Topic	The mole	**Level**	GCSE (or any course for students aged 14-16)
Outcomes	1. To understand what a mole is and why we use it in chemistry 2. To calculate the molar mass of a substance		

Understanding moles in chemistry

Imagine that a chemist wanted to react substance A with substance B to make substance AB, as outlined below, with no A or B particles leftover.

$$A + B \rightarrow AB$$

Reactants   **Products**
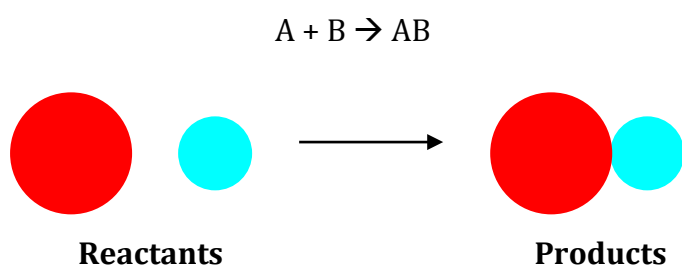
How could the chemist make sure that they have an equal number of A particles and an equal number of B particles, so that no reactants are wasted?

1. Could they count the particles?
2. Could they react 1g of substance A with 1g of substance B?

No, the chemist cannot count the number of particles because they are too small to see.

The chemist could weigh out exactly the same amount of A and B, but equal masses of A and B will not contain the same number of particles, just as two apples and two bananas will not have the same mass.

However, a clever system has been worked out. This system uses the fact that it is possible to work out the mass of 602 200 000 000 000 000 000 000 (6.02×10^{23}) particles of any substance.

This huge number is called a mole and is simply 6×10^{23} particles. A mole is just a number, just like:

A pair = 2
A dozen = 12
A mole is = 6.02×10^{23}

We can work out the mass of one mole of any substance using the relative atomic masses or *Ar*. The relative atomic mass of an element is defined as *the weighted average of all the masses of an element's isotopes relative to 1/12 of the mass of a carbon-12 atom.* We use the term 'weighted average" because we need to take account of the fact that not all isotopes are equally abundant.

The mass of one mole of substance is called the molar mass and is given the unit grams per mole (g/mol). To work out the molar mass of a compound you add together the relative atomic masses, which you will find on any periodic table.
E.g. the molar mass of methane, CH_4 = 12 + 1 + 1 + 1 + 1 = 16 g/mol

Substance	Formula	Number of atoms in one mole of substance	Mass of one mole of substance in grams (g/mol)
Magnesium	*Mg*	*6.02×10^{23}*	*24*
Carbon	C		
Sodium	Na		
Oxygen	O_2		
Magnesium	Mg		
Magnesium (II) oxide	MgO		
Copper (II) oxide	CuO		
Water	H_2O		
Methane			
Carbon monoxide			
Copper (II) sulphate			
Zinc (II) carbonate			
Tetrachloromethane			

Look at the equation below.

iron   +   sulphur   →   iron (II) sulphide

Fe   +   S   →   FeS
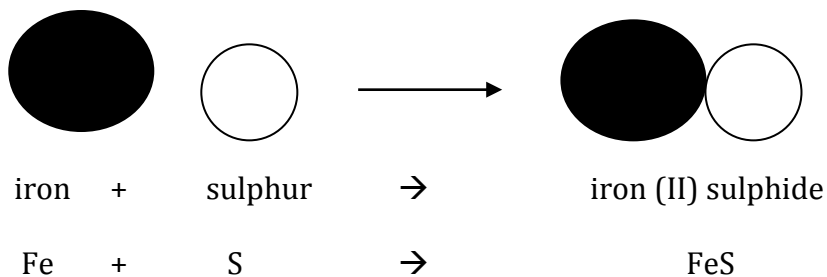
1. If we want one mole of iron how much should we weigh out?

2. If we want one mole of sulphur how much should we weigh out?

3. How many moles of iron (II) sulphide will be produced in this reaction?

4. What mass of iron (II) sulphide should be produced?

5. If you had 1 mole of Fe and 0.5 moles of S, what is the maximum number of moles of FeS you could make?

6. Jenny thinks that if you have one mole of iron and one mole of sulphur you will make two moles of iron (II) sulphide.

   a. Why do you think Jenny would think this?
   b. How would you help Jenny understand that she is wrong?

Progress: further resources on amounts of substance are available here
http://www.thescienceteacher.co.uk/moles/