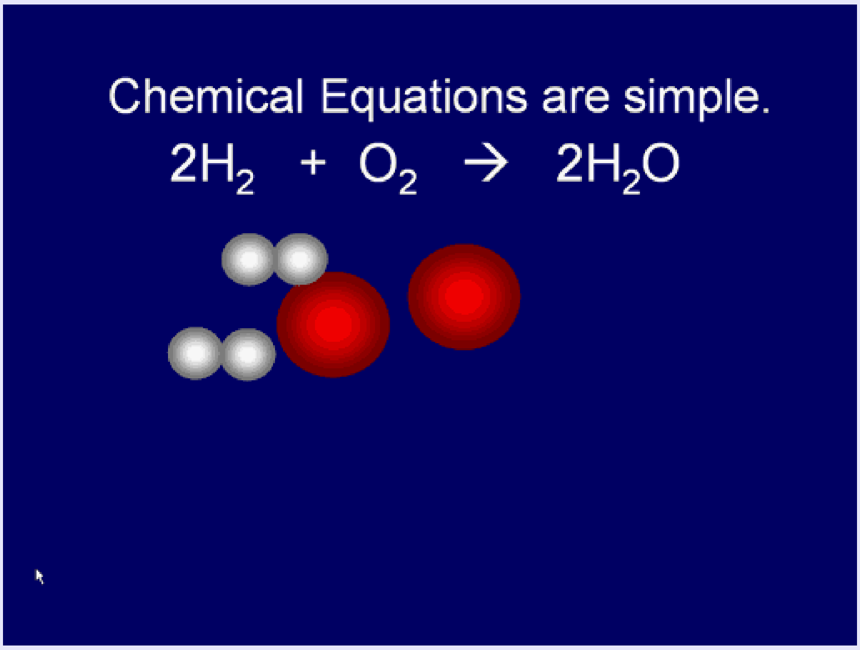
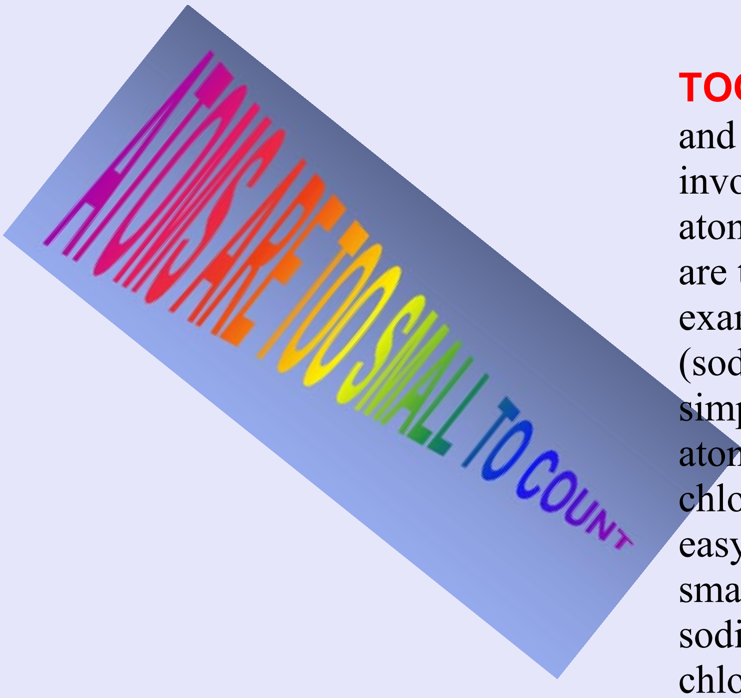


GOOD NEWS

Here we see how hydrogen and oxygen (reactants) react and produce water. It's a simple rearrangement.

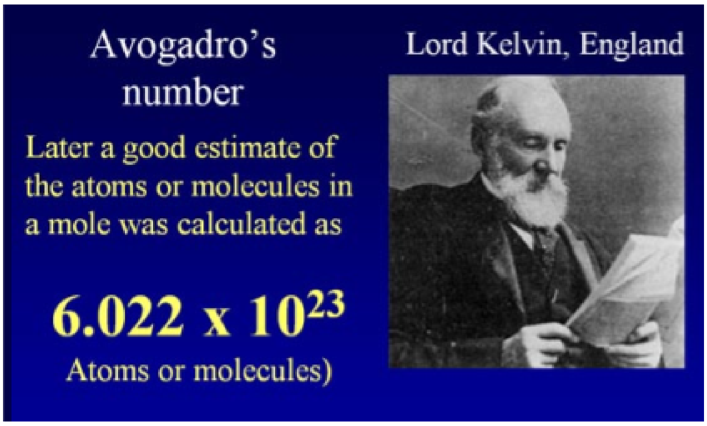
Good news. Your car did not fall into the water when it rolled off the dock. **Bad news**. A yacht stopped the fall but the damage to the yacht is more than the value of the car.
We've talked about the good news regarding chemistry, now the **bad news**.

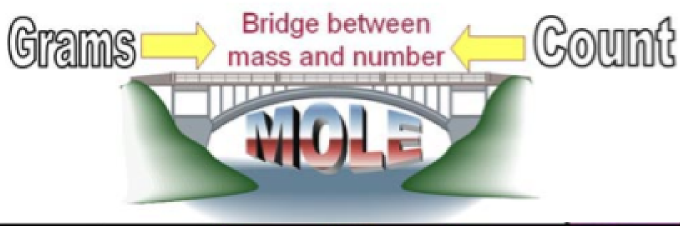


TOO SMALL: Compounds and chemical equations involve simple numbers of atoms; unfortunately, atoms are too small to count. For example, to make table salt (sodium chloride, NaCl), we simply need one sodium atom to combine with one chlorine atom. It sounds easy, but these atoms are too small to see that we have one sodium atom for each chlorine atom.

To get an idea how small atoms are, think about trying to count some grains of sand. It wouldn't be easy, but we could count out, let's say, 100 grains of sand. Now try to imagine trying to count these 100 grains of sand not in your hand, but from 3,000 miles away. From that distance, the grains of sand would seem terribly small requiring an incredible telescope and tweezers that are 3,000 miles long. That is what counting atoms would be like.

Lord Kelvin (inventor of the Kelvin temperature scale) helped with calculating Avogadro's number. This number is also referred to as the mole.
It's a huge number, $6.022x10^{23}$.
602,200,000,000,000,000,000,000
This is the number of atoms or molecules of gas to make 22.4 liters (at 0 degrees Celsius and 1 atmosphere of pressure).





5 **B** Boron 10.811	6 **C** Carbon 12.0107	7 **N** Nitrogen 14.00674	8 **O** Oxygen 15.9994	9 **F** Fluorine 18.99840	10 **Ne** Neon 20.1797
13 **Al** Aluminum 26.98154	14 **Si** Silcon 28.0855	15 **P** Phosphorus 30.97376	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.4527	18 **Ar** Argon 39.948

The bridge between the mass and number requires the use of the Peroidic Table to find out the mass of one mole of an element.

The bridge goes both ways. Starting with grams, you can count the moles (or atoms) of the element. Or, starting with moles (a count), you can find out how much that quantity weighs.

Motto: Use **weight** to *count without counting* and a **count** to *weigh without weighing*.

Every year people die from carbon monoxide poisoning because they bring a charcoal fire into their tent, house, or enclosed area. If carbon burns, it can produce carbon dioxide (CO_2); however, this requires the number of oxygen atoms to be twice the number of carbon atoms.

$C + O_2$ --> CO_2

If there's not enough oxygen atoms, two carbons may share the O_2 to make two carbon monoxide molecules.

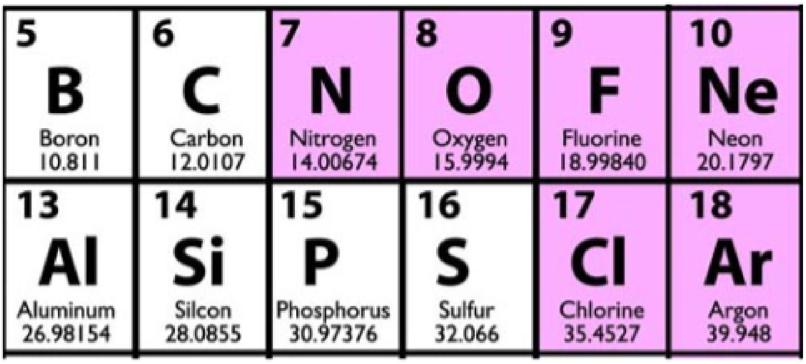
$2C + O_2$ --> $2CO$

If you started with a pound of charcoal briquettes (carbon), how many grams of oxygen is needed to turn all of the carbon into the safe carbon dioxide?


A pound of carbon needs to be converted to a a number of carbon atoms.

$$454 \text{ grams} \times \frac{1 \text{ mole}}{12.0107 \text{ grams}} = 37.8 \text{ moles}$$

A pound is 454 grams, which is a certain number of carbon atoms. We need twice as many oxygen atoms, but that does not mean twice the weight, because oxygen and carbon atoms don't weigh the same. We have to turn the 454 grams of carbon into moles of carbon so that we have a count of carbon atoms. Only then can we double that number. Here we calculate that 454 grams of carbon has 37.8 moles of carbon atoms.



$C + O_2 \rightarrow CO_2$

Since this is our equation, we see that we need twice the number of oxygen atoms. We counted the carbon atoms as being 37.8 moles. Oxygen will be twice that number, or 75.6 moles. The Periodic Table says one mole of oxygen weighs 15.9994 grams. We need 75.6 moles.

$$75.6 \text{ moles O} \times \frac{15.9994 \text{ g.}}{1 \text{ mole}} = 1{,}209 \text{ g. Oxygen}$$

It's hard to picture 1,209 grams of oxygen (about 2.5 lbs). Remember 22.4 liters is one mole of O2 (2 moles of single oxygen atoms). We need 75.6 moles.

$$75.6 \text{ moles O} \times \frac{22.4 \text{ Liter } O_2}{2 \text{ moles O}} = 847 \text{ Liters } O_2$$

That's 847 liters of pure O_2. However, O_2 in the air is only 20%, so we need five times as much air to have 847 liters of oxygen. So 5 x 847 liters = 4235 liters of air. That's 4.235 cubic meters of air (about the volume of an two-person tent. So if they brought the charcoal briquette fire into the tent to stay warm, the fire would have to use every bit of the oxygen in order to only produce carbon dioxide. If it did, there's no oxygen to breathe. If it left some oxygen and produced carbon monoxide, you'd be poisoned. So there no good outcome here.