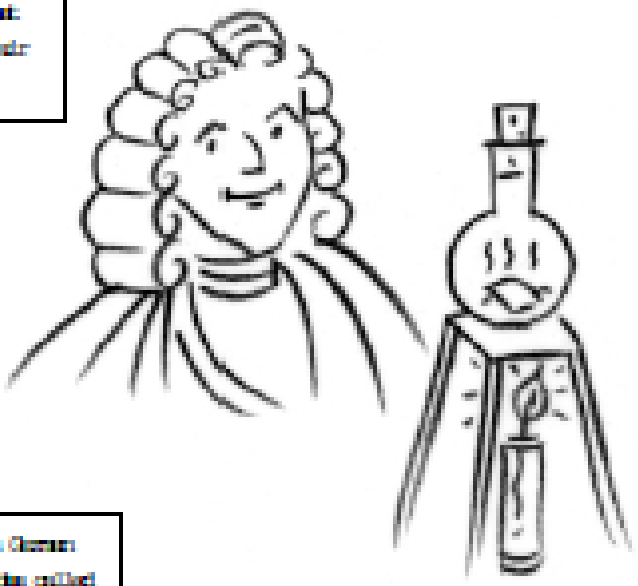
What happens when things burn? (1)

The ancient greeks thought everything was made from fire, water, air and earth.

So what happens when something burns?

The fire is released. The water and air escape. The earth or ashes are left behind.

In the 1600s, scientists thought that burning depended on air and that air was one single substance.



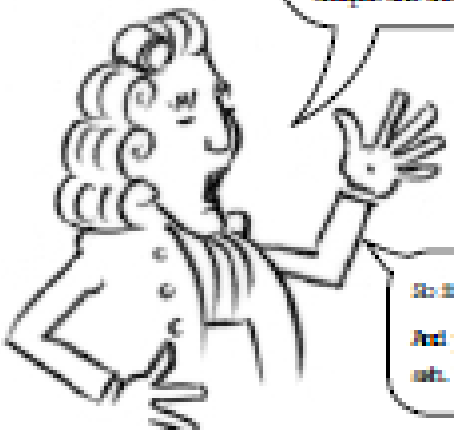
Robert Boyle heated some tin in a sealed flask. He found the tin weighed more after heating than before.

He thought the particles of fire had lodged between the particles of tin.

Georg Stahl (1660 – 1734) was a German scientist who developed another idea called the Phlogiston theory (from the Greek phlox – flame).

Many substances that burns has 2 parts – ash and PHLOGISTON.

When something burns the PHLOGISTON escapes and the ash is left behind.



So it should get lighter.

And you are a genius or ash. This ash is similar.

That is because it contains no much PHLOGISTON!

But this bark charcoal has only left a little ash.

Deciding what happens when things burn

Imagine that you are a scientist in the 1780's and you are fascinated by burning. You want to understand what really happens when something burns. Your favourite explanation is the theory put forward by Georg Stahl in 1723.

When materials burn they give off a substance called Phlogiston.

According to the theory 'Phlogiston' is a real substance with mass that could be transferred from one material to another. Stahl used his theory to explain the following reactions, which were all of great economic importance:

- **Calcination** A metal ore heated with charcoal turns into a metal because Phlogiston is transferred from the charcoal to the ore.
- **Smelting** When a metal is heated in the air it becomes a powder because it loses its Phlogiston.
- **Making alkali** When limestone is heated to high temperatures, it changes into quicklime, because it has picked up Phlogiston from the fire.

You can investigate the theory by looking at the results of these experiments.

Predictions for the three experiments

Calcination
Magnesium (a silvery metal ribbon) burns when heated in air.

Smelting
Copper ore (a black powder) changes when heated with charcoal or natural gas

Making alkali
Limestone (a white rock) changes into quicklime when heated in air.

Use the Phlogiston theory to make the following prediction:

Expt.	What will be formed? (Metal/alkali/powder)	What happens to the Phlogiston?	Change in mass? (Increase/decrease/ no change)
A			
B			
C			

(A) Calcination (burning metals)

3. How would you make sure that all of the Phlogiston has been taken from the magnesium?

(B) Smelting (heating a metal ore with charcoal or natural gas)

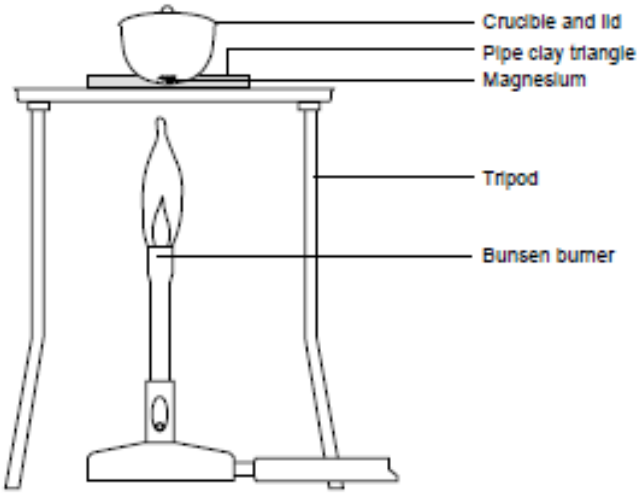
4. What would you do to obtain more reliable results for the 'change in mass'?

Experiment A – Calcination (burning metals)

1. When magnesium is heated in air it will burn. Using the Phlogiston theory predict what will happen to:

   (a) the mass of magnesium
   (b) the appearance of magnesium?

2. Carry out the experiment as described below.



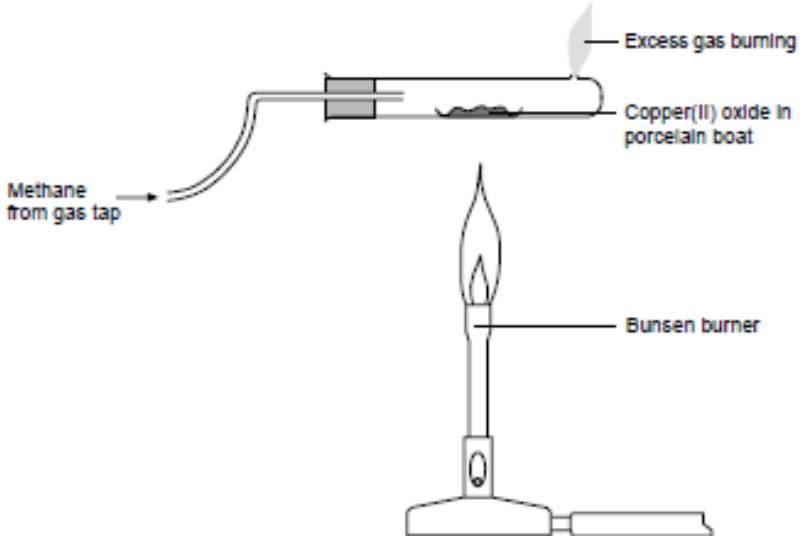
Wear eye protection

- Clean a 10–20 cm length of magnesium ribbon with emery cloth to remove the oxide layer. Loosely coil it.
- Weigh a clean crucible and lid. Place the magnesium inside and reweigh.
- Heat the crucible for 5–10 minutes, lifting the lid a little from time to time with tongs. Ensure that as little product as possible escapes.
- Continue heating until glowing ceases.
- Cool the crucible and reweigh.

Experiment B - Smelting

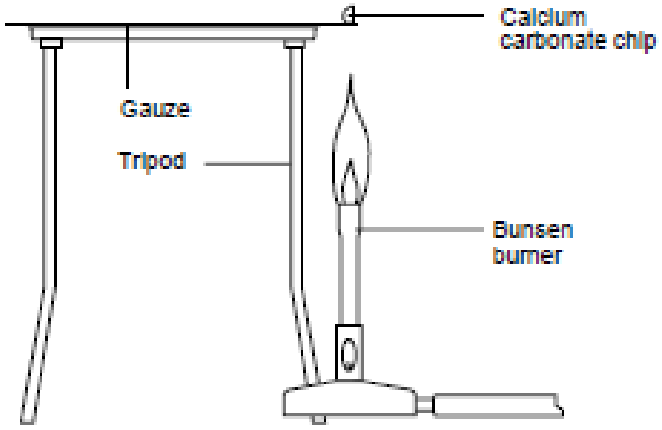
Heating a metal ore with charcoal or natural gas

1. When copper(II) oxide is mixed with methane and heated, it will burn. Using the Phlogiston theory predict what will happen.
2. Your teacher will demonstrate the experiment.



Experiment C – Making alkali (heating limestone)

1. Using Phlogiston theory, predict what will happen when limestone, calcium carbonate is heated?
2. Carry out the following experiment.



- Take 2 limestone chips, which look similar and weigh them.
- Place one of the limestone chips on the gauze as shown in the diagram and heat it over the hottest Bunsen flame for 10 minutes.
- **Do not touch the chip – it is now corrosive.**
- Let it cool down for a few minutes and then use tongs to move the chip and reweigh it.

3. Carry out the following tests on both chips.

- Compare their appearances.
- Use a nail to see if they scratch easily. Make sure you hold the chip in the tongs.
- Place the chips on a watch glass, add two drops of water to each chip and test the solution with pH paper.