# Chemical Reactions: An Introduction

- An unbalanced chemical equation is not an accurate representation of the reaction that occurs.
- Whenever you see an equation for a reaction, you should ask yourself whether it is balanced.
- Atoms are conserved in a chemical reaction.
  - Atoms are neither created nor destroyed.
  - They are just grouped differently.

The identities (formulas) of the compounds must never be changed in balancing a chemical equation.

## NEVER TOUCH THE SUBSCRIPTS!



 The subscripts in a formula cannot be changed, nor can atoms be added to or subtracted from a formula.

- Most chemical equations can be balanced by trial and error.
  - Keep trying until you find the numbers of reactants and products that give the same number of each type of atom on both sides of the arrow.
  - It's okay to make a few wrong turns before you get to the right answer.







#### The Combustion of Hydrogen

- Consider the reaction of hydrogen gas and oxygen gas to form liquid water.
- First, we write the unbalanced equation from the description of the reaction.

 $H_2(g) + O_2(g) \rightarrow H_2O(l)$ 

• We can see that this equation is unbalanced by counting the atoms on both sides of the arrow. • We can see that this equation is unbalanced by  $H_2(g) + 0_2(g) \Rightarrow H_2(g)$ •  $H_2(g) + 0_2(g) \Rightarrow H_2(g)$ 



- We have 1 more O atom in the reactants than in the products.
- Because we cannot create or destroy atoms and because we cannot change the formulas of the reactants or products, we must balance the equation by adding more molecules of reactants and/or products.

- In this case we need 1 more O atom on the right, so we add another water molecule (which contains one O atom).
- Then we count all of the atoms again.



• We have balanced the O atoms, but now the H atoms have become unbalanced.

- There are more H atoms on the right than on the left.
- We can solve this problem by adding another hydrogen molecule (H<sub>2</sub>) to the reactant side.



- The equation is now balanced!
- We have the same numbers of H and O atoms represented on both sides of the arrow.

 Collecting like molecules, we write the balanced equation as: <u>coefficient</u>

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$$

- This equation is balanced (count the atoms to verify this).
- The accepted convention is that the "best" balanced equation is the one with the *smallest* whole numbers.
  - These whole numbers are called the coefficients for the balanced equation.

- **Coefficient**  $\rightarrow$  number written in front of the chemical formulas in a balanced chemical equation.
  - Coefficients indicate the relative numbers of reactants and products in the reaction.

 Therefore, for the reaction of hydrogen and oxygen to form water, the "correct" balanced equation is:

 $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$ – The coefficients 2, 1 (never written), and 2, respectively, are the smallest *whole numbers* that give a balanced equation for this reaction.

## **Combustion of Ethanol**

 We will balance the equation for the reaction of liquid ethanol, C<sub>2</sub>H<sub>5</sub>OH, with oxygen gas to form gaseous carbon dioxide and water.

> corn is good for you

 This reaction, among many others, occurs in engines that burn a gasoline-ethanol mixture called gasohol.

- The <u>first step</u> in obtaining the balanced equation for a reaction is always to identify the reactants and products from the description given for the reaction.
- In this case we are told that liquid ethanol, C<sub>2</sub>H<sub>5</sub>OH (I), reacts with gaseous oxygen, O<sub>2</sub> (g), to produce gaseous carbon dioxide, CO<sub>2</sub> (g), and gaseous water, H<sub>2</sub>O (g).
- Therefore, the unbalanced equation is:  $C_2H_5OH(I) + O_2 \rightarrow CO_2(g) + H_2O(g)$

#### **Combustion of Ethanol** Recorded Lesson-Click link below

#### http://community.palcs.org/p46132763/

#### Balancing Chemical Equations How to Write and Balance Equations



Read the description of the chemical reaction.

- What are the reactants, the products, and their states?
- Write the appropriate formulas.



Write the unbalanced equation that summarizes the information from step 1.

#### Balancing Chemical Equations How to Write and Balance Equations



- Balance the equation by inspection, starting with the most complicated molecule.
  - Go element by element to determine what coefficients are needed so the same number of each type of atom appears on both sides.
  - Do not change the formulas of any of the reactants or products.

#### Balancing Chemical Equations How to Write and Balance Equations



Check to see that the coefficients used give the same number of each type of atom on both sides of the arrow.

- Note that an "atom" may be present in an element, compound, or an ion.
- Check to see that the coefficients used are the smallest whole numbers that give the balanced equation. This can be done by determining whether all coefficients can be divided by the same whole numbers to give a set of smaller whole number coefficients.

