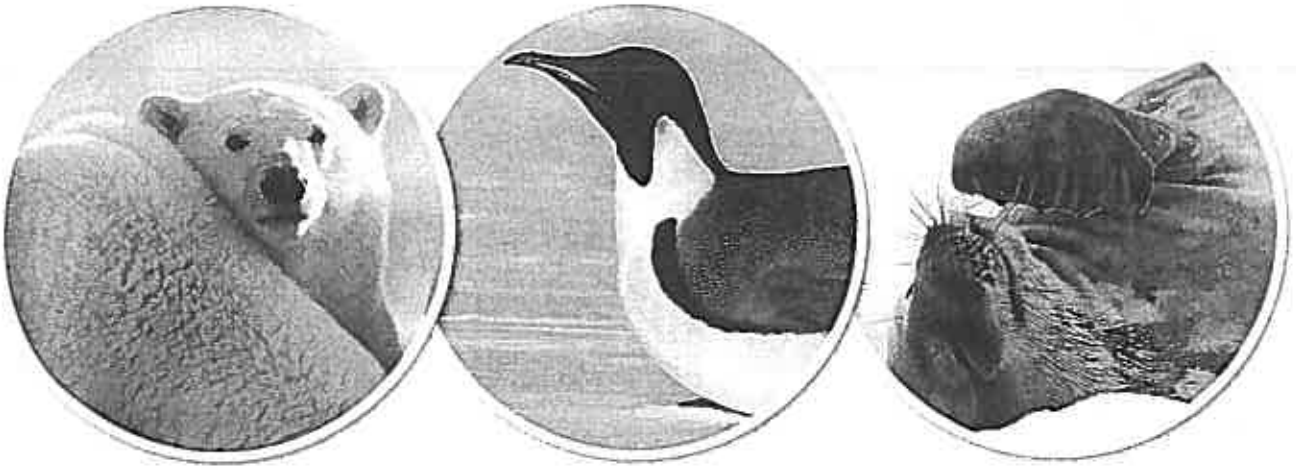

Fig 6.2.6 Fur and feathers provide good insulation by trapping air.

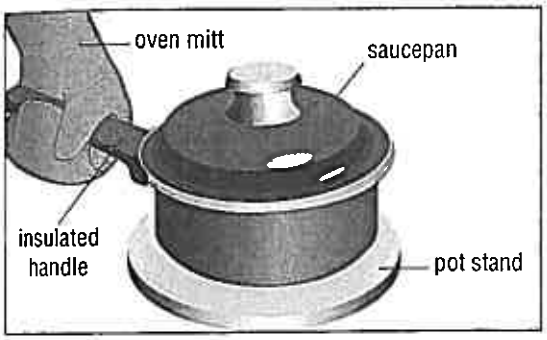

Fig 6.2.7 In the kitchen, burns would happen without insulation.

R ratings

Insulation batts are often given 'R' ratings. The R stands for resistance to heat flow.

Material	R rating (for a 2.5 cm thickness of the material)
Polystyrene foam	4.5
Insulation batt	4.0
Wood	2.3
Chipboard	2.0
Window (double glazing)	1.6
Window (single glazing)	0.9

Fig 6.2.8 Insulation batts can be used to insulate roofs, floors and walls.

Convection

More heat is transferred in liquids and gases by convection than by conduction. Whereas the particles in a solid have fixed positions and can only vibrate, the particles in liquids and gases can move about. They can easily carry their heat energy with them, spreading the heat to other parts of the substance. The spread of heat due to the movement of particles in liquids and gases is called **convection.**

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Hot air rises

Hot air rises because its particles are spread out more than in cold air. This makes hot air less dense than cold air and so it will rise to get on top of it. The same happens to liquids—hot liquids rise because they are less dense than cold liquids. As they rise, the hot gases and liquids take their heat energy with them, spreading it throughout the container.

Convection explains why:

- Hot-air balloons rise.
- Smoke rises from a fire.
- It is hotter near the ceiling than near the floor.
- Central heating vents are usually fitted in the floor, allowing hot air to rise from them.
- Hot-water systems have their heating elements or flames at the bottom of the tank so that the heated water will rise and mix with the cold water in the tank.

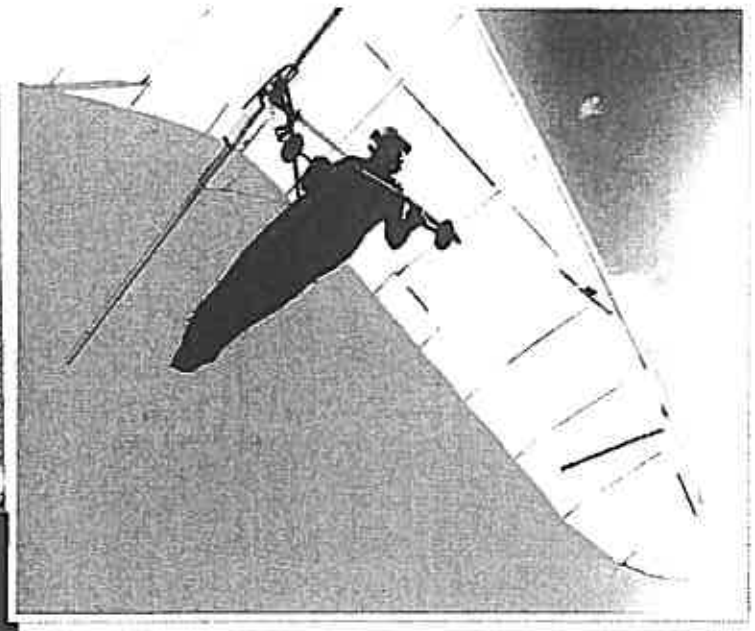


Fig 6.2.9 Gliders and hang-gliders use convection currents in the air to stay aloft much longer than would be possible otherwise.

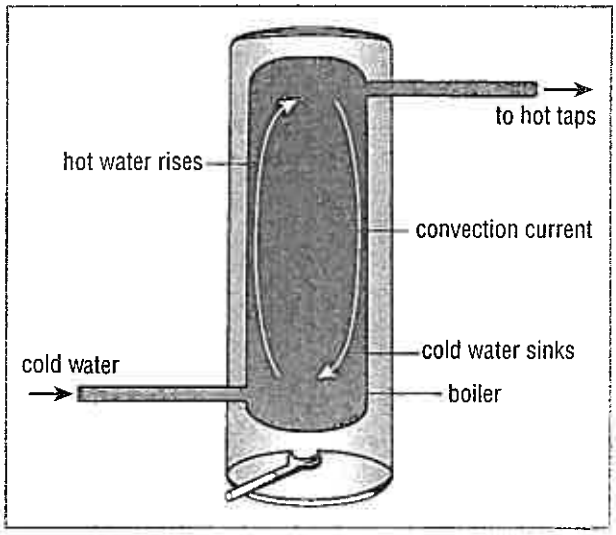


Fig 6.2.10 A hot-water system showing the movement of water by convection.

Cold air drops

Cold air drops because its particles are packed together more tightly than in hot air. The same happens in liquids. Cold liquids are denser than hot liquids and so will drop to the bottom of their container.

This is why:

- Air conditioning vents are often in the ceiling.
- There is a flow of cold air onto your feet when you open an upright freezer's door.
- 'Tub' type supermarket freezers do not need a lid since the cold air cannot escape easily.
- If caught in a fire, the safest place to be is close to the floor.

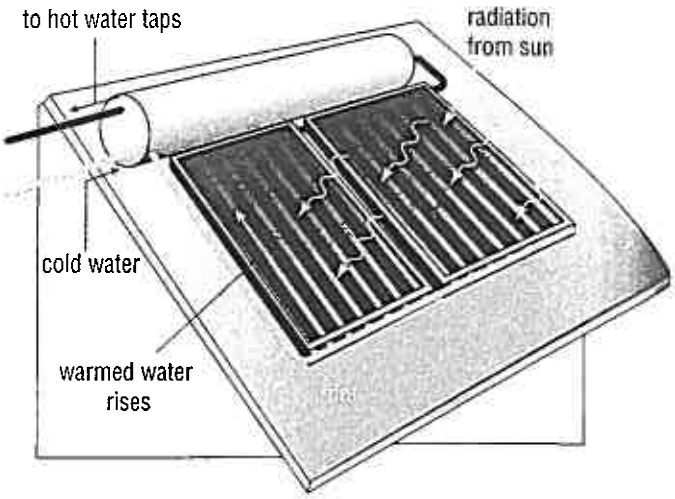
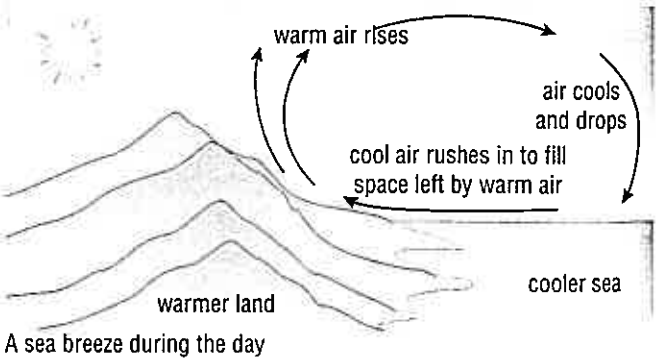


Fig 6.2.11 A solar hot-water system also makes use of convection.

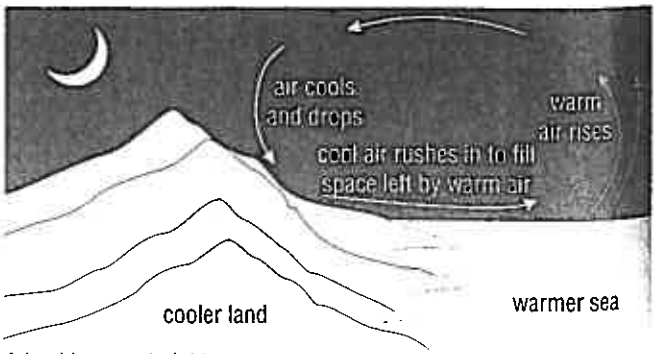
Winds

Hot air rises and cold air drops. This results in convection currents. In the atmosphere, these currents are felt as wind. Wind is caused by hot air in one region rising and its place being taken by colder air coming in from another region. For example, air at the equator is hotter than air at the Poles, causing global winds.

A sea breeze occurs during the day because the land warms up more quickly than the sea. As warm air rises above land, cooler air moves in from just above the sea to replace it. The opposite occurs at night, when the land loses heat more quickly than the sea.



A sea breeze during the day



A land breeze at night

Fig 6.2.12 Land and sea breezes are convection currents at work.

The thermos flask

The thermos flask is constructed to minimise all three possible ways of losing heat.

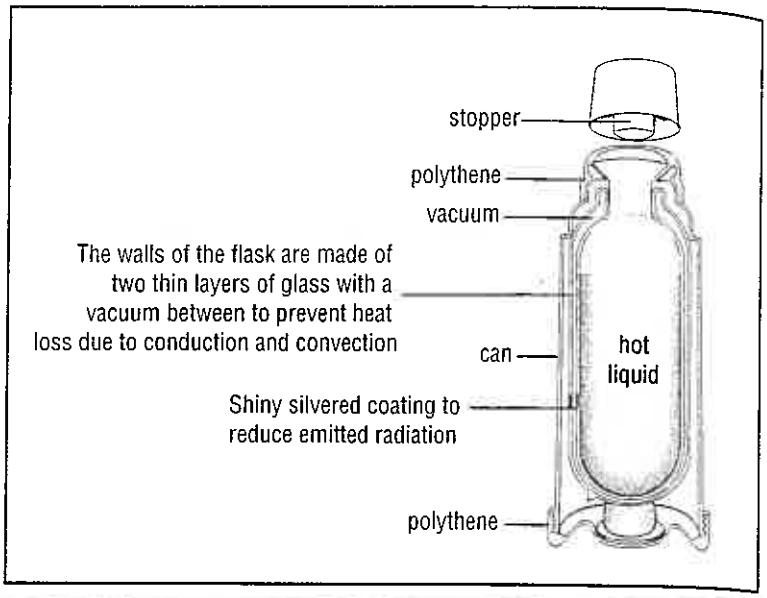


Fig 6.2.15 A vacuum flask reduces heat loss by conduction, convection and radiation.

6.2 QUESTIONS

Remembering

1 **List** three sources of heat.

2 **List** the following in order from best to worst conductor of heat:
water, air, copper, outer space.

3 **State** another name for a poor conductor. Give an example.

4 **List** the three ways that heat can move from one place to another.

Understanding

5 **Explain** the difference between *temperature* and *heat*.

6 **Explain** conduction in terms of what is happening to the particles involved.

7 For heat to conduct from one solid to another, two things must happen. **Explain** what are these two requirements.

8 **Explain** how a fur coat insulates the person who wears it.

9 **Describe** what double glazing is and when it is used.

10 There are many differences between *convection* and *conduction*. **Explain** some of these.

11 **Explain** why cloudy nights are usually not as cold as nights when the sky is clear.

12 **Explain** how some supermarket freezers can be open at the top without losing too much cold air.

13 Some central-heating systems release hot air into a house through vents near the ceiling. **Explain** why this is a poor design.

14 **Explain** why heat cannot reach the Earth from the Sun by conduction or convection.

Applying

15 Draw a particle diagram to **demonstrate** conduction in a metal rod.

16 Draw a diagram to **demonstrate** convection currents in a beaker of water being heated from underneath by a Bunsen burner.

17 Draw a diagram to **demonstrate** how a sea breeze works.

18 **Identify** the type of heat transfer that applies in each case below.

a No material is required.

b Particles vibrate.

c Particles move through a material.

19 **Identify** a household device that gives out both light and radiated heat.

20 **Identify** the correct statement and copy it into your workbook.

A Black objects are better emitters but poorer absorbers of heat than white objects.

B Black objects are better emitters and better absorbers of heat than white objects.

C Black objects are worse emitters and better absorbers of heat than white objects.

D Black objects are worse emitters and worse absorbers of heat than white objects.

E The colour of an object does not affect how it emits or absorbs heat.

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