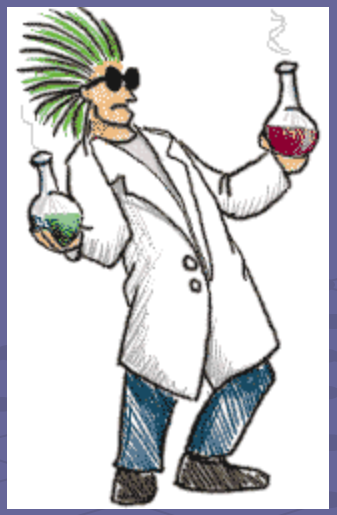


Properties of Matter

O’Connor/chapter 4

Physical Property vs Chemical Property

A property that describes the behavior of a substance without reference to any other substance

A property that describes the behavior of a substance when it reacts or combines with another substance.

Typical Physical Properties

Weight

Volume

Color

Boiling point

Melting point

Things that can be measured without altering the material's composition through a chemical reaction.

Typical Examples of Chemical Properties

When wood burns it chemically combines with oxygen in the air to create a new substance this transformation describes a chemical property of wood.

A color transformation of heroin exposed to a chemical called Marquis reagent is to turn purple, it allows for a simple test to confirm if a substance is heroin in a laboratory setting.

How are properties used in a lab?

- Which properties forensic scientists choose to observe & measure depends on the type of material that is being examined.
- If a property can be assigned a numerical value, it must relate to a standard system of measurement (metric) that is accepted throughout the scientific community.

Metric System (SI)

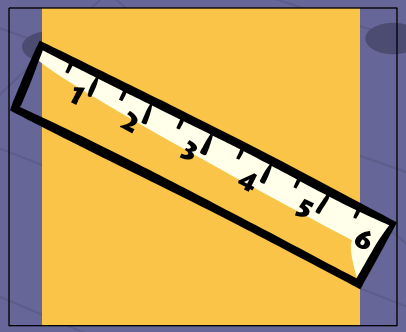
Devised in 1791 by the French Academy of Science.

Uses a simple decimal relationship so that a unit of length, volume, or mass can be converted into a subunit by simply multiplying or dividing by a multiple of 10.

At times, it may be necessary to convert units from the metric system into the English system, or vice versa.

Basic Conversions

- 1 inch=2.54 centimeters
- 1 meter=39.37 inches
- 1 pound =453.6 grams
- 1 liter=1.06 quarts
- 1 kilogram=2.2 pounds



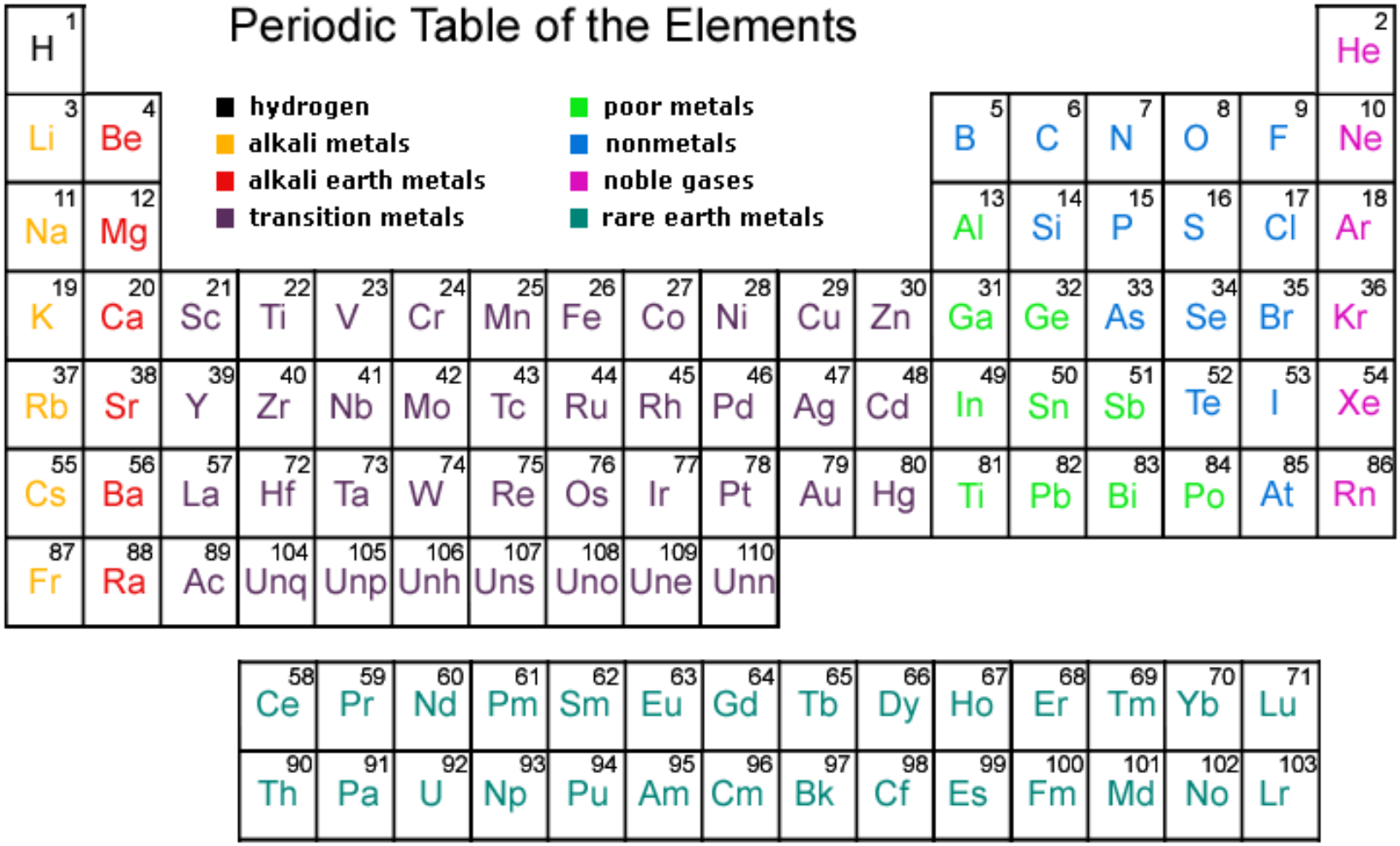
The Nature of Matter

- Matter is anything that has mass & occupies space.
- Atomic Theory and the discovery of matter's simplest identity the element lets us understand the composition of all matter.

Element

- Is a fundamental particle of matter that cannot be broken down into a simpler substances by chemical means.
- Elements provide the building blocks from which all matter is composed. At present, 118 elements have been identified, 89 occur naturally on Earth and the rest are created in a lab.

Periodic Table



Compound

- A pure substance composed of two or more elements.
- When two or more elements are combined. example Carbon Dioxide
- Since there are 89 natural elements, there are huge possibilities for combinations. More than 16 million known compounds have already been identified.

Compound cont.

- An atom is the basic unit of an element, the molecule is the smallest unit of a compound.
- A molecule of NaCl (table salt) represents the combination of one atom of the element sodium (Na) with one atom of the element chlorine (Cl).

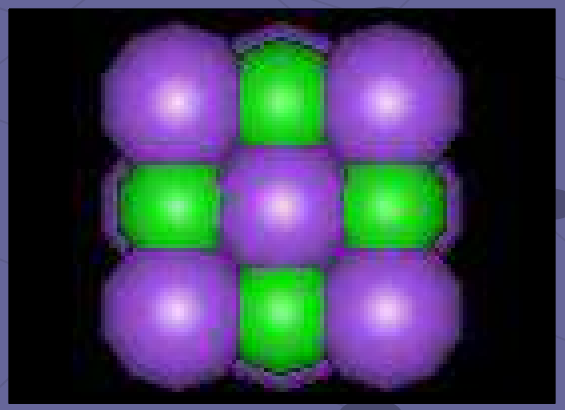
States of Matter

Organizing what we find on Earth is complicated so we classify it by the physical form it takes.

Physical States- solid, liquid, & gas (vapor)

Solid State

- Molecules in matter are held closely together by strong attractive forces. This molecular arrangement makes solid matter rigid and gives it a definite shape and volume.



Liquid State

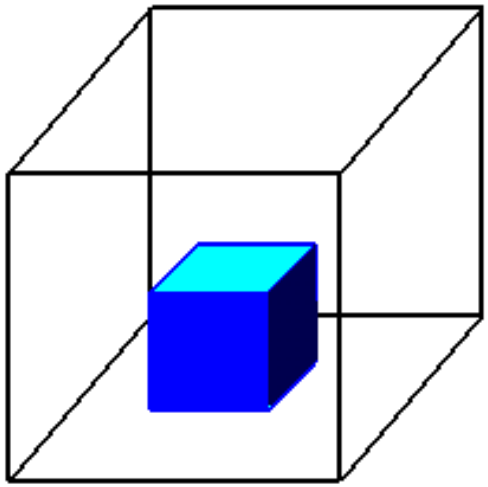
- The attractive forces between molecules are weaker.
- The molecules are in contact with one another, but are not held as rigidly in place.
- A liquid occupies a specific volume, but its fluidity causes it to take the shape of the container in which it resides.

Gas

- Attractive molecules are much weaker, allowing them to move freely.
- Gaseous matter has neither a definite shape nor volume, and it will completely fill any container into which it is placed.

States of Matter

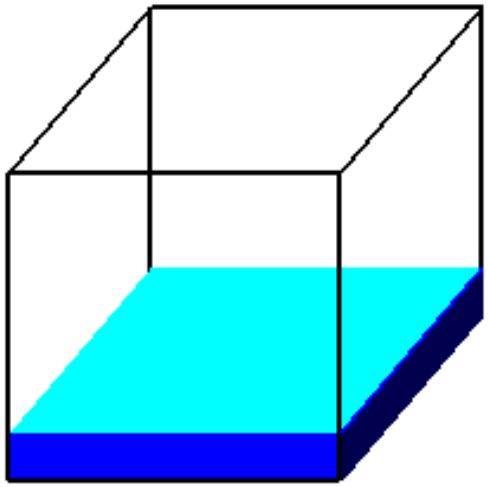
Glenn Research Center



Solid

Holds Shape

Fixed Volume

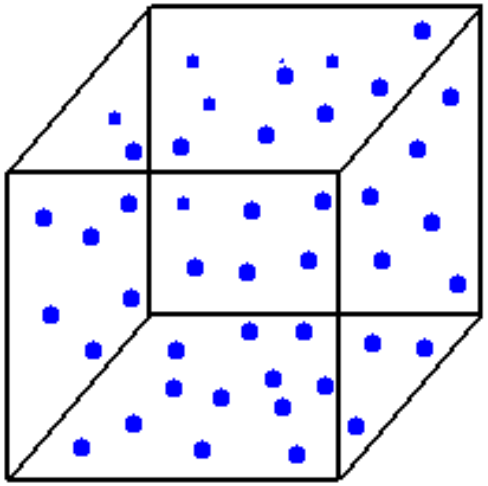


Liquid

Shape of Container

Free Surface

Fixed Volume



Gas

Shape of Container

Volume of Container

Changes of State

Substances can change form one state to another.

Example:

Water is heated to 100 °C, water boils and rapidly changes into steam. At 0 °C, water solidifies or freezes into ice. Under some conditions a solid can go directly to a gaseous state. We call this sublimation~ steam off snow.

No new chemical species was formed; matter simply changed state.

http://www.harcourtschool.com/activity/states_of_matter/

Phases

Whenever substances can be distinguished by a visible boundary, different phases are said to exist.

- Oil floating on water is an example of a two-phase system. The oil & water each constitute a separate liquid phase, clearly distinct from each other.
- Forensic Scientists use the existence of different phases to identify & classify evidence found at a crime scene.