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ACP - Unit 2 – Chemical Reactions and Quantities – Part 1 – Chemical Reactions

Unit Essential Questions:
What do we call the tiny particles?
How do we count up the tiny particles?

Unit Reactions:
Candle Lab Reaction
$C_{25}H_{52}(s) + 38\ O_2\ (g) \rightarrow 26\ H_2O\ (g) + 25\ CO_2\ (g)$

Crystal Lab Reaction
$KAl(SO_4)_2 \cdot 12H_2O\ (s) \rightarrow K^+(aq) + Al^{3+}\ (aq) + SO_4^{2-}\ (aq) + 12\ H_2O\ (l)$

Introduction to Chemical Reactions
Goals for Worksheet

- Understand the parts of a chemical reaction.
- Understand how to balance a chemical reaction and why.
- Understand the difference between chemical and physical changes
- Represent and identify chemical and physical changes from a reaction.

In the last unit you performed an experiment with a candle. In the burning of the candle you witnessed the transformation of candle wax into carbon dioxide and water!

In this unit you will be learning about crystals and solutions and applying this knowledge to grow a crystal of your own here in our lab!

Today we are going to introduce the concept of chemical reactions and start to look at how we name the tiny particles involved in the cool labs we performed with a candle in unit 1 and now to build our crystal in unit 2.

Parts of a chemical reaction
A chemical reaction can be broken down into two parts, the reactants and the products. The reactants are listed on the left of the reaction arrow and the products are written on the right. Chemical reactions are a way of explaining what is happening with the tiny particles using symbols.

Let's use the burning of paraffin wax from our candle lab as an example.

$$C_{25}H_{52}(s) + 38\ O_2\ (g) \rightarrow 26\ H_2O\ (g) + 25\ CO_2\ (g)$$

How would you explain this reaction in words?
paraffin reacts with oxygen under high temperature (combustion) to make water and carbondi

List the Reactants $C_{25}H_{52}$ and O_2 List the Products H_2O and CO_2

You will notice that this reaction has large numbers beside each reactant and product.
What do you think the numbers are for? i
ratio : how much of each reactants is requised and how much is prod

How many carbons are on the left of the equation? 25 on the right? 25

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The numbers of carbon atoms on the left and the right of the reaction arrow should be the same. This is because in nature whatever the number of atoms that "go in" to a reaction the same number of atoms must "come out" of the reaction. A **balanced equation** such as the one in our example show us that chemical reactions represent what is happening to the tiny particles while also abiding by the **law of conservation of mass.**

In our candle lab the paraffin wax combined with oxygen in the air and the atoms where completely shuffled around breaking chemical bonds to form completely different substances on the right side of the equation, water and carbon dioxide. This type of a reaction represents a **chemical change.**

Not all chemical reactions represent a chemical change. Some chemical reactions represent a **physical change** that is happening to the substance such as the one below:

$$H_2O\ (s) \rightarrow H_2O\ (l)$$

In this reaction the (s) tells us that water is going from a solid state to a liquid state (l). In this example water is not breaking bonds to make different substances it is simply changing its physical appearance from a solid to a liquid or melting.

We could also use a chemical reaction to show a chemical change in water. What do you think this reaction would look like?

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Chemical reactions can also be used to show when a substance is dissolved in water. Let's look at an example:

$$NaCl\ (s) \rightarrow Na^+\ (aq) + Cl^-\ (aq)$$

The symbol (aq) tells the reader that the substance is being dissolved in water, or it ends up in what we like to call an aqueous state. The + and – symbols tell us the charge of the ions that break apart from the salt crystal and float around in the water. This reaction represents salt being dissolved in water. When a substance is dissolved in water it does not change what the substance is chemically, therefore substances dissolved in water are going through physical changes.

Lets see how much you have learned about chemical reactions. In the examples below you will be doing the following; identifying the reactants and products, identifying the chemical reaction as a chemical or a physical change and balancing the reaction.

Example Reaction	Chemical or Physical Change	Reactant(s) include the physical state	Product(s) include the physical state
$1\ CO_2\ (s) \rightarrow 1\ CO_2\ (g)$ the dry ice that they use in theatre	physical	$CO_2\ (s)$	$CO_2(g)$
$2\ Mg\ (s) + 1\ O_2\ (g) \rightarrow 2\ MgO\ (s)$	chemical	$Mg(s)$ $O_2(g)$	$MgO(s)$
$1\ AgNO_3\ (aq) + 1\ NaCl\ (aq) \rightarrow 1\ AgCl\ (s) + 1\ NaNO_3\ (aq)$	chemical	$AgNO_3(aq)$ $NaCl(aq)$	$AgCl(s)$ $NaNO_3(aq)$

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Example Reaction	Chemical or Physical Change	Reactant(s) include the physical state	Product(s) include the physical state
1 $CaCl_2$ (s) → 1 Ca^{2+} (aq) + 2 Cl^- (aq) the white "stuff" you use to de ice your walk in the winter	Physical	$CaCl_2$ -solid	Ca^{2+} and Cl^- ions in aqueous.
1 C_3H_8 (g) + 5 O_2 (s) → 3 CO_2 (g) + 4 H_2O (g) your propane gas grill	Chemical	C_3H_8 (gas) O_2 (gas)	CO_2 (gas) H_2O (gas)
1 H_2O_2 (aq) → 1 O_2 (g) + 1 H_2 (g) hydrogen peroxide	Chemical	H_2O_2 (aq)	O_2 (gas) H_2 (gas)
4 Fe (s) + 3 O_2 (g) → 2 Fe_2O_3 (s) iron on your car — rust ⊗	Chemical	Fe (solid) O_2 (gas)	Fe_2O_3 (solid)
1 Zn (s) + 2 HCl (aq) → 1 H_2 (g) + 1 $ZnCl_2$ (aq)	Chemical	Zn (solid) HCl (aq)	H_2 (gas) $ZnCl_2$ (aq)
$NaHCO_3(s) + CH_3COOH(l) \rightarrow CO_2(g) + H_2O(l) + Na^+(aq) + CH_3COO^-(aq)$ The baking soda and vinegar volcano from elementary school ☺ Whew, complex reaction for a fuzzing volcano!	Chemical	$NaHCO_3$ (s) CH_3COOH (l)	CO_2 (g) H_2O (l) Na^+ ion (aq) CH_3COO^- ion (aq)

Now that you have become familiar with chemical reactions we are going to take a look at the reaction you will be performing this unit in your crystal lab.

$$KAl(SO_4)_2 \cdot 12H_2O\ (s) \rightarrow K^+(aq) + Al^{3+}\ (aq) + SO_4^{2-}\ (aq) + 12\ H_2O\ (l)$$

In this reaction we are dissolving solid alum powder in it hydrated state into water to make a saturated solution of alum.

Does this reaction represent a chemical or a physical change? physical change

Explain alum is dissolved in water.

You are now ready to look more closely at the reactants and products and begin to learn what we call of these tiny particles. Nomenclature, or the system we use to name chemicals will come next in our unit of study.