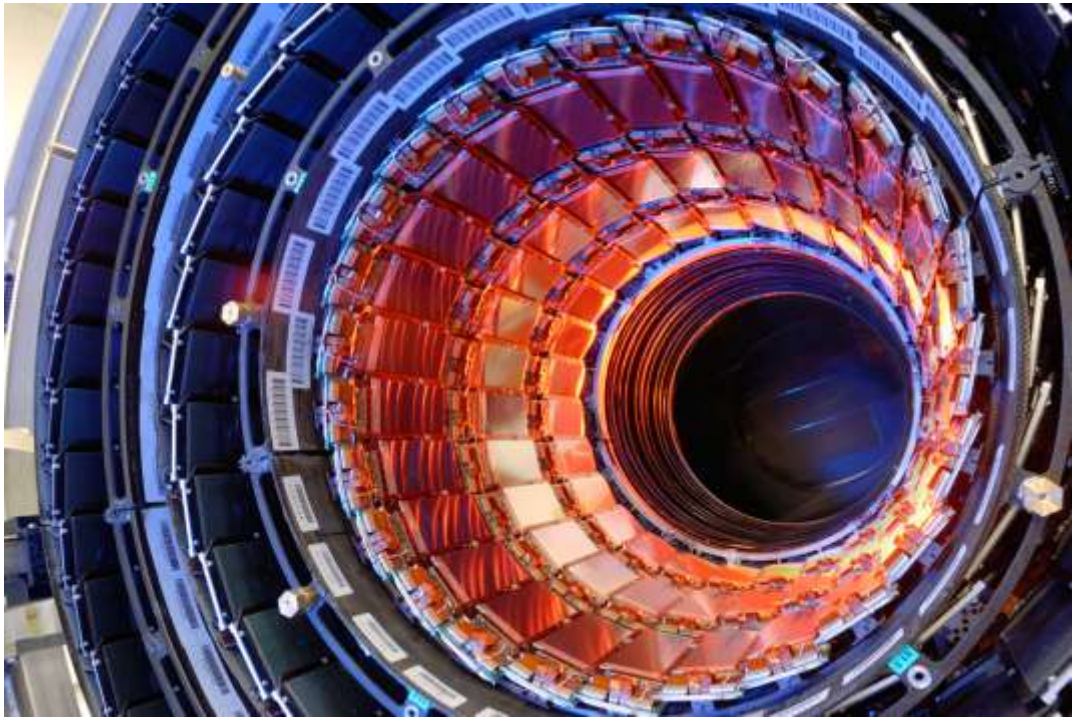
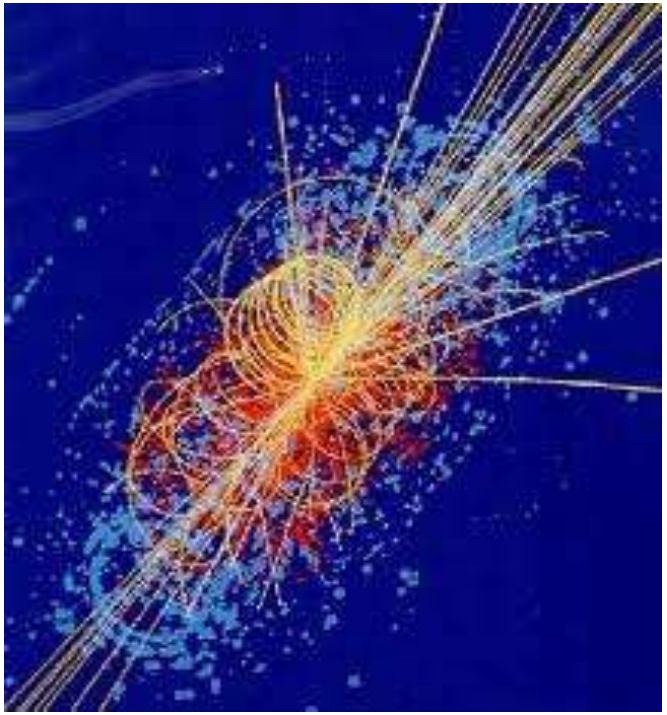
Pre-AP Chemistry

September 4, 2011

4. Composition of Matter





Sig Figs and Scientific Notation

Population of China: 1,344,060,000 people

Area of China: 9,640,821 km^2

- Calculate population density of China
- Express in 4 significant figures
- Express in scientific notation

Outline

- Components and Classification of Matter
- Physical vs Chemical
- Separation Techniques

- Components and Classification of Matter
  - Atoms and Molecules
  - Substances and Mixtures
  - Phases of Matter
- Physical vs Chemical
  - Properties
  - Change
- Separation Techniques

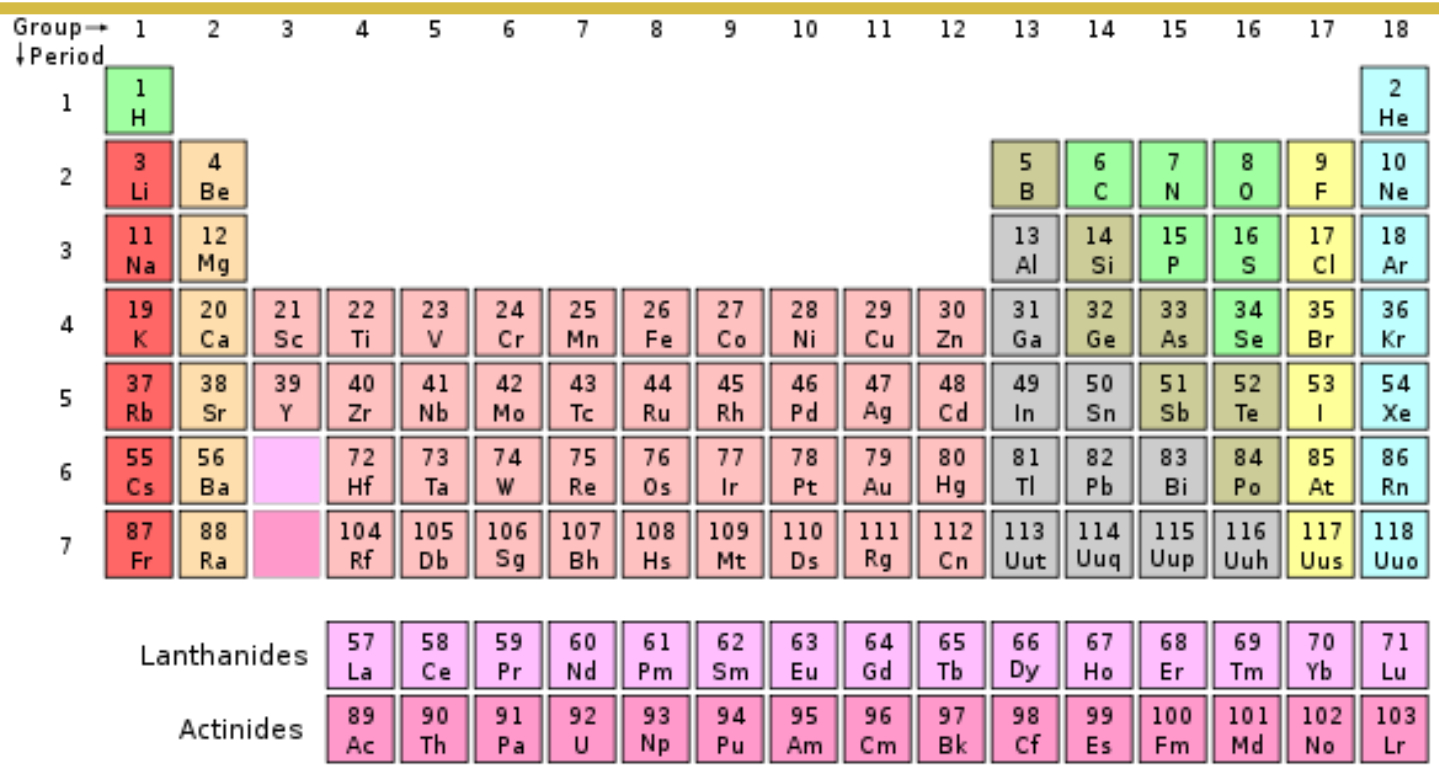
Outline

- Components and Classification of Matter
- Physical vs Chemical
- Separation Techniques

- Components and Classification of Matter
  - Atoms and Molecules
  - Substances and Mixtures
  - Phases of Matter
- Physical vs Chemical
  - Properties
  - Change
- Separation Techniques

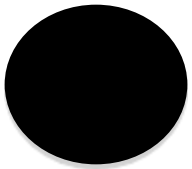
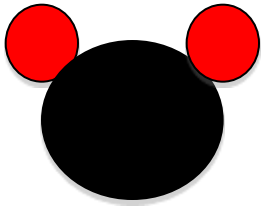
Atoms

- ‘Atom’ comes from the Greek ‘uncuttable’
- All matter is made of atoms
- There are only 118 known types of atoms

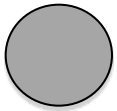


Molecules

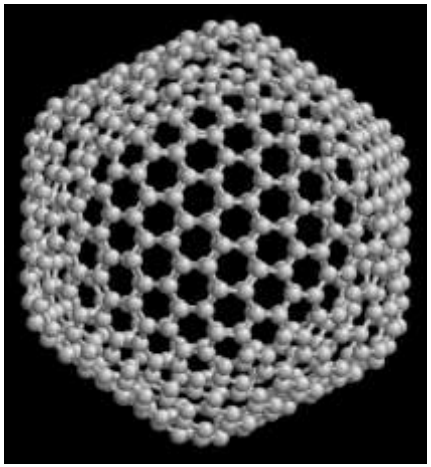
- Two or more atoms combine to form molecules

2 x  + 1 x  = 1 x 

Hydrogen Oxygen Water

540 x  =

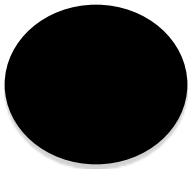
Carbon



Buckyball

Molecules

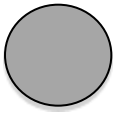
- Two or more atoms combine to form molecules

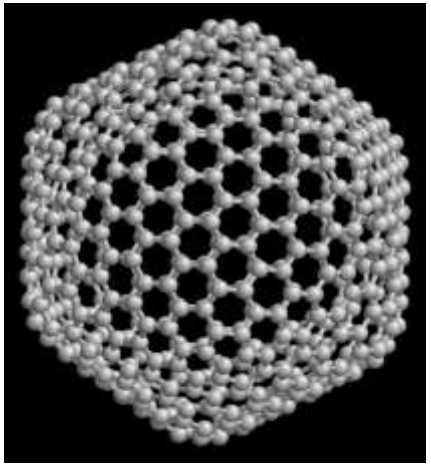
2 x  + 1 x  = 1 x 

Hydrogen

Oxygen

Mickey Mouse

540 x  =



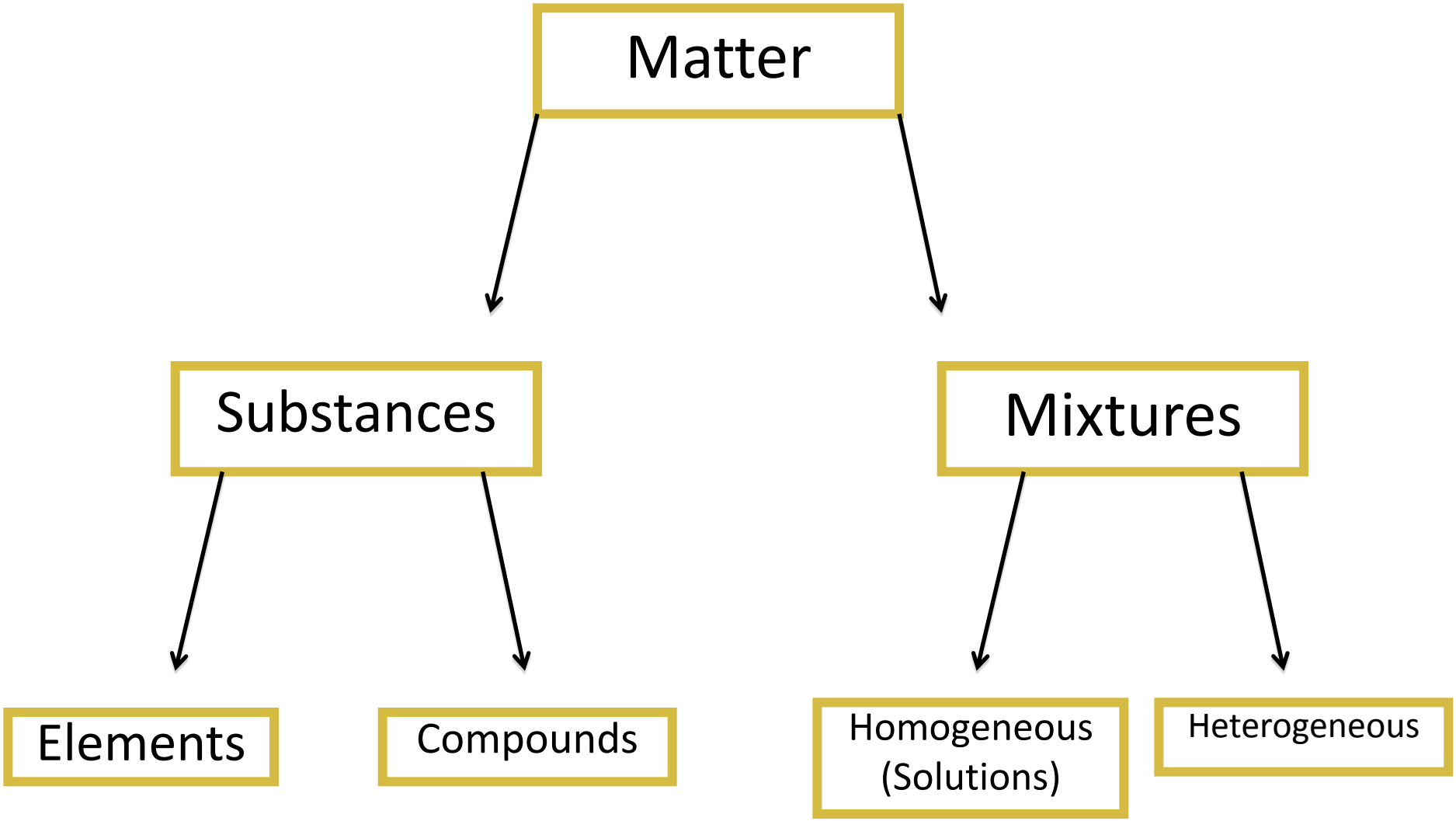
Carbon

Buckyball

Outline

- Components and Classification of Matter
- Physical vs Chemical
- Separation Techniques

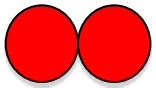
- Components and Classification of Matter
  - Atoms and Molecules
  - Substances and Mixtures
  - Phases of Matter
- Physical vs Chemical
  - Properties
  - Change
- Separation Techniques


Matter
Substances
Mixtures
Elements
Compounds
Homogeneous (Solutions)
Heterogeneous

Elements

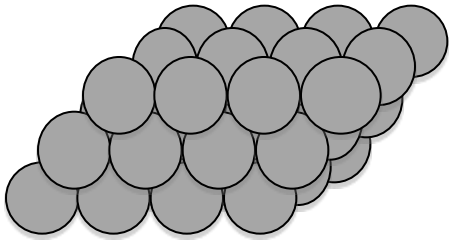
- Sample made of only one type of atom

Hydrogen atoms
(H)



Hydrogen molecule
(H_2)

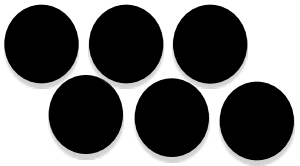
Iron atom
(Fe)



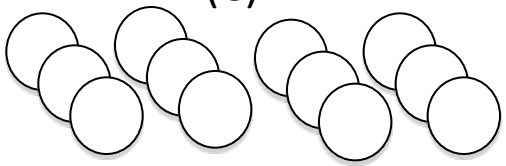
Iron crystal
(Fe)

Compounds

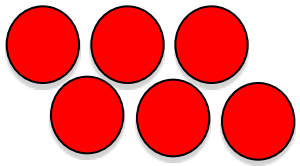
- Sample made of two or more elements in definite ratios
- **Molecule** = smallest unit of a compound with same ratio of elements



Carbon atoms (C)

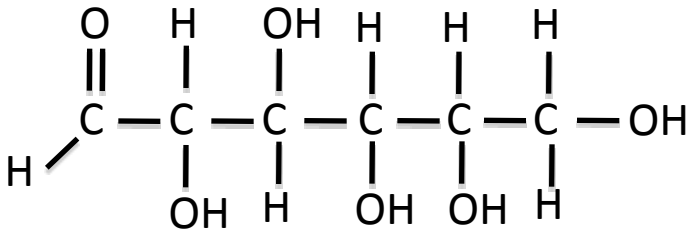


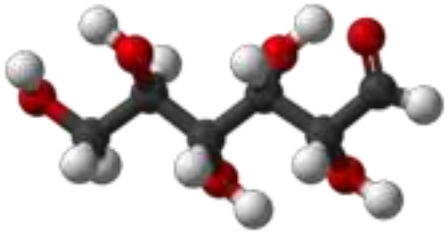
Hydrogen atoms (H)



Oxygen atoms (O)

$C_6H_{12}O_6$





Glucose (Sugar)

Mini Quiz

- Which of the substances below are elements? Which are compounds?

Mini Quiz

- Which of the substances below are elements? Which are compounds?

Al

$C_7H_6(NO_2)_3$

CH_3COOH

Au

Substances

- Uniform composition throughout sample
- Composition does not vary from sample to sample

Mixtures

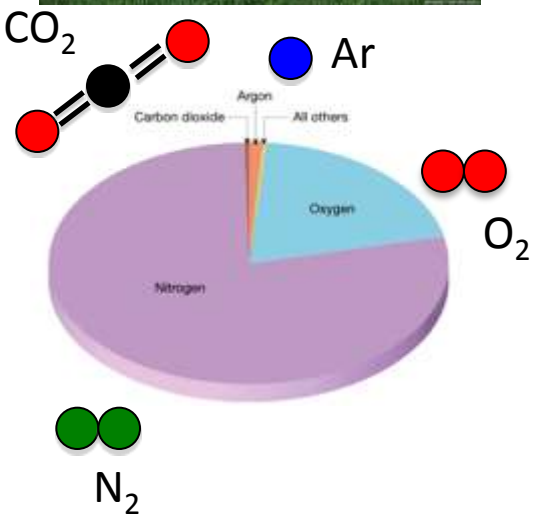
- Contains more than one element
- Composition **varies** from sample to sample

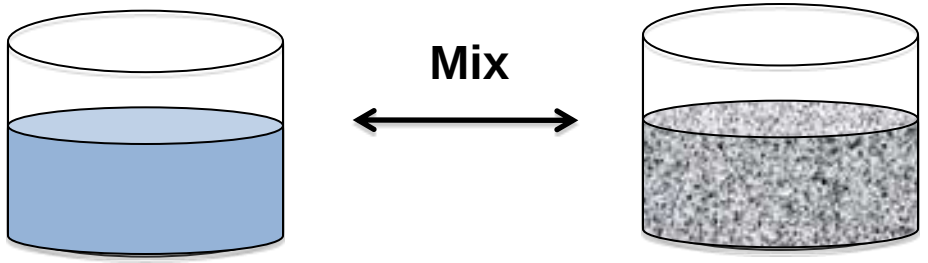
Homogeneous (Solutions)

Heterogeneous

Homogeneous (Solutions)

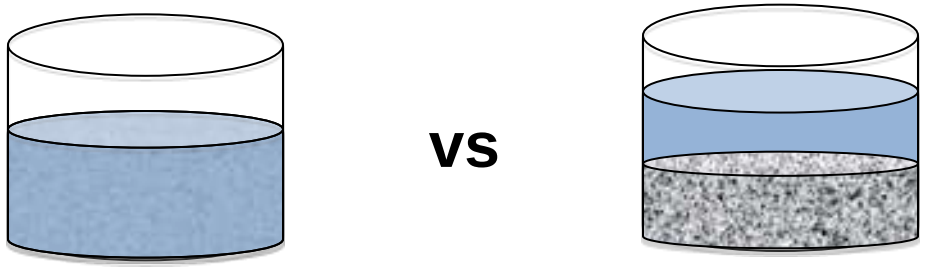
- Uniform throughout a given sample





- Solvent: majority component of solution

- Solute: minority component of solution



- Soluble: solute uniformly dissolved in solvent

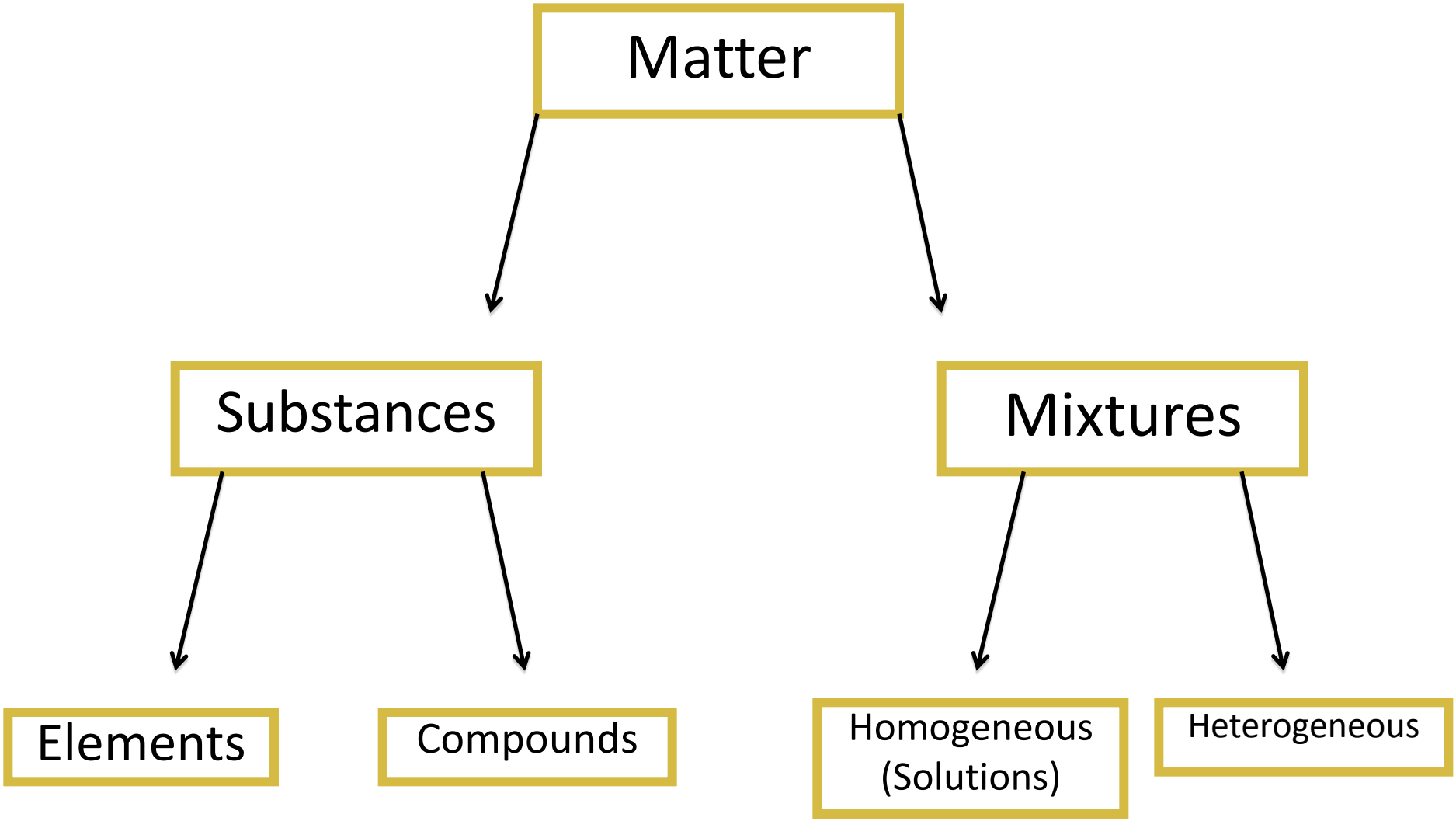
- Insoluble: solute **precipitates** out of solution

Heterogeneous

- Non-uniform in a given sample
- Components separate into different regions

Oil

Vinegar


Matter
Substances
Mixtures
Elements
Compounds
Homogeneous (Solutions)
Heterogeneous

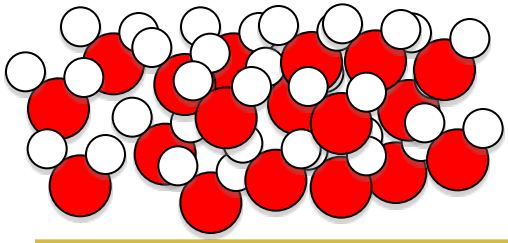
Outline

- Components and Classification of Matter
- Physical vs Chemical
- Separation Techniques

- Components and Classification of Matter
  - Atoms and Molecules
  - Substances and Mixtures
  - Phases of Matter
- Physical vs Chemical
  - Properties
  - Change
- Separation Techniques

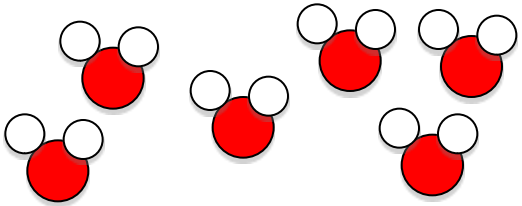
Phases of Matter

Solid



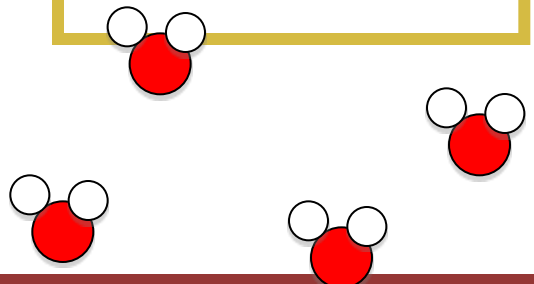
- Definite shape
- Molecules close together

Liquid



- Takes shape of container
- Molecules farther apart

Gas



- Fills container
- Molecules very far apart

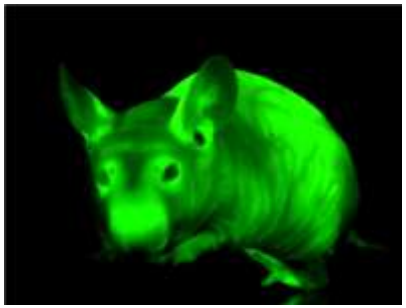
Outline

- Components and Classification of Matter
- Physical vs Chemical
- Separation Techniques

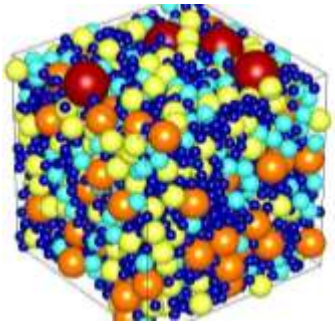
- Components and Classification of Matter
  - Atoms and Molecules
  - Substances and Mixtures
  - Phases of Matter
- Physical vs Chemical
  - Properties
  - Change
- Separation Techniques

Physical vs Chemical Properties

- Physical: Measurement of **physical properties** does not change the chemical composition of a substance



Color



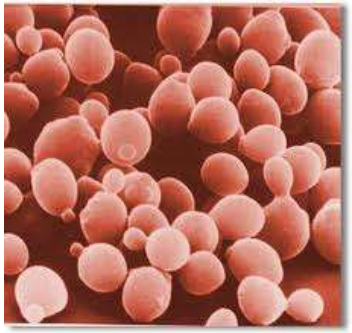
Density

Melting Point

- Chemical: Measurement of **chemical properties** requires chemical reaction

$Na + H_2O$

$C_6H_{12}O_6$



CO_2

H_3CCH_2OH

Outline

- Components and Classification of Matter
- Physical vs Chemical
- Separation Techniques

- Components and Classification of Matter
  - Atoms and Molecules
  - Substances and Mixtures
  - Phases of Matter
- Physical vs Chemical
  - Properties
  - Change
- Separation Techniques

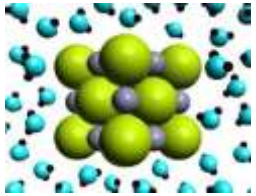
Physical vs Chemical Change

- After a **physical change**, a substance is the same chemically as before the change. No chemical reaction.



Phase Change

Separation

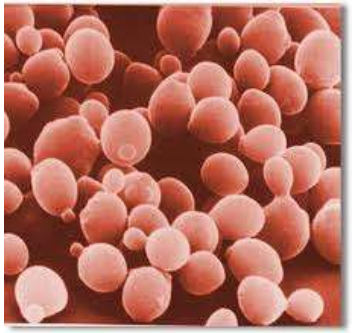



Dissolution

- After a **chemical change**, a chemical reaction causes the physical and chemical properties of a substance to change.

$$Na + H_2O$$

$$C_6H_{12}O_6 \rightarrow$$



$$CO_2 \rightleftharpoons H_3CCH_2OH$$

Mini Quiz

- Fill in the blanks:

Molecules are farthest apart in a _____ and closest in a _____.

- Consider a piece of white paper:

Coloring the paper is a _____ change.

Burning the paper is a _____ change.

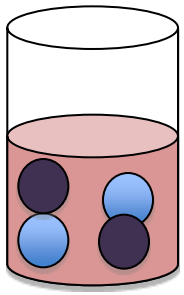
Outline

- Components and Classification of Matter
- Physical vs Chemical
- Separation Techniques

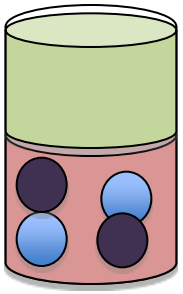
- Components and Classification of Matter
  - Atoms and Molecules
  - Substances and Mixtures
  - Phases of Matter
- Physical vs Chemical
  - Properties
  - Change
- Separation Techniques

Separation Techniques

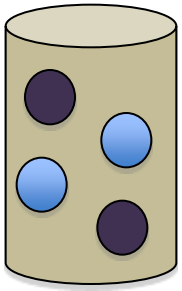
- **Extraction**: Using a solvent to selectively dissolve one component of a solid mixture. This separates soluble from insoluble solids.



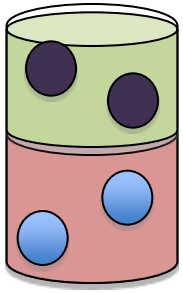
Mix solutes A and B in solvent 1



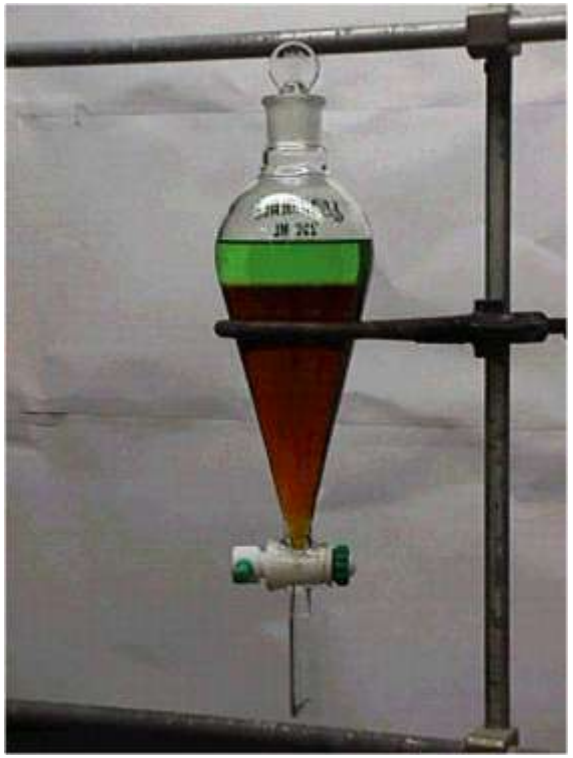
Add immiscible solvent 2 to mixture



Shake up mixture



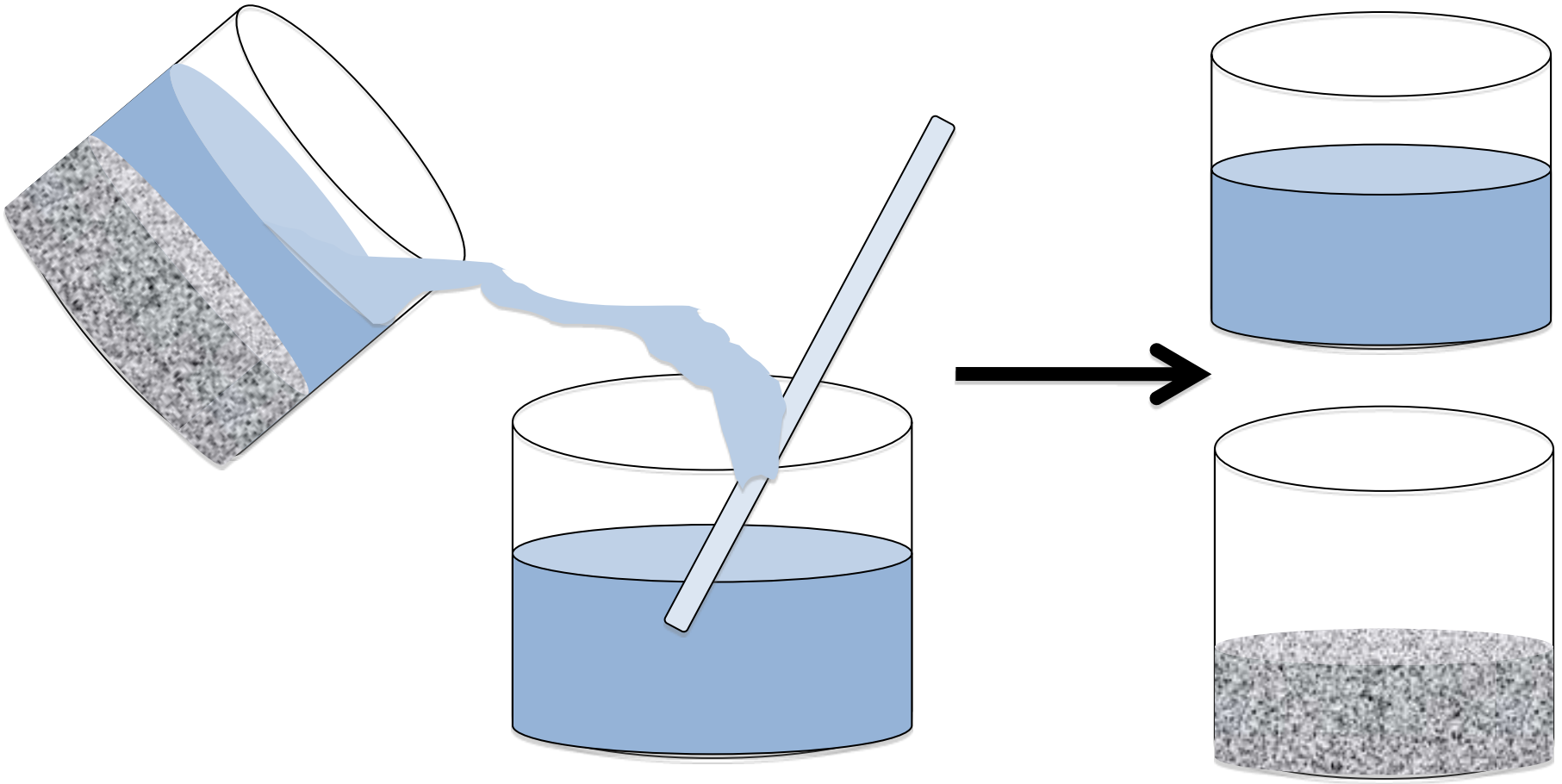
Solutes A and B separate based on solubility in solvents 1 and 2



Extract one phase from another with funnel.

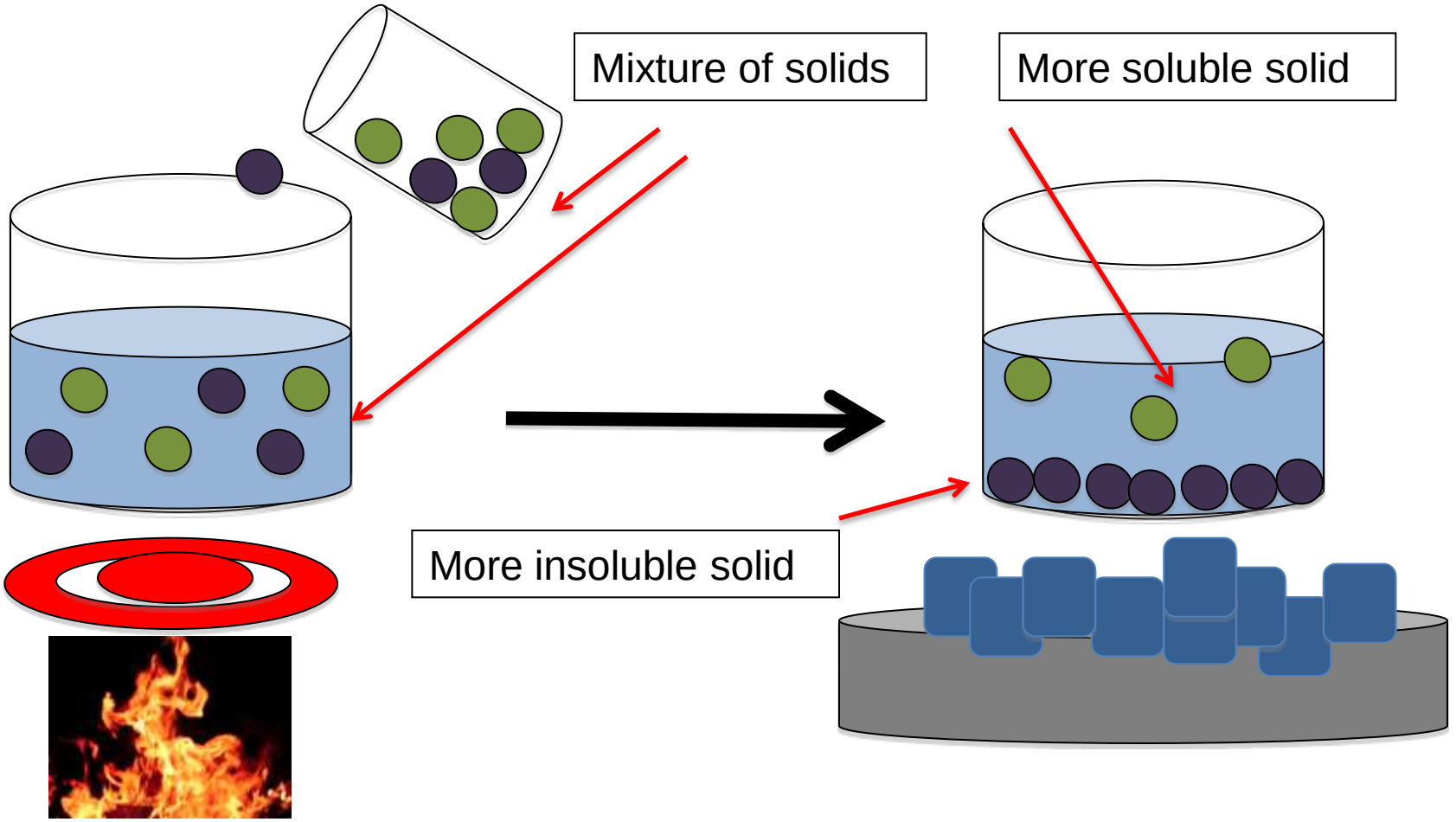
Separation Techniques

- **Decantation**: Separating a liquid from an insoluble solid by carefully pouring off the liquid.



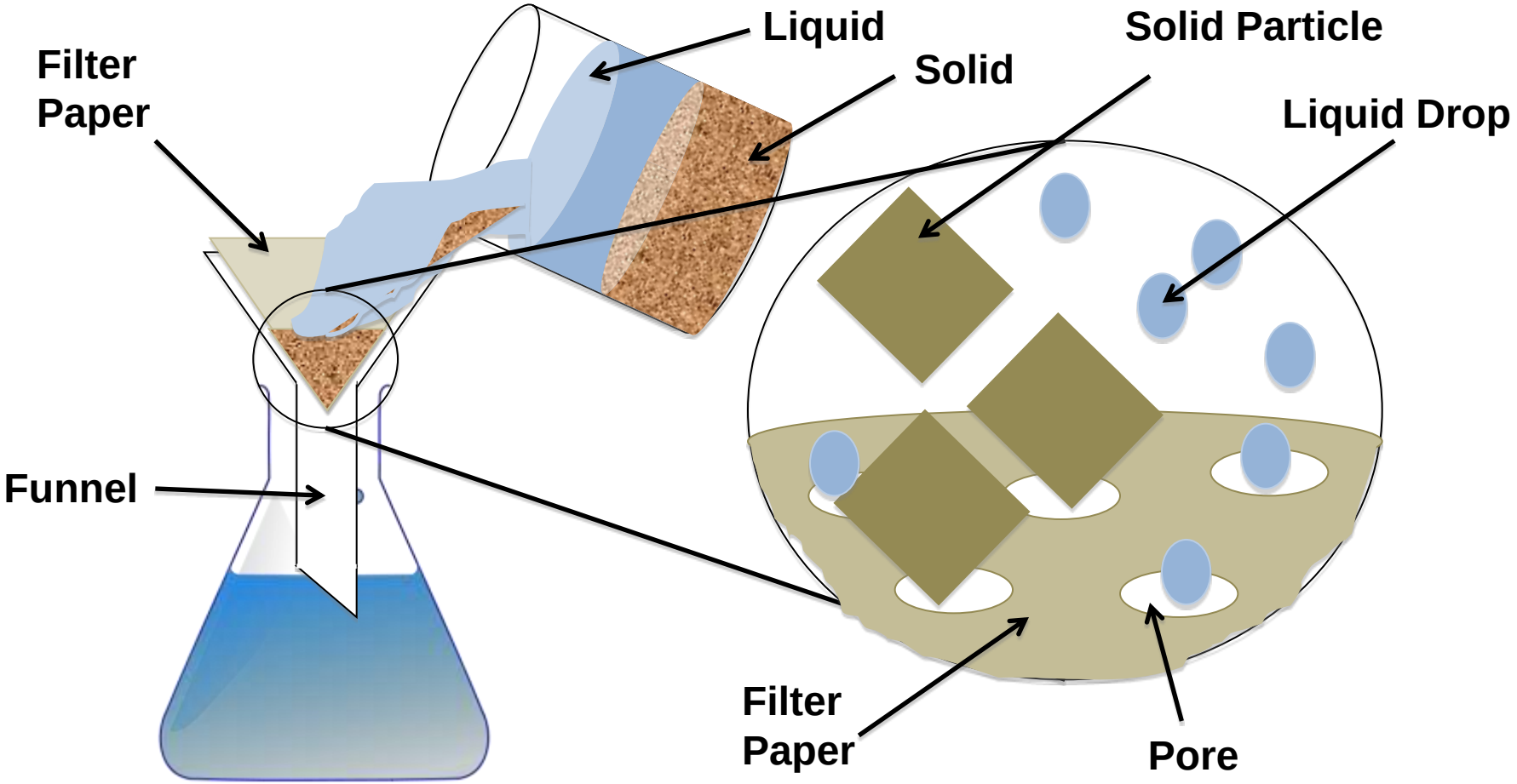
Separation Techniques

- **Recrystallization**: Dissolving a solid mixture in a hot solvent, then cooling to crystallize the more insoluble solid.



Separation Techniques

- **Filtration**: Separating a solid from a liquid using a porous filter. Pore size determines which materials are separated.



Summary

- Matter is made of atoms and molecules and can be classified as substance (element or compound) or mixture (homogeneous or heterogeneous)
- Physical properties and change do not require chemical reactions or change chemical composition, whereas chemical reactions do
- Separation techniques take advantage of different materials' different physical properties

Homework

- Review Ch. 2, Read Ch. 3
- pp. 51 – 55, # 65,69,87,89,91,143,157
- pp. 68 – 71, # 1,5,7,17,27,29,31,35
- Study for quiz (9/17)