HEAT TRANSFER
CONDUCTION

S2 Physics

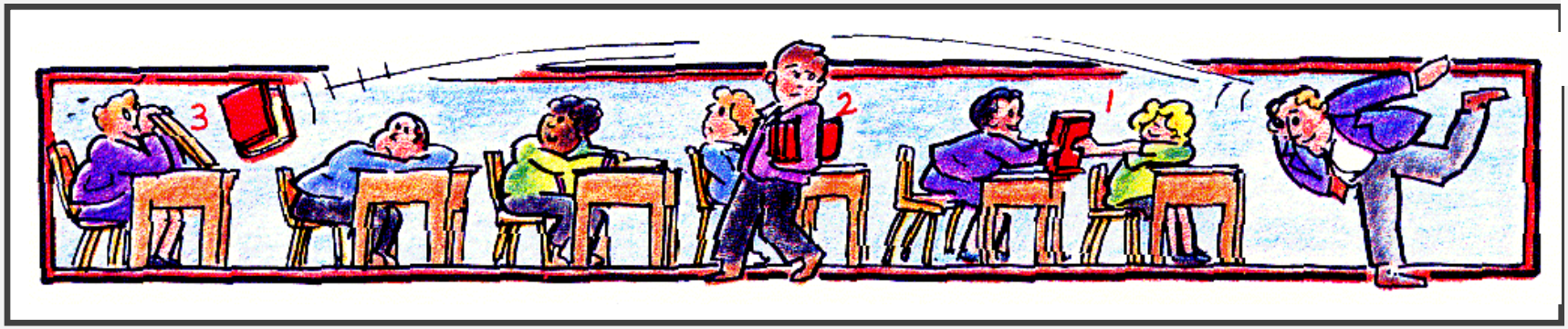
HEAT CAN BE TRANSFERRED IN 3 WAYS

- CONDUCTION
- CONVECTION
- RADIATION

- Usually heat is transferred in all 3 ways at once.

- Heat ALWAYS travels from **HOT** places to **COLD** places

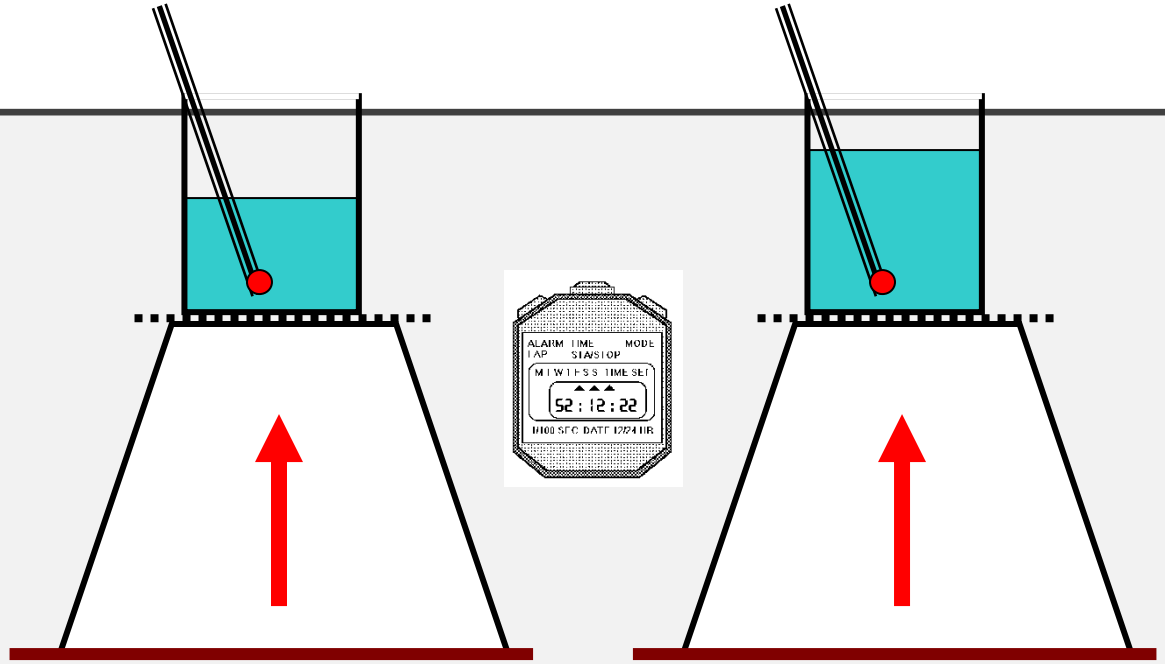
Hot → **cold**



book is like heat energy

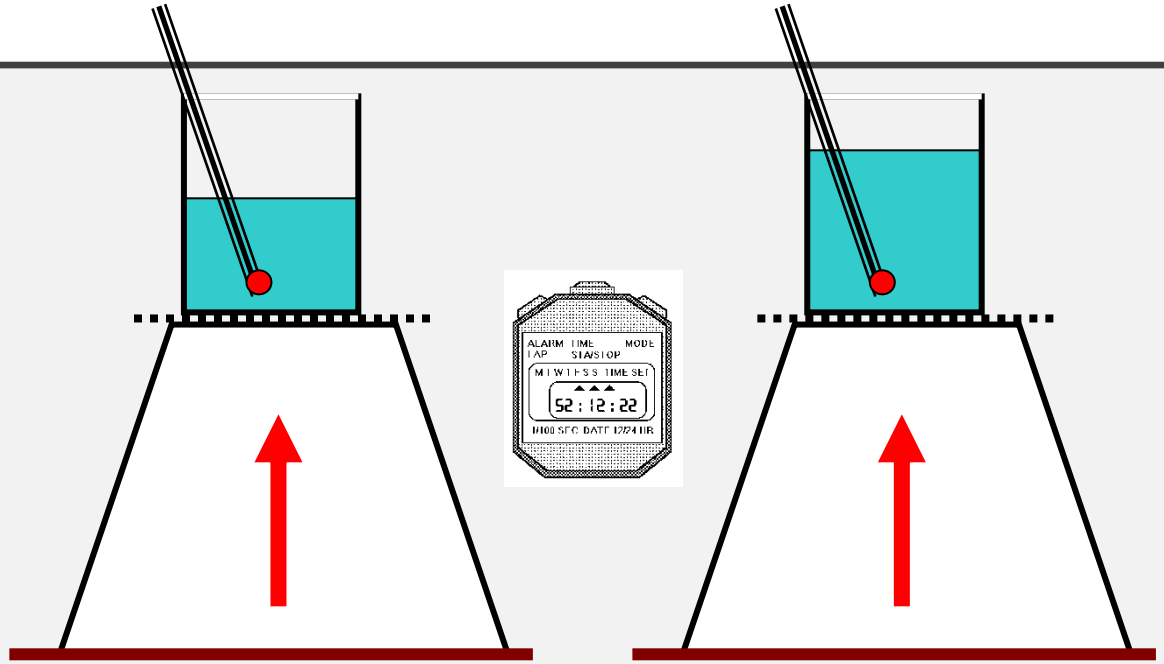
1. CONDUCTION – book passed from student to student. The particles vibrate more and pass energy on to particles touching them.
2. CONVECTION – book taken by a student to the back of the room. The particles carry the energy to a different place.
3. RADIATION – book thrown to the back of the room. The energy does not need particles to transfer the energy.

TEMPERATURE V HEAT – ARE THEY THE SAME?



- We often talk about heat and temperature as if they were the same thing – they are not!
- After 2 mins there was a temperature increase in each beaker. The smaller volume of water had a higher increase in temp as there was less mass of water to heat.
- Energy input is proportional to the rise in temperature. $E_h \alpha T$
- Temperature and Heat are related. The **heat** caused a **change in temperature** but they are NOT the same thing.....

TEMPERATURE V HEAT – ARE NOT THE SAME



- Temperature is how HOT or COLD something is, and it a measure of the speed of the particles.
- Temperature is measured in degrees Celsius (°C)
- HEAT is a form of ENERGY. Energy is measured in JOULES

We can heat an object by using various types of heaters; for example, an electrical convector heater to heat the air in a room, a kettle to heat water, a camping stove to melt snow on a mountain. What happens to the object when we heat it?

When we supply heat to the air in a room the air molecules move faster. The kinetic energy of the molecules increases.

When water is heated the water molecules vibrate faster.

When snow is heated the vibration of the molecules increases and eventually the solid turns into a liquid.

In everyday conversation we use the words 'hot' and 'heat'. In physics it is a good idea to be quite clear about the difference between the words.
'Hotness' and 'coldness' are used to compare the temperature of two objects.
A hot object will have a higher temperature than a colder object.

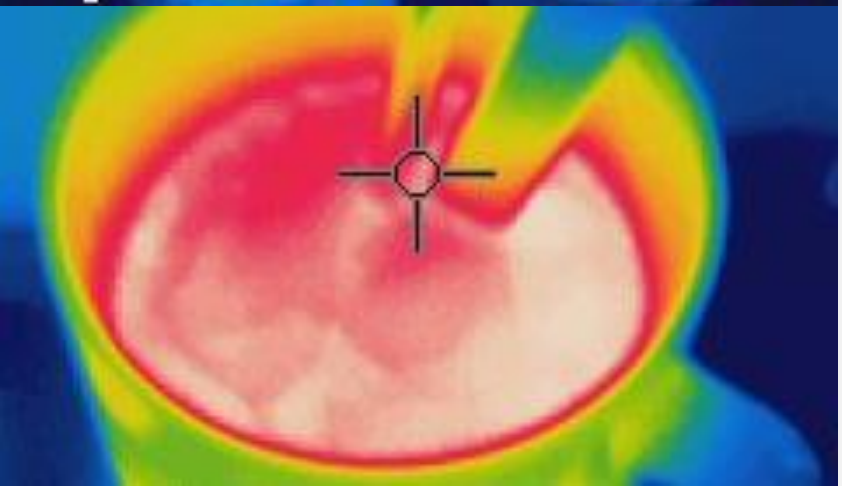
Note that the three animations are not drawn to the same scale. The air molecules are approximately the same size as the molecules of water and snow.

https://physicsflashrepo.cyou/ YY^LU3!9X$cadc6h

https://youtu.be/qW59Y9lJso8

HEAT LOSS FROM HOUSES

- How is heat lost from houses?
- How can we test this in the lab?
- How would it depend on ambient (air) temperature?
- Can we do a fair test to find out?



CONDUCTION

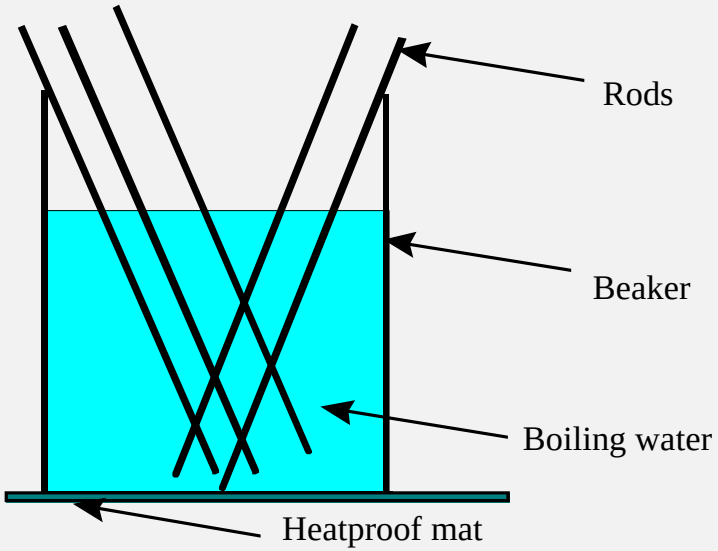
- Have you ever made a cup of tea or coffee and found the spoon you left in it was hot? The part of the spoon you touched wasn't in the drink, so why did it feel hot?

CONDUCTION

- Conduction occurs in solids.
- Metals are good conductors.
- Non metals, liquids and gases are bad conductors.
- Bad conductors are good insulators.

WHICH MATERIAL IS THE BEST CONDUCTOR?

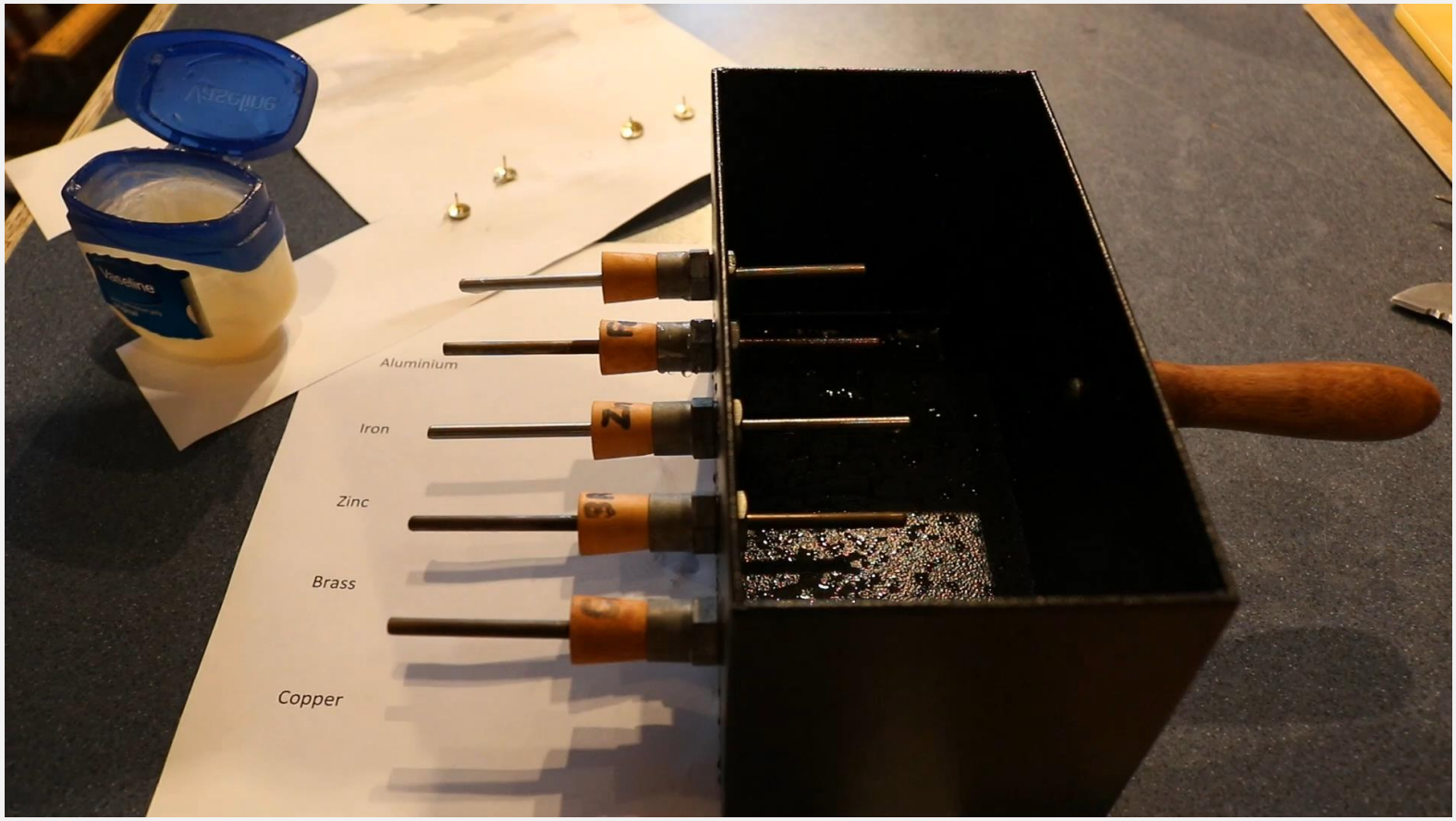
Material	Prediction	Rank (first to heat up as no. 1)
Copper		
Iron		
Aluminium		
Glass		
Brass		



INGEN-HAUZE'S APPARATUS.

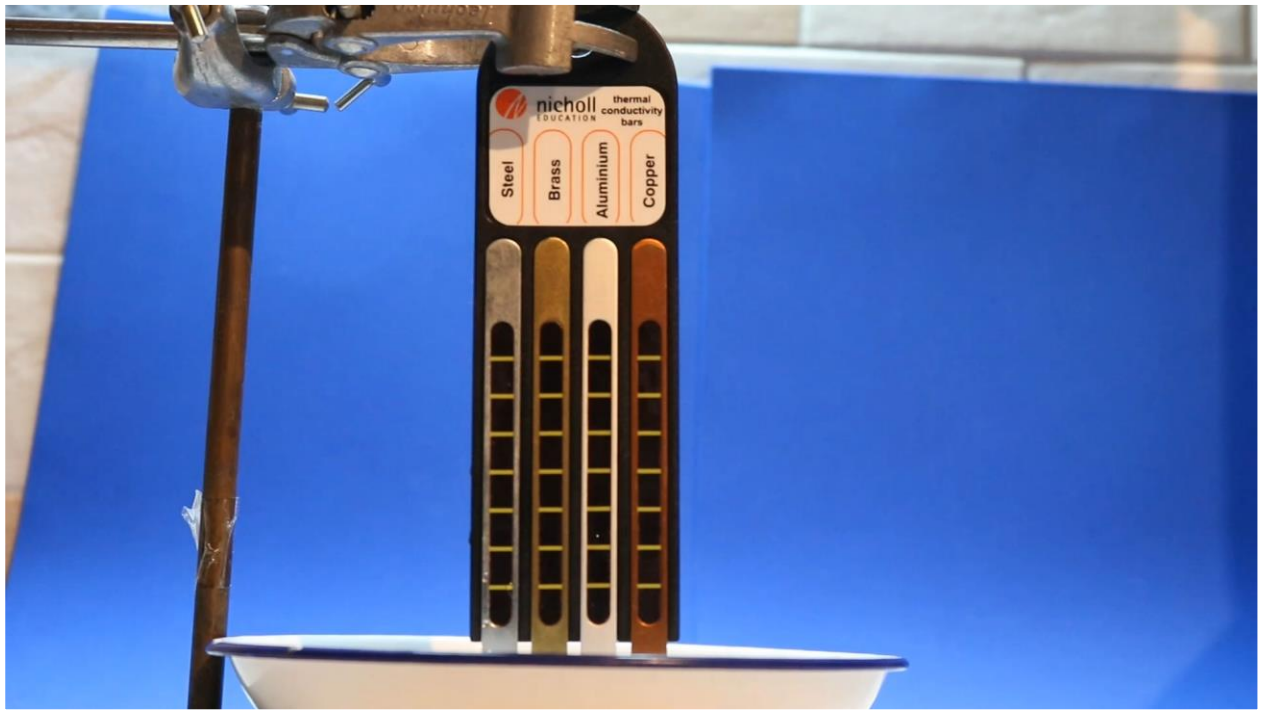
Material	Time for the pin to fall off (Minutes and seconds)
Copper	
Brass	
Zinc	
Iron	
Aluminium	

1. Write out	2. Describe	3. Watch	4. Explain
Write out the order you think the drawing pins will fall off the metals.	Describe how the experiment is completed.	Watch the video and record the time when the pin falls off (for the last one you'll have to guess!)	Explain what this experiment shows

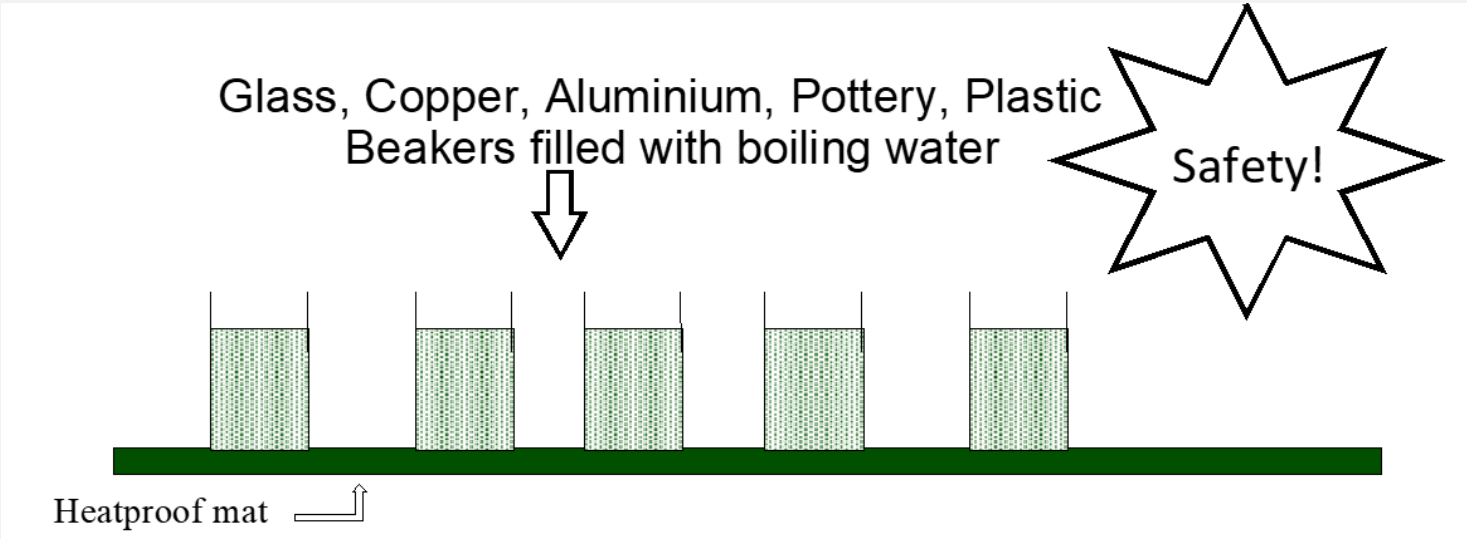

Aluminium
Iron
Zinc
Brass
Copper

WHICH METAL IS THE BEST CONDUCTOR?

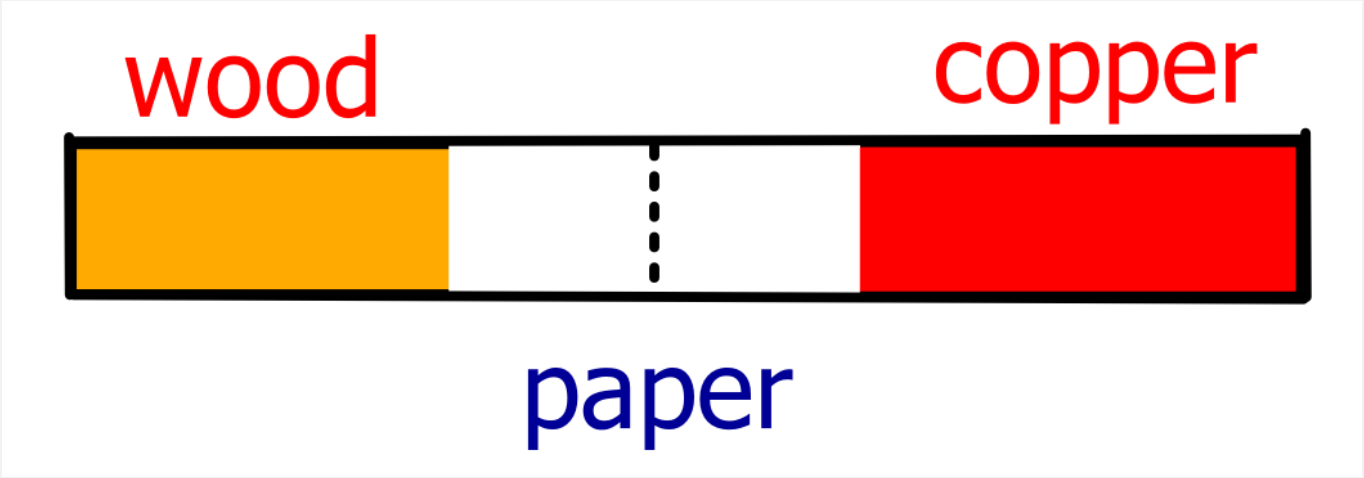
- Here is another experiment to show which materials make the best conductors. There is a colour change when the heat moves up the rods. Do the results agree with the last experiment?
- Draw the diagram and record the results



BEWARE

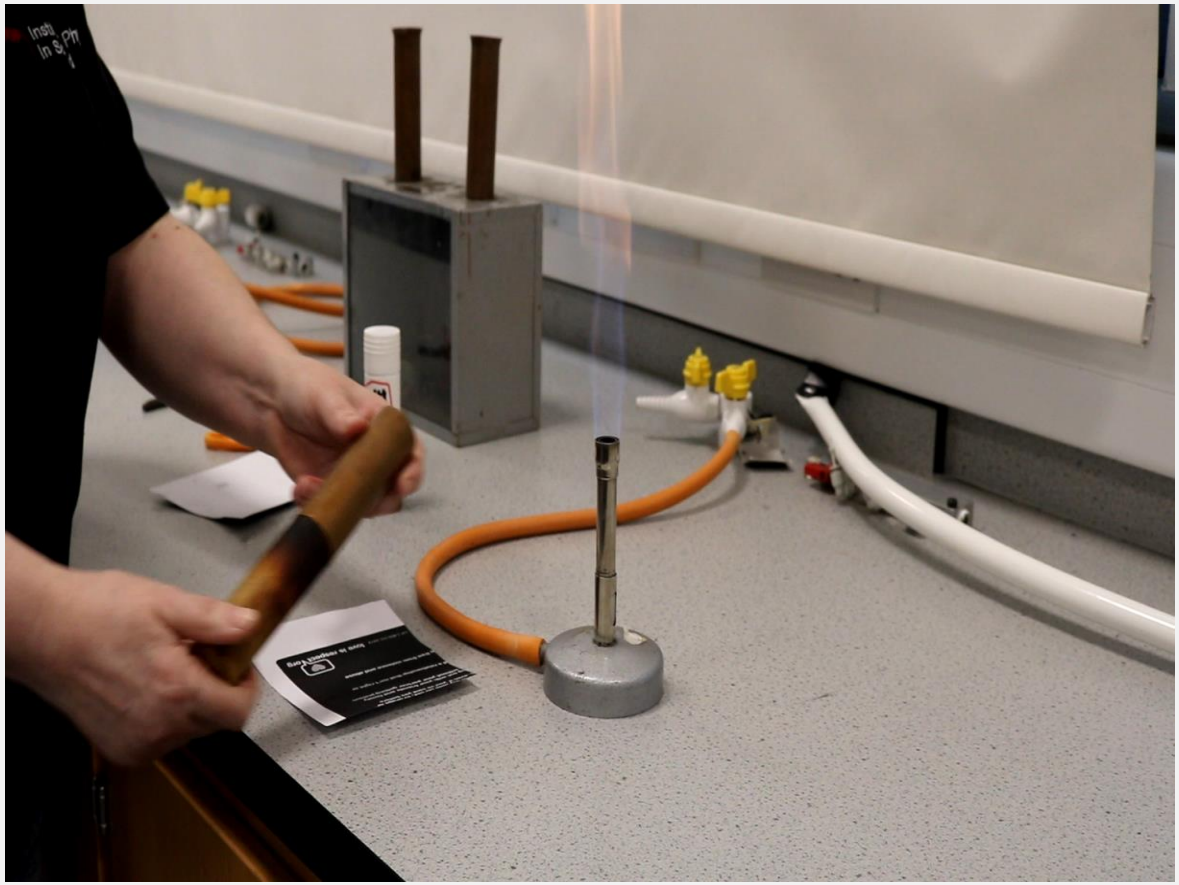

Glass, Copper, Aluminium, Pottery, Plastic
Beakers filled with boiling water
Safety!
Heatproof mat

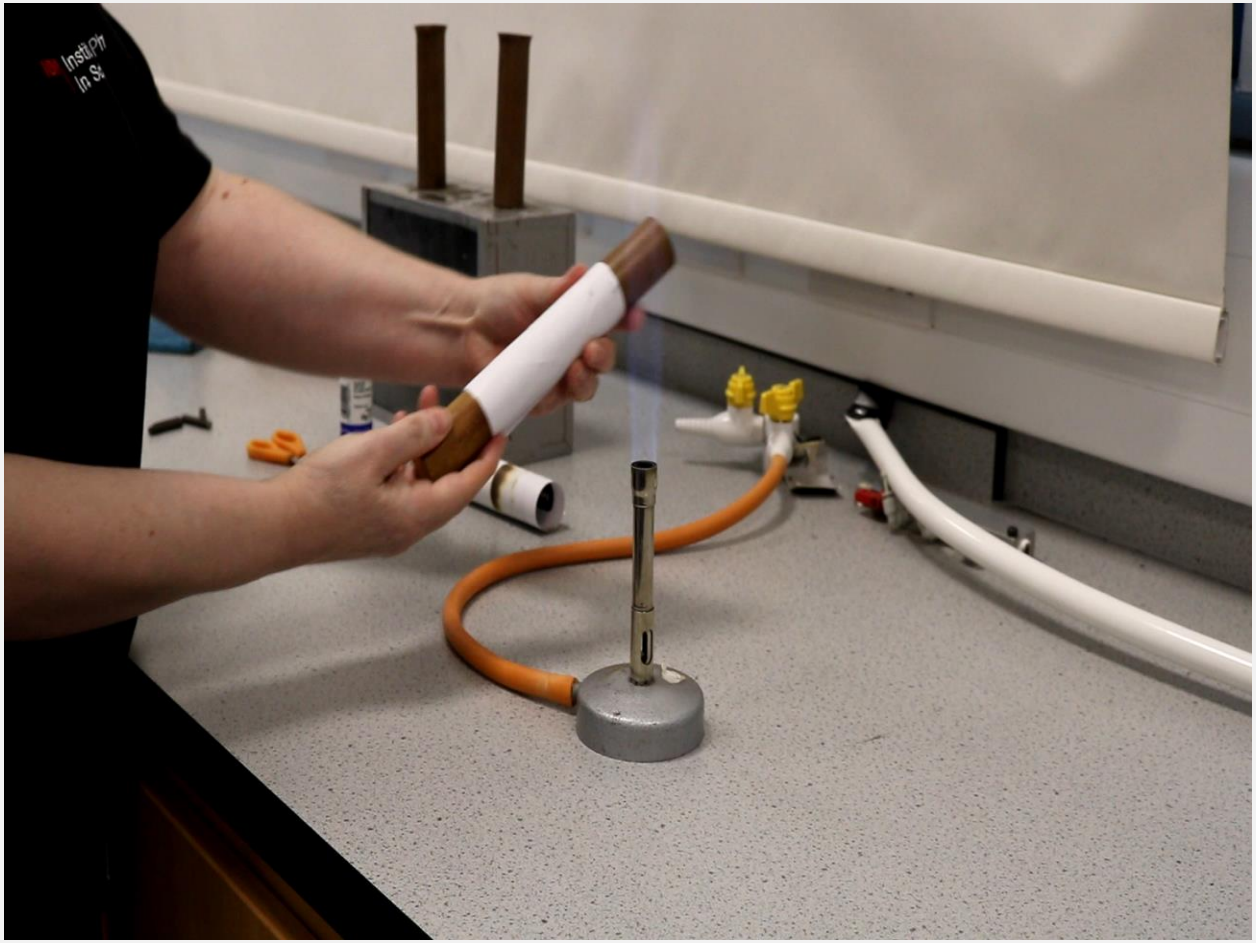
Conduction and Insulation



PREDICT!

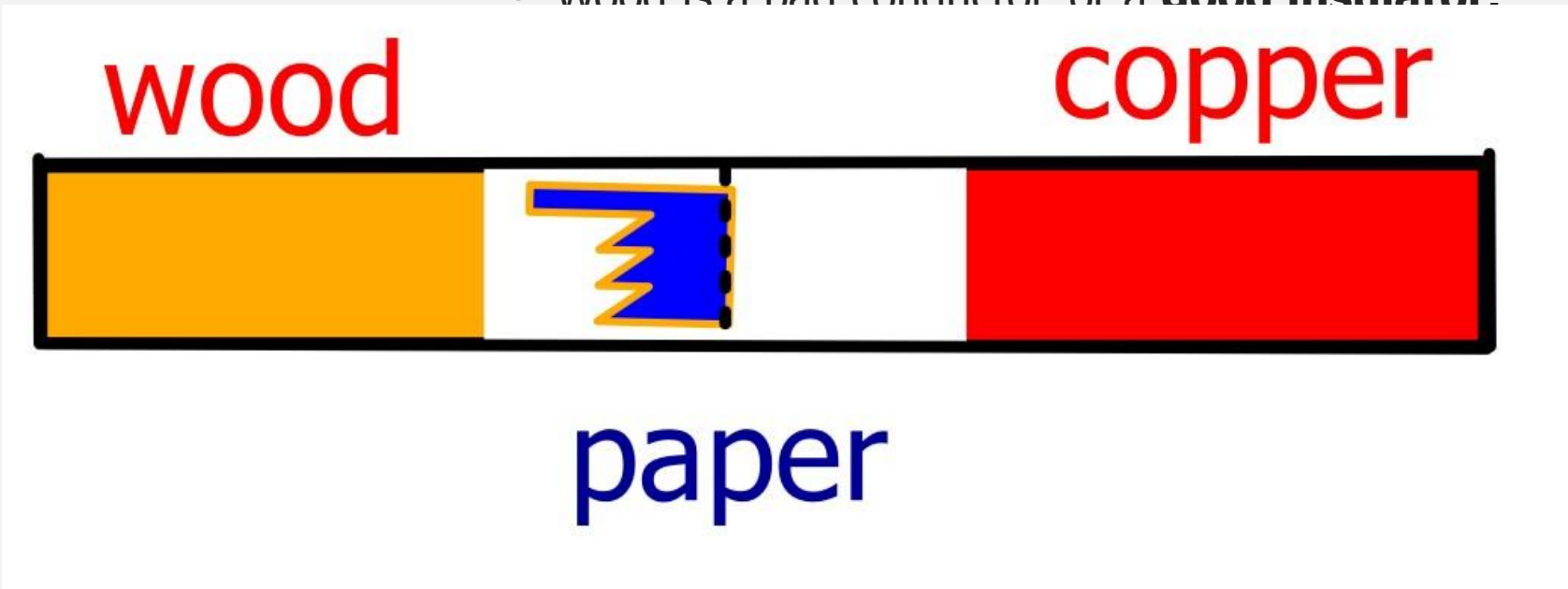
- Predict what will happen when I put the paper, wrapped over copper and wood, into the flame and move the paper over the flame.



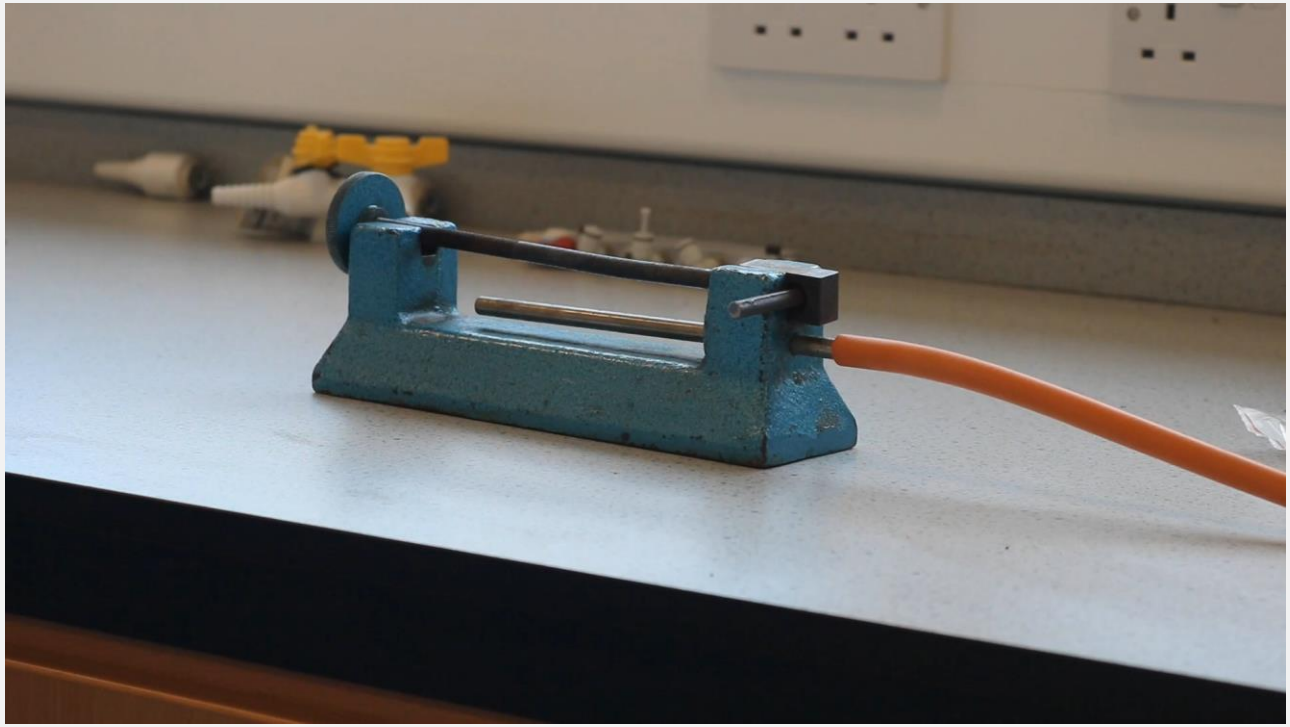


WHY?

- The paper over the wood burns but not the over the copper.
- This is because the copper **conducts** the heat away and the paper over the copper does not get hot enough to catch fire.
- (most paper catches fire at 220 °C - 250 °C)
- Wood is a bad conductor, or a **good insulator**.



- The paper over the wood burns as the wood is an insulator and the heat cannot escape. The temperature increases above the temperature at which paper catches fire.



HEATING METALS CAUSES THEM TO EXPAND

- When the metal is heated it expands.
- We can stick a cast iron rod in the hole and tighten it.
- As it has been heated the bar is longer than it was when cold.
- When we cover the bar with a cold damp lab coat the bar contracts (gets smaller)
- The force of contraction is so large it can break the cast iron rod.

CONDUCTION SUMMARY

- Conduction occurs when heat passes through a SOLID
- Heat is transferred by making the particles vibrate more passing the energy along the conducting material.
- http://www.echalk.co.uk/Science/physics/conduction/conduction.html
- **Conduction occurs in solids.**
- **Metals are good conductors.**
- **Non-metals, liquids and gases are poor conductors.**

- **Bad conductors are good insulators.**
- **Good conductors of heat are the same materials as good conductors of electrical current, electrical insulators are also insulators of heat**