B2 - Describe and interpret patterns in chemical reactions

B2.1 identify and evaluate dangers of caustic materials and potentially explosive reactions

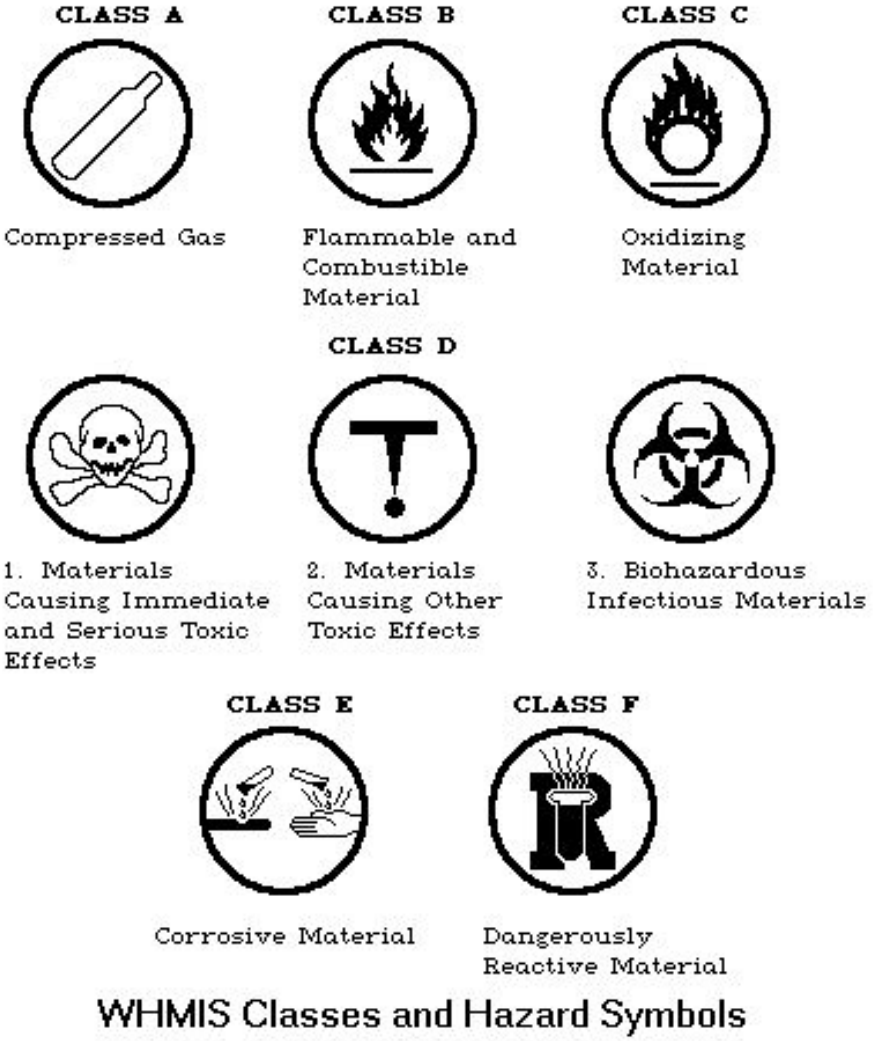
B2.3 distinguish between materials that react readily and those that do not (e.g., compare reactions of different metals to a dilute corrosive solution)

Chemical Safety

Chemical reactions provide many benefits to society; they are used in the creation of useful compounds and in the processing of many different materials. A solid understanding of the reactions involved is required to avoid and minimize potential safety and environmental issues. For Example, both ammonia and chlorine bleach are used as household cleaning agents. If the two substances are mixed, they produce highly toxic chlorine gas.

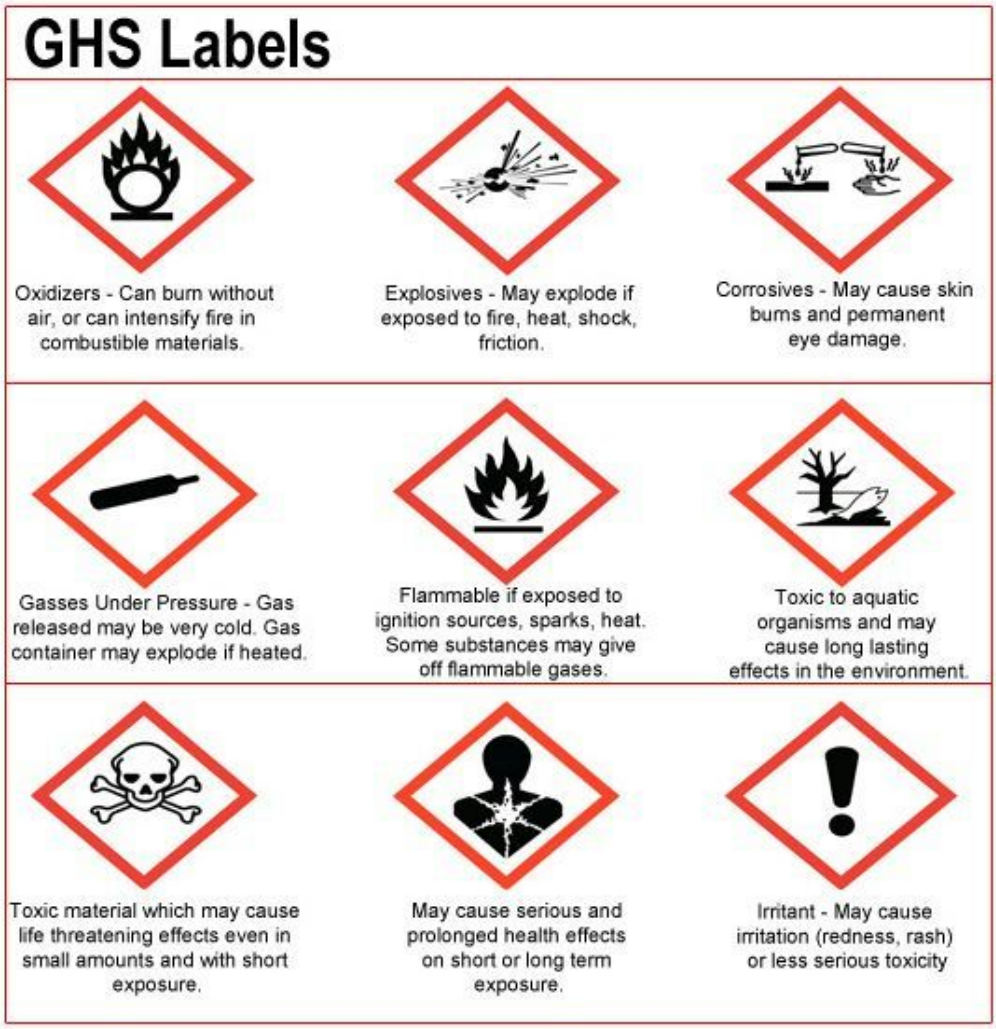
The Workplace Hazardous Materials Information System (WHMIS) is a system created to reduce the number of safety and environmental issues that can arise as a result of chemical reactions.

The eight WHMIS symbols and what they represent are as follows:



WHMIS Classes and Hazard Symbols

As of February 2015 Canada has adopted the new Globally Harmonized System of Classification and Labeling of Chemicals (GHS) for labeling hazardous materials the nine symbols are as follows:



B2.4 observe and describe patterns of chemical change, by:

- ***observing heat generated or absorbed in chemical reactions, and identifying examples of exothermic and endothermic reactions***
- ***identifying conditions that affect rates of reactions (e.g., investigate and describe how factors such as heat, concentration, surface area and electrical energy can affect a chemical reaction)***
- ***identifying evidence for conservation of mass in chemical reactions, and demonstrating and describing techniques by which that evidence is gathered.***

B4.5 describe familiar chemical reactions, and represent these reactions by using word equations and chemical formulas and by constructing models of reactants and products (e.g., describe combustion reactions, such as: carbon + oxygen → carbon dioxide [C(s) + O2(g) → CO2(g)]; describe corrosion reactions, such as: iron + oxygen → iron(II) oxide [Fe(s) + O2(g) → FeO(s)]; describe replacement reactions, such as the following: zinc + copper(II) sulfate → zinc sulfate + copper [Zn(s) + CuSO4(aq) → ZnSO4(aq) + Cu(s)])
[Note 1: This outcome does not require students to explain the formation of polyatomic ions. Some chemicals with polyatomic ions may nevertheless be introduced; e.g., a brief introduction to CuSO4(s), ZnSO4(s) and H2SO4(aq) can help prepare students for further study of these materials in units C and D.]
[Note 2: At this grade level, students are not required to balance reactants and products in chemical equations. Teachers may want to inform students about opportunities for further study of chemistry in Science 10 and in Science 14–24.]

Chemical Reactions

In a chemical reaction, the starting materials, which are called **reactants**, react to create new materials called **products**. The law of conservation of mass states that the mass of the reactants equals the mass of the products. Matter is neither created nor destroyed; it is only changed.

Chemical reactions can be represented in word equation form or in symbol equation form.

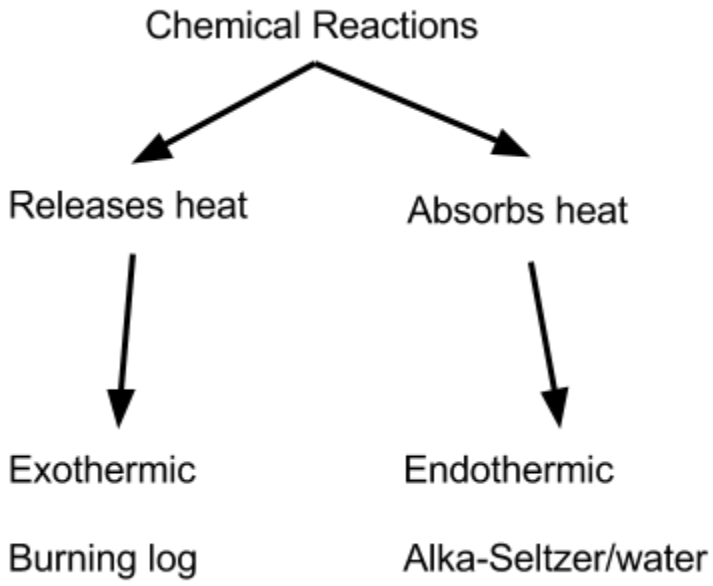
The reaction of magnesium in hydrochloric acid can be written in the following two ways.

Word Equation
Magnesium reacts with hydrochloric acid to produce magnesium chloride and hydrogen gas.

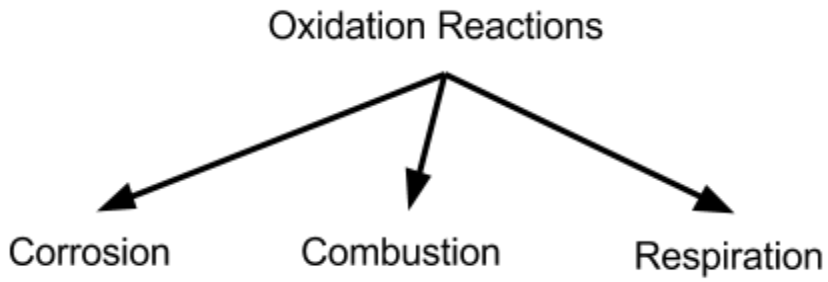
Symbol Equation
$Mg_{(s)} + 2HCl_{(aq)} \rightarrow MgCl_{2(aq)} + H_{2(g)}$
REACTANTS PRODUCTS

The balanced symbol equation shows that the reaction conforms to the law of conservation of matter. The total number of atoms on the reactant side is equal to the total number of atoms on the product side.

One way of classifying chemical reactions is by whether they release or absorb heat. A reaction that releases heat is known as **exothermic**, while a reaction that absorbs heat is called **endothermic**.



Different reactions occur at at different rates. For example, some oxidations reactions, which involve oxygen and are common in nature, are very rapid, while others are very slow. When fuel is burned in a car, the reaction happens quickly to produce carbon dioxide and water vapour. A much slower oxidation reaction is rusting, which is an example of corrosion.



The rate of a chemical reaction can be increased or decreased by the following factors:

- Introducing a catalyst
- Changing the temperature
- Changing the surface area
- Changing the concentration