

Ms. C

## Introduction to Chemistry



## Part I Chemistry and Technology



## Chemistry

The study of:

- the composition (make-up) of matter
- the changes that matter undergoes

## What is matter?

- Anything that:
  - has mass
  - and
  - occupies space (volume).

## Mass vs Weight

- **Mass:** measure of the amount of matter that an object contains. (SI unit kilogram, kg)
- **Weight:** measure of the pull of gravity on an object. (SI unit Newton, N)

## The 5 Branches of Chemistry

- Inorganic
- Organic
- Analytical
- Physical
- Biochemistry

## Inorganic Chemistry

- The study of chemicals that do not contain carbon.

## Organic Chemistry

- The study of chemicals that contain carbon.
- Origin: study of chemicals in living organisms.

## Organic or Inorganic ?

- |                     |                         |
|---------------------|-------------------------|
| ■ Sulfuric Acid     | $\text{H}_2\text{SO}_4$ |
| ■ Methane           | $\text{CH}_4$           |
| ■ Hydrochloric Acid | $\text{HCl}$            |
| ■ Ethane            | $\text{C}_2\text{H}_6$  |

## Analytical Chemistry

- Composition of matter



Ex:  
Mass Spectrometer  
Gas Chromatograph

<http://besg.group.shef.ac.uk/Facilities/Images/gcms.JPG>


## Physical Chemistry

- The study of :
  - The mechanism
  - The rate
  - The energy transferthat happens when matter undergoes change.

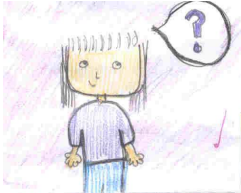
## Biochemistry

- Study of processes that take place in organisms.

## Science



- What?
- Why?
- How?
- When?




## Science and Technology

- Science → Pure
  - Does not necessarily have an application
- Technology → Applied
  - Has practical applications in society
  - Engineering

## Question: Science or Technology?

Studying or forming aspirin in a lab in small scale (small amounts).

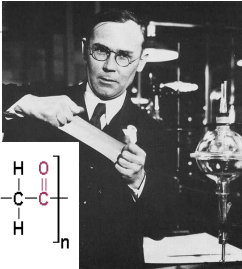


## Question: Science or Technology?

- Producing aspirin tablets so that consumers can use them.



## Example: Discovery of Nylon by Wallace Carothers in 1930's



$$\left[ \begin{array}{cccccccccccc} \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{O} & \text{H} & \text{H} & \text{H} & \text{H} & \text{O} \\ | & | & | & | & | & | & || & | & | & | & | & || \\ -\text{N} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{N} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C}- \\ | & | & | & | & | & | & | & | & | & | & | & | \\ \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \end{array} \right]_n$$

the repeat unit of nylon 6-6

<http://www.chemheritage.org/EducationalServices/nylon/nylon.html>

[http://heritage.dupont.com/touchpoints/tp\\_1935-2/depth.shtml](http://heritage.dupont.com/touchpoints/tp_1935-2/depth.shtml)

## Microscopic- Macroscopic

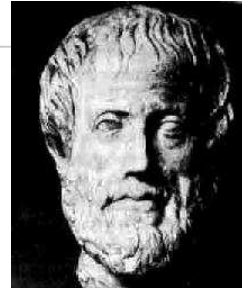
- Micro –(small)
  - Microscopic- objects can be seen with a microscope.
- Macro-(from afar)
  - Macroscopic- objects are seen without a microscope.

## Part II – A Brief History and the Scientific Method

### Aristotle (Greece, 4<sup>th</sup> Century BC)

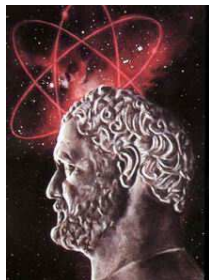
Philosopher who believed that:

- There are 4 elements: earth, water, air, fire
- Matter is perpetually divisible



### Democritus (Greece, 4<sup>th</sup> Century BC)

- First atomic theory
- Atom (indivisible)



### Alchemists (~300BC-1650 AD) China, India, Arabia, Europe, Egypt



- Aiming to:
  - Change common metals to gold
  - Develop medicines
- Developed lab equipment
- Mystical

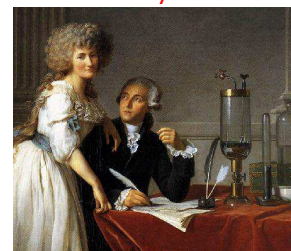
### Galileo Galilei (Italy 1564 AD)

- Father of the **scientific method** (along with the Englishman Francis Bacon 1500's).



### Antoine Lavoisier (France 1743-1794)

- Regarded as the **Father of Chemistry**
- Designed equipment
- Used **observations** and **measurements**
- Discovered nitrogen



## Antoine Lavoisier (cont'd)

- Discovered the Law of Conservation of Mass:
  - In a chemical reaction mass is conserved

## Antoine Lavoisier (cont'd)

- Explained burning as reaction with oxygen
- Old theory: release of "phlogiston".

## Question:

- Does an iron nail gain mass or lose mass when it rusts (a form of burning)?



## John Dalton (England 1766-1844)

- Atomic theory - matter is composed of discrete units called atoms

## Amedeo Avogadro (Italy, 1776-1856)

- Avogadro's Number  $6.02 \times 10^{23}$
- One mole of any substance contains  $6.02 \times 10^{23}$  particles

## Dmitri Mendeléeiev (Russia, 1834-1907)

- First Periodic Table of elements

## The Scientific Method

- Steps followed during scientific investigations

## Scientific Method

- **Observation**- recognition of a problem.
- **Hypothesis**- a proposed explanation of an observation
  - an educated guess
  - must be testable.
- **Experiment**- a procedure used to test a hypothesis (measurement, data collection, manipulated and responding variables)
- **Theory**
- **Law**

## Note:

- The order of the steps can vary and additional steps may be added.

## Theory

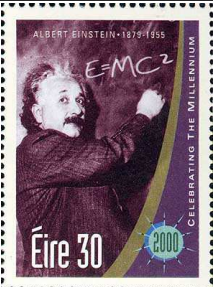
- A well tested **explanation** for a broad set of observations
- May use **models**
- May allow **predictions**
- Theories may change to explain new observations

## Law

- A statement that **summarizes** results of observations, but does not explain them.
- Changes or is abandoned when contradicted by new experiments.

## "No number of experiments can prove me right; a single experiment can prove me wrong."

*Albert Einstein*



## Part III Math and Chemistry

- Math- the language of Science

## Units

- SI Units – International System
  - Basic Units

		<u>mks</u>
Length	(meter)	m
Mass	(kilogram)	kg
Time	(second)	s
  - National Bureau of Standards

## Solving Word Problems

- Analyze
  - List knowns and unknowns.
  - Devise a plan.
  - Write the math equation to be used.
- Calculate
  - If needed, rearrange the equation to solve for the unknown.
  - Substitute the knowns with units in the equation and express the answer with units.
- Evaluate
  - Is the answer reasonable?