GRADE 10 NOTES

CHEMISTRY

COMPREHENSIVE HANDBOOK NOTES

Well-organized, simplified learning notes that provide clear, concise information in a logical sequence, making key concepts easily accessible and memorable, enhancing understanding and retention while fostering engagement and facilitating effective study.

By providing a clear focus on key ideas, these Mwalimu Consultancy Ltd Notes foster better retention and comprehension, making learning more accessible and enjoyable.

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Mr Isaboke 0746-222-000 / 0753-222-000

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SUMMARY OF STRANDS AND SUB STRANDS

1.0 INORGANIC CHEMISTRY

1.1. Introduction Chemistry

1.2. The Atom

1.3. The periodic Table

1.4. Chemical Bonding

1.5. Periodicity

2.0 PHYSICAL CHEMISTRY

2.1. Acids and Bases

2.2. Introduction to Salts

3.0 ORGANIC CHEMISTRY

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STRAND 1.0: INORGANIC CHEMISTRY

Sub-Strand 1.1: Introduction to Chemistry

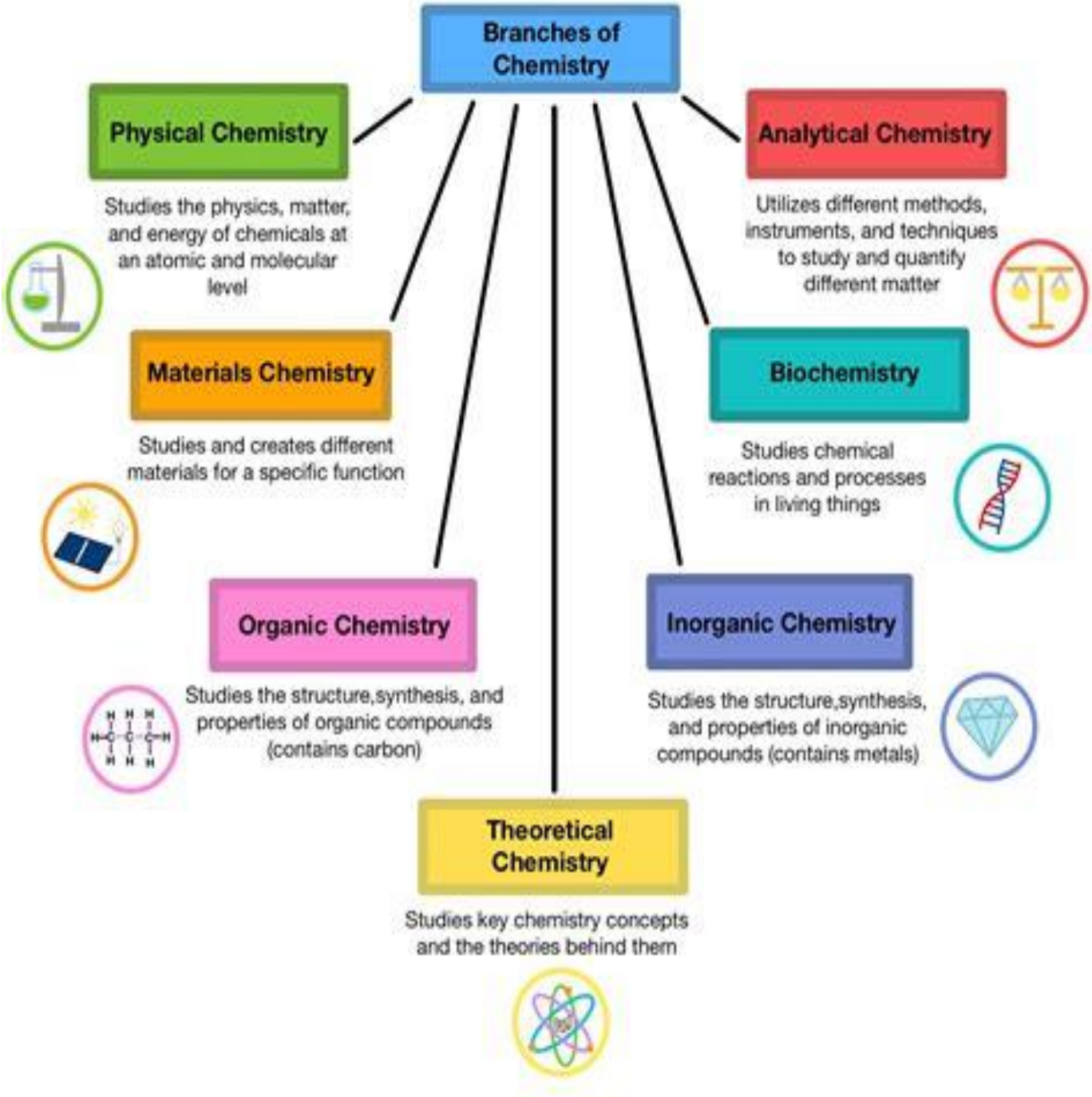
(a) Meaning of Chemistry as a Field of Science

Chemistry is a **branch of science** that studies **matter** and its **properties**, as well as how matter **changes** and **interacts** with energy. It focuses on the fundamental building blocks of matter, which are **atoms**, and how these atoms combine to form **molecules** and **compounds**. Chemistry seeks to understand the composition, structure, properties, and reactions of these substances.

(b) Branches of Chemistry

Chemistry is a broad field with many specialized areas. Some of the main branches include:

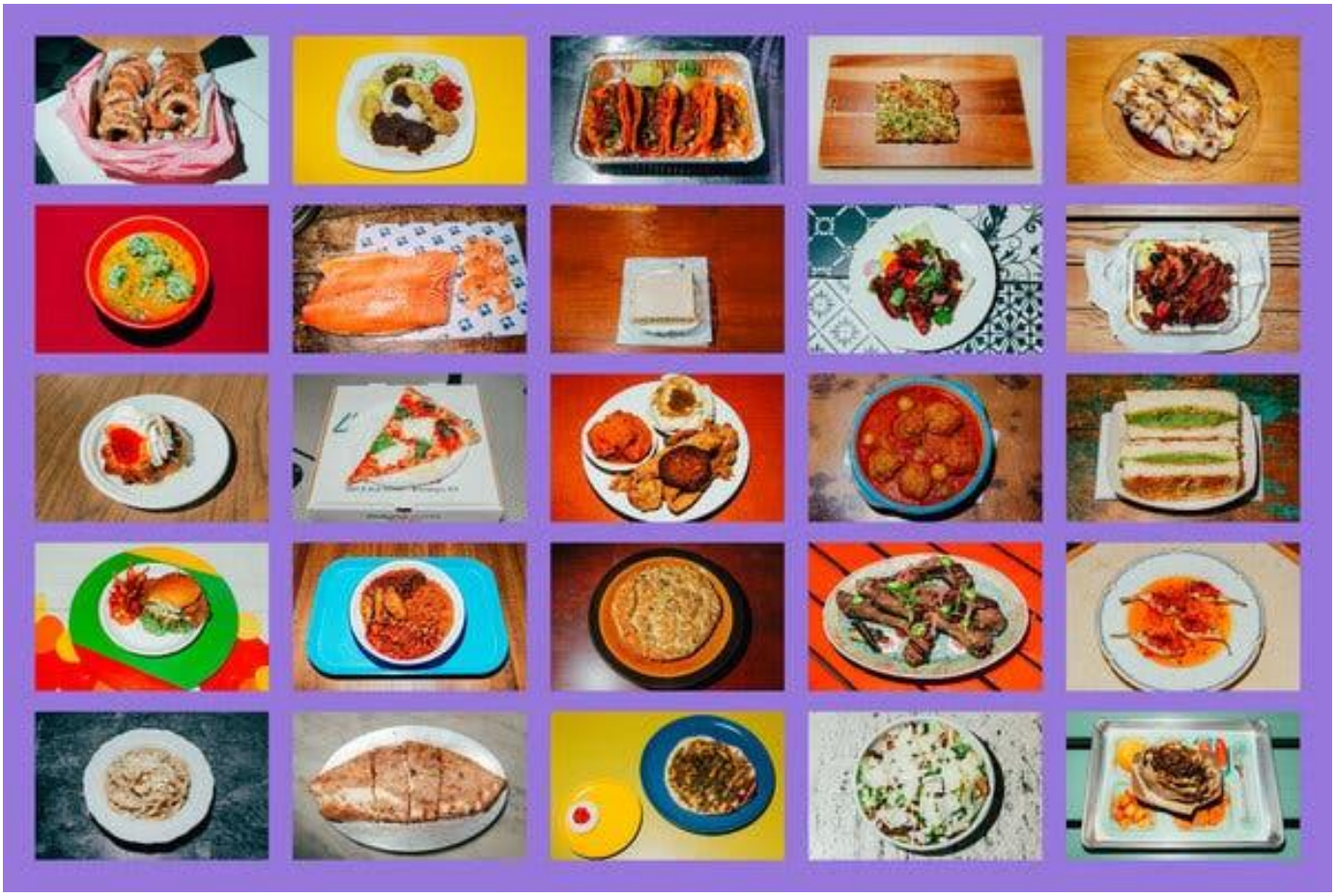
- ✓ **Organic Chemistry:** The study of carbon-containing compounds (with some exceptions). This branch is crucial for understanding life processes and creating many synthetic materials.
- ✓ **Inorganic Chemistry:** The study of compounds that generally do not contain carbon. This includes metals, minerals, and many industrial chemicals..
- ✓ **Physical Chemistry:** This branch deals with the principles of physics that underlie chemical interactions and processes. It involves studying energy changes, reaction rates, and the structure of matter.
- ✓ **Analytical Chemistry:** This involves identifying and quantifying the components of substances. It plays a vital role in quality control, environmental monitoring, and medical diagnostics.
- ✓ **Biochemistry:** This is the study of chemical processes within living organisms. It explores the chemistry of proteins, carbohydrates, lipids, and nucleic acids.
- ✓ **Industrial Chemistry:** This branch focuses on the chemical processes involved in manufacturing products on a large scale, from pharmaceuticals to plastics.



(c) Chemistry in Our Daily Lives

Chemistry plays a fundamental role in almost every aspect of our lives:

- ✓ **Food:** Chemistry helps us understand food composition, preservation, and digestion. Fertilizers and pesticides, developed through chemistry, increase food production.



- ✓ **Medicine:** The development of new drugs and pharmaceuticals is heavily reliant on chemistry. Understanding chemical reactions in the body helps treat diseases.



- ✓ **Clothing:** Many fabrics we wear are synthetic polymers developed through chemical processes. Dyes used to color clothes are also products of chemistry.



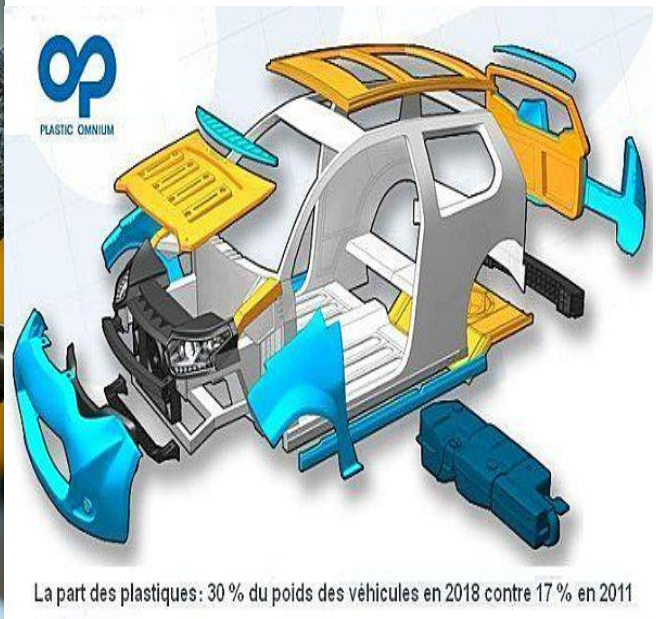
- ✓ **Household Products:** Soaps, detergents, cleaning agents, and cosmetics are all formulated using chemical principles.



- ✓ **Transportation:** Fuels like petrol and diesel are hydrocarbons, and the development of alternative fuels like biofuels involves chemistry. Materials used in vehicles, such as plastics and alloys, are also products of chemical research.

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- ✓ **Agriculture:** Fertilizers, herbicides, and pesticides are chemically formulated to improve crop yields and protect plants from diseases and pests.



- ✓ **Energy:** Chemistry is central to energy production, from burning fossil fuels to developing renewable energy sources like solar panels and batteries.



- ✓ **Environment:** Chemistry helps us understand and address environmental issues like pollution and climate change. It is used in developing solutions for waste management and water purification.



- ✓ Cooking and food preservation
- ✓ Cleaning products
- ✓ Medicines and healthcare
- ✓ Fuels and energy
- ✓ Plastic and textile industries
- ✓ Agriculture (fertilizers, pesticides)
- ✓ Cosmetics

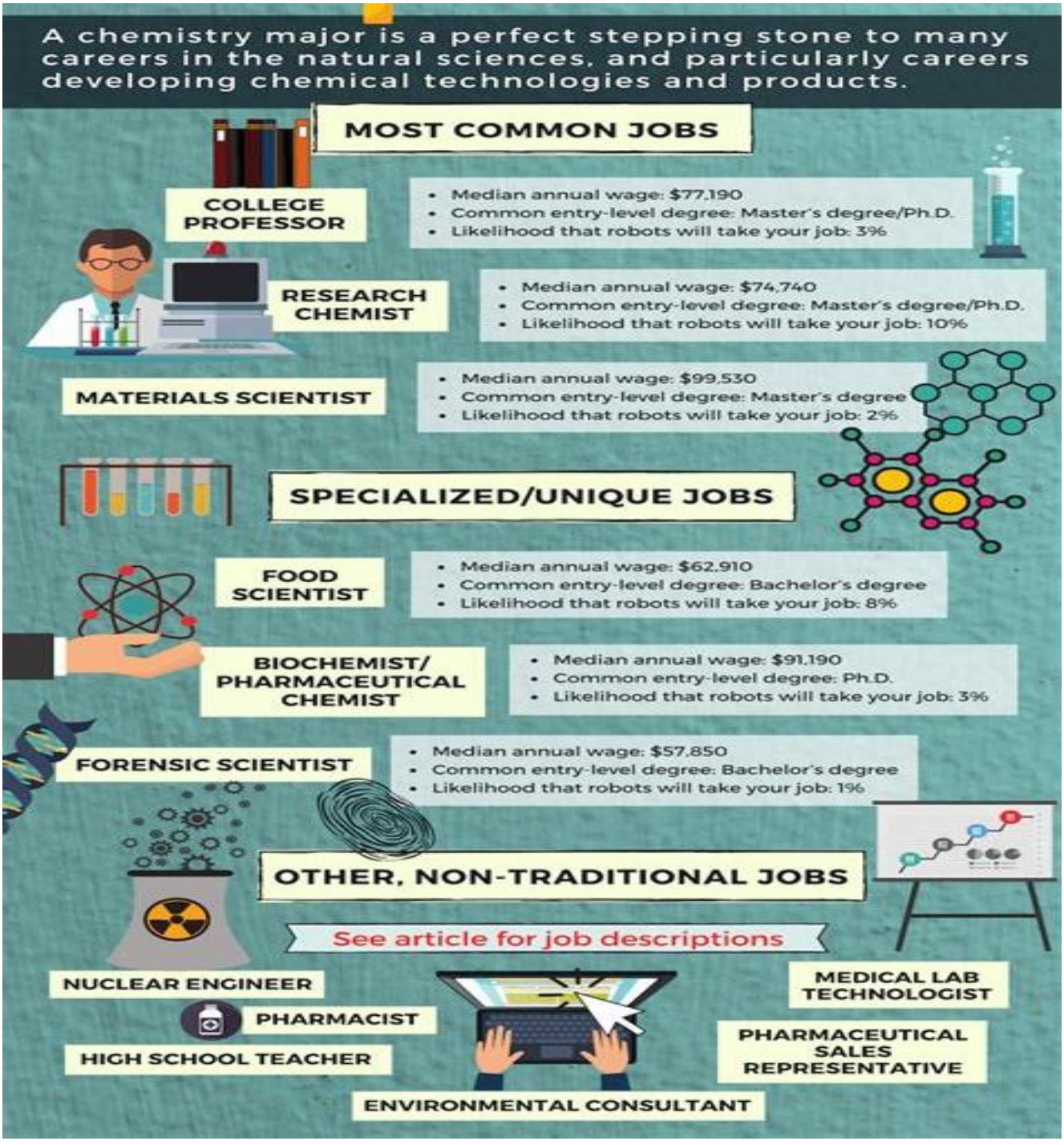
Careers in Chemistry

Studying chemistry opens doors to a wide range of exciting career paths in Kenya and globally, including:

- **Chemical Engineer:** Designs and operates chemical plants.
- **Analytical Chemist:** Analyzes substances to determine their composition. (e.g., at the Kenya Revenue Authority (KRA) as seen in recent job postings)..
- **Biochemist:** Studies the chemistry of living organisms.
- **Forensic Scientist**
- **Pharmacist:** Dispenses and advises on medications.

- **Materials Scientist:** Develops and tests new materials.
- **Food Scientist:** Works on the chemistry of food production and safety.
- **Environmental Chemist:** Studies the chemical processes in the environment and works on pollution control.
- **Research Chemist:** Conducts experiments to discover new chemical knowledge.
- **Teacher/Lecturer:** Educates future generations about chemistry.
- **Lab Technician:** Assists scientists in conducting experiments and analyses.

Visual Aid:



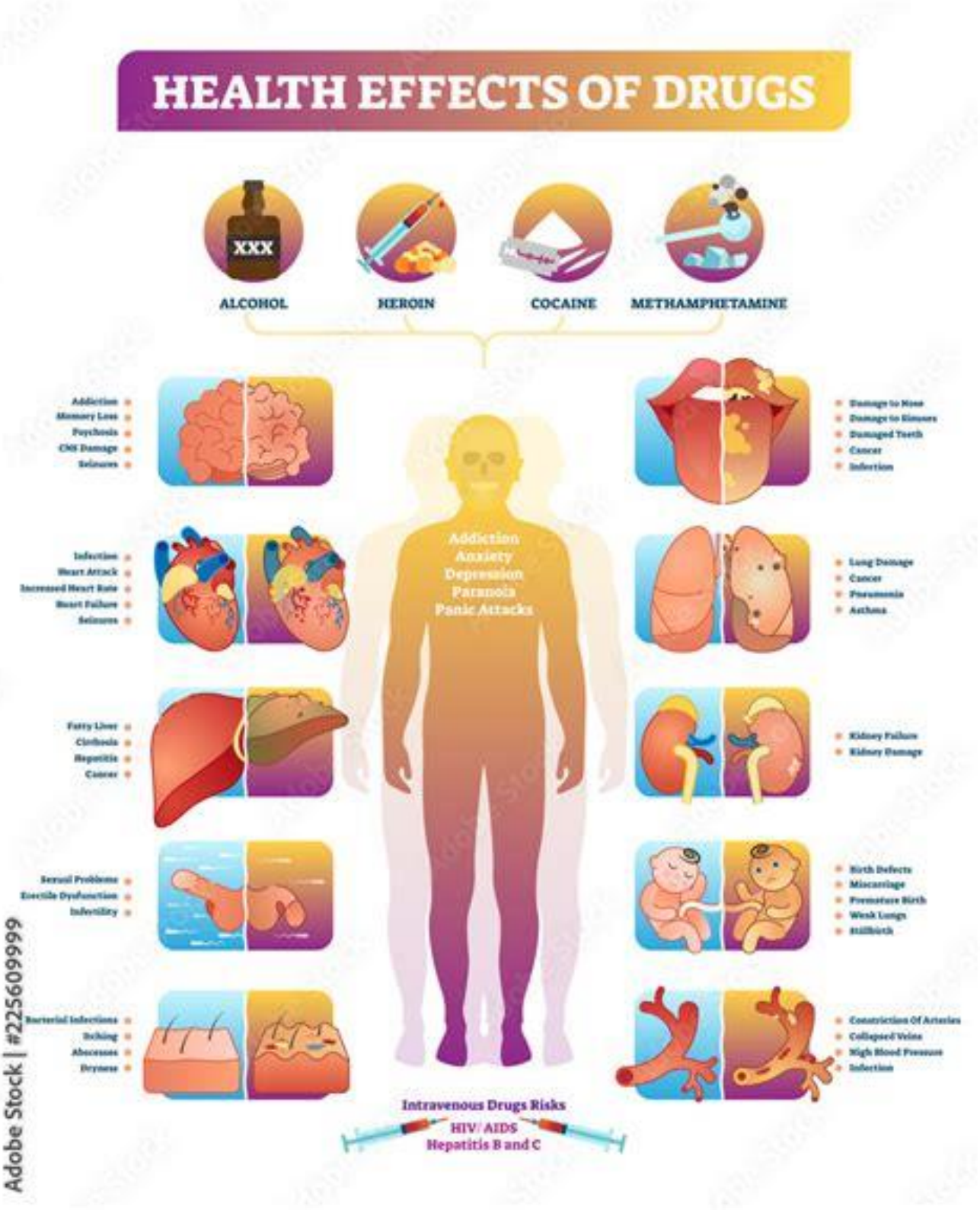
d) Effects of Drug and Substance Use in Day-to-Day Life

A **drug** is any substance that causes a change in an organism's physiology or psychology when consumed.

Drug and substance use can have severe negative effects on individuals and society:

- ✓ **Health Problems:** Substance abuse can lead to various physical and mental health issues, including addiction, organ damage, mental disorders like depression and anxiety, and even death.
- ✓ **Academic and Work Performance:** Drug and substance use can impair concentration, memory, and motivation, leading to poor performance in school or work, and potentially job loss..
- ✓ **Social Problems:** Substance abuse can strain relationships with family and friends, lead to social isolation, and increase the risk of criminal activity. **Economic Burden:** Drug and substance abuse can lead to significant financial problems for individuals and families due to the cost of drugs, treatment, and legal issues. It also places a burden on society through increased healthcare costs and reduced productivity.
- ✓ Mental health issues (e.g., anxiety, depression)
- ✓ Poor academic performance
- ✓ Addiction
- ✓ Risky behavior
- ✓ Diseases such as liver damage and heart disease

Visual Aid:



(e) Promoting Rights and Responsibilities to a Safe and Healthy Learning Environment

It is our right and responsibility to ensure a safe and healthy learning environment. This includes:

- ✓ **Staying informed:** Learning about the risks and effects of drug and substance use.
- ✓ **Making healthy choices:** Avoiding drug and substance use.

- ✓ **Seeking help:** Encouraging peers and seeking help if struggling with substance use or witnessing others who are.
- ✓ **Respecting oneself and others:** Promoting a culture of health and well-being.
- ✓ **Understanding consumer rights:** Being aware of regulations related to drug prescription and usage to ensure safety.

Promoting Safe and Healthy Learning

Learners should:

- ✓ Respect school rules and policies
- ✓ Avoid harmful substances
- ✓ Report unsafe conditions
- ✓ Support one another's health and well-being
- ✓ Promote gender equality in science careers

Project:

Develop posters or presentations to sensitize your peers and the community on the risks associated with drug and substance use and promote healthy lifestyles.

Suggestion for Project:





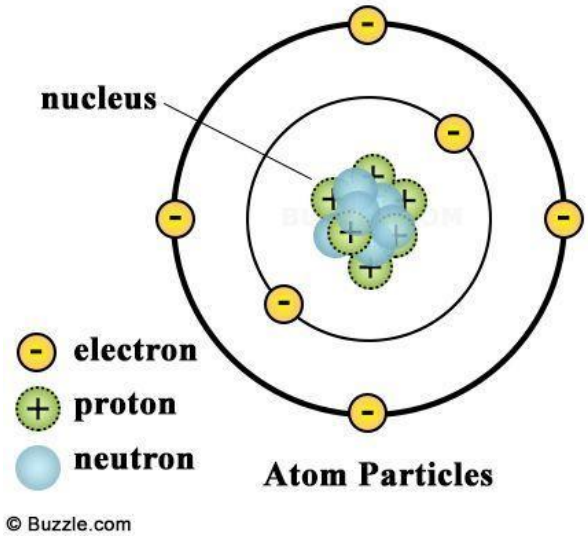


Sub-Strand 1.2: The Atom

(a) Structure of the Atom

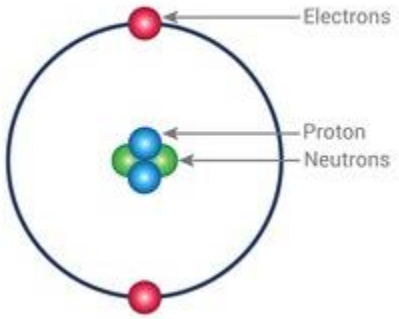
The atom is the basic unit of a chemical element. It consists of a dense central **nucleus** surrounded by a cloud of negatively charged **electrons**. The nucleus contains:

- **Protons:** Positively charged particles. The number of protons in an atom determines its **atomic number (Z)** and defines the element.
- **Neutrons:** Neutrally charged particles. The number of protons and neutrons together determines the **mass number (A)** of an atom.



(i) Dalton's Atomic Model (Brief Review)

John Dalton proposed that all matter is made of tiny, indivisible particles called atoms. He suggested that atoms of the same element are identical and that chemical reactions involve the rearrangement of atoms.

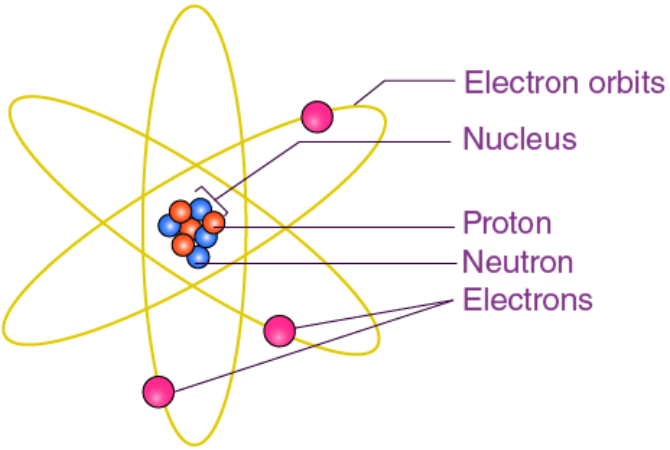


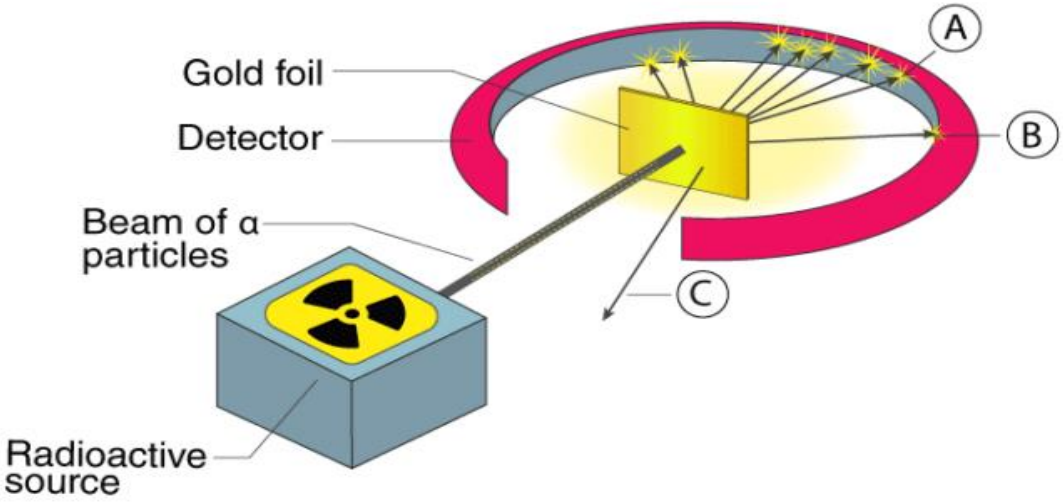
(ii) Rutherford's Atomic Model

Ernest Rutherford's gold foil experiment led to the discovery of the nucleus. He proposed that:

- The atom has a small, dense, positively charged nucleus at its center.
- Most of the atom is empty space.
- Electrons orbit the nucleus like planets around the sun.

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A diagram illustrating Rutherford's gold foil experiment with alpha particles being scattered by the nucleus. Another diagram showing the Rutherford atomic model with a central nucleus and orbiting electrons.

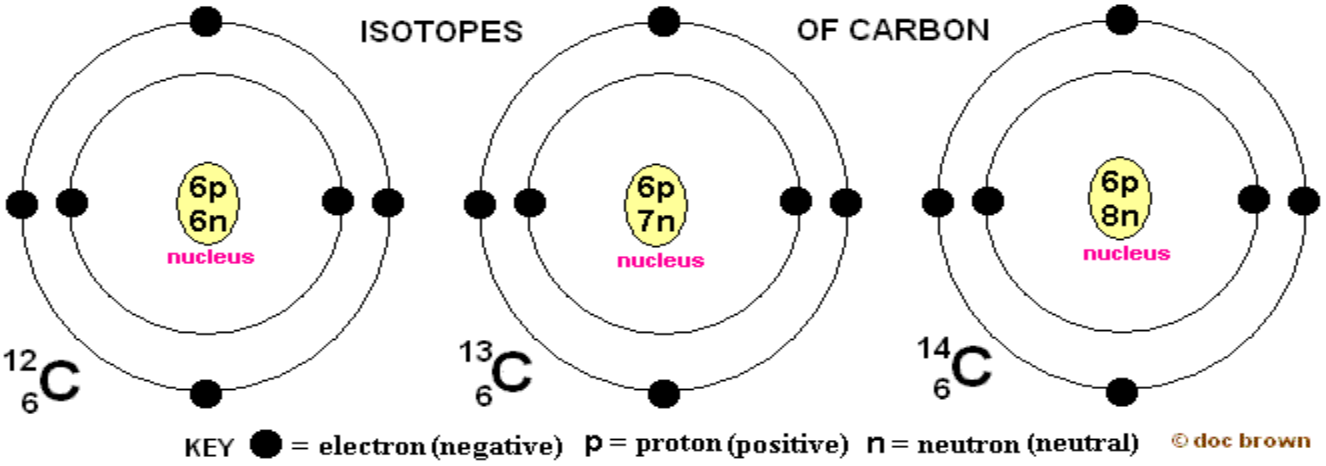
(iii) Atomic Number and Mass Number

- **Atomic Number (Z):** The number of protons in the nucleus of an atom. It uniquely identifies an element. For example, Hydrogen (H) has Z=1, Carbon (C) has Z=6.
- **Mass Number (A):** The total number of protons and neutrons in the nucleus of an atom. Number of neutrons = A - Z. For example, Carbon-12 has A=12 and Z=6, so it has 6 neutrons.

(b) Relative Atomic Mass of Elements

(i) Isotopes

Isotopes are atoms of the same element that have the same number of protons (same atomic number) but different numbers of neutrons (different mass numbers). For example, Carbon-12 (612C), Carbon-13 (613C), and Carbon-14 (614C) are isotopes of carbon.



A diagram showing the nuclei of the three isotopes of carbon, highlighting the different numbers of neutrons.

(ii) Relative Atomic Mass (RAM)

The relative atomic mass of an element is the weighted average of the masses of its naturally occurring isotopes, compared to 1/12th the mass of a carbon-12 atom. It takes into account the abundance of each isotope.

Formula for RAM:

RAM = [(% Abundance of Isotope 1 × Mass of Isotope 1) + (% Abundance of Isotope 2 × Mass of Isotope 2) + ...] / 100

Example:

Chlorine exists as two common isotopes: Chlorine-35 (35Cl) with an abundance of 75.77% and a mass of 35 amu, and Chlorine-37 (37Cl) with an abundance of 24.23% and a mass of 37 amu.

RAM of Chlorine = [(75.77 × 35) + (24.23 × 37)] / 100 = [2651.95 + 896.51] / 100 = 3548.46 / 100 = 35.48 amu

(c) Electron Arrangement using s and p Notation

(i) Energy Levels and Orbitals

Electrons in an atom are arranged in specific energy levels or shells around the nucleus. These energy levels are further divided into sublevels called **orbitals**. Orbitals are regions of space where there is a high probability of finding an electron.

The first energy level (n=1) has one type of orbital called the **s orbital**. The second energy level (n=2) has two types of orbitals: one **s orbital** and three **p orbitals**. The third energy level (n=3) has s, p, and d orbitals, and so on. For the first 20 elements, we mainly focus on s and p orbitals.

- **s orbital:** Spherical in shape. Each s orbital can hold a maximum of **2 electrons**.**:** A diagram showing the spherical shape of an s orbital.
- **p orbitals:** Dumbbell-shaped. There are three p orbitals in each energy level (except the first one), oriented along the x, y, and z axes (px, py, pz). Each p orbital can hold a maximum of **2 electrons**, so a set of three p orbitals can hold a total of **6 electrons**..

(ii) Order of Filling Electrons (Aufbau Principle)

Electrons fill atomic orbitals in order of increasing energy. For the first 20 elements, the order of filling is approximately:

1s, 2s, 2p, 3s, 3p, 4s

(iii) Writing Electron Arrangement using s and p Notation

The electron arrangement (or electron configuration) shows how electrons are distributed among the orbitals in an atom. The notation indicates the principal energy level (n), the type of orbital (s or p), and the number of electrons in that orbital as a superscript.

Electron Arrangements of the First 20 Elements:

Atomic Number (Z)	Element	Symbol	Electron Arrangement (s and p notation)
1	Hydrogen	H	$1s^1$
2	Helium	He	$1s^2$
3	Lithium	Li	$1s^2\ 2s^1$
4	Beryllium	Be	$1s^2\ 2s^2$
5	Boron	B	$1s^2\ 2s^2\ 2p^1$
6	Carbon	C	$1s^2\ 2s^2\ 2p^2$
7	Nitrogen	N	$1s^2\ 2s^2\ 2p^3$
8	Oxygen	O	$1s^2\ 2s^2\ 2p^4$
9	Fluorine	F	$1s^2\ 2s^2\ 2p^5$
10	Neon	Ne	$1s^2\ 2s^2\ 2p^6$
11	Sodium	Na	$1s^2\ 2s^2\ 2p^6\ 3s^1$
12	Magnesium	Mg	$1s^2\ 2s^2\ 2p^6\ 3s^2$
13	Aluminium	Al	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$
14	Silicon	Si	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$
15	Phosphorus	P	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$

16	Sulfur	S	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$
17	Chlorine	Cl	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$
18	Argon	Ar	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$
19	Potassium	K	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$
20	Calcium	Ca	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$

(d) Interest in the Study of Structure of the Atom

Understanding the structure of the atom is fundamental to comprehending how elements behave and interact to form molecules and compounds. This knowledge is crucial for advancements in various fields like medicine, materials science, and energy production. By exploring the subatomic world, we gain insights into the very nature of matter.

Activity Suggestion:

Watch a simulation of the Rutherford Gold Foil experiment and discuss the findings with peers to appreciate the scientific process of understanding atomic structure. You can also engage in simple activities to visualize the filling of electrons into orbitals using diagrams or models.

Sub-Strand 1.3: The Periodic Table



(a) Development of the Periodic Table

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