Chapter 2 Notes
(Common Reactions in Our Lives)

Section 2.1 (Useful Reactions)

Science Background

To make use of chemical reactions, scientists need to know what is causing the reaction and, just as importantly, exactly what is being produced.

In many instances, more than one product results from the chemical reaction. Scientists need to distinguish between these products. The sense of sight is generally relied on the most; unfortunately, many things look exactly the same. To help with this problem, scientists use diagnostic tests such as the burning flint tests for oxygen and hydrogen, the cobalt (II) chloride test for the presence of water, and the limewater test for the presence of carbon dioxide.

Diagnostic tests allow scientists to differentiate between various substances based on their specific chemical and physical properties.

Reading Check Answer (p. 24)

Answers will vary, but may include:

• A banana left out on the kitchen counter changes from green to yellow to brown. This results in more sugar (fructose) in the banana.

• Taking an antacid involves the magnesium hydroxide (a base) of the tablet or liquid reacting with the excess hydrochloric acid in the stomach.

• Wrenches rust in the rain. This is due to the iron in the wrench reacting with the water and oxygen in the air.

Reading Check Answer (p. 24)

Oxygen gives bleach its whitening power.

Reading Check Answer (p. 25)

Ingredients react chemically react to produce a loaf of fluffy bread.

Reading Check Answer (p. 25)

Hypochlorous acid is produced when chlorine is added to water.

- Chemical reactions occur daily. Whether it is a banana turning color (enzyme amylase breaking the starch into sugar), or an antacid used to treat heart burn(magnesium hydroxide).

- The launching of a space shuttle (liquid hydrogen and liquid oxygen, producing energy and water) is an example of a complex chemical reaction.

- In most chemical reactions there are more than one product.

"Whitening Whites"

- Whether it is hydrogen peroxide or sodium hypochlorite, the oxygen component is responsible for the reaction that makes a stain colorless.

"Baking Bread"

- The cereal grains that release starch and proteins, when mixed with water and yeast aids in the break rising. Enzymes in the yeast break the starch into glucose. Carbon dioxide are also produced, which bubbles up, causing the bread to rise.

- Our digestion system also uses enzymes. **Amylase** in our mouths is an example of the breakdown of food. In the stomach the enzyme **protease** speeds up the breakdown of proteins into amino acids. The intestine also has the enzyme **lipase**, which breaks fats into glycerol and fatty acids.

- We feel the effects of alcohol quickly because it starts to be absorbed in the mouth.

"Swimming Pools"

- The chlorine smell at a pool is the result of the chlorine being poured in the water, to produce hypochlorous acid. This acid is used to kill the bacteria in the pool. Chlorine gas is very dangerous and should always be used with protective eyewear and gloves.

Investigation 2-A Identifying Common Gases

Check your Understanding page 28 (1-5)

Check Your Understanding Answers

1. Answers will vary but should include common examples such as:
   - Hydrogen and oxygen react to form water and energy to power the space shuttle.
   - Sugar (sucrose) is burned to produce carbon dioxide and water.
   - Magnesium hydroxide (an antacid) reacts with hydrochloric acid in the stomach to produce magnesium chloride and water.
2. Answers will vary but may include common examples such as:
   - Baking powder reacts with vinegar to produce gas bubbles.
   - Water in the air reacts with emissions of carbon, nitrogen, and sulfur oxides to produce acid precipitation.
3. chlorine or oxygen
4. Students should predict that they will never see a transparent bleach container because exposure to light degrades bleach, producing poisonous chlorine gas.
5. Look for one of the following tests:
   - A piece of cobalt (II) chloride paper placed in the test tube will turn from blue to pink in the presence of water vapour.

• To test for carbon dioxide, place a test tube loosely over the reaction to collect the gases produced. Add a small amount (full eyedropper) of limewater into the test tube containing the gases. The solution will cloud if carbon dioxide is present.

Section 2.2 (The changes that occur)

Science Background
The combustion and neutralization reactions covered in the student textbook do not get into the specifics of what is occurring. However, students have an opportunity to discover what happens with some common reactions. Be sure students understand they are only scratching the surface. Upon completion, they may well be very interested in delving deeper into the topic.

Reading Check Answer (p. 28)
A reactant is a substance (atom or compound), that is present before a chemical reaction. A product is the substance present after the reaction is completed.

Reading Check Answer (p. 29)
The reactants of a combustion reaction include (but are not limited to) wax, oil, or natural gas (fuel), thermal energy, and oxygen. In a neutralization reaction, the reactants are an acid and a base.

- Chemical reactions usually either use energy or release energy
- The substances that are there before the chemical reaction is known as **reactants**, which the substances that are produced from the reaction is **products**.
- Some chemical reactions produce gas, while others solidify or have a change in color.
- Cigarettes are an example of chemical reactions.
    - **What is in a cigarette**? Paper, nicotine, tar, tobacco. Remember that cigarettes expose you to carbon monoxide, which replaces O2 in the blood. There is also cyanide, which in high doses attacks the CNS
-

"Combustion and Neutralization"

- The type of chemical reaction where fuel burns in oxygen is known as combustion. Much of Alberta's oil and gas industry depends on combustion. This is an exothermic reaction

- Chemical reactions can also result in neutralization. In this case an acid is added to a base to produce a compound and water.

- Reactions can be describe in a sentence or using symbols.

Check your Understanding page 30 (1-3)

Section 2.3 (Evidence that he change has occured)

Science Background

The background behind the evidence for chemical reactions has been covered in the chapter text as well as in the chapter opener notes. The most important concept to emphasize to your students is that with chemical changes, a new substance must be formed that has completely different physical and chemical properties than the original reactants.

This is a difficult concept and some students will continue to wrongly associate some *physical* changes with *chemical* changes. For example, when water is evaporated, a gas is produced (water vapour). In many instances, gas production is a sign of a chemical reaction. However, in this case, the gas is the exact same substance as the liquid. We still have H_2O, but because it is now a gas, students might show it as $H_2O_{(g)}$. The only difference is that the water molecules are moving faster.

Any phase change is a physical change. It is just a matter of the molecules of a substance moving faster or slower, depending on their collective temperature.

In the examples in this section of the student textbook, the changes show chemical changes as new substances are produced. In these examples, water vapour may be one of these new substances.

Reading Check (p. 31)

Examples of chemical change in nature are in the Off the Wall and include:
• bacteria producing methane (also known as marsh gas) in wet locations
• bacteria producing methane gas in cow's intestines

Reading Check Answer (p. 34)

Some possible questions are:
• Did the colour change during the reaction?
• Was there a difference in the odour before and after the reaction?
• Did I see any bubbles, which are evidence of a gas being produced?
• Was a new substance (precipitate) visible after the reaction?
• Did the temperature change?
• Was light produced?

Reading Check Answer (p. 34)

Some possible questions are:
• Did the colour change during the reaction?
• Was there a difference in the odour before and after the reaction?
• Did I see any bubbles, which are evidence of a gas being produced?
• Was a new substance (precipitate) visible after the reaction?

• Did the temperature change?
• Was light produced?

Section 2.4 (Energy and Chemical Reactions)

The section opener explains the basics of energy changes associated with all chemical reactions. The most difficult concept for students will be grasping the idea that although we may not be able to physically observe (without the assistance of sophisticated technology) an energy change, it is still occurring.

Any energy change resulting from a chemical reaction is due to the rearrangement of atoms within the molecules involved. In an endothermic reaction, the reactants are more stable than the products. This is why energy needs to be added to the reactant(s) for the chemical change to occur.

Endothermic reactions are non-spontaneous, meaning that they require help to occur. Additional energy is required in order to disrupt the stable state of the reactant(s). When the bonds do break, the elements involved are then free to rearrange to form totally new substances.

The opposite is true of exothermic reactions. These reactions are spontaneous, suggesting that the products formed in the reaction are more stable than the reactants. When these reactions begin (with the help of a catalyst such as a spark, flame, or another chemical), the bonds spontaneously break and rearrange themselves to form new, more stable products. Energy is one of the by-products.

Reading Check Answer (p. 35)
Exothermic reactions release thermal energy, whereas endothermic reactions absorb thermal energy as one of the products. Exo- is a Greek prefix, meaning "out," and endo- is a Greek prefix, meaning "in."

- Chemical changes always involve energy changes. For example a battery (chemical energy) releases electric energy. The electric energy flows through the light bulb, which converts to light energy.

- The burning of gasoline in your engine is a chemical reaction that results in forward motion and produces heat. The production of heat is known as an **exothermic reaction.**

- The body breaking down of fats and carbohydrates is also an example of an exothermic reaction.

- Chemical reactions that need or absorb energy (photosynthesis) are known as **endothermic reactions.** For example in a cold pack the ammonium nitrate and water mix once the seal is broken. The reaction of these two compounds is an example of an endothermic reaction.

Check your Understanding page 37 (#1-3)
Check Your Understanding Answers

1. Both endothermic and exothermic reactions involve energy as evidence of a chemical reaction. Endothermic reactions involve adding energy to the reactants before the reaction will proceed. Exothermic reactions involve the release of energy after the reaction has occurred.
2. Look for suggestions such as the following:
   - Exothermic reactions may involve very large amounts of energy. This energy may take several forms, including heat.
   - The combustion of various materials could lead to forest or house fires.
   - Explosives rely on massive amounts of energy being released very quickly. If proper safety precautions are not in place, serious injury or even death may result.
3. Fossil fuel combustion reactions are exothermic because they all involve the release of energy.

Chapter 3 Notes
(Types of Chemical Reactions)

- Chemical reactions may give off sounds, which others may give off light.

Section 3.1 (Word Equations)

- Word equations are used to indicate what changed during the chemical reaction and what is produced.

- Word equations are usually written in the same format
  a. The left side of the equation lists the reactants
  b. The right side of the equation lists all the products
  c. An arrow points from the reactants to the products

  All reactants ⟶ All Products

- All the reactants are separated by an addition symbol (+), while all the products are also separated by an addition symbol.

Sample Chemical Reactions

Ex. 1 (Conversion of food to energy)

Oxygen + Glucose ⟶ Carbon Dioxide + Water + Energy

Ex. 2 (Chemical Reaction that produces limestone caves)

Carbonic Acid + Calcium Carbonate ⟶ Cal. Hydrogen Carbonate

Check your Understanding page 43 (#1)

Section 3.2 (Types of Reactions)

- Patterns are very important to a chemists. By knowing how certain elements and compounds go together, they can group them together to make similar reactions.
- This allows for easier predictions as well as providing a means for understanding the behavior of the substance.

"Simple Composition Reactions"

- The adding of two or more elements together to form a compound .
- The product in a SCR is always a compound
- Most SCR are exothermic (energy/heat is released)

"Simple Decomposition Reactions"

- A reaction that breaks a compound into its component elements
- Most SDR are endothermic, meaning that energy is absorbed.

"Combustion Reactions"
- The burning in the presence of oxygen.
- The products are always carbon dioxide, water and energy

"Neutralization Reactions"
- An acid reacts with a base to produce water and a from of salt.
- An antacid is an example of this. Hydrochloric acid and magnesium hydroxide produces magnesium chloride and water.

Check your Understanding page 49 (1-2)

Section 3.3 (Formulas for Common Compounds)

- Scientists created their own language for the simple reason that they needed to have the ability to communicate with each other. Hence the importance of symbols to this communication process.

Chemical Name vs. Chemical Formulas

- Most chemical compounds are named according to the major elements they contain.

- When you write the equation using words, you are using the **chemical names** for the reactants and products. However when you use symbols and numbers in the equation you are using a **chemical formula**.

- The rule for naming compounds like this is to name the metal first, followed by the name of the non metal. The name of the non metal is changed to **"ide"**

- States of matter is also important. There are the big three **(solid, liquid and gas)**, however we also have to be aware of two special names when working with states of matter. **Aqueous solution** (aq) is a substance dissolved in water and which is a **synthetic element**.

Common Names
- Unfortunately we are not all scientists, and as a result simple, daily household names had to be put on complex compounds

** Add the chart on chemical/Common names to your notebook. WITH ELEMENTS**

Check your Understanding page 51 (#1)

Section 3.4 (Chemical Equations)

What happens to the mass of the reactants and products once they go through a chemical reaction?

- The answer may surprise you as it appears that the mass of the reactants or the products may be destroyed. Lavoisier concluded in his studies the atoms are just rearranged between reactants and products, rather than destroyed. As a result he invented what is known as the Law of Conservation of Mass, which sates "In a chemical reaction, matter is not created or destroyed. If you start a reaction with 10 g of reactants, you will end up with 10 g or products.

Staying Balanced

- Chemists do not use words when working with equations, as it is not precise enough. Rather they use chemical formulas that where they can measure exactly the atoms that are involved.

** Math Connect on page 53**

Chapter 4 Notes
(Reactions and the Environment)

- Read the introductory pages on page 58 and 59.

Section 4.1 (Fossil Fuel Combustion)

- Energy, in most cases, needs to be transformed into another form so we can use it. The most common method of this is combustion.

- During a combustion reaction, the fossil fuel reacts with oxygen to produce carbon dioxide and water. Naturally energy is also a product since it is a combustion reaction.

- **Remember any explosion is a combustion reaction**

- Any combustion activity is an example of an exothermic reaction.

Note:

- **about 56 percent of electricity in Alberta is produced by coal**
- **24 percent of the provinces power is generated from natural gas**
- **20 approx. rely on other methods (solar panels, wind turbines & water**

- A car is an example of a combustion reaction. Below you will see the chemical equation, as well as the word equation for the combustion of octane (a component of gas)

$$2C_8H_{18} + 25O_2 \longrightarrow 16CO_2 + 18H_2O + \text{energy}$$

OR

Octane + Oxygen $\longrightarrow$ Carbon Dioxide + Water Vapor + Energy

- When you feel the hood of your car, you will notice that the majority of heat is given off as energy.

*** Find Out Activity***

"Incomplete Combustion"

- If fossil fuels do not burn completely, they undergo a chemical reaction called incomplete combustion. This occurs when there is not enough oxygen available.

- Complete combustion has 3 products, where as incomplete combustion has 5 (carbon dioxide, water, energy, carbon and carbon monoxide.

Note:

- Carbon monoxide is a colorless, odorless gas that is extremely poisonous. It combine with the blood stream to rid the body of oxygen causing death.

- The carbon is usually in the form of soot

"Greenhouse Gases"

- Just as a greenhouse traps heat and prevents it from escaping the atmosphere works the same way in prevent heating from escaping. This is known as the greenhouse effect.

- One of the gases that is mass released into the atmosphere is Carbon Dioxide. The burning of all of the fossil fuels produces way more than we need.

"Global Climate Change"

- The recent intervals of warming and cooling has created an effect known as global warming. This has resulted in glaciers melting, sea levels rising and climate zones shifting.

- Is there a danger of climate change and if so what?

- **Internet Activity** Climate Change: What is your position

"Air Pollution"

- There are many other pollutants that are added to the environment other than Carbon Dioxide. Nitrogen Dioxide and Sulfur Dioxide (released through the burning of wood) represents examples of this.

- Pollutants in the air can cause asthma, headaches or irritation of the eyes, nasal passages or throat.

Natural forms of Acid Deposition

- Sulfur Dioxide Gas + Water to produce Sulfurous Acid (from volcanoes)

$$SO_2 + H_2O \longrightarrow H_2SO_3$$

- Nitrogen Dioxide Gas + water to produce nitric acid and nitrogen monoxide gas.

$$3NO_2 + H_2O \longrightarrow 2HNO_3 + NO$$

Human Contribution to Acid Deposition

- Cars and factories pump tons and tons of sulfur dioxide gas and nitrogen dioxide gas into the atmosphere.

Check Your Understanding (page 65 #'s 1-4)

Section 4.2 (Acid Base Reactions)

- Neutralization occurring daily in our body.

For example

- Your stomach is constantly releasing hydrochloric acid to help digest food. The reason that this acid does not eat through the lining of your stomach is that the stomach is also releasing mucous (a base) that neutralizes any acid that comes in contact with the lining of your stomach.

Note: Fish is a basic compound food, which tastes bitter. That is why most people put vinegar or lemon juice on their fish.

"Acids and Bases in the Environment"

- Liming is a technique that has been used for years, which involves the release of Calcium Carbonate into the lakes that have large amounts of acid precipitation. This helps raise the pH level of the water.

"Reducing Emissions"

- One way to reduce the sulfur emissions are to remove the sulfur from the fuel before it is burned. Plants such as the one in Waterton, Alberta attempt this process.

- Since some coal has a high amount of sulfur in it, some areas are using sulfur scrubbing as a means of removing sulfur from the coal.

- Scrubbing in a chemical and physical process that removes sulfur during the combustion phase. See caption 4.8 on page 68 for greater detail. (CaO is injected and reacts with SO2 to form CaSO3. This calcium sulfite forms the sludge that is washed away with water.)

Check your Understanding page 68 (#'s 1-4)

Section 4.3 (Corrosion of Iron)

- Corrosion refers to the process that chemically breaks down or degrades metal. Rusting is the best example of this.
- Rusting forces the weakening of a structure as most of the substance is exposed to the environment.
- Rusting is a simple composition reaction. (Iron + Oxygen to produce iron oxide.)

Note: - Gold and platinum are examples of metals that do not rust. However since they are so expensive, they are rarely used to construction purposes.

Check your Understanding page 71 (#'s 1-3)

Section 4.4 (Solving the problem of Corrosion)

What can we do to prevent the onset of rusting? Name some draw backs of that method?

1. Painting: Using the proper paint will actually provide a coat and prevent oxygen and water from reaching the metal.

   Problem: Chipping allows the water and oxygen to attack the steel.

2. Galvanizing: The process of applying a zinc coating to iron or steel.

   Problem: Initial price of nails.

3. Sacrificial Metal: The process of burying other metals alongside and touching your initial metal. An example includes magnesium. The byproduct will corrode, but the original product will not.

   Problem: Wasteful and potential environmental impact.

Check your Understanding page 73 (#'s 1-3)

Chapter 4 Review # 1-12