

Tishk International University
Faculty of Applied Science
Department of Nutrition & Dietetics
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Course Name: General Chemistry /NUT 106

Lecture 1:
Introduction to General Chemistry

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Objectives

The top of the slide features a dark green background on the left with the word 'Objectives' in white. On the right, there is a photograph of several glass test tubes, some containing a yellowish liquid, set against a light background.

- What is Chemistry?
- Experimentation in Chemistry
- Matter
- Elements & Compounds
- Measurements and Units

What is Chemistry?

- Chemistry - descriptive and quantitative study of the properties of matter
 - composition and structure
 - physical and chemical properties
 - transformations (changes in any of the above or energy)
- Chemistry is typically involved in making new materials for society, measuring the amount of matter in something, or determining the physical/chemical properties of matter



Cont.

- Everything around us is made up of chemicals. From the color that makes a rose so red to the gasoline that fills our cars and the silicon chips that power our computers and cell phones.
- Chemistry is everywhere! Understanding how chemical molecules form and interact to create complex structures enables us to harness the power of chemistry and use it, just like a toolbox, to create many of the modern advances that we see today.

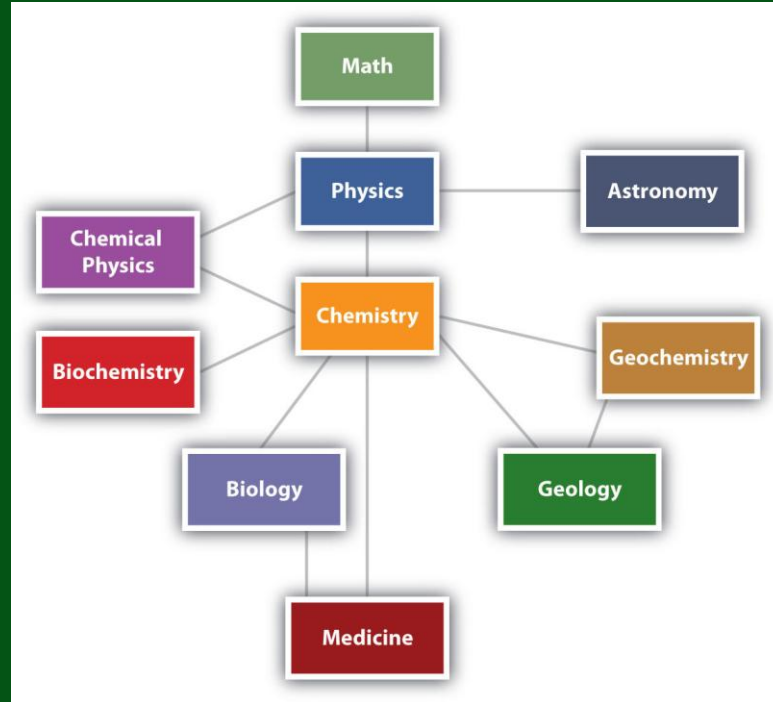


This includes advances in:

- medicine,
- communication,
- transportation,
- building infrastructure,
- food science and agriculture,
- and nearly every other technical field that you can imagine.



The Relationships Between Some of the Major Branches of Science. Chemistry lies more or less in the middle, which emphasizes its importance to many branches of science.



Experimentation in Chemistry

Chemistry is an Experimental Science

- **The Experiment** – observation of natural phenomena under controlled conditions such that the results can be duplicated and conclusions made
- **Law** – statement or equation describing the regularity of a fundamental occurrence in nature
- **Hypothesis** – statement of fact governing an observed natural processes testable through experimentation
- **Theory (Model)** – repeatedly tested and observed relationships in nature involving natural phenomena



Scientific Method

A photograph of several glass test tubes and beakers, some containing a yellow liquid, set against a white background. The image is partially obscured by a dark green banner at the top of the slide.

- ✓ Statement of the problem: statement based on observations.
 H_0 : The atmosphere is warming from fossil fuel emissions
- ✓ Design Experiments to test the hypothesis (H_0)
- ✓ How can the temperature of the troposphere be measured accurately?
- ✓ What is the role of the control? Baseline?
- ✓ Collect data from an experiment.
- ✓ Analyze data statistically (relative to control).
- ✓ Accept or reject the hypothesis.
- ✓ Provide a conclusion.

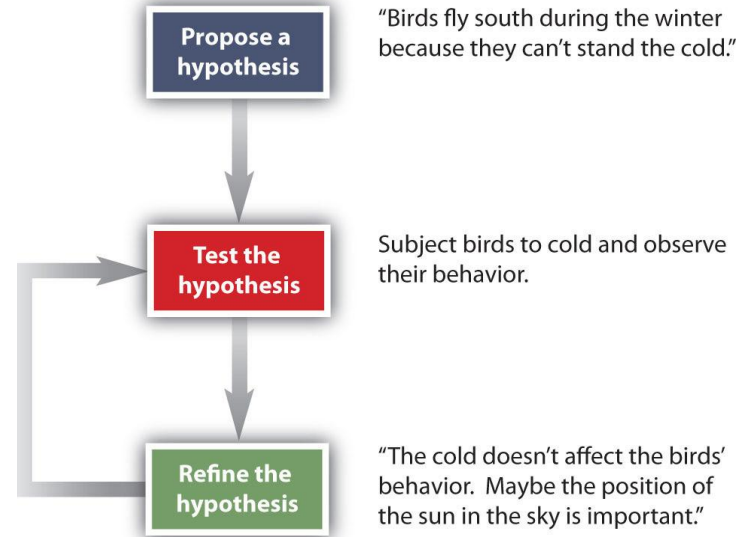
How Scientists Study Chemistry



How do scientists work?

Generally, they follow a process called the scientific method.

The scientific method is an organized procedure for learning answers to questions. To find the answer to a question (for example, “Why do birds fly toward Earth’s equator during the cold months?”), A scientist goes through the following steps, which are also illustrated.



Scientific Method

A photograph of laboratory glassware, including test tubes and beakers, some containing a green liquid. The image is partially obscured by a dark green background on the left side of the slide.

The General Steps of the Scientific Method. The steps may not be as clear-cut in real life as described here, but most scientific work follows this general outline.

1. Propose a hypothesis

2. Test the hypothesis

3. Refine the hypothesis if necessary.

Not all scientific investigations are simple enough to be separated into these three discrete steps. But these steps represent the general method by which scientists learn about our natural universe.

Matter: Physical and Chemical Make-Up



Matter - Anything that has mass and occupies space

Mass = quantity of matter

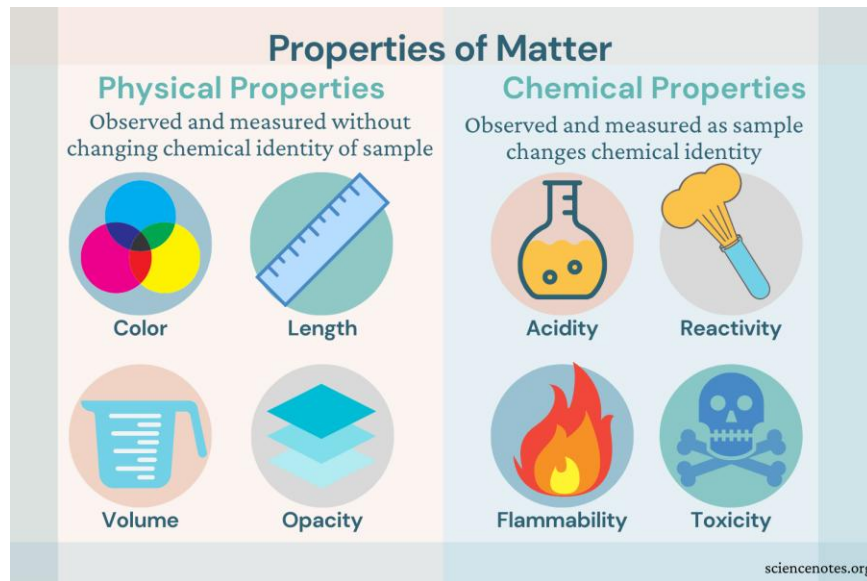
Space = volume of matter

Physical Forms Of Matter

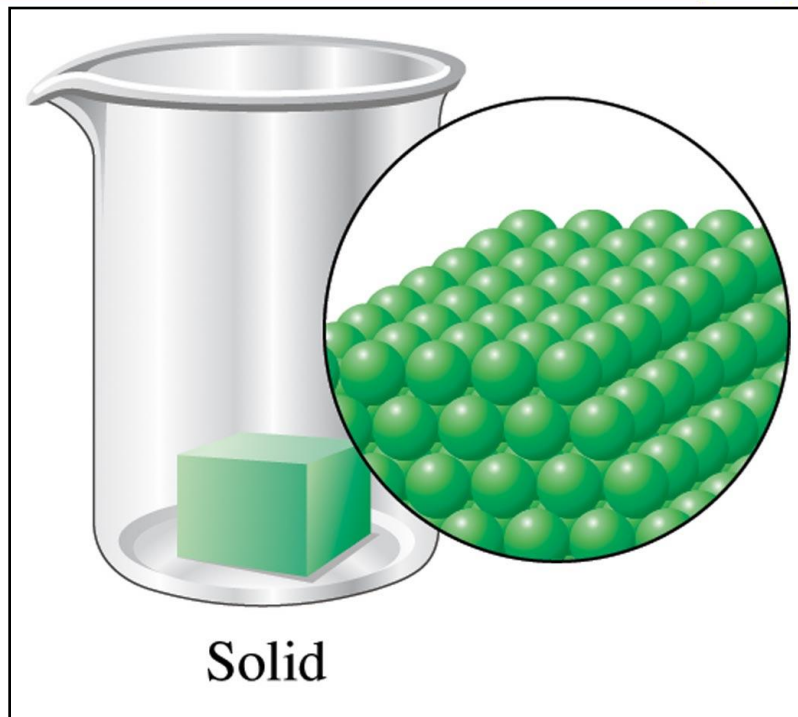
Solid- Matter with fixed shape and volume; generally incompressible

Liquid- Matter with fixed volume and shape according to container; generally, incompressible

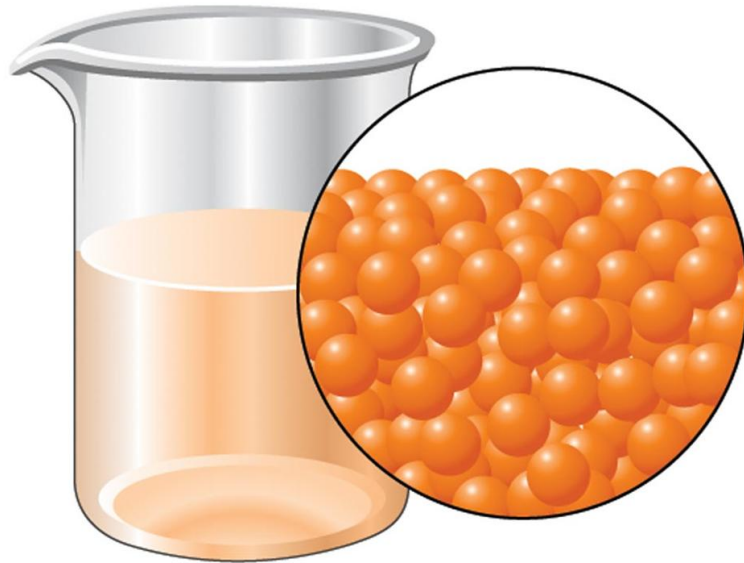
Gas- Matter that conforms to the shape and volume of its container; compressible



Molecular Representation of A Solid

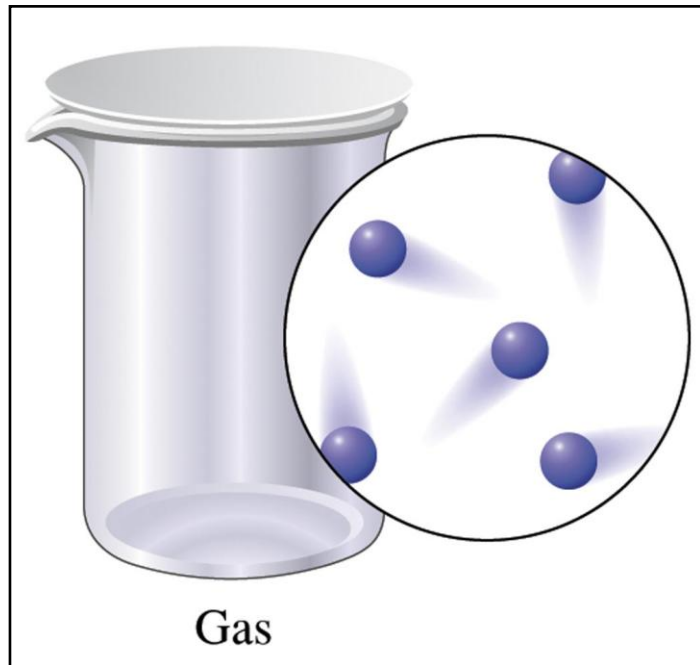


Molecular Representation of A Liquid



Liquid

Molecular Representation of A Gas



Physical & Chemical Properties



Physical Change— a change in which the form of matter does not change identity.

Physical Property— an observed characteristic whereby the chemical form remains intact (e.g., mp, bp, density, color, refractive index).

Chemical Change— change in which matter changes from one form to another or other forms through a chemical reaction.

Chemical Property- Any of a material's properties that becomes evident during a chemical reaction; that is, any quality that can be established only by changing a substance's chemical identity.

Law of Conservation of Mass

- Modern chemistry emerged in 18th century upon the advent of the analytical balance; provide accurate mass measurements
- Antoine Lavoisier - French chemist who used balance measurements to show weighing substances before and after change that mass is conservative
- Law of conservation of mass - total mass remains constant during a chemical change



Elements and Compounds

A photograph of several glass test tubes and beakers containing a blue liquid, set against a white background. The glassware is arranged in a cluster, with some tubes in the foreground and others slightly behind.

Substance – a type of matter that cannot be further separated by physical processes.

Element – substance that cannot be decomposed into simpler substances.

Compound – a substance formed when two or more elements are combined.

✓ Compounds obey the *Law of Definite Proportions*

A pure compound contains **constant proportions of elements by mass.**

Mixtures



Mixture –material that can be separated into two or more substances.

Heterogeneous mixture – a mixture that is divided among parts with distinctly different physical properties.

Phase – part of a mixture with uniform properties.

Homogeneous mixture – a mixture with no visible boundaries and uniform physical properties throughout.

Cont.



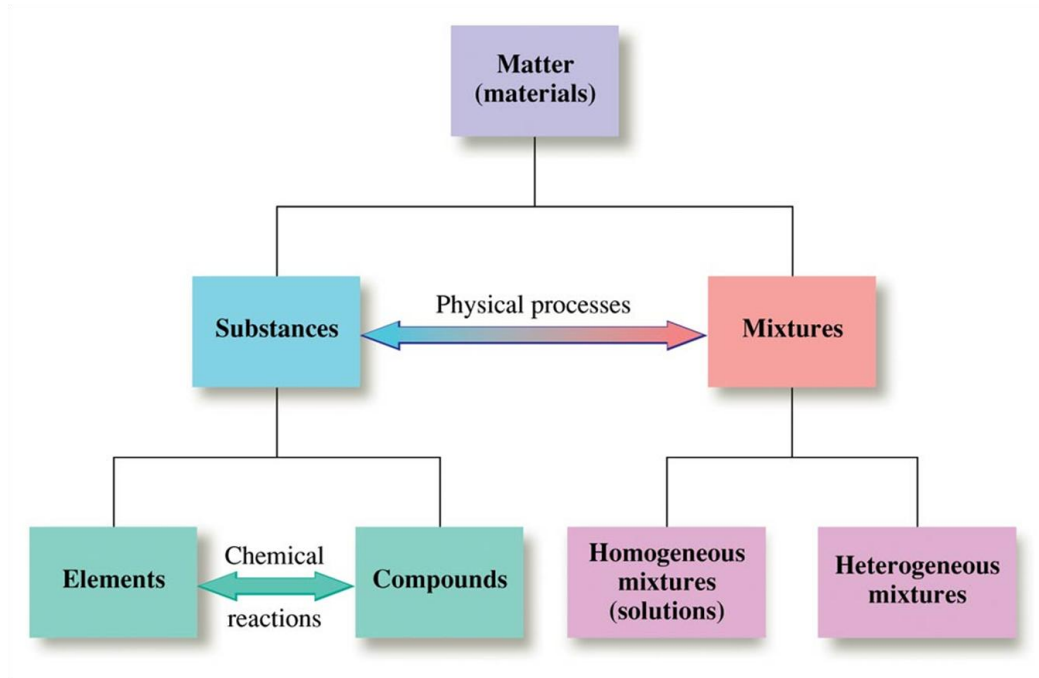
Mixtures separated by:

Filtration: A Mixture consists of a solid and a liquid; the liquid is separated by filtration.

Chromatography: Separates mixtures by distributing components between a mobile and stationary phase.

Distillation: A Liquid mixture is boiled; components in the mixture boil off at different temperatures.

Relationships Among Elements, Compounds, and Mixtures



Measurements and Units

A photograph of several glass test tubes and beakers in a laboratory setting. Some contain a yellow liquid, while others are empty. The background is slightly blurred, focusing on the glassware.

Measurements are reported in a variety of units or dimensions. Units are somewhat standardized globally in the form of the International System (metric units) called SI units.

Units are often associated with prefixes that make them more convenient to use and report.

The most common prefixes include:

tera-	= 10^{12}	giga-	= 10^9
mega-	= 10^6	kilo-	= 10^3
deci-	= 10^{-1}	centi-	= 10^{-2}
milli-	= 10^{-3}	micro-	= 10^{-6}
nano-	= 10^{-9}	pico-	= 10^{-12}

Base SI Units

- There are seven base units, which are listed in Table
- Chemistry primarily uses five of the base units: the mole for amount, the kilogram for mass, the meter for length, the second for time, and the kelvin for temperature. The degree Celsius (0°C) is also commonly used for temperature. The numerical relationship between kelvins and degrees Celsius is as follows
- $\text{K} = 0^{\circ}\text{C} + 273$

Table 1.2: The Seven Base SI Units

Property	Unit	Abbreviation
Length	meter	m
Mass	kilogram	kg
Time	seconds	s
Amount	mole	mol
Temperature	kelvin	K
electric current	ampere	amp
luminous intensity	candella	cd

International System of Units and the Metric System



- The International System of Units, abbreviated SI from the French *Système International D'unités*, is the main system of measurement units used in science.
- Since the 1960s, the International System of Units has been internationally agreed upon as the standard metric system

SI Base Units



Quantity	Unit	Symbol
Length	Meter	m
Mass	Kilogram	Kg
Time	Second	s
Volume	Liter	l
Temperature	Kelvin	K
Pressure	Pascal	Pa
Amount of substance	Mole	mol
Electric current	Ampere	A
Luminous intensity	Candela	cd
Energy	Joule	J

Volume & Density



Volume is the amount of 3-D space matter that occupies and is described as length-cubed

$$1 \text{ mL} = 1 \text{ cm}^3$$

$$1 \text{ dm} = 10 \text{ cm}$$

$$1 \text{ L} = 1 \text{ dm}^3 = 1000 \text{ cm}^3 = 1000 \text{ mL}$$

Density (d) is mass per unit volume

$$d = \text{mass (g)}/\text{volume (mL)}$$

$$D = \text{g/mL} = \text{g/cm}^3$$

Practice Problem

A photograph of several glass test tubes or beakers containing a blue liquid, set against a white background. The tubes are arranged in a slightly overlapping manner, with some in the foreground and others in the background.

The density of 1.59 mL of a solution is 1.369 g/mL. What is the mass of the solution?

$$d = m / v$$

$$m = d \times v$$

$$m = 1.369 \text{ g/mL} \times 1.59 \text{ mL}$$

$$m = 2.18 \text{ g}$$

Mass

A photograph of several glass test tubes or beakers containing a green liquid, set against a white background. The tubes are arranged in a row, with some in the foreground and others slightly behind. The lighting is bright, highlighting the glass and the color of the liquid.

The mass of an object is a measure of the amount of matter in it.

The mass (amount of matter) of an object remains the same regardless of where the object is placed.

For example, moving a brick to the moon does not cause any matter in it to disappear or be removed.

Weight

- The *weight* of an object is determined by the force that gravitation exerts upon the object.
- The weight is equal to the mass of the object times the local acceleration of gravity. Thus, on the Earth, weight is determined by the force of attraction between the object and the Earth.
- Since the force of gravity is not the same at every point on the Earth's surface, the weight of an object is not constant.



Length

- The SI unit of length is the meter.
- In 1889, the definition of the *meter* was a bar of platinum-iridium alloy stored under conditions specified by the International Bureau of Standards.
- In 1960, this definition of the standard meter was replaced by a definition based on a wavelength of krypton-86 radiation.
- In 1983, that definition was replaced by the following: *the meter is the length of the path traveled by light in a vacuum during a time interval of a second.*

Volume



Volume is a significant quantity that uses a derived unit.

Volume is the amount of space a given substance occupies and is defined geometrically as length \times width \times height.

$$1 \text{ mL} = 1 \text{ cm}^3$$

Energy

- Energy, another important quantity in chemistry, *is the ability to perform work.*
- Moving a box of books from one side of a room to the other side, for example, requires energy.
- Note that all chemical processes or reactions occur with a simultaneous change in energy and that energy can be stored in chemical bonds.



Density

Density is defined as the mass of an object divided by its volume; it describes the amount of matter contained in a given amount of space.

$$\text{density} = \text{mass} / \text{volume}$$



Homework part 1



Identify each of the following properties as physical or chemical:

1. Oxygen is a gas
2. Helium is unreactive
3. Water has a high specific heat
4. Gasoline is flammable
5. Sodium is soft and shiny

Homework part 2



Identify each of the following changes as physical or chemical:

1. Cooking food
2. Mixing sugar in tea
3. Carving wood
4. Burning gas
5. Food molding

References



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