Matter

- *Volume* is the amount of three dimensional space an object occupies.
- *Mass* is a measure of the amount of matter.
  - Mass & Weight are NOT the same (see next slide)
- **Matter** is anything that has mass and takes up space.

End of Slide

Differences between Mass and Weight:

Mass	Weight
Mass is a measure of the amount of matter in an object.	Weight is a measure of the gravitational force on an object.
Mass is always constant for an object despite its location in the universe.	Weight varies depending on where the object is in relation to the Earth.
Mass is measured using a balance.	Weight is measured using a spring scale.
Mass is expressed in kilograms (kg), grams (g), and milligrams (mg).	Weight is expressed in (N).

Basic Building Blocks of Matter

- ATOM (the basic building block)
- ELEMENT
- COMPOUND

- **Atom:** An **atom** is the smallest unit of an element that maintains the chemical identity of that element.

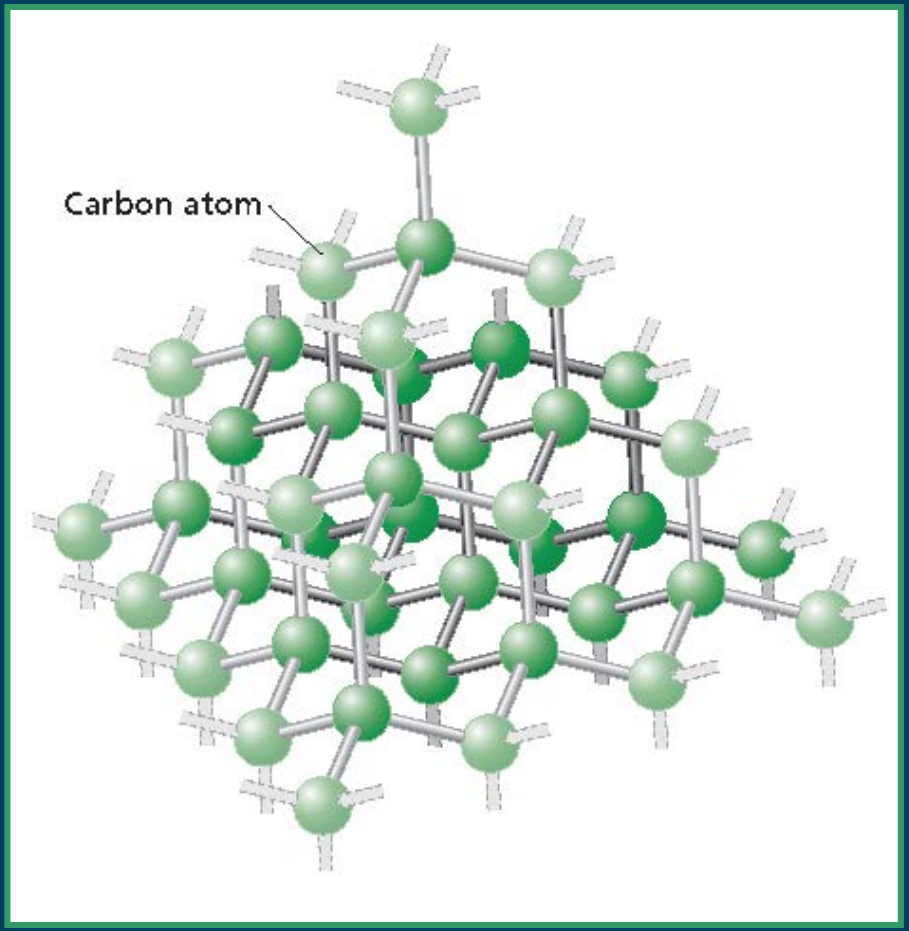
End Of Slide

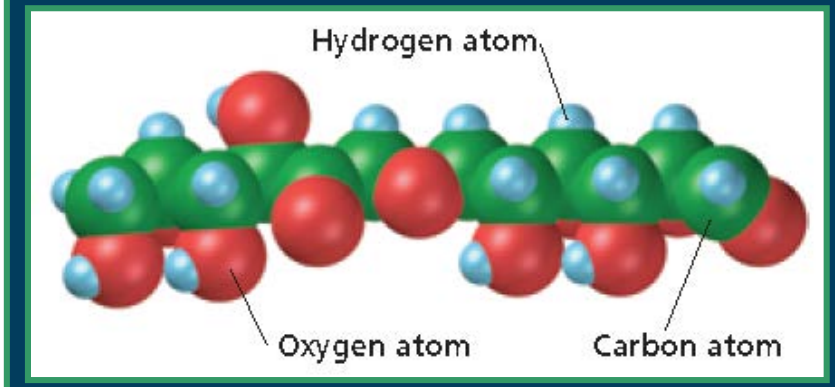
Atom: An **atom** is the smallest unit of an element that maintains the chemical identity of that element.

Element: An **element** is a pure substance that cannot be broken down into simpler, stable substances and is made of one type of atom

Compounds: A **compound** is a substance that can be broken down into simple stable substances. Each compound is made from the atoms of two or more elements that are chemically bonded

Basic Building Blocks of Matter, *continued*





Properties and Changes in Matter

- **Extensive properties** depend on the AMOUNT of matter that is present. (*the value of these properties change as the amount of matter changes*)
  - volume
  - mass
  - the amount of energy in a substance.

End Of Slide

Properties and Changes in Matter

- **Intensive properties** do not depend on the amount of matter present. Instead depend on the TYPE of matter. (*as the amount of matter changes, these properties do NOT change*)
  - melting point
  - boiling point
  - density
  - electrical conductivity
  - thermal conductivity

End Of Slide

Properties of Matter

Property	Description	Example
Electrical conductivity	ability to carry electricity	Copper is a good electrical conductor, so it is used in wiring.
Heat conductivity	ability to transfer energy as heat	Aluminum is a good heat conductor, so it is used to make pots and pans.
Density	mass-to-volume ratio of a substance; measure of how tightly matter is "packed"	Lead is a very dense material, so it is used to make sinkers for fishing line.
Melting point	temperature at which a solid changes state to become a liquid	Ice melts to liquid water at the melting point of water.
Boiling point	temperature at which a liquid boils and changes state to become a gas at a given pressure	Liquid water becomes water vapor at the boiling point of water.
Index of refraction	extent to which a given material bends light passing through it	The index of refraction of water tells you how much light slows and bends as it passes through water.
Malleability	ability to be hammered or beaten into thin sheets	Silver is quite malleable, so it is used to make jewelry.
Ductility	ability to be drawn into a thin wire	Tantalum is a ductile metal, so it is used to make fine dental tools.

Physical Properties and Physical Changes

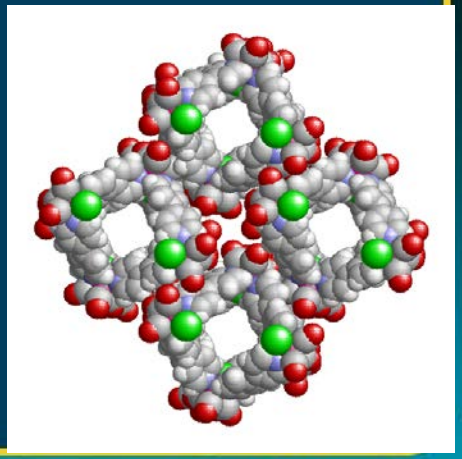
- A **physical property** is a characteristic that can be observed or measured without changing the identity of the substance. Physical Properties are used to identify a material, choose a material for a specific purpose, or to separate substances

•See the examples on the next 9 slides of various physical properties.

End Of Slide

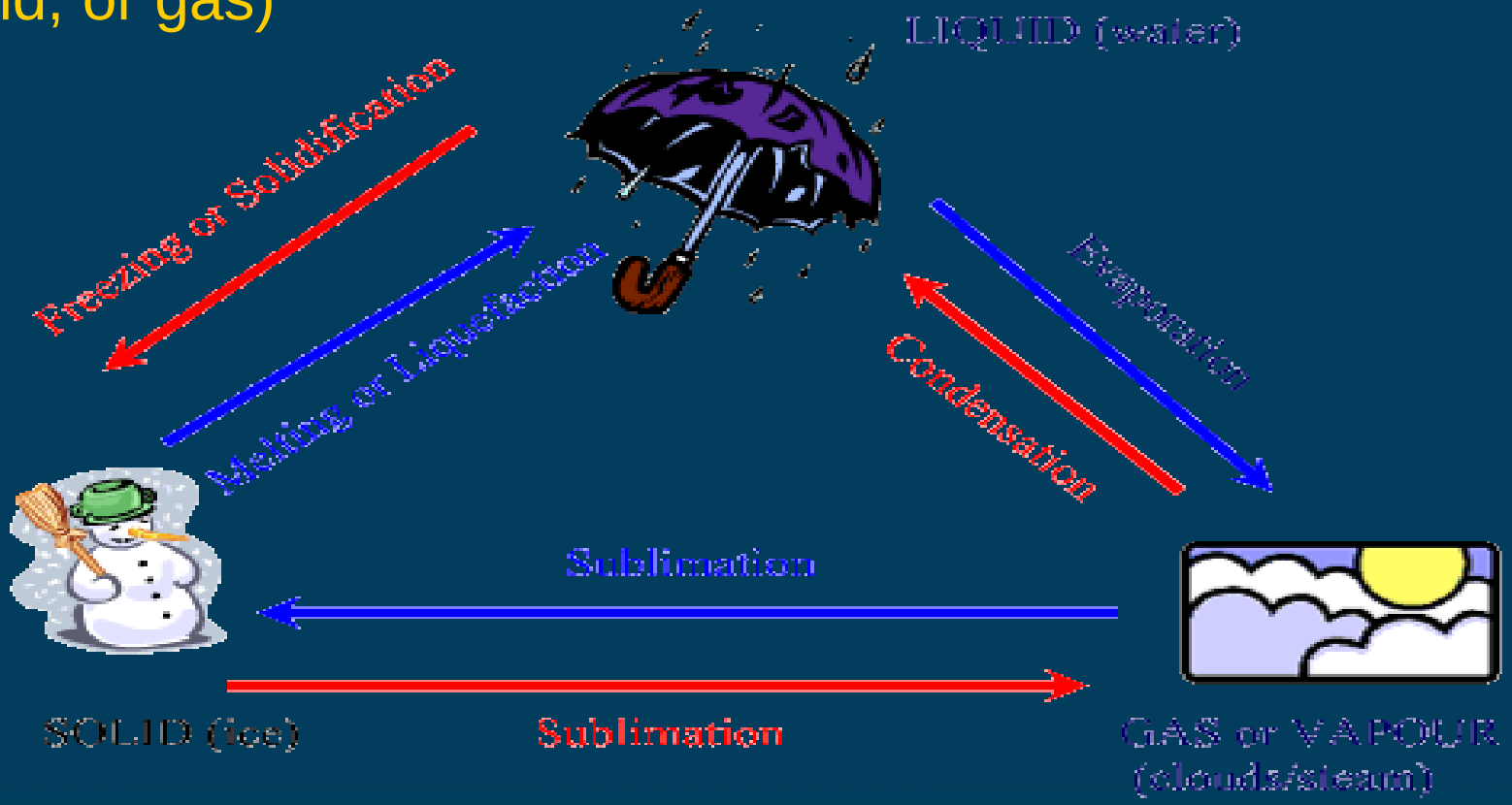
Examples of Physical Properties:

1) Thermal (or Electrical) conductivity – The rate at which a substance transfers heat (or electricity)



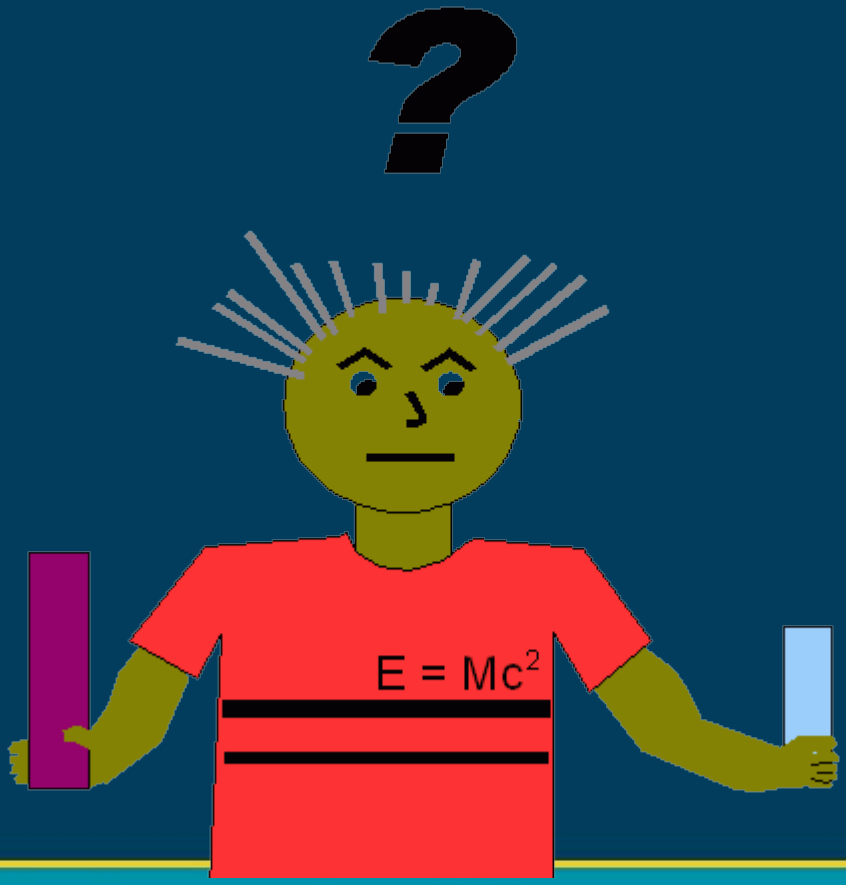
Examples of Physical Properties:

2) State (or Phase) – The physical form of matter (solid, liquid, or gas)



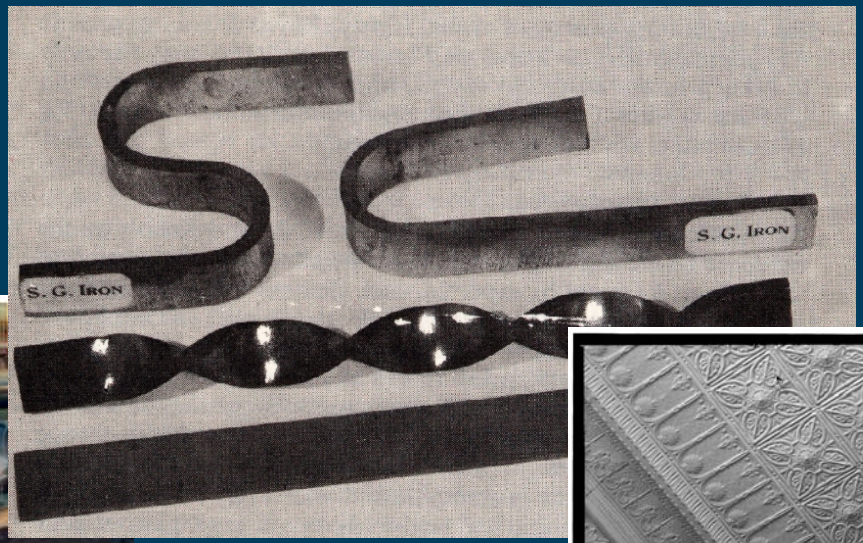
Examples of Physical Properties:

3) Density – The mass per unit volume of a substance.



Examples of Physical Properties:

4) Ductility – The ability of a substance to be pulled into a wire



Main

Examples of Physical Properties:

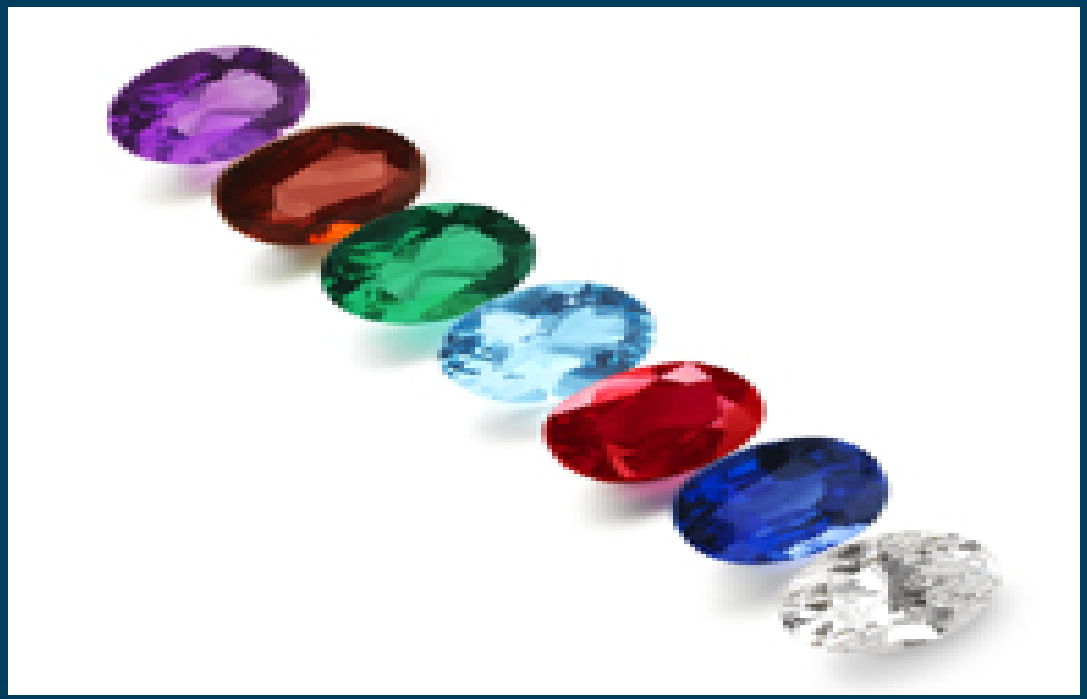
5) Viscosity – The tendency of a liquid to keep from flowing, it's resistance to flowing

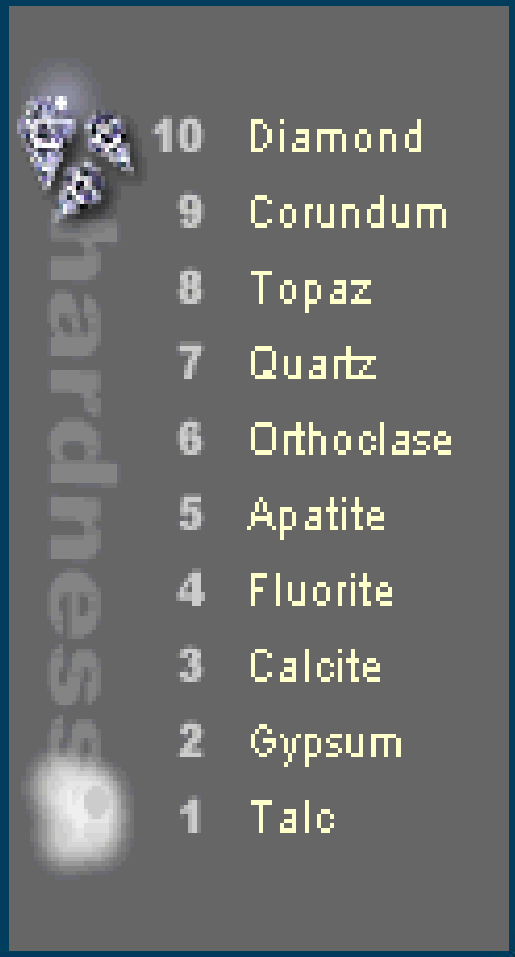
Examples of Physical Properties:

6) Malleability – The ability of a solid to be hammered without shattering

Examples of Physical Properties:

7) Hardness – A comparison between two materials to see which of the materials can scratch the other

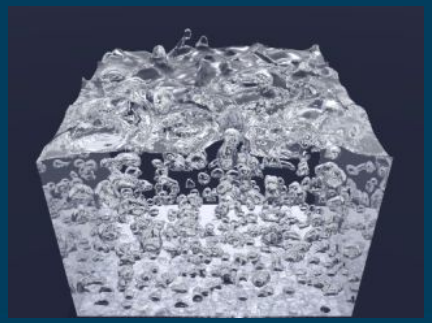




Examples of Physical Properties:

8) Melting Point – The temperature at which a substance changes from solid to liquid

9) Boiling Point – The temperature at which a substance boils



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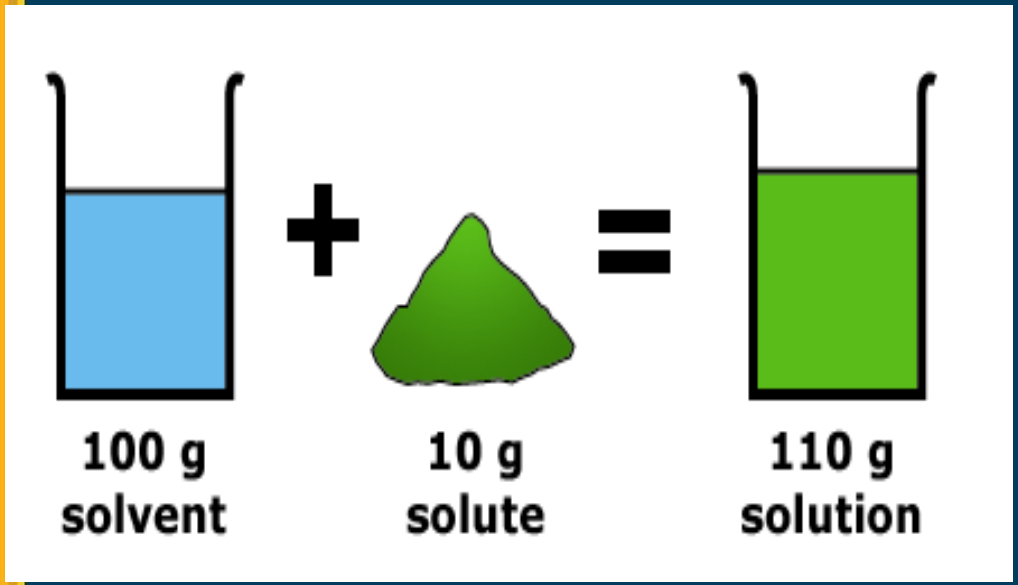
Examples of Physical Properties:

10) Solubility – The ability of a substance to dissolve in another substance



Physical Properties and Physical Changes

- A **physical change** is a change in a substance that does not involve a change in the identity of the substance. Some of the properties may change, but the makeup (composition) of the material stays the same.
  - grinding, cutting, melting, and boiling

End Of Slide

Chemical Properties and Chemical Changes

- A **chemical property** relates to a substance's ability to undergo changes that transform it into different substances. *Chemical properties can't be observed without changing the makeup of the substance.*
  - Flammability
  - Reactivity

End Of Slide

Chemical Properties and Chemical Changes

- If one or more substances are converted into different substances is called a **chemical change** or **chemical reaction.**
- **Some indicators of a chemical change:**
  - Change in ***color***
  - Production of a ***gas***
  - Formation of a ***precipitate***
  - Production of an ***odor***
  - ***Temperature*** change (not from heating or cooling)
  - Production of a ***new substance***
  - ***Light*** given off

End Of Slide

Chemical Reaction

Click below to watch the Visual Concept.
How many of the indicators can you spot?

Parts of a reaction

- The **reactants** are the substances that react in a chemical change. (substances that go into a rxn)
- The **products** are the substances that are formed by the chemical change. (substances that come out of a rxn)

reactants ***product***

Carbon plus oxygen yields (or forms) carbon dioxide.

carbon + oxygen ⟶ carbon dioxide

End Of Slide

Energy and Changes in Matter

- Energy is always involved when physical or chemical changes occur.
- Energy can be in various forms.
  - heat
  - light
- Energy can be absorbed or released in a change, it is **not** destroyed or created.
  - law of conservation of energy

End Of Slide

Energy and Chemical Reactions

Click below to watch the Visual Concept.

Visual Concept

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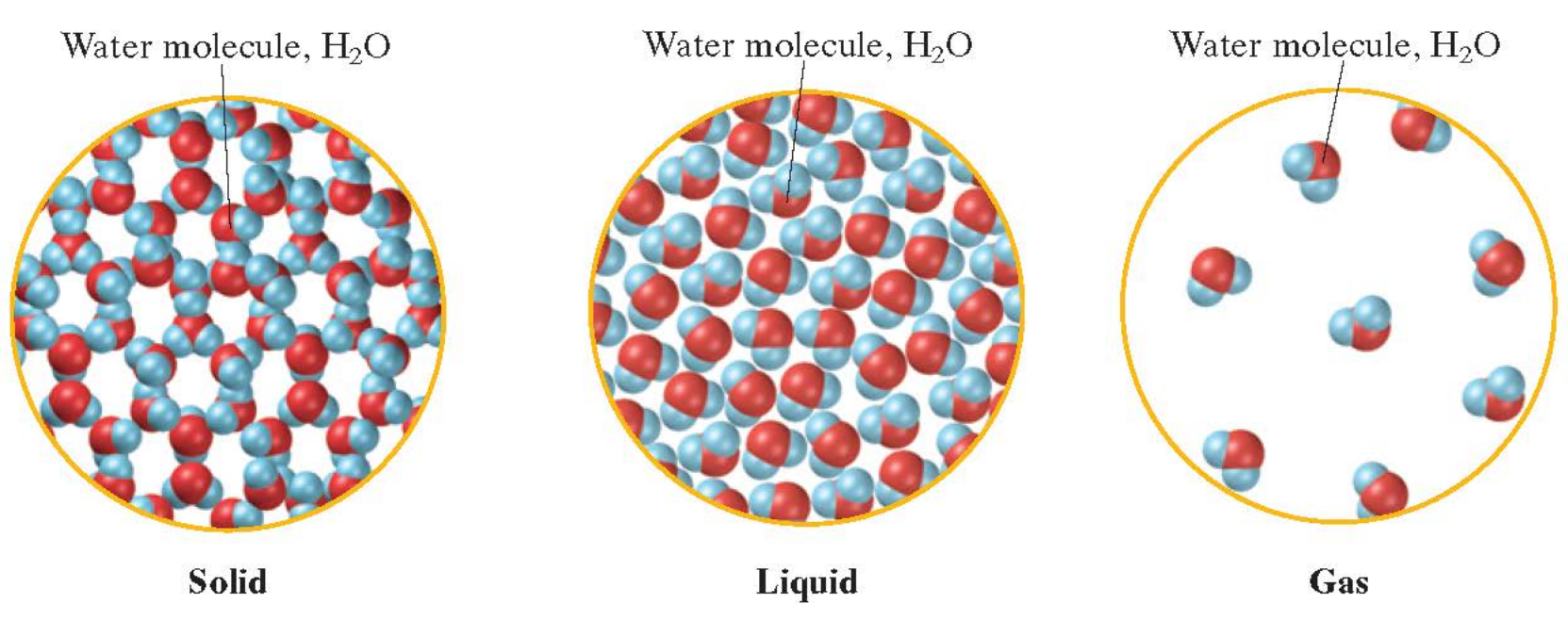
Water in Three States

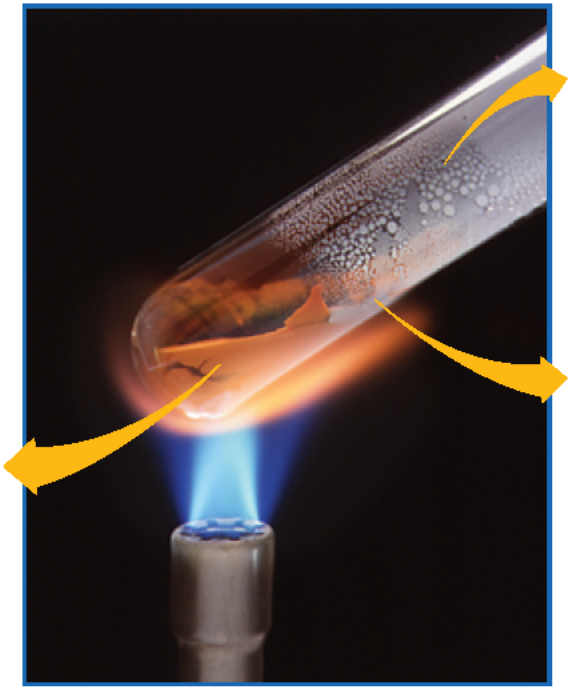


Comparison of Physical and Chemical Properties

MERCURY(II) OXIDE

Physical properties: Bright red or orange-red, odorless crystalline solid; almost insoluble in water

Chemical properties: Decomposes when exposed to light or at 500°C to form mercury and oxygen gas



OXYGEN

Physical properties: Colorless, odorless gas; soluble in water

Chemical properties: Supports combustion; reacts with many metals

MERCURY

Physical properties: Silver-white, liquid metal; in the solid state, mercury is ductile and malleable and can be cut with a knife

Chemical properties: Forms alloys with most metals except iron; combines readily with sulfur at normal temperatures; reacts with nitric acid and hot sulfuric acid; oxidizes to form mercury(II) oxide upon heating

Evidence of a Chemical Change

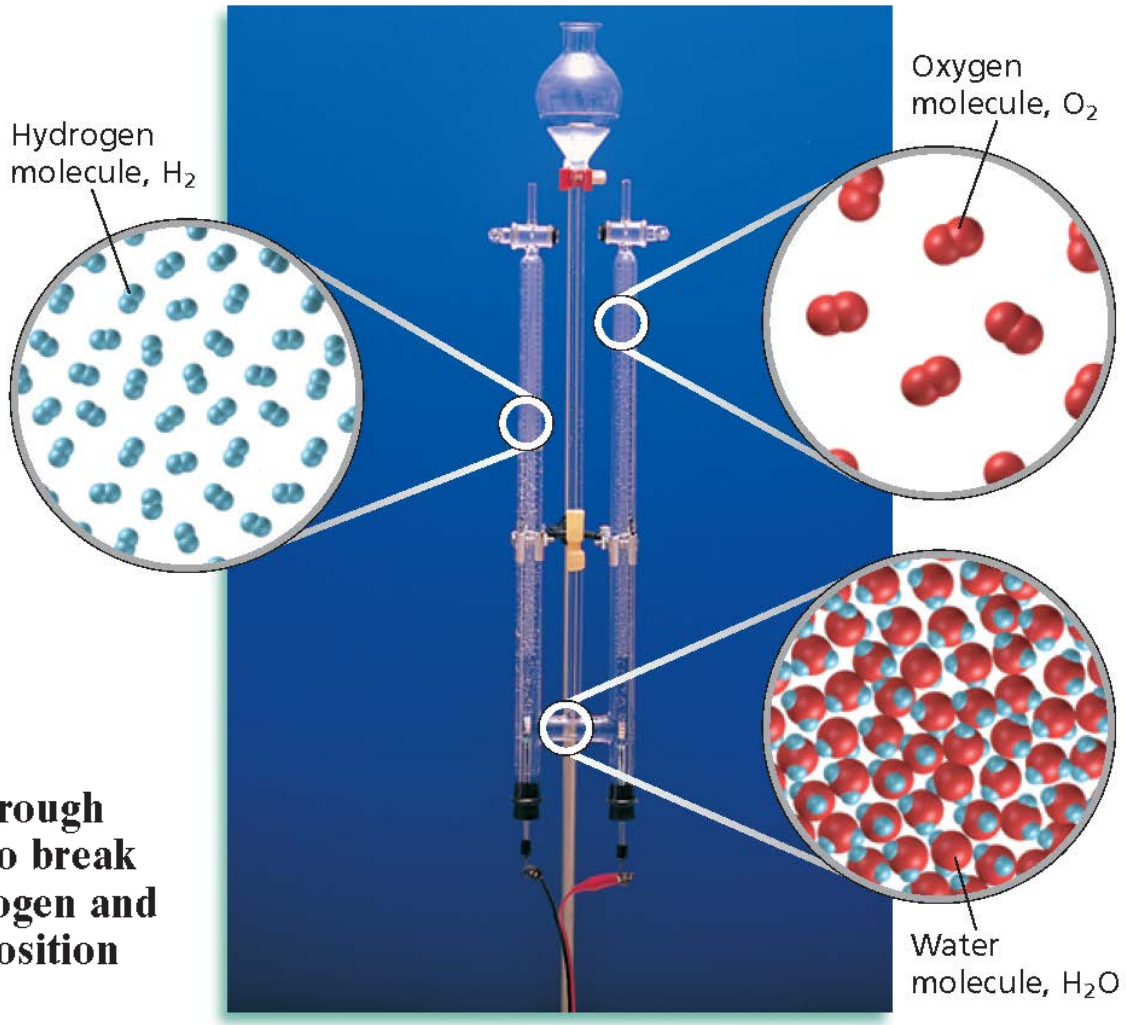
a When acetic acid, in vinegar, and sodium hydrogen carbonate, or baking soda, are mixed, the solution bubbles as carbon dioxide forms.

b When solutions of sodium sulfide and cadmium nitrate are mixed, cadmium sulfide, a solid precipitate, forms.

c When aluminum reacts with iron(III) oxide in the clay pot, energy is released as heat and light.

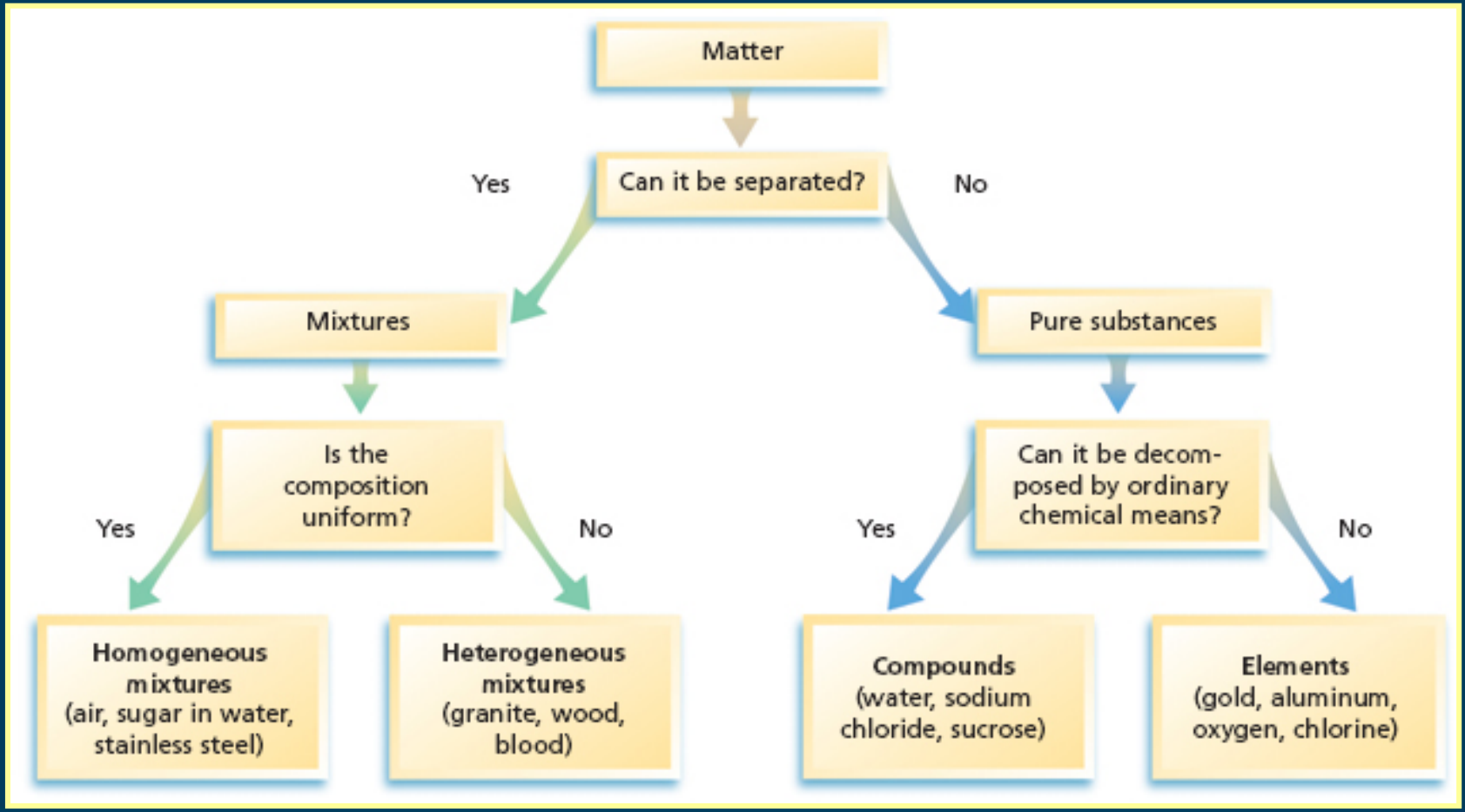
d When phenolphthalein is added to ammonia dissolved in water, a color change from colorless to pink occurs.

Electrolysis of Water



Passing an electric current through water causes the compound to break down into the elements hydrogen and oxygen, which differ in composition from water.

Classification of Matter

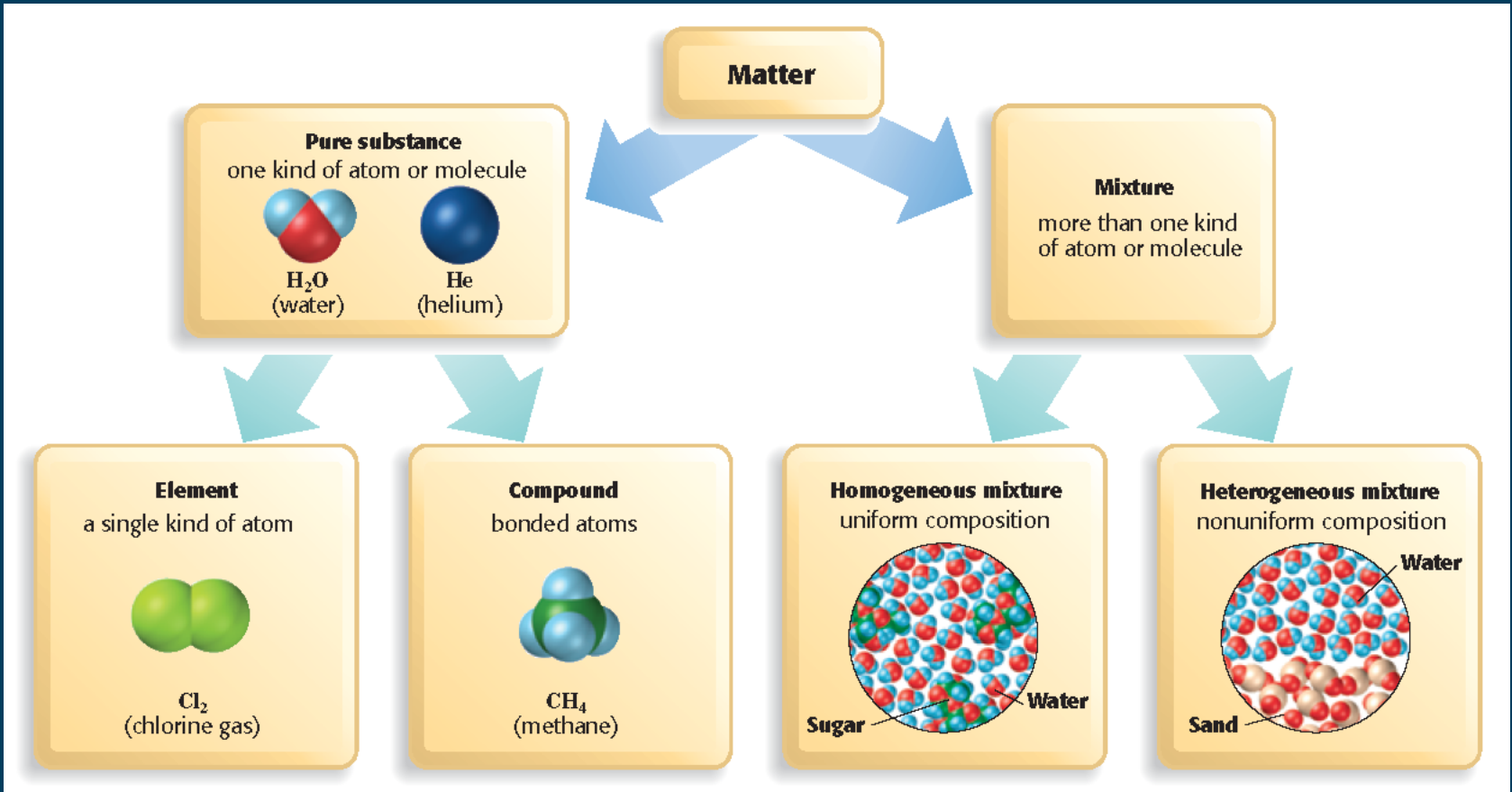


Classification Scheme for Matter

Click below to watch the Visual Concept.

Visual Concept

Classifying Matter



Classification of Matter

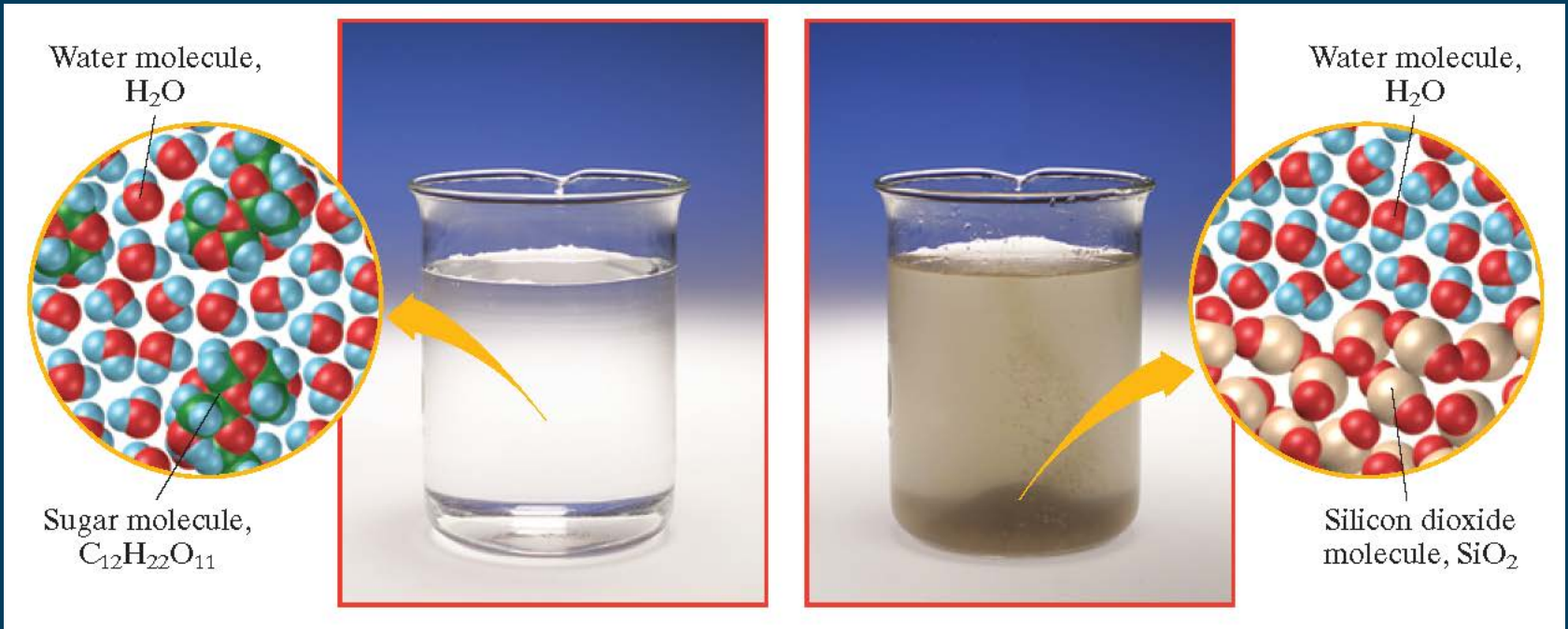
- A **mixture** is a blend of two or more kinds of matter, each of which retains its own identity and properties.
  - mixed together physically
  - can usually be separated

- **Homogeneous** mixtures are called **solutions**
  - uniform in composition (salt-water solution)

- **Heterogeneous** mixtures
  - not uniform throughout (clay-water mixture)

End Of Slide

Types of Mixtures



Pure Substances

- A **pure substance** has a fixed composition.
- Pure substances are either compounds or elements.
- A pure substance differs from a mixture in the following ways:
  - Every sample of a given pure substance has exactly the same characteristic properties.
  - Every sample of a given pure substance has exactly the same composition.
  - Water is always 11.2% hydrogen and 88.8% oxygen by mass.

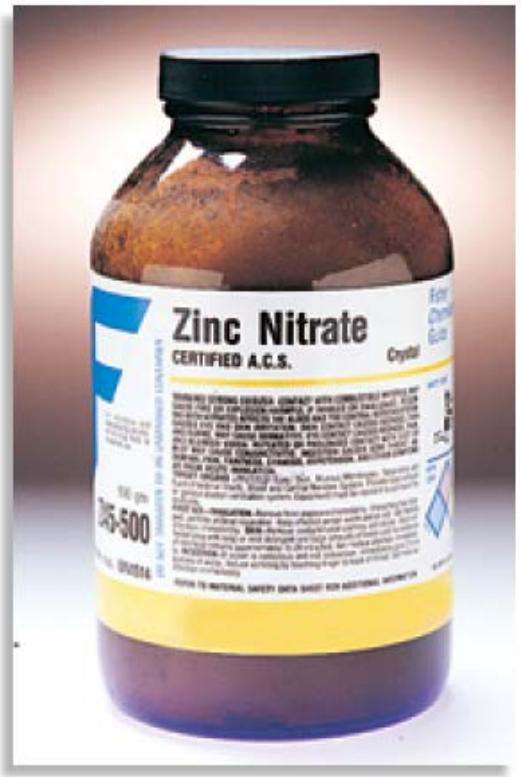
End Of Slide

Laboratory Chemicals and Purity

TABLE 1 *Some Grades of Chemical Purity*

Increasing purity ↑

- Primary standard reagents
- ACS (American Chemical Society–specified reagents)
- USP (United States Pharmacopoeia standards)
- CP (chemically pure; purer than technical grade)
- NF (National Formulary specifications)
- FCC (Food Chemical Code specifications)
- Technical (industrial chemicals)



$Zn(NO_3)_2 \cdot 6H_2O$ F.W. 297.47

Certificate of Actual Lot Analysis

Acidity (as HNO_3)	0.008%
Alkalies and Earths	0.02%
Chloride (Cl)	0.005%
Insoluble Matter	0.001%
Iron (Fe)	0.0002%
Lead (Pb)	0.001%
Phosphate (PO_4)	0.0002%
Sulfate (SO_4)	0.002%

Store separately from and avoid contact with combustible materials. Keep container closed and in a cool, dry place. Avoid contact with skin, eyes and clothing.

LOT NO. 917356

FL-02-0588 CAS 10196-18-6

Examples of Mixtures

Homogeneous	Iced tea—uniform distribution of components; components cannot be filtered out and will not settle out upon standing
	Stainless steel—uniform distribution of components
	Maple syrup—uniform distribution of components; components cannot be filtered out and will not settle out upon standing
Heterogeneous	Orange juice or tomato juice—uneven distribution of components; settles out upon standing
	Chocolate chip pecan cookie—uneven distribution of components
	Granite—uneven distribution of components
	Salad—uneven distribution of components; can be easily separated by physical means

End of Section 2

Preview

- Objectives
- Introduction to the Periodic Table
- Types of Elements

Objectives

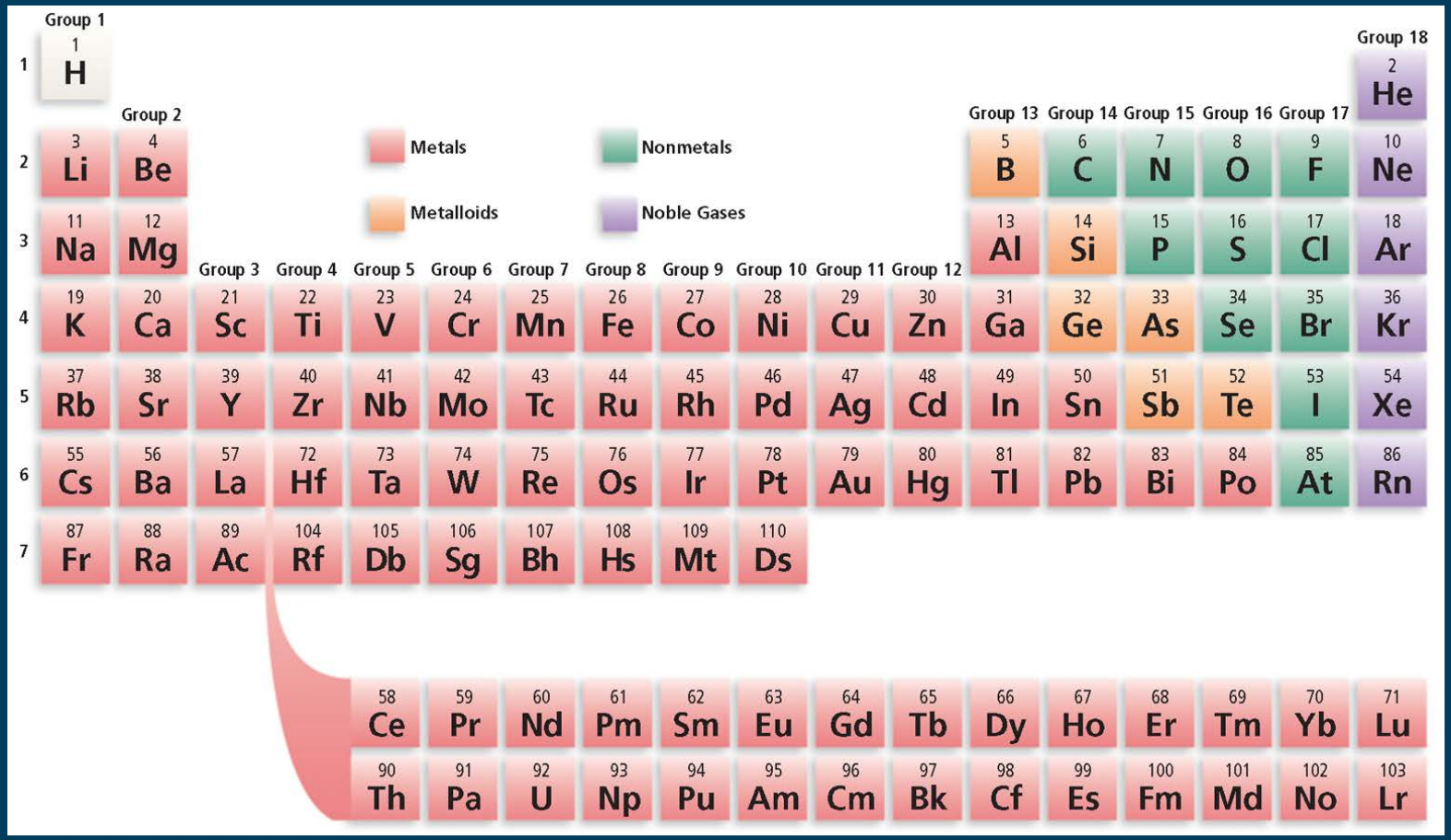
- **Use** a periodic table to name elements, given their symbols.
- **Use** a periodic table to write the symbols of elements, given their names.
- **Describe** the arrangement of the periodic table.
- **List** the characteristics that distinguish metals, nonmetals, and metalloids.

End Of Slide

Introduction to the Periodic Table

Modern name	Symbol	Older name
Antimony	Sb	stibium
Copper	Cu	cuprum
Gold	Au	aurum
Iron	Fe	ferrum
Lead	Pb	plumbum
Mercury	Hg	hydrargyrum
Potassium	K	kalium
Silver	Ag	argentum
Sodium	Na	natrium
Tin	Sn	stannum
Tungsten	W	wolfram

Regions of the Periodic Table



Chapter 1

Section 3 Elements

Introduction to the Periodic Table

- The vertical columns of the periodic table are called **groups,** or **families.**
  - Each group contains elements with similar chemical properties.

- The horizontal rows of elements in the periodic table are called **periods** or **series. .**
  - Physical and chemical properties change somewhat regularly across a period.

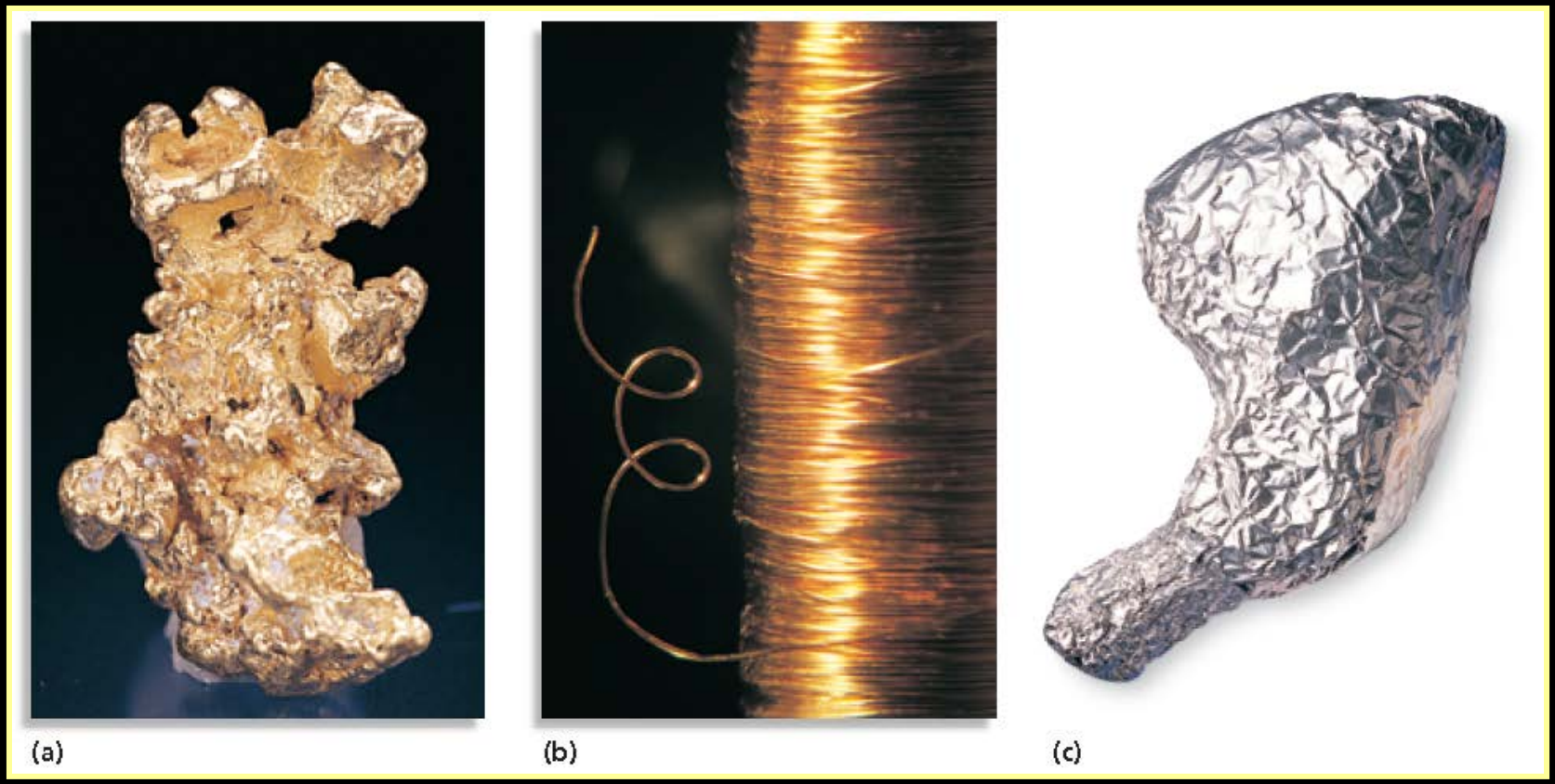
Types of Elements

Metals

- A **metal** is an element that is a good electrical conductor and a good heat conductor.
  - Properties of metals
    - most are solids at room temperature
    - malleable - they can be hammered or rolled into thin sheets
    - ductile - they can be drawn into a fine wire
    - conduct electricity and heat well

Types of Elements

- Gold, copper, and aluminum are metals



Types of Elements

Nonmetals

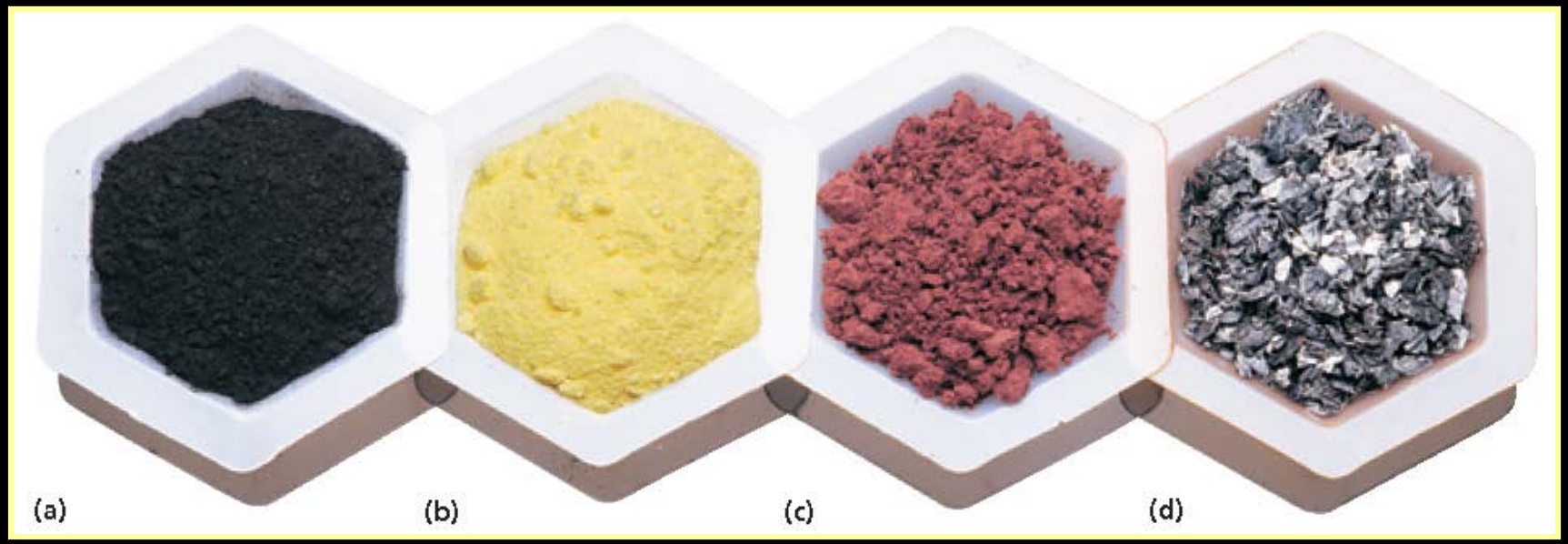
- A **nonmetal** is an element that is a poor conductor of heat and electricity.

  - Properties of nonmetals
    - many are gases
    - solids are brittle
    - poor conductors of heat and electricity

Types of Elements

- **Various nonmetal elements**

(a) carbon, (b) sulfur, (c) phosphorus, and (d) iodine



Types of Elements

Metalloids

- A **metalloid** is an element that has some characteristics of metals and some characteristics of nonmetals.

  - Properties of metalloids
    - all metalloids are solids at room temperature
    - semiconductors of electricity

    7 elements we will label as metalloids:

    B, Si, Ge, As, Sb, Te, Po

End Of Slide

Types of Elements

Noble Gases

- elements in Group 18 (sometimes called Group 8 – or Group VIII) of the periodic table

- generally unreactive

- gases at room temperature

End of Chapter 1