

Enthalpy Change

- **Thermochemistry** is the study of energy changes (energy produced or absorbed) by a chemical system during a chemical reaction
 - Energy is always conserved, just converted from one form to another
- Chemical systems have different forms of energy
 - **Kinetic energy:** energy of motion from moving electrons and also moving/vibrating atoms "heat energy"
 - **Potential energy:** stored energy in the form of intermolecular bonds (between molecules) and intramolecular bonds (between atoms within the molecule) "bond energy"
- To study energy changes, an **isolated system** is required (neither matter nor energy can enter or leave)
 - However it is impossible to create an isolated system
 - Usually takes place in a **closed system** (matter cannot enter or leave, but energy can enter or leave)

- The **enthalpy change (ΔH)** of a chemical reaction is the change in potential energy of the reactants compared to the potential energy of the products
 - Also referred to as the **net energy** for a reaction

* measured in
joules
(J or kJ)

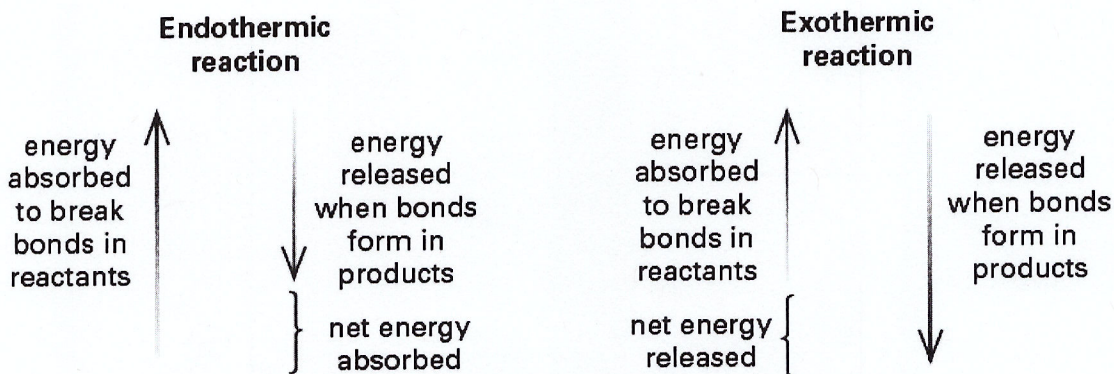
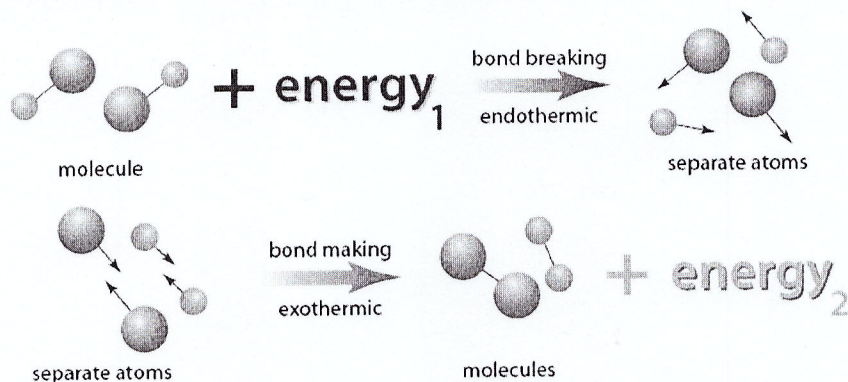
$$\Delta H = H_{\text{products}} - H_{\text{reactants}}$$

or

$$\Delta H = H_p - H_r$$

- If a chemical reaction produces or releases energy to the surroundings, ΔH will be negative because the chemical system is losing energy. This type of reaction is called an **exothermic reaction**.
 - Examples:
combustion rxns
cellular respiration
- If a chemical reaction gains or absorbs energy from the surroundings, ΔH will be positive because the chemical system is gaining energy. This type of reaction is called an **endothermic reaction**.
 - Examples:
ice packs
photosynthesis

- * All reactions involve the breaking and forming of bonds, but exothermic and endothermic reaction can be explained in terms of bond energy
 - When bonds break, energy is required
 - When bonds form, energy is released



OR

Type of Reaction	Breaking chemical bonds (reactants)	Forming chemical bonds (products)	Overall energy change
exothermic			energy released
endothermic			energy absorbed

- All chemical reactions/systems are accompanied by a change in energy. A common, naturally occurring example is the photosynthesis and cellular respiration reactions \rightarrow *combustion rxn!*
- * \circ All combustion reactions in an open system will produce gaseous water
- \circ All combustions reactions in a closed system will produce liquid water

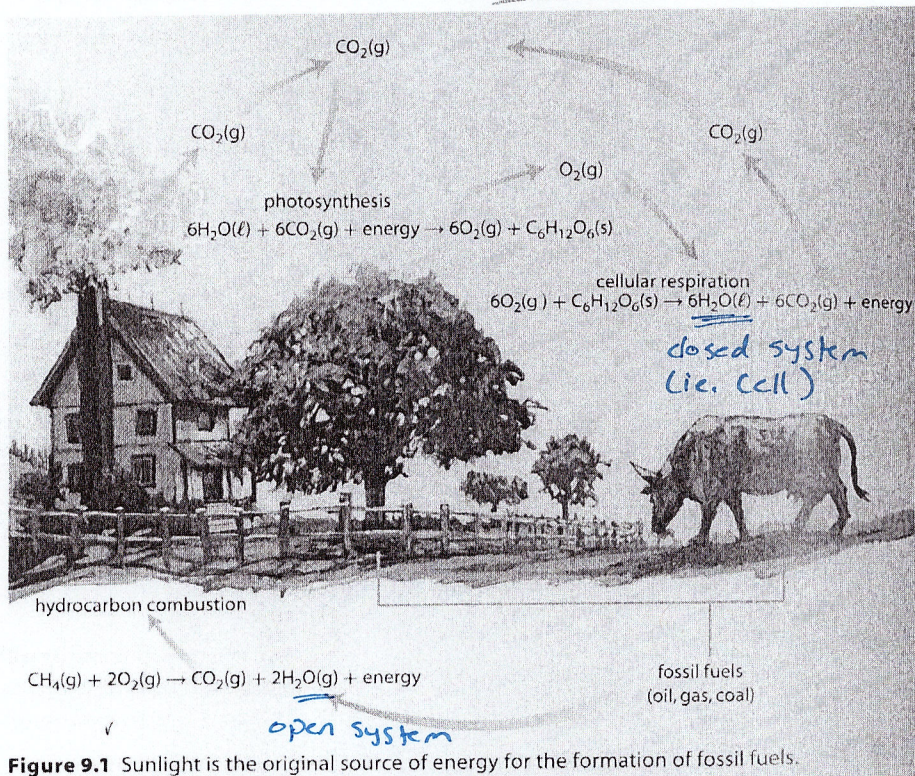


Figure 9.1 Sunlight is the original source of energy for the formation of fossil fuels.

- * • Sunlight is the original source of energy for many biological chemical reactions and ultimately the energy source for the formation of fossil fuels