Hewitt/Lyons/Suchocki/Yeh

Conceptual Integrated Science

Chapter 11
INVESTIGATING MATTER

The Nature of Chemistry

Chemistry is. . .

- the study of matter and the transformations it can undergo.

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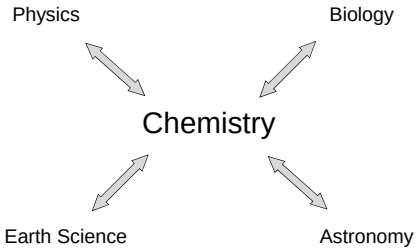
- the study of matter and the transformations it can undergo.
- the "central" science.

The Nature of Chemistry



The Nature of Chemistry

Chemistry is. . .

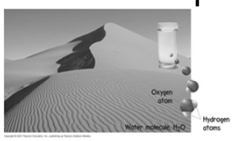
- the study of matter and the transformations it can undergo.
- the "central" science.
- a "materials" science.

Most of the material items in any modern house are shaped by some human-devised chemical process.

The Submicroscopic World

A single grain of sand contains about 125 million trillion atoms.

The Submicroscopic World



Roughly 250,000 dunes of this size contain about 125 million trillion grains of sand. Yet, that's how many atoms there are in a single grain of sand.

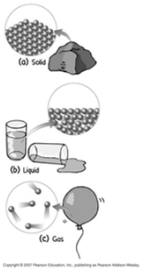
Phases of Matter

Solid : Occupies definite volume and shape

Liquid: Occupies definite volume, indefinite shape

Gas: Occupies indefinite volume and shape

Phases of Matter



Phases of Matter

Diffusion is the tendency of molecules to move from an area of high concentration to one of low concentration.

Changes of Phase

Melting: A change of phase from solid to liquid

Freezing: A change of phase from liquid to solid

Evaporation: A change of phase from liquid to gas

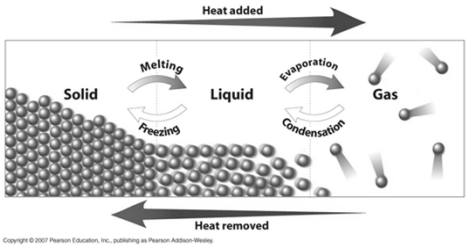
Changes of Phase (cont.)

Sublimation: A change of phase from solid to gas

Boiling: Evaporation occurring beneath the liquid's surface

Condensation: A change of phase from gas to liquid

Change of Phase



Changes of Phase

Latent Heat is **h**eat added or taken away from a substance without a change in temperature.

Integrated Science—Physics

How is it possible to add heat to water without an increase in temperature?

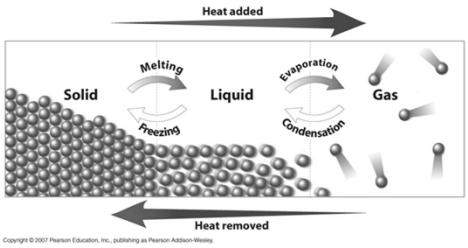
Increase the water's potential energy by pulling water molecules apart from one another, which is what happens when water changes phase.

Changes of Phase

Latent Heat is heat added or taken away from a substance without a change in temperature.

Heat of Fusion is the heat energy needed to change a substance from solid to liquid (and vice versa).

Heat of Vaporization is the heat energy needed to change a substance from liquid to gas (and vice versa).

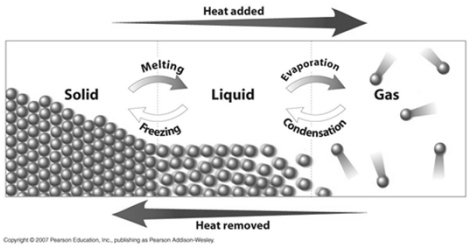


Notice how going from liquid to gas requires the complete separation among molecules.

Changes of Phase

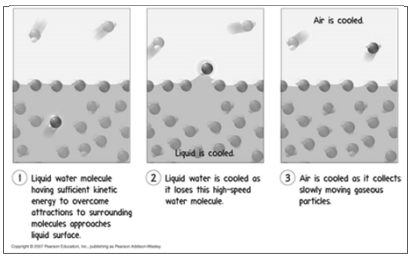
Therefore, evaporation is a cooling process.

It follows that condensation is a warming process.



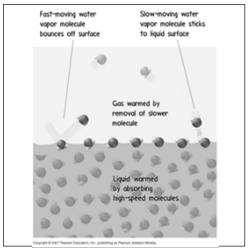
Change of Phase

Evaporation is a cooling process.



Change of Phase

Condensation is a warming process.

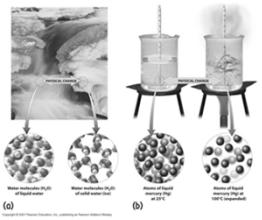


Physical and Chemical Properties

- A physical property describes the look or feel of a substance.

Physical and Chemical Properties

A change in phase is a physical change.



Physical and Chemical Properties

- A chemical property describes the tendency of a substance to transform into a new substance.

It is a chemical property of iron to transform into rust.

Physical and Chemical Properties

- The transformation of one or more substances into others is a chemical change.

Methane
Reacts with oxygen to form carbon dioxide and water, giving off lots of heat during the reaction.

Baking soda
Reacts with vinegar to form carbon dioxide and water, absorbing heat during the reaction.

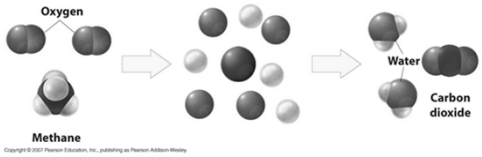
Copper
Reacts with carbon dioxide and water to form the greenish-blue substance called patina.

Physical and Chemical Properties

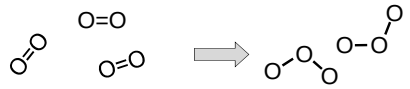
A substance is identified not only by the kinds of atoms it contains but also by how those atoms are connected to one another.

During a chemical change, a new substance is formed as atoms rearrange themselves into new configurations.

Physical and Chemical Properties



The transformation of oxygen, O2, into ozone, O3, is an example of



oxygen ozone

- ✘ A. a physical change.
- ✓ B. a chemical change.
- ✘ C. both a physical and chemical change.
- ✘ D. neither a physical nor chemical change.

✓ [Default]

Elements

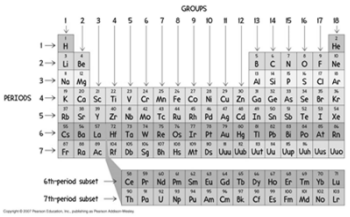
Element: A material made of only one kind of atom.

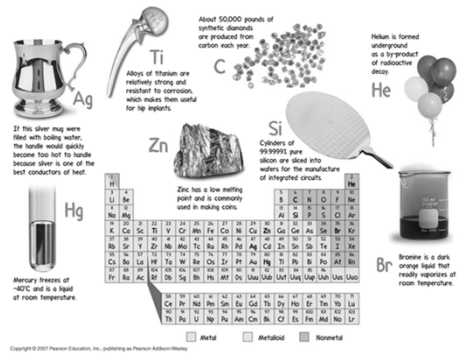
Elements

- Element: A material made of only one kind of atom.
- Atom: The fundamental unit of an element.

The Periodic Table

- The Periodic Table is a listing of all the known elements.

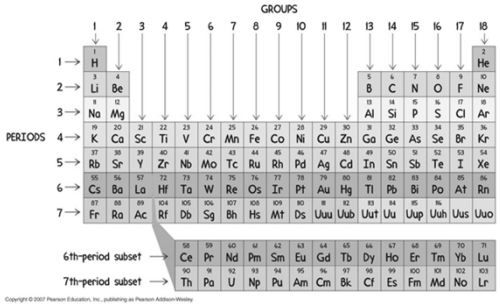




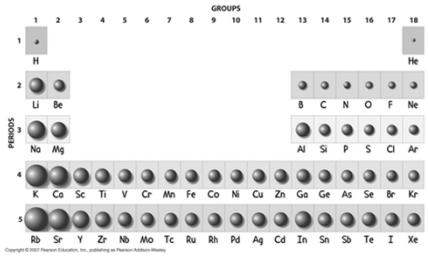
The Periodic Table

- The elements are highly organized within the Periodic Table.
- Each vertical column is called a “group.”
- Each horizontal row is called a “period.”

The Periodic Table

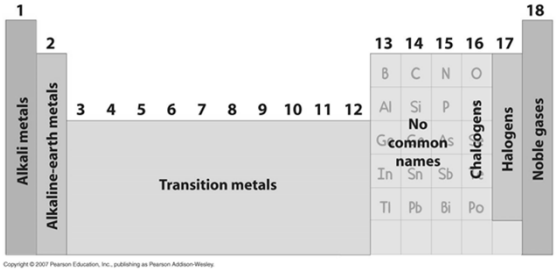


The Periodic Table



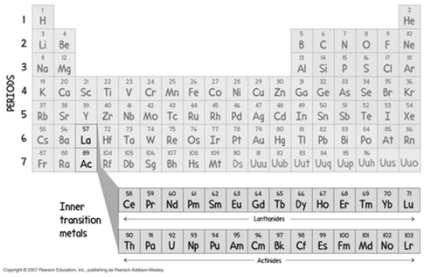
Sizes of the different atoms; size decreases to the right and upwards.

The Periodic Table



Elements are grouped naturally by type.

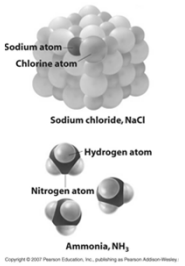
The Periodic Table



The Inner Transition Elements are special.

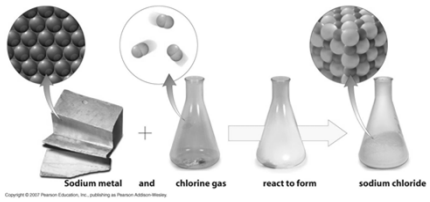
Chemical Compounds

- Compound: A substance consisting of atoms of different elements.



Chemical Compounds

- Compounds have properties uniquely different from the elements from which they are made.



Chemical Compounds

- Chemical formula: Used to show the proportion by which elements combine to form a compound.

Compound	Formula
Sodium chloride	NaCl
Ammonia	NH_3
Water	H_2O

Elements

- Elemental formula: Used to show the proportion by which atoms combine to form an element.

Compound	Formula
Oxygen	O_2
Ozone	O_3
Sulfur	S_8
Gold	Au

Naming Compounds

Guideline 1

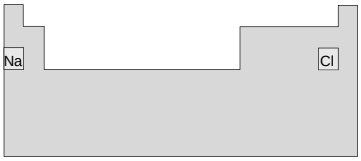
- Start with the element farthest to the left in the periodic table.
- For the element to the right, add the suffix -ide.

Example:

NaCl = “Sodium Chloride”

Naming Compounds

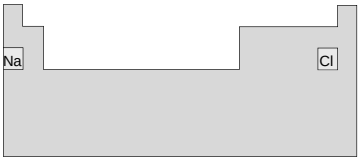
Sodium Chlorine



NaCl = “Sodium Chloride”

Naming Compounds

Sodium chloride

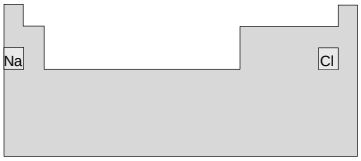


Example:

NaCl

Naming Compounds

Sodium chloride



Example:

NaCl

Naming Compounds

Guideline 2

- With different possible combinations of elements, use prefixes to remove ambiguity.

mono-	1
di-	2
tri-	3
tetra-	4

Naming Compounds

Examples:

CO	carbon monoxide
CO_2	carbon dioxide

Naming Compounds

Examples:

H_2O	dihydrogen monoxide
H_2O_2	dihydrogen dioxide

Naming Compounds

Guideline 3

- Common names are sometimes used for convenience.

H_2O “Water”

H_2O_2 “Hydrogen peroxide”