KS3 Science Independent Learning Booklets

Heating and Cooling

If you have internet at home, you can use bitesize to help you with some of the activities.

Try your hardest to work through the booklets

Heating and temperature

Temperature

The temperature of an object is to do with how hot or cold it is, measured in degrees Celsius. Note that the unit of temperature is written as °C, (not °c or oC).

A thermometer is used to measure the temperature of an object

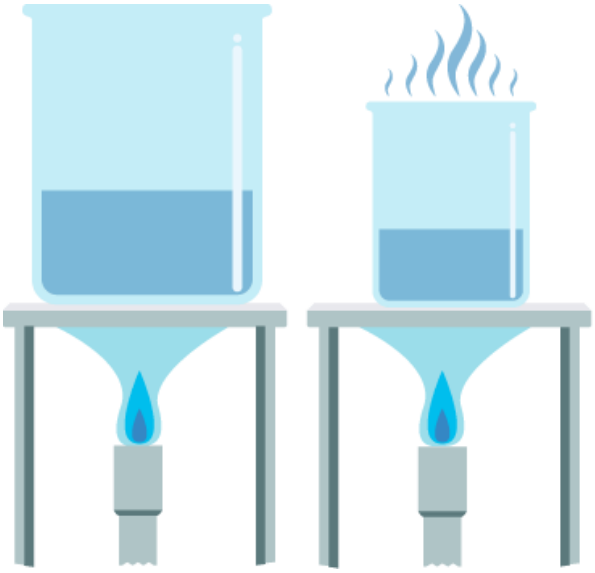
All objects contain internal energy. Some of this is due to the movement of the particles in the object. When an object is heated, its particles move more vigorously and its internal energy increases. Unless the object changes state (eg melts or boils), its temperature will increase.

Example 1

A swimming pool at 30°C is at a lower temperature than a cup of tea at 80°C. But the swimming pool contains more water, so it stores more internal energy than the cup of tea.

Example 2

To boil water we must increase its temperature to 100°C. It takes longer to boil a large beaker of water than a small beaker. This is because the large beaker contains more water and needs to gain more internal energy to reach 100°C.



When heated, the temperature of a small beaker of water will increase faster than the temperature of a large beaker of water

Thermal equilibrium

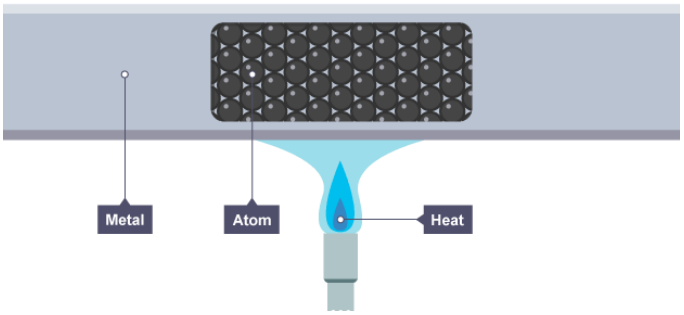
If there is a difference in temperature between two objects, energy is transferred from the hotter object to the cooler one. This will continue until both objects are at the same temperature. When they are at the same temperature, we say that they are in thermal equilibrium, and there is no overall transfer of energy any more between the two objects.

Energy can be transferred from a hot object to a cooler one by:

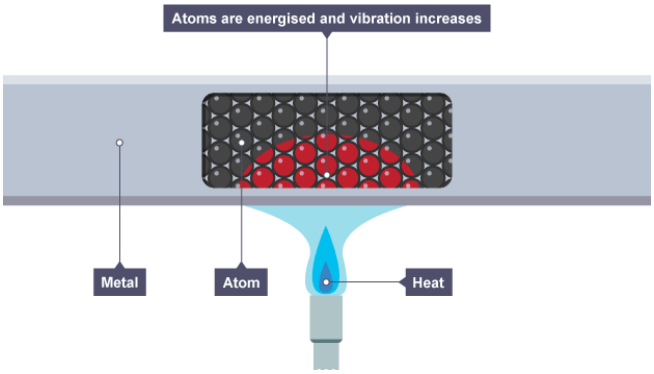
- conduction (if they are touching each other)
- convection
- radiation

Conduction

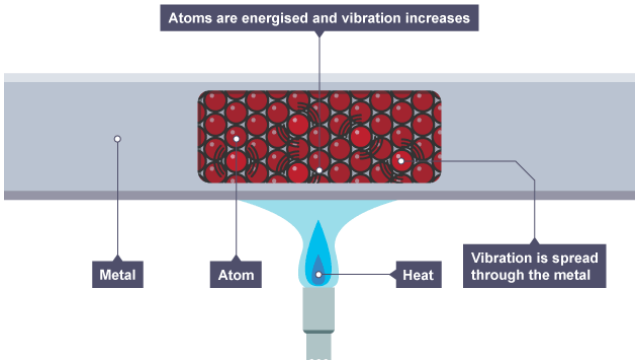
When a substance is heated, its particles gain internal energy and move more vigorously. The particles bump into nearby particles and make them vibrate more. This passes internal energy through the substance by conduction, from the hot end to the cold end.



A Bunsen burner flame heats the metal rod



The atoms in the rod increase in internal energy



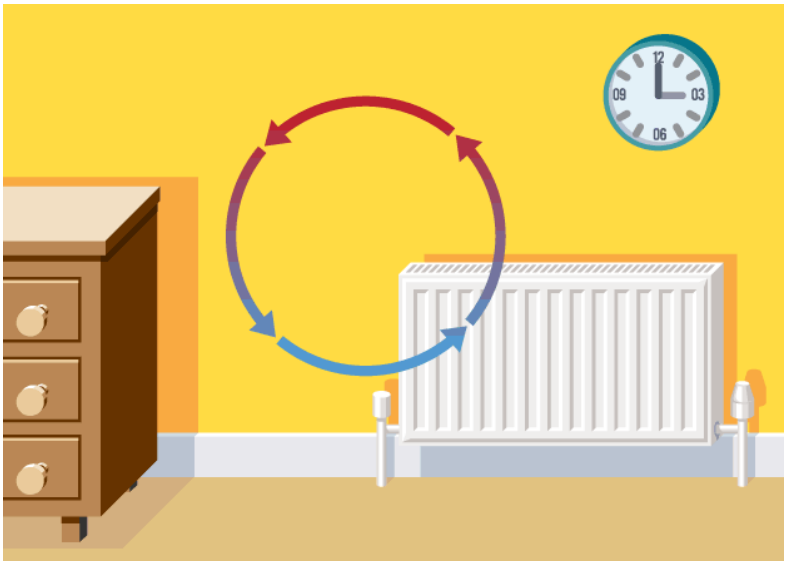
The increased vibrations spread form one atom to the next, eventually increasing the temperature of the whole rod.

This is how the handle of a metal spoon soon gets hot when the spoon is put into a hot drink.

- A substance that transfers energy easily from the hot part to the cold part is called a conductor. Metals are good conductors.
- A substance that does not transfer energy easily from the hot part to the cold part is called an insulator. Air and plastics are insulators.

Convection

The particles in liquids and gases can move from place to place. Convection happens when particles with a lot of thermal energy in a liquid or gas move, and take the place of particles with less thermal energy. Thermal energy is transferred from hot places to cold places by convection.



As the hot air above a radiator rises it pushes cooler air away from it. The cooler air eventually circulates back round to the radiator where it gets heated and the cycle continues.

Radiation

All objects transfer energy to their surroundings by infrared radiation. The hotter an object is, the more infrared radiation it gives off.

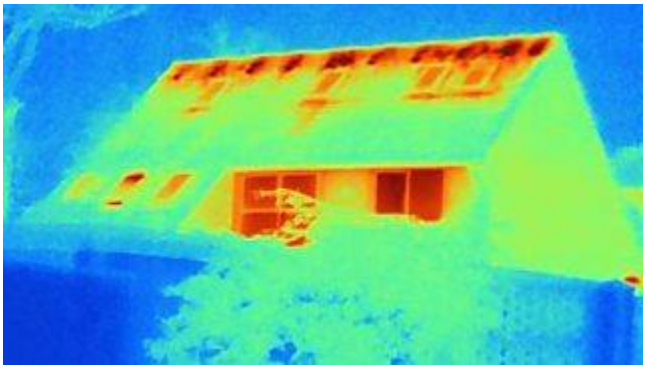
No particles are involved in radiation, unlike conduction. This means that energy transfer by radiation can work when objects are not touching, even in space:

- radiation is why we are warmed by the Sun, even though it is millions of kilometres away in space
- infrared cameras give images even in the dark, because they are detecting infrared light, not visible light

In this thermogram of a pan on a stove, the hottest parts are coloured white, yellow or red; the coldest parts are coloured purple or black

Insulation

Take a look at this thermogram of a house. Its roof and windows are the hottest, showing that most energy is lost from the house that way.



A thermogram of house, showing areas of heat loss

Energy is transferred from warm homes to the outside by:

- conduction through the walls, floor, roof and windows
- radiation from the walls, roof and windows

Ways to reduce energy transfer

There are some simple ways to reduce energy transfers from a house, including fitting:

- carpets and curtains
- reflective foil on the inside walls
- double glazing

Double glazing involves having two panes of glass in the window instead of just one. There is air or an even better insulator such as argon gas between the two panes of glass. This reduces energy transfer by conduction.

Energy loss through walls can be reduced using cavity wall insulation. This involves blowing insulating material into the gap between the outside wall and the inside wall to reduce conduction. Loft insulation works in a similar way.

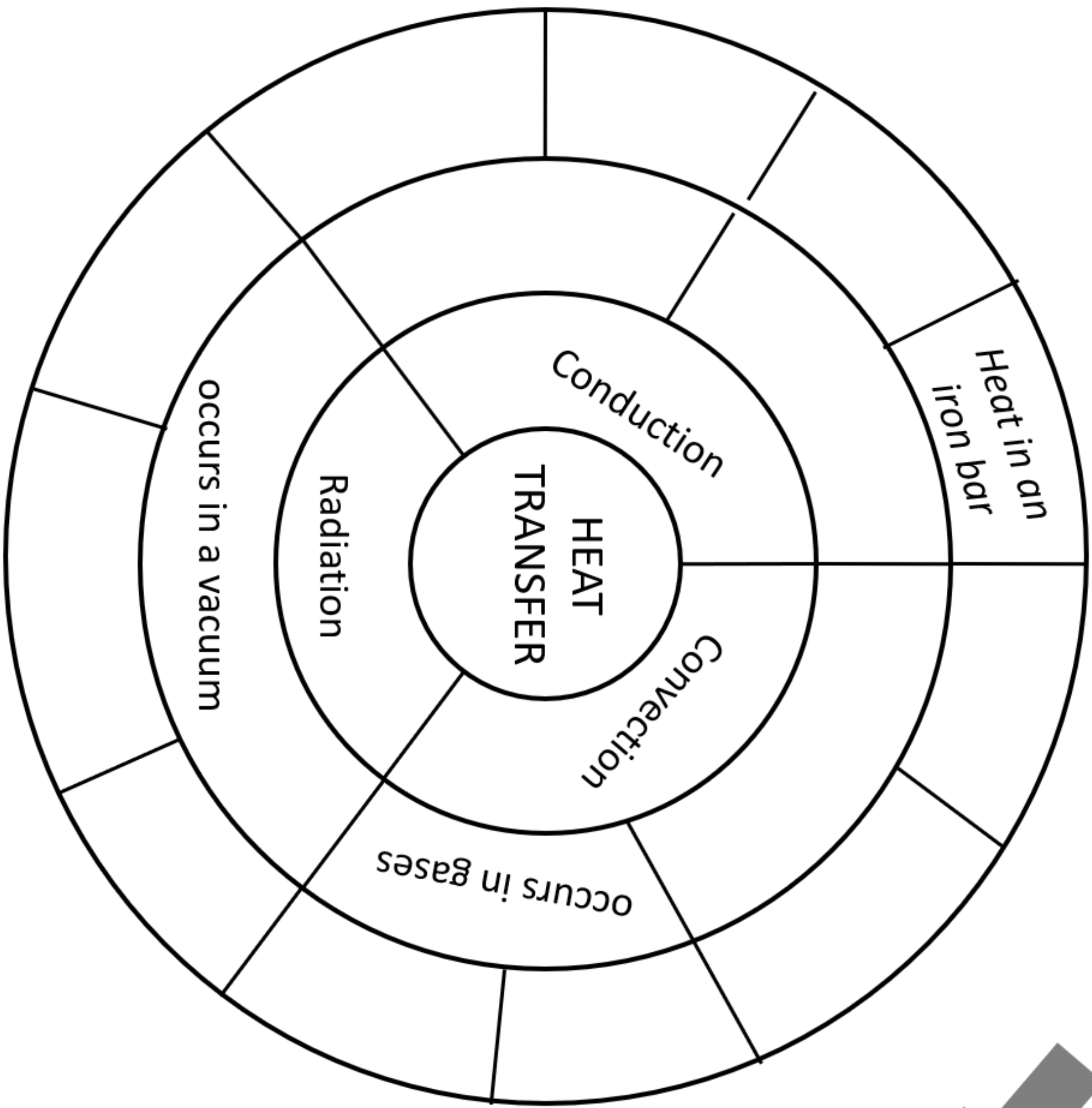
Activities

Task 1

This is called a mandala it is like a mind map for key words, you need to use the key words at the side and sort them to the correct box. I have helped by doing a couple for you to help you. It helps to distinguish between keywords that look the same but are different!

Year 8 Heating & Cooling Revision activity

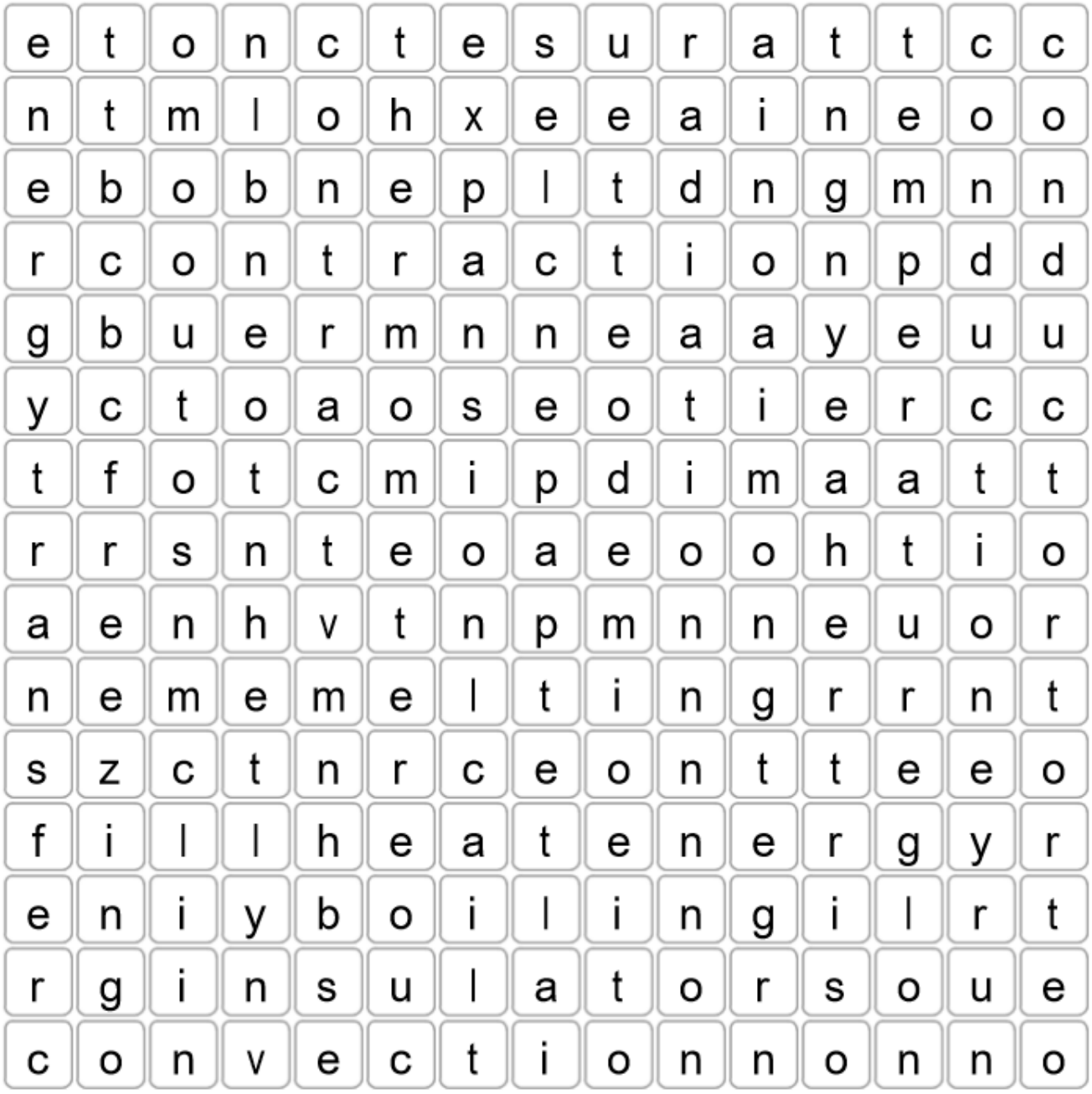
Find the right box below for each of these words



air is trapped to retain heat
can be seen with purple crystals
causes heat haze
cavity walls
conduction
convection
creates a current
doesn't need particles
heat in an iron bar
how the Sun heats Earth
occurs in a vacuum
occurs in gases
occurs in liquids
occurs in some solids
opposite is insulation
particles do not move about
particles move about
radiation
travels as waves

Task 2

Wordsearch find the keywords



Words to find:

boiling, conduction, conductor, contraction, convection, energy transfer, expansion, freezing, heat energy, insulator, melting, radiation, temperature, thermometer.

Task 3

Complete the questions

1. Fill in the blanks by choosing from the following words:

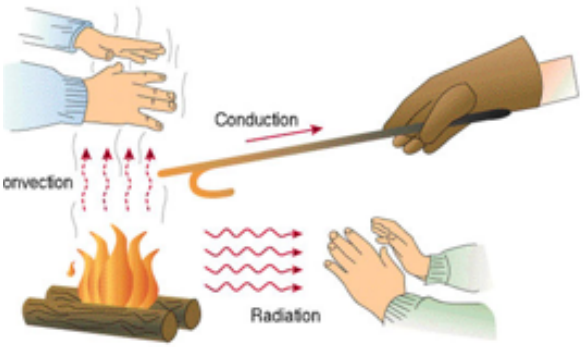
Heat **Currents** **Radiation** **Warm** **Cold** **Density**

Earth **Convection**

Convection and Radiation

There are three types of heat transfer: radiation, conduction and _____. When _____ air rises, cooler air rushes in to take its place. This cooler air is then heated and the process continues. This forms convection _____. Another form of heat transfer is radiation. This is when hot objects give off infrared radiation. Infrared radiation is invisible to the naked eye, however, can be seen using a special camera. The Sun heats the _____ through _____.

2. Indicate whether the statement is true or false:	True	False
All metals conduct at the same rate	☐	☐
Gases and Liquids can carry heat by conduction	☐	☐
A thermal insulator is a material that does not let heat energy flow through it	☐	☐
A cup of hot tea has **less** heat energy than a bath full of water	☐	☐
A grill cooks food using infrared radiation	☐	☐



4. Why does conduction not occur in gases?

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3. Explain how a radiator in a room is able to warm the whole room

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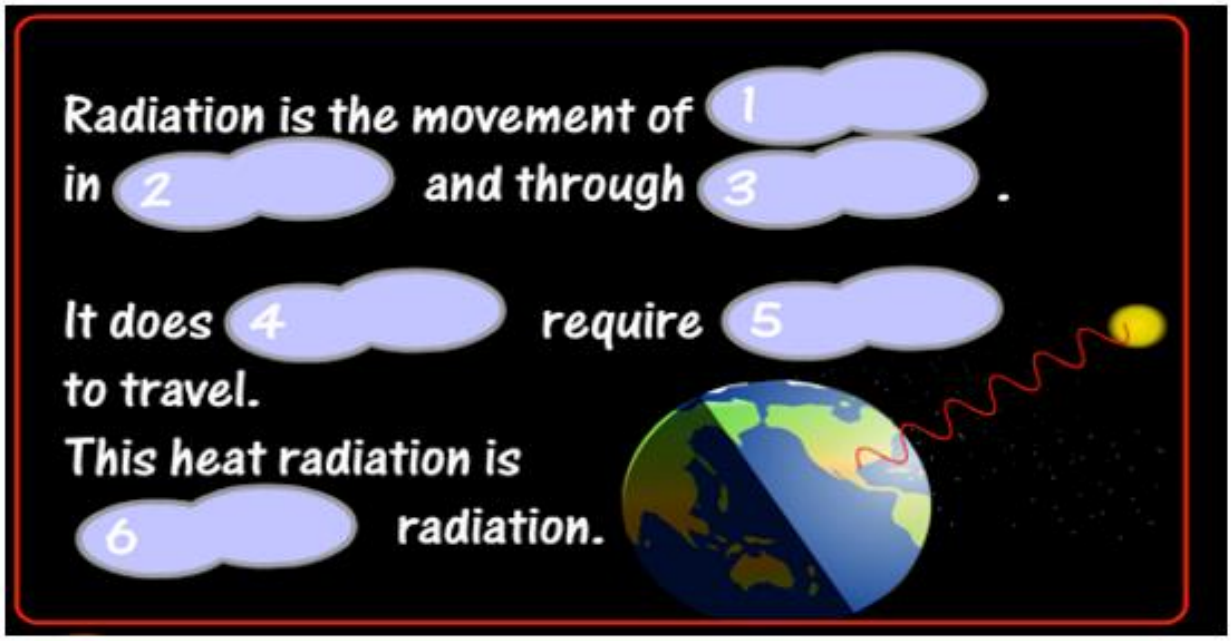
5. Match the following statements to the correct definition:

Temperature	is transferred from a hot object to a cold object
Insulator	Heat energy cannot pass easily through this material
Convection current	How hot or cold something is
Radiation	When hot particles rise and then fall as they cool down
Thermal energy	Heat energy that can move without particles touching

6. Fill in the missing words on the diagram below:



7. After a marathon many runners are given a shiny, aluminium blanket to wrap around their bodies. Explain why the blanket is shiny and a metal?

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Final Fun Task

See if you and someone at home can have a game of Heat (it is just like snakes and ladders the rules are below and the board is on the next page. Have fun!!!!

The rules are pretty much like Snakes and Ladders.

Throw the die once. Player with highest score in one throw will be first.

Throw the die again and start.

Box number 3: The Convection Cloud

You are trapped in a liquid or gas that is heating up. The particles vibrate and separate, making it less dense. Less dense fluids will rise and take you with them to box 13.

Box number 9: Conductivity

The particles of the solid are vibrating with the heat and transferring the heat energy from one to the next. As they get gaps between them, the solid expands and drags you down to box 2.

Boxes number 12 and 14: The Convection Cloud – Expansion

The hot particles are now far from the source of heat and have expanded to be far apart. As they cool down, they get closer to each other and the fluid gets more dense. Therefore, they start falling down again, and you fall to box 10 (from 12) or 6 (from 14).

Box number 17: Density

When something is cold, its particles are all close together and they do not move. There are a lot of particles in a small space (high density). When the particles get hotter, they vibrate and separate so there are less particles in a small space (less dense). Things that are less dense rise, and you are risen to box 24.

Box number 19: Radiation

The third form of transferring heat is radiation. It does not involve particles moving, only heat energy is sent across and transferred. The sun radiates its heat to box 21, and you go there to keep warm.

Box number 20: Insulated box

An insulator is something that isolates from the environment and does not allow exchange of heat in any direction. You are trapped in the box and your heat cannot escape. You miss one turn.

Box number 24: Density (2)

When hot things start to cool down, their particles vibrate less and start to fall, so that they accumulate in a smaller space (higher density). High density things drop down, and you are dropping to box 17.

21

RADIATION

22

23

24

HOT

LOW DENSITY

25

WINNER

20

INSULATED BOX

19

18

17

COLD

HIGH DENSITY

16

11

12

13

EXPANSION

14

15

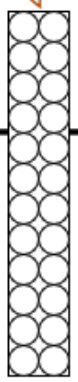
COOLING DOWN

COOLING DOWN

10

9

CONDUCTION



8

HOT PARTICLES

7

6

1

START

2

3

The CONVECTION cloud

4

5