Energy

4. Heating and Cooling

CONCEPT 3

LESSON GUIDE

INSULATION

PRECISE LEARNING POINTS

KNOW

I know what conductors and insulators are.

APPLY

I can apply my knowledge of conductors and insulators to explain how insulation works

EXTEND

I can extend my knowledge to explain how everyday objects can reduce conduction, convection and radiation.

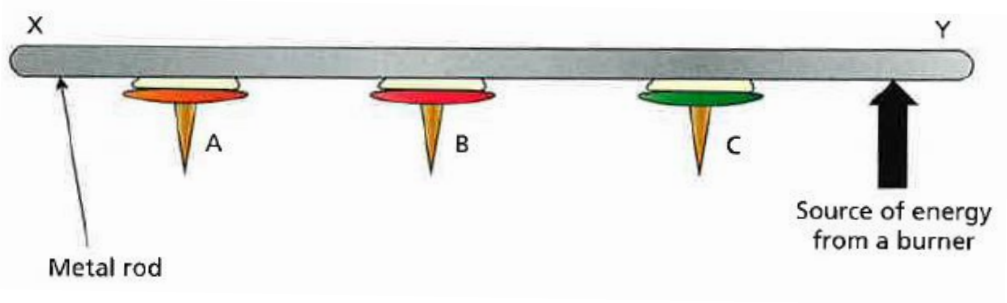
NOTES

As we've seen, energy can be three quite different ways. This means that if we want to stop it from entering or leaving, we have to be quite clever about it and understand how it moves. **Insulation** is important in the home; as well as coats and duvets, we have insulation in cookers, fridges, walls and the loft.

In the photograph, you can see snow has fallen on the houses, but only one of the houses in the row has good loft insulation. This means that heat in the living floors of the house isn't escaping through the loft and roof and staying inside to keep the house warmer. This means less heating is required by the heating system – which means less energy required and cheaper for the owners.

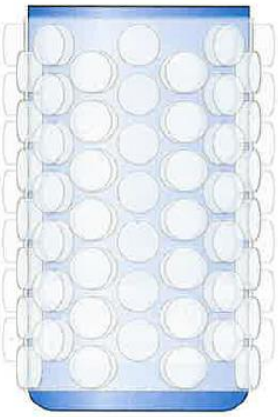
We might think we can divide materials into **conductors** and **insulators**, but it's not as simple as that. Energy is transferred through materials at different rates. If it moves slower we tend to regard the material as an insulator and if it travels faster, it's considered to be a conductor.

The following simple experiment can be used to compare how good a conductor different metals are.



Pins are stuck to a metal rod using petroleum jelly or wax. As a rod of metal is heated at position Y, it will conduct heat energy along to position X. As the particles at positions C, B and A increase in temperature, the petroleum jelly or wax will melt and pins will drop off the metal rod.
If a metal is a good conductor of heat then the pins will drop in sequence quickly. If a metal is a poorer insulator then it will take a longer time for the pins to drop. Metals that are not good conductors may result in pin A taking a very long time to fall.

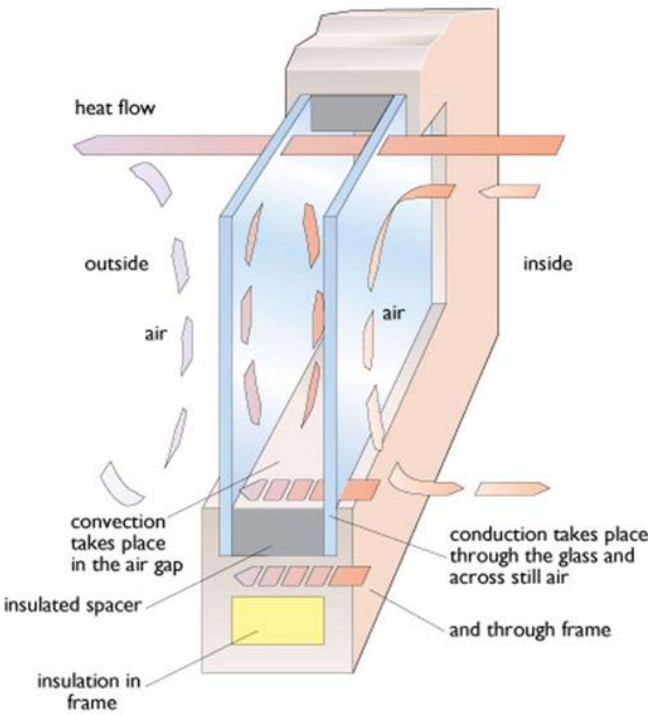
Remember that for a material to stop energy from being transferred it has to stop all three methods of transfer. Metals tend to be good conductors so we should avoid those, and if fluids are allow to flow they will carry energy by convection. Air is a good insulator, as long as it's held still. Stopping radiation is trickier because any hot object will radiate and it doesn't need anything to carry it, but it's worth remembering that shiny objects are good are reflecting waves (like light and infrared light – heat) and not good at radiating it.



Would bubble wrap make a good insulator? If we put hot water in a beaker and surround it with bubble wrap, would it stay hot? It's not a metal so it won't be good at conducting and bubble wrap holds air in pockets so it can't move in convection currents. It's pale and slightly shiny so it won't be great at radiating energy.

Modern house have to have large amounts of insulation built in. As a result, they use relatively little energy to keep them warm in the winter. The insulation is used in a variety of ways; one of them is wall insulation.

The builder is fitting wall insulation to a house extension – you can see the thick layers being fitted. The thick layers consist of many layers of insulating material then air then insulating material then air etc. This helps to stop conduction of heat because of the type of material and the many layers of air.



Another common insulation method for homes is double (or triple) glazing windows. The extra layer of glass with air in between reduces the flow of energy from inside to outside. Ideally, the gap between the glass layers would be a vacuum. This would stop conduction and convection in this layer.