1.4: Physical and Chemical Changes and Physical and Chemical Properties

(section 1.3 of OpenStax Chemistry 2e)

1.5: Energy: A Fundamental Part of Physical and Chemical Change

(Introduction to energy; energy is covered in detail in Chapter 7 of the Tro textbook

In the OpenStax textbook, the intro to energy is in the first part of section 5.1)

1.4: Physical and Chemical Changes

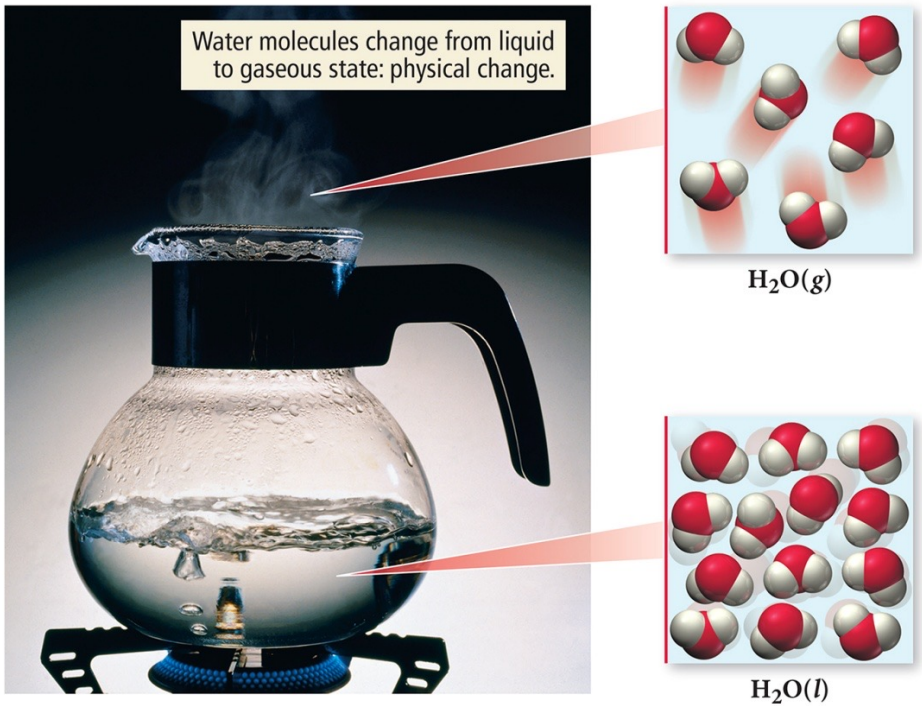
Physical Change:

- Changes that alter only the state or appearance of a substance, but not composition, are **physical changes**.

- The atoms or molecules that compose a substance *do not change* their identity during a physical change.

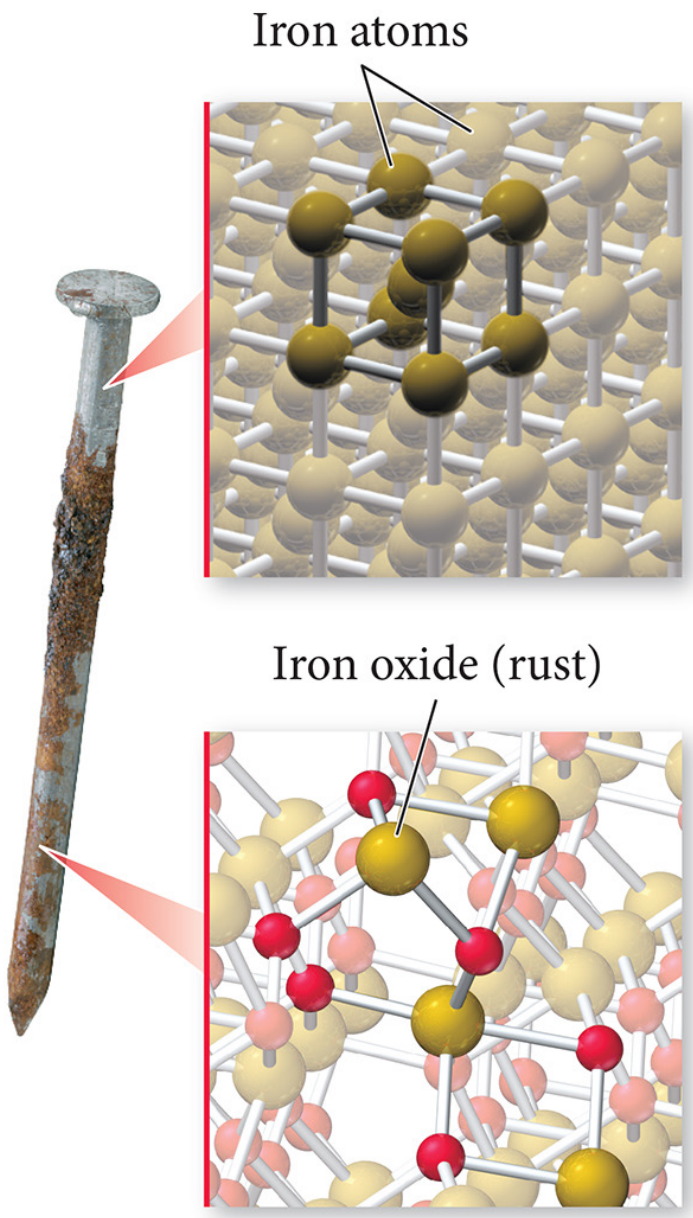
A Change of State is a Physical Change

- When water boils, it changes its state from a liquid to a gas.
- The gas remains composed of water molecules, so this is a physical change.

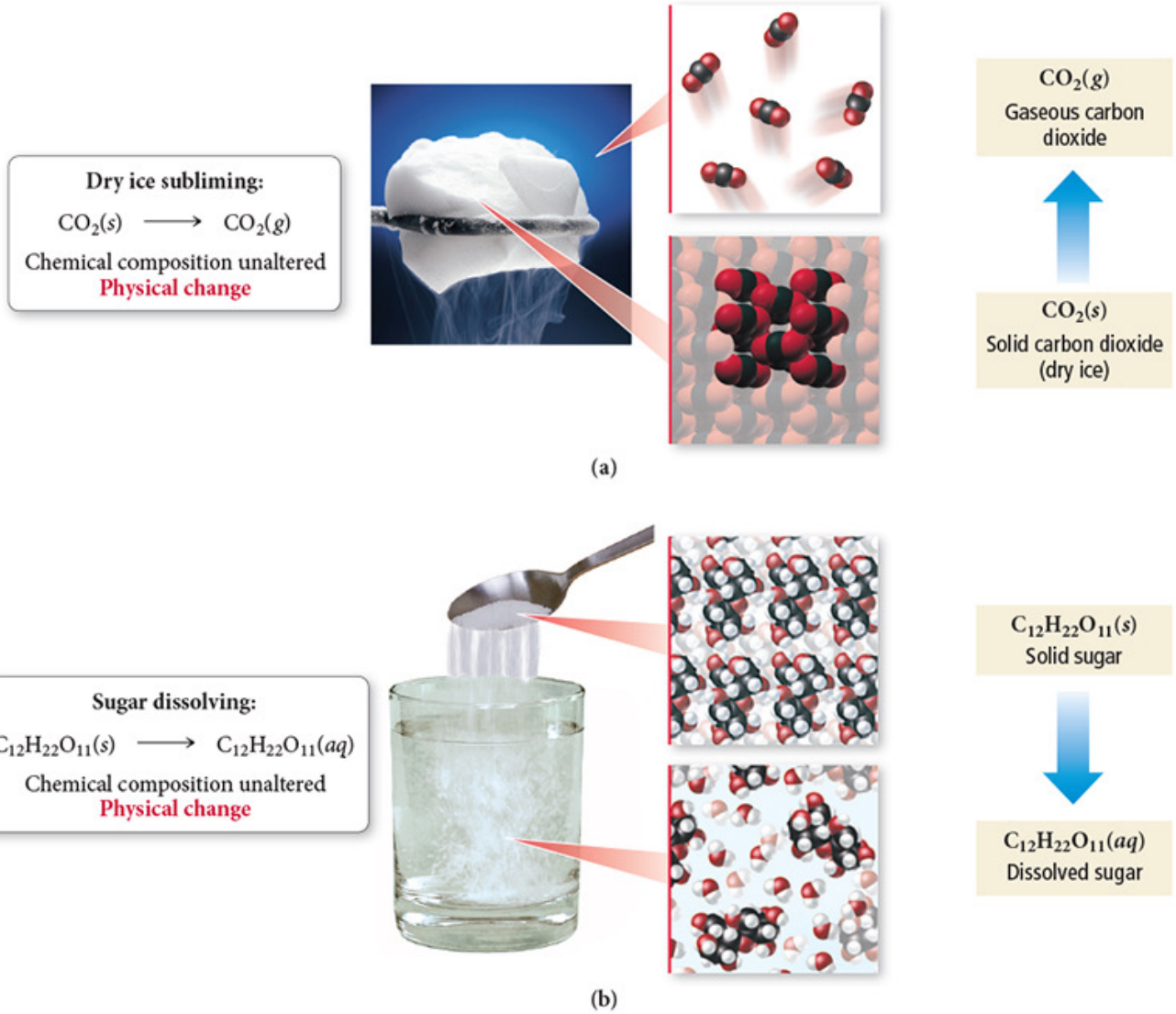


Chemical Change

- Changes that alter the composition of matter are **chemical changes**.
- During a chemical change, atoms rearrange, transforming the original substances into different substances.
- Rusting of iron is a chemical change.



Physical and Chemical Changes (1 of 2)



Physical and Chemical Changes (2 of 2)

Physical and Chemical Properties

- **Physical property**
  is a property that a substance displays without changing its composition.
  - The smell of gasoline is a physical property.
  - Odor, taste, color, appearance, melting point, boiling point, and density are all physical properties.

- **Chemical property**
  is a property that a substance displays only by changing its composition via a chemical change (or chemical reaction).
  - The flammability of gasoline is a chemical property.
  - Chemical properties include corrosiveness, acidity, and toxicity.

Learning Check

Classify each of the following changes as physical or chemical:

A. Ice cubes melting **physical (change of state)**

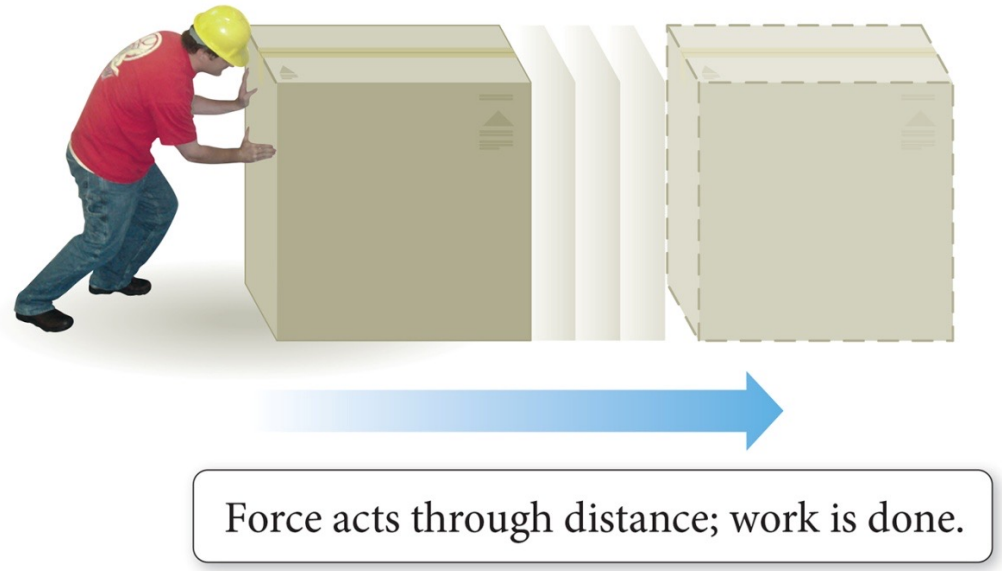
B. Paper burning **chemical (composition changes)**

C. A silver knife tarnishing **chemical (silver undergoes a chemical reaction)**

D. A log being cut into kindling wood **physical (change in shape/size but not composition)**

1.5: Energy: A Fundamental Part of Physical and Chemical Change

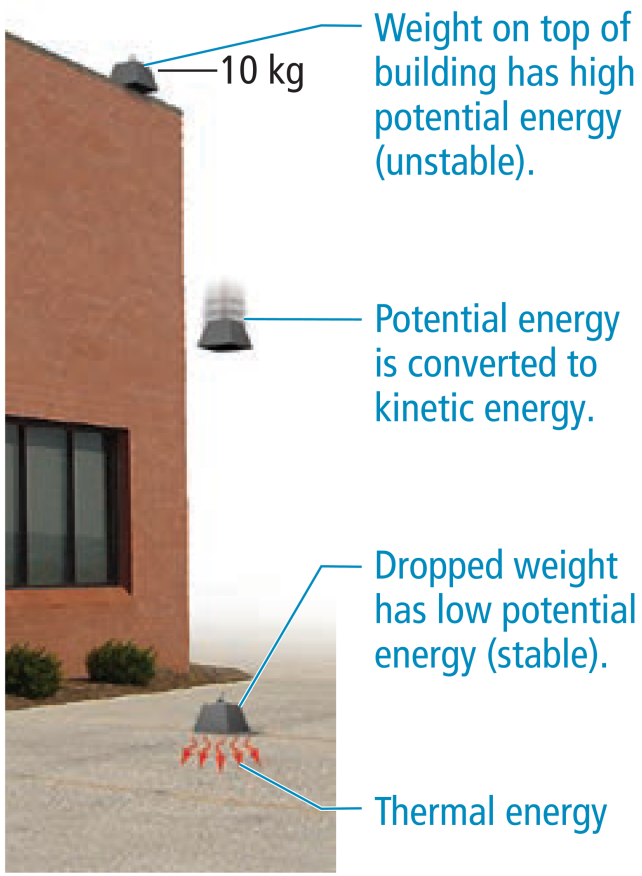
- **Energy** is the *capacity to do work.*
- **Work** is defined as the action of a force through a distance.
- When you push a box across the floor or pedal your bicycle across the street, you have done work.



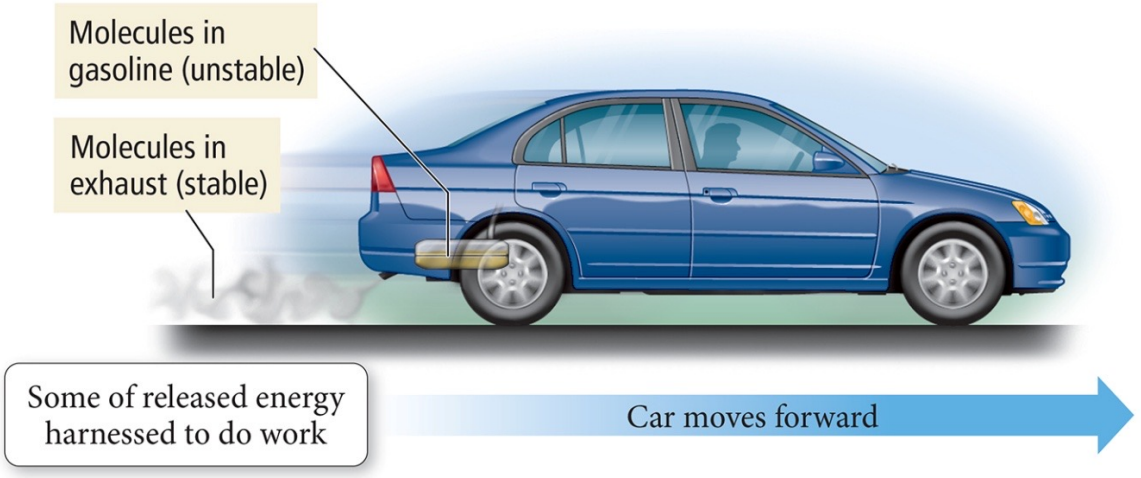
Force acts through distance; work is done.

Energy

- **Kinetic energy** is the energy associated with the motion of an object.
- **Potential energy** is the energy associated with the position or composition of an object.
- **Thermal energy** is the energy associated with the temperature of an object.
  - Thermal energy is actually a type of kinetic energy because it arises from the motion of the individual atoms or molecules that make up an object.



Summarizing Energy



- Energy is always conserved in a physical or chemical change; it is neither created nor destroyed (law of conservation of energy).
- Systems with high potential energy tend to change in a direction that lowers their potential energy, releasing energy into the surroundings.