3.1

Chemical reactions alter arrangements of atoms

* Atoms interact in chemical reactions
  + **Chemical reaction**: produces new substances by changing the way in which atoms are arranged.
    - Bonds between atoms are broken and new bonds form between different atoms
    - A new substance is formed
  + Physical changes
    - Change in the state of a substances
    - Same substance as original substances, may be some slightly different properties
  + Chemical Changes
    - New substance is produced
    - Breaking apart original substance, or adding to the original substance
  + Reactants and Products
    - **Reactants**: substances present at the beginning of a chemical reaction
    - **Products**: substances formed by a chemical reaction
    - Reactants and products can be elements or compounds depending on the reaction
  + Evidence of Chemical Reactions
    - Color Change
    - Formation of Precipitate
      * Precipitate: solid product from a chemical reaction
    - Formation of a Gas
    - Temperature Change
* Chemical reactions can be classified
  + **Synthesis**: a new compound is formed by the combination of simpler reactants
  + **Decomposition**: a reactant breaks down into simpler products, which could be elements or other compounds
  + **Combustion**: one reactant is always oxygen and another reactant often contains carbon and hydrogen
* The rates of chemical reactions can vary
  + Most chemical reactions take place when particles of reactants collide with enough force to react
  + Three physical factors and a chemical factor can greatly affect the rate of a chemical reaction
    - Physical Factors
      * **Concentration**: measures the number of particles present in a certain volume
        + High concentration of reactants means there is a large number of particles that can collide and react.
      * **Surface Area**: area of the surface of the reactant
        + Breaking large piece of material into smaller parts increases the surface area of the material and the rate of reaction
      * **Temperature**: increasing temperature increases molecular motion which increases the number of collisions and the rate of reaction
    - Chemical Factor
      * **Catalyst**: a substance that increases the rate of a chemical reaction but is not itself consumed in the reaction
        + After the reaction, the catalyst remains unchanged

3.2

The masses of reactants and products are equal

* Careful observations led to the discovery of conservation of mass
  + 1780s French chemist Antoine Lavoisier showed that matter can never be created or destroyed in a chemical reaction
  + Law of Conservation of Mass: in a chemical reaction, atoms are neither created nor destroyed. All atoms present in the reactants are also present in the products
* Chemical reactions can be described by chemical equations
  + Total mass of reactants is equal to the total mass of products
  + Chemical equations represent how atoms are rearranged in a chemical reaction
    - Reactants on the left
    - Products on the right
  + To write a chemical equation you need:
    - Reactants and the products in the reaction
    - The atomic symbols and chemical formulas of the reactants and products in the reaction
    - The direction of the reaction
* Chemical equations must be balanced
  + You can balance a chemical equation by changing the amounts of reactants or products represented
  + Using Coefficients to balance equations
    - Coefficients: the numbers in front of the chemical formulas, indicate how many molecules take part in the reaction.
      * If there is no coefficient, there is only one molecule of that type
    - Only a coefficient can be changed in order to balance a chemical equation

3.3

Chemical reactions involve energy changes

* Chemical reactions release or absorb energy
  + Chemical reactions involve breaking bonds in reactants and forming new bonds in products.
  + Breaking bonds requires energy, forming bonds releases energy
  + **Exothermic reaction**: a reaction in which energy is released
  + **Endothermic reaction**: a reaction in which energy is absorbed
* Exothermic reactions release energy
  + Often produce an increase in temperature
  + Bond energies of the reactants are less than the bond energies of the products
  + Excess energy can be released as light or heat energy
* Endothermic reactions absorb energy
  + Often produce a decrease in temperature
  + All endothermic reactions absorb energy, but do not all absorb energy as heat
  + **Photosynthesis**: plants absorb energy from sunlight to turn carbon dioxide and water into glucose and oxygen
* Exothermic and endothermic reactions work together to supply energy
  + Exothermic Reaction
    - Reactants 🡪 products + energy
  + Endothermic Reaction
    - Reactants + energy 🡪 Products

3.4

Life and industry depend on chemical reactions

* Living things require chemical reactions
  + Respiration: how living cells obtain energy from glucose molecules
    - Requires the “combustion” of glucose to obtain this energy
  + To increase rates of reactions, body uses chemical catalysts called enzymes for each step
* Chemical reactions are used in technology
  + Driving a car – combustion reaction
  + No chemical reaction is completely efficient
    - Some reactants don’t change completely into products
    - Sometimes unwanted waste products are produced
* Industry uses chemical reactions to make useful products
  + **Electronics industry** – semiconductor used to precisely control the conduction of electrical signals