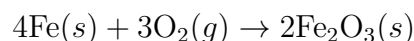
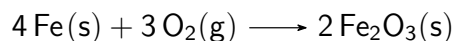


Chapters 1-5 study matter, now we study energy.

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:



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

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

## 6.3 sec:1st-law-of-thermodynamics

- The total energy of the universe is constant  $\rightarrow$  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.