Balancing Equations

The basic principle of equation balancing is that stuff doesn't pop in and out of existence just cos you want it to.

If you react two chemicals, there must be Exactly the same amount of each element in the Products as there were in the Reactants.

e.g. Hydrochloric acid + Sodium Hydroxide making Table Salt and Water:

$NaOH + HCl \Longrightarrow NaCl + H_2O$

If you count up the elements on each side, you get :
Na : 1 ==> 1
O: 1 ==> 1
H: 2 ==> 2
Cl: 1 ==> 1

So this equation balances perfectly. There's the same amount of each element on each side.

Now look at Aluminium and Sulphuric acid, making Hydrogen gas and Aluminium Sulphate and quite a lot of heat:

(if you do this reaction, it starts off doing nothing, then gradually goes apeshit)

$Al + H_2SO_4 \Longrightarrow Al_2(SO_4)_3 + H_2$

Count the elements ...

Al: 1 ==> 2
H: 2 ==> 2
S: 1 ==> 3
O: 4 ==> 12

All gone mad ! More Al, S and O on the Right hand side than we started with ! Obviously that isn't Correct, and the Extra stuff has to come from somewhere.

You can sometimes easily see where to shove in extra quantities, or you can Guess a lot and then test to see if you got it right, then try again.

There's also a Half Reaction method and several other methods too, like typing the unbalanced equation into http://www.webqc.org/balance.php ;)
The method i like best is the Algebraic method, as it always works.

Here's how to do it :

Instead of numbers of each chemical, assign each one a Letter:
a Al + b H_2SO_4 ==> c $Al_2(SO_4)_3$ + d H_2

Now do the Equations for each element:
Al: a = 2c (it's Al_2 on the right hand side)
H: 2b = 2d (same as b = d)
S: b = 3c
O: 4b = 12c (same as b = 3c)

Now, let **a = 1** (gotta start somewhere. Could start with c=1 if you like)
so, if a = 1, shoving that into the equations we just made:
a = 2c, so **c = 1/2**

b = 3c, so **b = 3/2**

b = d, so **d = 3/2** as well

Dunno about you, but i don't like nasty fractions, so multiply them all by 2:
a=2, b=3, c=1, d=3
now replace the letters in the original equation with the numbers (if the number is 1, you leave it out):

2 Al + 3 H_2SO_4 ==> $Al_2(SO_4)_3$ + 3 H_2

Properly Balanced now. 2 mols of Al react with 3 mols of Sulphuric Acid, making 1 mol of Aluminium Sulphate and 3 mols of Hydrogen gas.

Test the result by adding up the elements on each side again :

Al: 2 ==> 2
H: 6 ==> 6
S: 3 ==> 3
O: 12 ==> 12
Success !