

Fold in half at the line ----->

Glue on this side

Heating and cooling

1	I can describe the difference between temperature and heat.
2	I can state that thermal energy is transferred by conduction in solids, convection in liquids and radiation in vacuums and transparent objects. I can state that thermal energy is transferred from hotter objects to colder objects.
3	I can name some thermal insulators and suggest why thermal insulators reduce thermal energy transfer.
4	I can describe and explain how thermal energy is transferred by conduction in solids, in terms of particles.
5	I can describe and explain how thermal energy is transferred by radiation, in terms of particles.
6	I can describe and explain the expansion of heated materials.

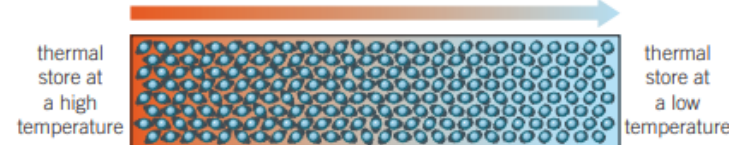
1	conduction	Transfer of thermal energy by the vibration of particles.
2	convection	Transfer of thermal energy when particles in a heated fluid rise.
3	convection current	The movement of heated fluids where hot fluid moves upwards, and cold fluid moves downwards.
4	infrared radiation	Radiation given off by the Sun and other objects that brings about energy transfer.
5	radiation	The transfer of energy as a wave.
6	temperature	A measure of the motion and energy of particles.
7	thermal conductor	Material that allows heat to move quickly through it.
8	thermal energy store	The store containing energy due to the vibration or movement of particles of a substance.
9	thermal insulator	Material that only allows heat to travel slowly through it.

Energy and temperature

- The **temperature** of a substance is a measure of how hot or cold it is
- Temperature is measured with a **thermometer**, it has the units of degrees Celsius (°C)
- The **thermal energy** of a substance depends on the individual energy of all of the particles, it is measured in Joules (J)
- As all particles are taken into account, a bath of water at 30 °C would have more thermal energy than a cup of tea at 90 °C as there are many more particles
- The faster the particles are moving, the more thermal energy they will have
- When particles are heated they begin to move more quickly
- The energy needed to increase the temperature of a substance depends on:
 - the mass of the substance
 - what the substance is made of
 - how much you want to increase the temperature by

Conduction

- Conduction** is the transfer of thermal energy by the vibration of particles, it cannot happen without particles
- This means that every time particles collide they transfer thermal energy
- Conduction happens effectively in solids as their particles are close together and can collide often as they vibrate around a fixed point
- Metals are also good **thermal conductors** as they contain electrons which are free to move
- In conduction the thermal energy will be transferred from an area which has a high **thermal energy store** (high temperature) to an area where there is a low thermal energy store (low temperature)
- Gases and liquids are poor conductors as their particles are spread out and so do not collide often, we call these **insulators**



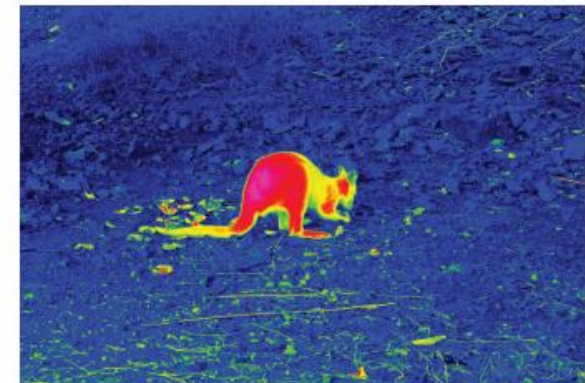
Convection

- Convection** is the transfer of thermal energy in a liquid or a gas, it cannot happen without particles
- As the particles near the heat source are heated they spread out and become less dense, this means that they will rise
- More dense particles will take their place at the bottom nearest the heat source creating a constant flow of particles
- This is known as a **convection current**
- Convection cannot happen in a solid as the particles cannot flow, they can only move around a fixed point



Radiation

- Radiation** is a method of transferring energy without the need for particles
- An example of radiation is thermal energy being transferred from the Sun to us through space (where there are no particles)
- This type of radiation is known as **infrared radiation**, it is a type of wave just like light
- The hotter an object is the more infrared radiation it will emit (give out)
- The amount of radiation emitted and absorbed depends on the surface of the object:
 - Darker matte surfaces absorb and emit more infrared radiation
 - Shiny and smooth surfaces absorb and emit less infrared radiation, instead reflecting this
 - The amount of infrared radiation being emitted can be viewed on a **thermal imaging camera**



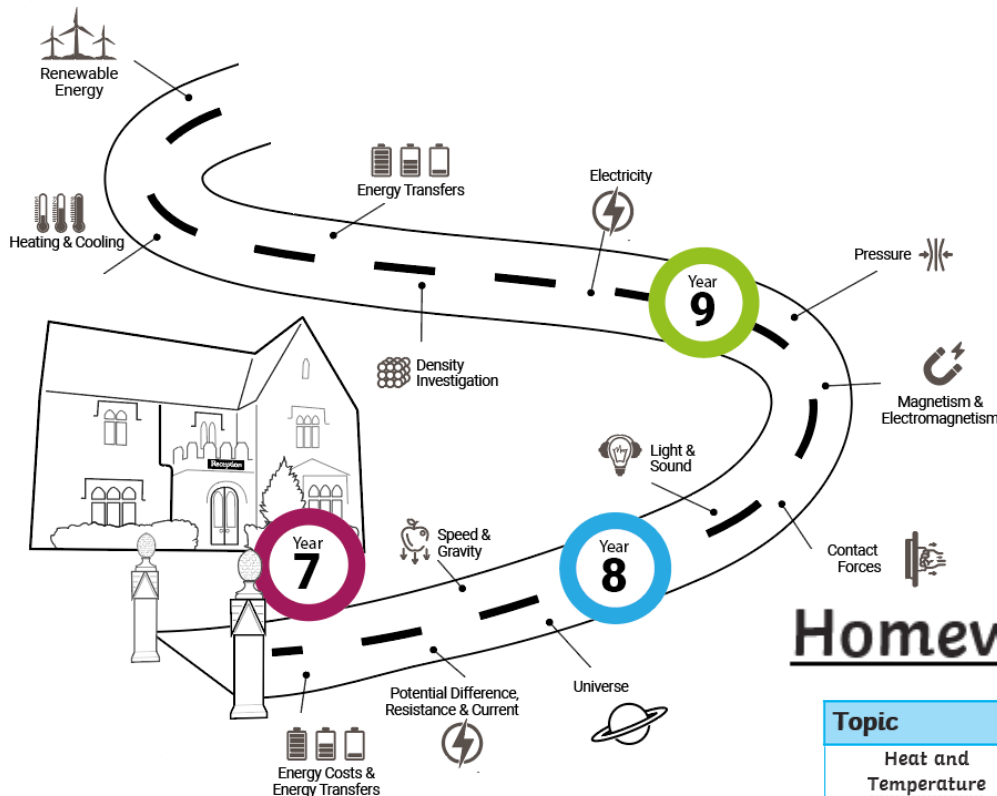
Why?

Important to identify conductors and insulators for safety. You need to consider the impact of energy wastage on the environment and economy.

Prior Knowledge From KS2:
At KS2 you will have covered some common **conductors and insulators**, and associate **metals with being good conductors**.

Homework Menu Grid

Topic	1 Point	2 Points	4 Points	6 Points	10 Points
Heat and Temperature 	Draw and label a simple Diagram to show what happens to particles as you apply heat energy. diagram.	In your own words, write down what equilibrium means.	You might hear someone say "Shut the door, you'll let the cold in". Rewrite the statement so that it is scientifically correct and explain why.	Write a short paragraph, explaining what the difference is between heat and energy.	Research the history of the thermometer and produce a timeline to show the events in history.
Conduction 	Write a definition for the word conductor.	Write a tweet that describes what conduction is (140 characters)	Write a poem to explain how heat is conducted through an object.	Write an exam question based on how a diver uses the insulating properties of liquids to stay warm when diving. (This should be a 3 mark questions so the answer should need 3 statements)	Write a letter to a scientific journal that describes the many ways that we can use both the insulating and conducting properties of materials.
Radiation 	Write down another name we can use to describe thermal radiation.	Survey each room in your house. Write a list of all the appliances that give off heat.	Write a short paragraph explaining why we often consider thermal radiation a "waste of energy".	Write a short paragraph explaining why the radiation of light and heat from the sun are necessary for keeping us alive.	Research the invention of the lightbulb by Thomas Edison and create a timeline of key events.



Careers:
Electrical engineer
Builder
Politician
Environmental scientist

Future Learning:
In GCSE physics you will also cover in more detail specific **heat capacity, energy transfer and efficiency**.