the same temperature. The temperature of a substance does not change while it is melting, even if it is still being heated.

