

# Classification of Matter

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## Matter

Stuff of which all materials are made: anything that has mass and takes up space.



# Define

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**Atoms- Extremely small building blocks of matter**

- All matter is composed of atoms
- Atoms cannot be broken down into smaller pieces by chemical means
- The smallest distinct units in a sample of matter

**Elements are made up the same atoms.**

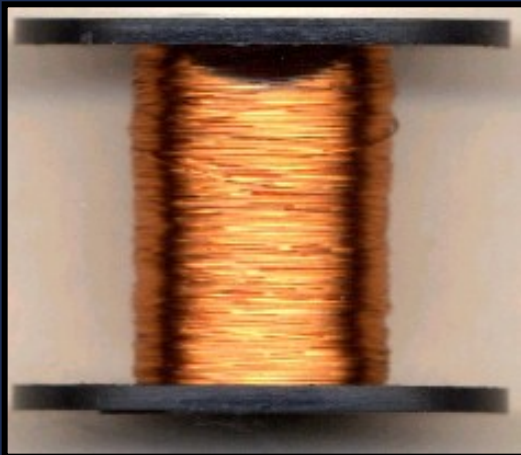
- Elements cannot be decomposed into other substances.

# B. Pure Substances

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## ✦ Element

- ◆ composed of identical atoms
- ◆ EX: copper wire, aluminum foil



# Define

- **Molecule** – a combination of 2 or more atoms (same or different) that are covalently bonded.
- A molecule is the smallest particle of a substance which exhibits the physical and chemical characteristics of the substance.
- **Diatomic molecules of elements :**  
 $H_2$   $O_2$   $Cl_2$   $N_2$   $F_2$   $Br_2$   $I_2$

# Define

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**Compounds a compound of 2 or more different elements bonded together in a fixed proportion.**



Molecules

# B. Pure Substances

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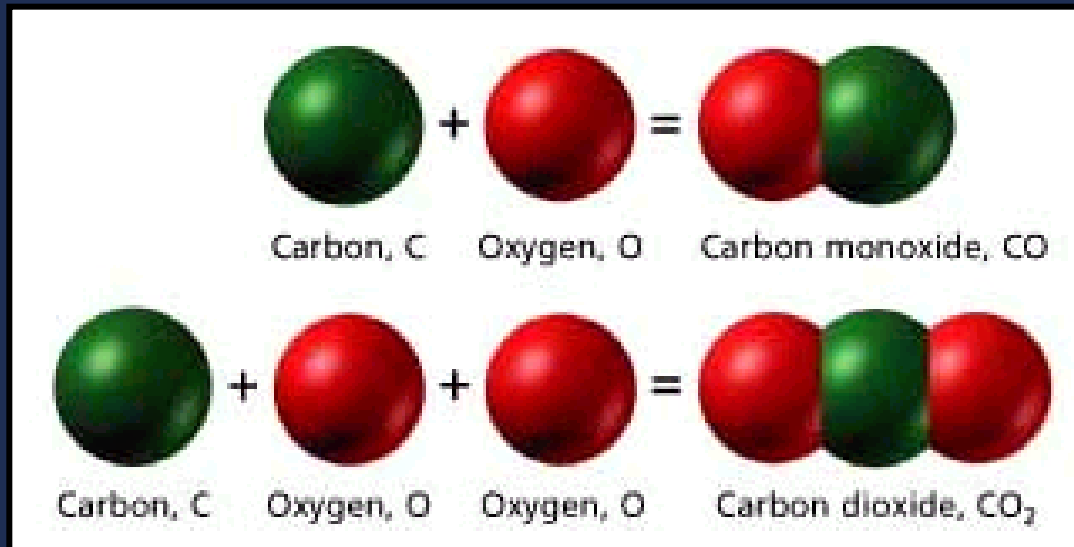
## ✦ Compound

- ◆ composed of 2 or more elements in a fixed ratio
- ◆ properties differ from those of individual elements
- ◆ EX: table salt ( $\text{NaCl}$ )



# B. Pure Substances

✦ For example...



Two different compounds,  
each has a definite composition.

# Compounds

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**Slight differences in combinations of atoms can have large difference in properties**

**$\text{H}_2\text{O}$ - water,**

**$\text{H}_2\text{O}_2$  – hydrogen peroxide**

**$\text{C}_2\text{H}_6\text{O}$  – ethanol, drinkable**

**$\text{C}_2\text{H}_6\text{O}_2$  – ethylene glycol, poisonous**



# Compounds

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## ✦ Law of Definite Composition

- ◆ A given compound always contains the same, fixed ratio of elements.

## ✦ Law of Multiple Proportions

- ◆ Elements can combine in different ratios to form different compounds.

# Pure Substances

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Same kind of particles throughout

**Compounds**

**Elements**

**Can be decomposed into simpler substances by chemical changes, always in a definite ratio**

**cannot be decomposed into simpler substances by chemical changes**

# Mixture

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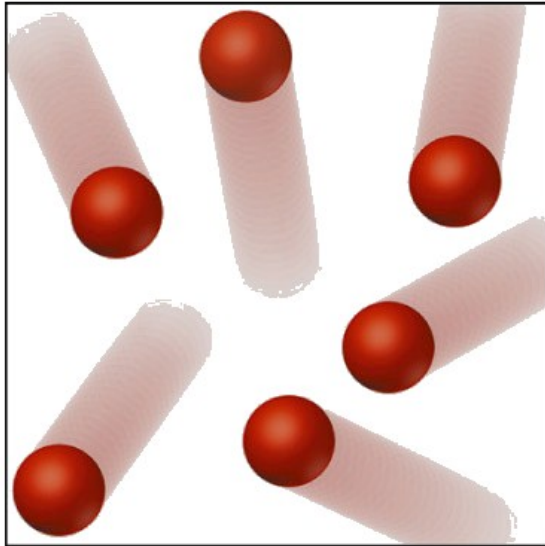
- ✦ **Mixtures are two or more substance that are not chemically combined.**
- ✦ **Mixtures do not have a fixed composition**
- ✦ **Mixtures do not have constant boiling points or melting points**
- ✦ **Variable composition**
- ✦ **Components retain their characteristic properties**

# Mixture

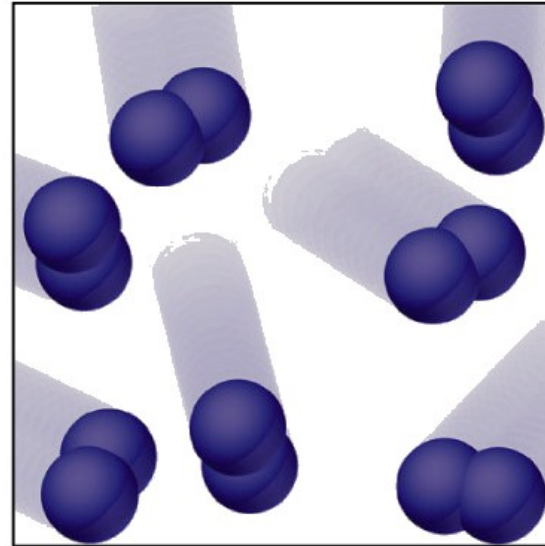
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- ✦ **May be separated into pure substances by physical methods**
- ✦ **Mixtures of different compositions may have widely different properties.**

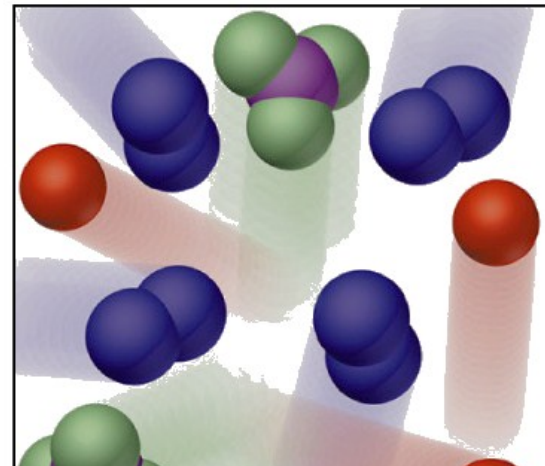
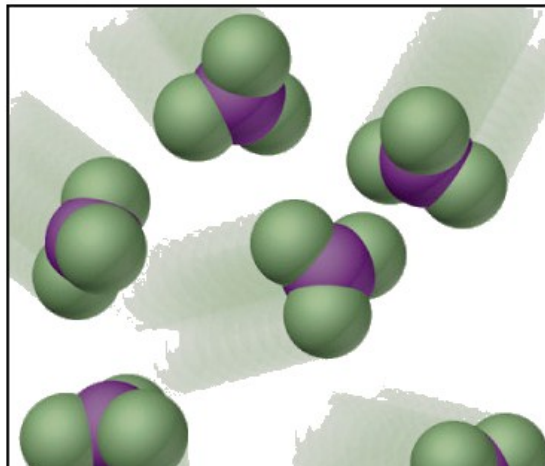
# ✦ Pure Substances and Mixtures



(a) Atoms of an element

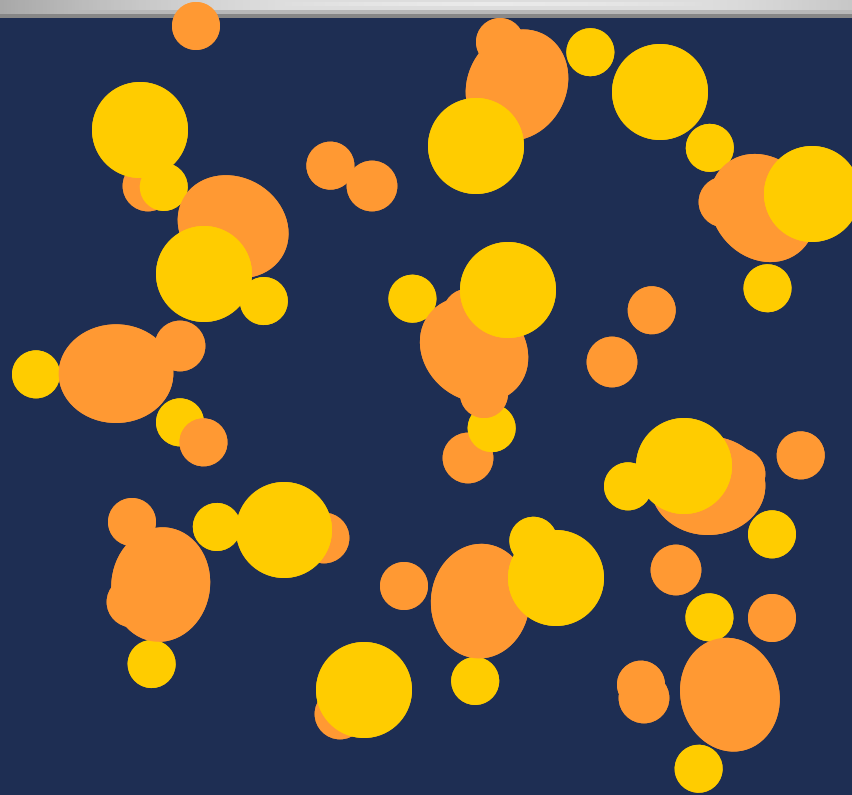


(b) Molecules of an element



# Which is it?

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Mixture  
Compound

# Physical Separation Techniques

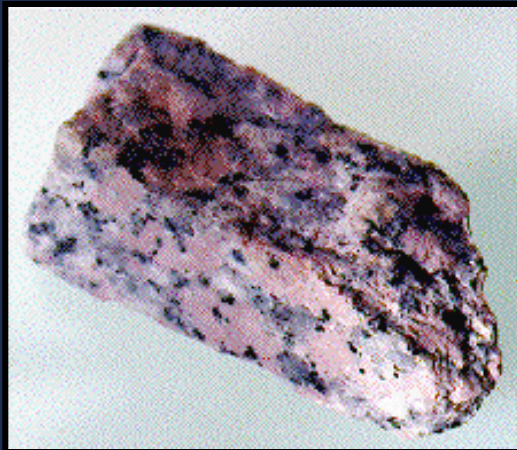
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- ✦ **By eye**
- ✦ **Filtration to separate solid and liquid**
- ✦ **Distillation to separate two or more liquids with different boiling points**
- ✦ **Chromatography to separate pure liquids or solutions of compounds**

# C. Mixtures

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- ✦ Variable combination of 2 or more pure substances.



Heterogeneous



Homogeneous



## Matter

```
graph TD; Matter[Matter] --> Mixture[Mixture]; Matter --> PureSubstance[Pure Substance];
```

### Mixture

1. Physical combination of two or more substances
2. Variable composition
3. Properties vary as composition varies
4. Components can be separated using physical means

### Pure Substance

1. Only one substance is present
2. Definite and constant composition
3. Properties are always the same under a given set of conditions

## Mixture

1. Physical combination of two or more substances
2. Variable composition
3. Properties vary as composition varies
4. Components can be separated using physical means

## Heterogeneous Mixture

1. Two or more visibly distinct phases
2. Each phase has different properties

## Homogeneous Mixture

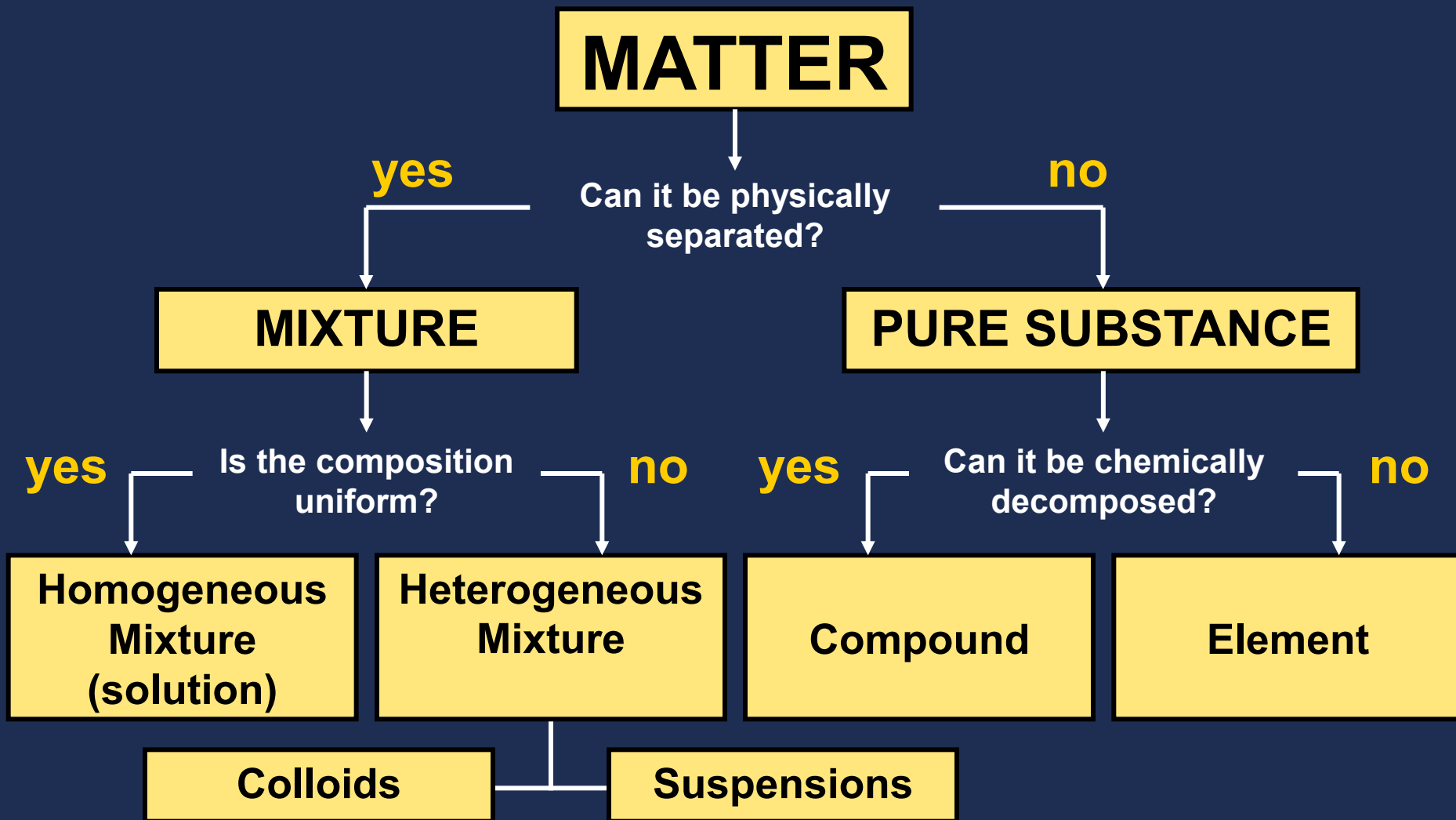
1. Only one visibly distinct phase
2. The phase has the same properties throughout

# Types of mixtures

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- ✦ Homogeneous mixture
  - 1 phase
  - uniform properties in a sample
  - same composition in a sample
  - eg: sugar and water
- ✦ Heterogeneous mixture
  - 2 or more phases (with same or different physical states)
  - each phase has different properties

# A. Matter Flowchart



# C. Mixtures

## ✦ Solution

- ◆ homogeneous
- ◆ very small particles
- ◆ no Tyndall effect
- ◆ particles don't settle
- ◆ EX: rubbing alcohol



Tyndall Effect



# C. Mixtures

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## ✦ Colloid

- ◆ heterogeneous
- ◆ medium-sized particles
- ◆ Tyndall effect
- ◆ particles don't settle
- ◆ EX: milk



# C. Mixtures

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## ✦ Suspension

- ◆ heterogeneous
- ◆ large particles
- ◆ Tyndall effect
- ◆ particles settle
- ◆ EX: fresh-squeezed lemonade



# C. Mixtures

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## ✦ Examples:

- |                          |            |
|--------------------------|------------|
| ◆ mayonnaise             | colloid    |
| ◆ muddy water            | suspension |
| ◆ fog                    | colloid    |
| ◆ saltwater              | solution   |
| ◆ Italian salad dressing | suspension |



# A. Matter Flowchart

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## ✦ Examples:

- |                   |                 |
|-------------------|-----------------|
| ◆ graphite        | element         |
| ◆ pepper          | hetero. mixture |
| ◆ sugar (sucrose) | compound        |
| ◆ paint           | hetero. mixture |
| ◆ soda            | solution        |

# Classifying Matter

Atoms

Molecules

make up

ALL MATTER

which exists as

Substances

Mixtures

which may be

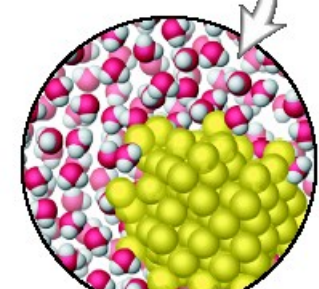
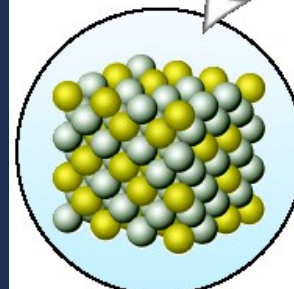
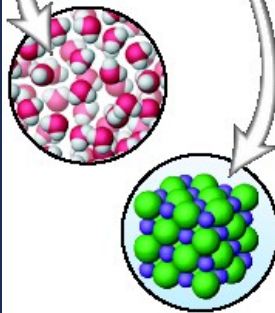
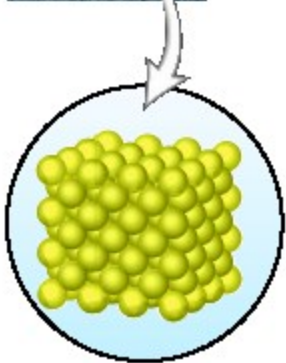
which may be

Elements

Compounds

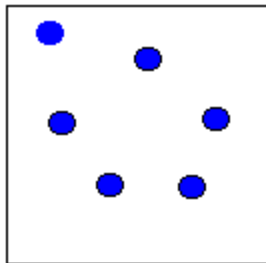
Homogeneous

Heterogeneous

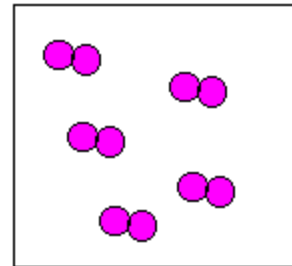


# The Atomic-Molecular Theory of Matter

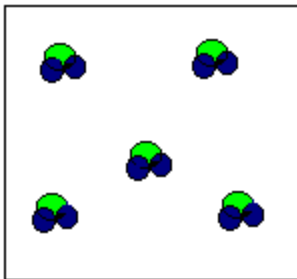
## A “microscopic” view



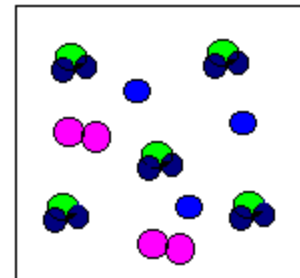
**Atoms of an element**



**Homonuclear diatomic molecules (elements)**



**Molecules of a compound**



**A mixture of elements & compounds**



