Chapter 20

Why we have to balance chemical reactions –

Imagine a preschool girl with a pitcher of milk. After she fills up 4 glasses, she exclaims: "Look, I have more milk!" She believes in magic – the milk has magically grown to more milk. But we all know she has the same amount of milk.

If I'm talking to someone, turn around for a minute, turn back around and find them gone my first reaction is not "they disappeared". Instead I look for them: "hide and seek", because I know that they must have just gone somewhere.

We have learned that magic doesn't exist. When things "disappear" we really mean they have gone somewhere. We believe chemicals "disappear" in chemical reactions like we believe in the Easter Bunny or The Tooth Fairy. We have learned to believe in "The Law of Conservation of Mass" by experience.

"The Law of Conservation of Mass" says that mass is neither created nor destroyed; it is just "transformed". Or, in other words, what you have before you have to have afterwards. It may change, but the same amount of stuff is still there somewhere. In class we proved this using a closed system (which traps the products). Using a flask and a balloon we captured the products made by mixing vinegar and baking soda. In our open system of two open beakers mass was lost, escaping into the room. But we know it is there somewhere! Science not magic!

Chemical reactions must then support this fact – that the mass is conserved on both sides of the reaction. Take our basic reaction: $H_2 + O_2$? H_2O. You can see that on the reactant side (left) there is one more oxygen than on the right side (product side). So the reaction does not support the Law of Conservation of Mass. That means we have to balance it.

How? You might think that we could take one of the reactant oxygens away. Though that would easily solve our problem, it can't be done. Why? Because you don't find oxygen as O, just O_2. It is a diatomic molecule (it always exists as a two atom molecule). We can't break up the O_2 like we can't break up H_2O. This is The Principle of Definite Proportions – molecules and compounds can only be put together one way.

If we can't break up the molecules, then we have to add molecules on either side until the reaction is balanced. This is why we add coefficients (numbers in front of molecules).

See the back side of worksheet 20:2 for how to balance reactions step-by-step.
If you REALLY want to be able to do this well, follow these steps exactly. It may take a while, but it works every time.