Chapters 1-5 study matter, now we study energy.
Warming your hands with chemical hand warmers involves many of the principles of thermochemistry, the study of the relationships between chemistry and energy. When you open the package that contains the hand warmer, the contents are exposed to air, and a reaction that gives off heat to its surroundings occurs. Most handwarmers involve the oxidation of iron:

$$4\,\mathsf{Fe(s)} + 3\,\mathsf{O_2(g)} \longrightarrow 2\,\mathsf{Fe_2O_3(s)}$$

$$4\mathrm{Fe}(s) + 3\mathrm{O}_2(g) \rightarrow 2\mathrm{Fe}_2\mathrm{O}_3(s)$$

In this chapter, we look at how chemical reactions can exchange energy with their surroundings and how we can quantify the magnitude of those exchanges.

6.0.1 Applications

- Heating of homes
- Production of energy

6.1 Key Definitions

Energy Capacity to do work

Work Result of a force active through a distance

Examples of work

- Pushing a box across the floor
- a billiard ball rolling across a billiard table and colliding with a second, stationary ball

Potential energy Associated with position or composition. Example: Raising a billiard ball off the table increases its potential energy.

Chemical energy Associated with relative positions of electrons and nuclei in atoms and molecules

Law of conservation of energy energy can be neither created nor destroyed; it can assume different forms

System chemicals in a beaker (or handwarmers) for example

Surrounding water that the chemicals are dissolved in, the beaker, the lab bench, air in the room, etc.

- Surroundings gain the exact amount of energy lost by the system and vice versa.

6.2 Units of Energy

- $KE = \frac{1}{2}mv^2$, $[KE] = [m][v] = \text{kg} \times \frac{m}{s}$

6.3 sec:1st-law-of-thermodynamics

- The total energy of the universe is constant → Energy is neither created, nor destroyed, universe does not exchange energy with anything else.
- According to the 1st law, a device that continually produces energy with no energy input cannot exist.

6.3.1 Internal Energy (IE)

- The internal energy of a system is the sum of the kinetic and potential energies of all the particles that compose the systems.
- It is a "state function".
- State of a chemical system is specified by parameters such as temperature, pressure, concentration, and phase (solid, liquid, or gas)
- Elevation of 10,000 ft, for example, is a state function no matter how you climbed it; the distance, however, is not a state function as you can take any route.