



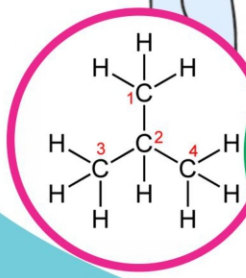
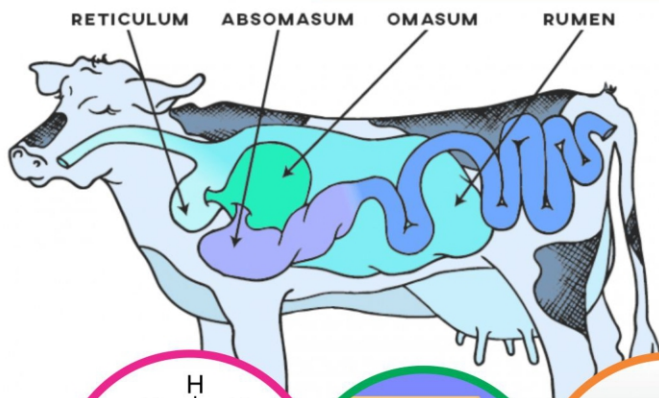
**SUCCESSLINK**

# SIMPLIFIED SCIENCE

FOR BASIC SEVEN, EIGHT & NINE

**LEARNERS**

FOR BASIC  
**7,8&9**  
COMBINED



STRICTLY BASED ON THE NEW NaCCA COMMON  
CORE PROGRAMME CURRICULUM

### SPECIAL FEATURES OF THIS BOOK:

- \* Based on the New NaCCA Common Core Curriculum
- \* Detailed, Simplified and Comprehensive
- \* Activity-Based and Learner-Centred
- \* Critical Thinking and Problem Solving
- \* Easy to Understand Language
- \* Abundant Use of Local Examples
- \* Minimum Teacher Assistance Required
- \* Self-Assessments (Both Objectives and Essays)
- \* Practicals, Project Works and Home Learnings
- \* Some Scientific Facts
- \* Examination Techniques.

**SAEED ADAM BANDA**

(PhD-Candidate, MPhil, M.Ed,  
BA. (Hons), PGDE, Cert-CRRPR)

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(PhD-Candidate, MPhil, M.Ed,  
BA.(Hons), PGDE, Cert-CRRPR)**

**COMBINED EDITION**

**BASIC 7-9**

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## PREFACE

With the introduction of the Common Core Programme (CCP) Curriculum, many changes have been made to the teaching and the learning of Science at the basic levels. Notwithstanding the efforts made by the Ministry of Education and the Ghana Education Service to provide the needed learning materials, there is still a deficit in the required learning aids.

**SUCCESSLINK Simplified Science Textbook**, therefore, has been carefully written in accordance with the new Common Core Programme (CCP) Curriculum for **Basic 7, 8 and 9** learners.

The book is organized under **five strands** under each class level strictly based on the Common Core Programme (CCP) Curriculum issued by the National Council for Curriculum and Assessment (NaCCA), Ministry of Education, Ghana.

Again, each strand and sub-strand contains a variety of illustrations, diagrams, photographs and key facts summarized. Enough exercises are given to learners at the end of every strand and sub-strand to assess the progress of learning outcomes of both facilitators and learners. Each content standard and its required indicator are fully covered.

Therefore, this book aims to develop individuals to become scientifically literate, problem solvers, have the ability to think creatively and have both the confidence and competence to participate fully in Ghanaian society as responsible local and global citizens.

More so, this book is to help learners and users to communicate scientific ideas effectively by using scientific concepts in explaining their own lives and the world around them. Develop skills for using technology to enhance learning for health and quality of life.

Although every care has been taken to check mistakes and misprints, it is hoped that readers would inform the author of inaccuracies detected in this book in order to enhance future editions.

I, hereby, recommend this book to all Basic 7, 8 and 9 learners and facilitators since it is currently the best and fast-selling book on the market. It has been by God's grace that this book has come out.

I, therefore, give God all the praises and gratitude. Amen!



## **DEDICATION**

This book is dedicated to the ever-loving memory of my late father Mr. Saeed Uthman (Anokeseε) who did not live to see the fruit of his labour. His toil and sweat have made me who I am today. Dad (Nje), may God (Allah) have mercy on you and all departed souls. Amen!

Also, to my lovely mother Hajia Fati Adam, my family and wife, for the love, support and inspiration that saw me through my writings.

Again, to my late grandfather, Imam Alhaji Adam Suallah - Wenchi Municipal Chief Imam, who taught me the purpose of hard work which is to contribute to a better society!!

Finally, to the source of all true gifts, the creator of destinies and sustainer of life. May your truth explode in the hearts of all who read this book. Amen!!!

## ACKNOWLEDGEMENT

Glory, honour and praises are to Almighty God for the abundance, guidance and protection for giving me the inspiration and courage for carrying out my vision and making this book a success. To my parents, I say thank you for the gift of life and the moral, spiritual and material help and support you gave me.

I sincerely appreciate the efforts made by Prof. Alexander Yao Segbefia (Senior Lecturer-KNUST), Dr. Gift Dumedah (G.I.S Specialist and Senior Lecturer - KNUST), Dr. Seth Agyeman (Senior Lecturer – KNUST), Dr. Eugene (Science Instructor - Anglican S.H.S – Kumasi), Mr. Fahad Musah (Science Instructor - Domaa S.H.S), Mr. Essandoh (Science Instructor - Mim S.H.S), Mr. Gilbert Atiiga Abangiba (UDS), Mr. Nuhu Ibrahim Zeba (Headteacher – Ashanti Pride International School, Ksi), and Mr. Luqman Fuseini (Gowrie S.H.S, Bongo) for their initiatives and guidance that put me on the path to this academic height, especially proofreading this book.

I am also particularly thankful to my able Director, Hon. Osei Kwadwo Hayford - former Member of Parliament for Wenchi Constituency and the National President of Conference of Directors of Education (CODE), Dr. Hadrat M. Yusif (Senior Lecturer-KNUST), Dr. Douglas Kparib (Lecturer-Takoradi Technical University) and Mr. Yakubu Saeed (NHIS-Techiman) for their invaluable contributions, motivation and guidance without which this book would not have been completed and whose sincerity and encouragement I will never forget.

Finally, I am solely responsible for any shortcomings, errors of omission and commission found in this book. May the peace of God that transcends human understanding be with you!!

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**SUCCESSLINK**  
**LEARNERS' BOOK**



**SCIENCE**

# STRAND 1: DIVERSITY OF MATTER

## Sub-Strand 1: Materials

**Content Standard:** This sub-strand will be guided by the following content standard:

1. Recognise materials as important resources for providing human needs
2. Understand the periodic table as different elements made up of metals and non-metals and noble gases arranged in an order.

**Indicators:** By the end of this section, you should be able to:

1. Classify materials into liquids, solids and gases
2. Discuss the importance of liquids in the life of human
3. Discuss the importance of specific solids to life
4. Demonstrate the knowledge of the orderly arrangement of metals, non-metals and noble gases in the periodic table.

### **WARMER**

*Look at pictures of some of the materials. Read the names. Which of them have you seen and used before?*



**Table**



**Stone**



**Water Vapour**



**Soup**



**Milk**



**Key**



**Phone**



**Air**



**Books**



**Coke**



**Pen**



**Shoe**



**Fish**



**Water**

### **Meaning of Materials**

Materials are substances from which things are made. For example, silk is a material. A shirt made up of silk and polyester is composed of two materials and is made up of matter.

### ***Meaning of Matter***

Matter is anything that has weight and occupies space. Or matter is anything that has mass and volume.

**Examples of matter are:** stone, water, chairs, pens, tables, erasers, carbon dioxide, oxygen, milk, soup, Fanta etc. These objects or things are made from materials.

**Example of Materials in the Environment:** Our environment is made up of different materials. These materials are used in our everyday activities. For example in the **classroom**, we see materials such as paper, pencil, eraser, table etc.

Also, in our **homes** and **communities**, we see materials such as water, stone, metals, cotton, glass, bowls etc.

### **Properties of Materials**

Properties of materials may be soft or hard, rough or smooth, opaque or transparent, bendable or non-bendable, able to conduct electricity or heat (conductor), unable to conduct heat or electricity (insulator) etc.

### **Grouping Materials Based on Texture, Appearance, Colour and Shape**

#### ***A. Grouping Material Based on Texture***

The texture of a material is how rough or smooth the material is. It is about how the material feels when touched. Some materials are rough and examples are the bark of a tree, soil (sandy) and stones. Other materials are also smooth and examples are paper, cardboard, human hair etc.

#### ***B. Grouping Material Based on Appearance***

Appearance can be nice, shiny, dull, transparent, translucent and opaque. Some materials have shiny surfaces. Examples are metals such as gold, steel etc. Other materials also have dull surfaces such as chalk, wood, rubber etc.

#### ***C. Grouping Material Based on Colour***

Materials such as clothes and crayons could be sorted out based on colour. Colours could be red, yellow, green, blue, violet, indigo, pink, black, brown, white etc.

#### ***D. Grouping Material Based on Shape***

Shape of a material is a particular external form or outline of it. Shape is usually described as square, triangle, rectangle, circular, cylindrical or conical.

**Table 1.1: A Table Showing the Texture, Appearance, Colour and Shape of a Group of Materials Assembled from the Environment**

<b>Materials</b>	<b>Texture</b>	<b>Appearance</b>	<b>Colour</b>	<b>Shape</b>
<b>Wood</b>	Smooth	Flat	Brown	Rectangular
<b>Cotton</b>	Soft	Flat	White	Elliptical
<b>Glass</b>	Smooth	Shiny	Blue	Cylindrical
<b>Leather</b>	Rough	Dull	Black	Rectangular
<b>Water</b>	Viscosity	Transparent	Colourless	Takes the shape of a container
<b>Plastic funnel</b>	Smooth	Shiny	Blue	Conical

### **Classifying Materials into Liquids, Solids and Gases**

Materials can be classified into three forms or states. They are liquids, solids and gases.

### **Liquid Materials**

A liquid material can flow when poured. The particles in a liquid state are free to move about the whole volume of the container. **Examples of liquids include:** water, soup, kerosene, diesel, petrol, cooking oil, milk, alcohol, wine, honey, Fanta, coca-cola etc.

### **Properties/Characteristics of Liquids**

1. The particles of a liquid are not as closely packed as those in solids
2. Liquids can flow
3. Liquid particles can slip past one another. That makes liquids flow.
4. Liquids have a definite volume
5. Liquids do not have a definite shape
6. Liquids take the shape of their container
7. Liquids can be any colour or colourless
8. The forces holding the particles together in a liquid are not as strong as in a solid.
9. Texture of liquids: Liquids can feel sticky, gooey, slippery or watery to touch.

### **Solid Materials**

A material in the solid state has a definite shape and fixed volume. It has its own shape. Thus, its shape does not depend on its container. **Examples of solids include:** stones, books, pencils, erasers, tables, chairs, pens, paper, calculators, wood, spoons, ice,



### Properties/Characteristics of Solids

1. The particles that make up a solid are very closely packed giving rise to its compact nature
2. Solids do not flow
3. Solids have definite shape
4. Solids have a definite volume
5. Solids have high density
6. A solid has a surface
7. Solid particles are held together by a strong force of attraction
8. Solids cannot be squeezed or compressed easily
9. Solids can be any colour
10. Solids have different textures: They can be smooth, rough, hard and soft.

### Gaseous Materials

Materials in the gas state have no fixed shape and volume. The particles in a gas are loosely packed. **Examples of gases include:** oxygen, carbon dioxide, carbon monoxide, sulphur dioxide, hydrogen, nitrogen, air, water vapour, natural gas etc.

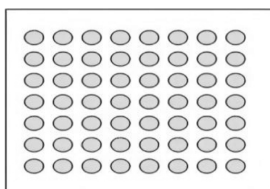
### Properties/Characteristics of Gases

1. The particles of a gas are widely separated from each other or the particles are far apart
2. Gases have no fixed volume
3. Gases have no fixed shape
4. Gases have low density
5. Particles in gasses move at high speed
6. Particles in gases are in random motion
7. Gases are compressible because their particles are far apart
8. Gases expand to fill their containers
9. Gases can flow
10. A gas has no surface.

**Table 1.2: Summary of Properties or Characteristics of Solids, Liquids and Gases**

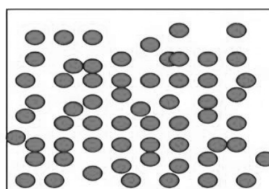
Properties/Characteristics	Liquids	Solids	Gases
Texture(Soft, hard, rough, smooth, opaque, transparent and bendable)	Slippery	Most are hard but some are relatively soft	Highly compressible
Shape	Indefinite	Definite	Indefinite

<b>Colour</b>	Some are colourless	White, green, yellow, blue, red, indigo, and violet	Some are colourless
<b>Appearance</b>	Colourless	Crystalline	
<b>Volume</b>	Definite	Definite	Indefinite
<b>Relative intermolecular force (forces holding the particles together)</b>	Moderate	Strong	Less moderate
<b>Relative particle position</b>	In contact but not fixed	Fixed in place and in contact	Particles are far apart but collided
<b>Examples</b>	Water, kerosene, oil, petrol, diesel, milk, wine, honey, orange juice, engine oil etc.	Table salt, sugar, diamond, wood, metals, rocks, pencils, erasers, chalk etc.	Carbon dioxide, oxygen, vapour, helium, argon, hydrogen gas, LPG etc.



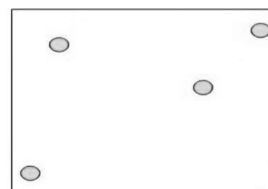
**Solid**

- Particles packed closely, often rigidly bonded to one another
- Definite shape
- Definite volume



**Liquid**

- Particles closely packed, but able to flow
- Indefinite shape
- Definite volume



**Gas**

- Particles far apart, able to shoot about freely
- Indefinite shape
- Indefinite volume

**Table 1.3: Differences Among Solids, Liquids and Gases**

<b>Solids</b>	<b>Liquids</b>	<b>Gases</b>
Solids are rigid in comparison to liquids and gas	The liquid is not so rigid	Gases are also not rigid
Solids have a definite shape and volume	Liquids have a definite volume but no definite shape	Gases have neither definite shape nor definite volume

Solid particles have low kinetic energy	Liquid molecules have intermediate kinetic energy	Gases possess very high kinetic energy
Solids cannot be compressed appreciably	Liquids can easily be compressed	Gases can be compressed easily to some extent level
Solid molecules are held tightly by strong nuclear forces	Molecules in liquids are held tightly at an intermediate level	Very weak attraction forces are present among the molecules of gases
Solids are present in a very dense form	In liquids, density is present at an intermediate level	Gases possess very low-density
Solids cannot flow easily	Liquids are known to flow properly	Gases flow and evaporate easily
In solids, the diffusion rate is very low	In liquids, the diffusion rate is moderate	Gases diffuse at a very high rate of diffusion.

### Reasons Why Gases have no Fixed Volume

Gases have no fixed volume because the force of attraction between the particles of gases is very weak and negligible. Therefore, the particles of a gas are said to be in a constant random motion.

#### Group Activity 1.1

1. Put learners into groups and different materials to the groups
2. Learners create and complete a table to record the texture, appearance, colour and shape of materials assembled from the environment
3. Learners group materials into solids, liquids and gases.

### The Importance of Liquids in the Life of Humans

There are many different liquid materials in our environment. Examples of liquids are: water, soup, milk, beverages, fruit juice, Fanta, coca-cola, cooking oil, kerosene, diesel, petrol etc. **The following are some of the importance of liquids to human life:**

1. Liquids help the human body to digest food
2. Liquids help to prevent constipation by keeping stools soft
3. Liquids are important parts of blood and help to carry nutrients around the body
4. Liquids help to protect and cushion joints and organs in the human body
5. Liquids help to prevent dehydration in the human body. Dehydration causes headaches, fatigue etc.
6. Liquids help the human kidney to work in order to produce urine and remove waste from the human body.

7. Liquids help prevent urinary tract infections by keeping the urinary tract healthy
8. Liquids have to be burnt in the engines of vehicles before the car moves from place to place
9. Liquids help in the regulation of human body temperature
10. Liquids such as water and cooking oil are used in the preparation of food
11. Liquids such as water in the human body transport various substances in the human body
12. Liquids moisturize the skin to maintain its texture and appearance.

### **Preservation of Liquids**

Have you ever thought of the need to make good use of liquids (water, soup, petrol, diesel, kerosene, Fanta etc.) in your homes, schools and the community? Do you think there is a need to preserve liquids such as water in the home, school and the community? Think about ways water and other liquids can be preserved in our homes, schools and the community.

### ***Meaning of Preservation of Liquids***

Preservation of liquid is the practice of using liquid efficiently to reduce unnecessary liquid wastage. That is, making good use of liquids such as water, soup, Fanta, diesel, petrol etc. to reduce wastage.

### **Ways of Preserving Liquids/How to Preserve Liquids**

1. Turn off the water while brushing your teeth. This is because when water is on while brushing the teeth, the water will be wasted since it will not be used for anything at that time.
2. Do not run more water than necessary while washing and cleaning clothes, utensils etc.
3. Do not prolong your bathing. Go for a quick shower rather than wasting buckets of water.
4. Leaks identified must be immediately fixed to avoid liquid wastage.
5. Harvest rainwater to wash cars and water lawns. This will be efficiently used by the plants or lawns.
6. Use just one glass every day for consuming water or other beverages. This will cut down on the number of glasses you have to use more water to wash.
7. Water your garden economically. In order to reduce water consumption in your garden you should water only what needs to be watered.

8. Use washing machine because washing machines significantly reduce water consumption (by 50%).
9. Always wash darker clothes in cold water. This conserves both water and energy, and your colours will not fade.
10. Reward your kids for turning the tap off completely every time they use it.

### **The Need to Preserve Liquids for Human Use**

There is a need to preserve liquids because humans cannot survive without the use of liquids. **Some of the need to preserve liquid are as follows:**

1. To save money
2. To prevent wastage
3. To prevent spoilage
4. To keep them for future use
5. To prevent contamination or pollution.

### **Liquids Used in Our Community**

There are different liquids used in our communities. Some of these liquids have colours while others are colourless.

**Some of the liquids used in our communities include:** water, cooking oil, palm oil, soup, alcohol, kerosene, petrol, diesel, Fanta, coca-cola, sprite, milk etc.



**Picture 1.1 Some Liquids in Our Communities**

### **Importance of Specific Solids to Life**

There are some solid materials in the environment that support the survival of humans and other forms of life.

**Some of these solid materials identified in our environment include:** foodstuffs (such as yam, cassava, maize, rice etc.), clothes, stones, woods, rocks, metals, leather, fertilizer (some solid fertilizers include NPK), wool, glasses, plastics, papers, chair, book, sand, table, belt, iron, money, dress, scissors, shoe etc.



### **Uses of Solids Found in the Environment**

1. **Foodstuffs:** Animals and humans eat food to get energy.
2. **Clothes:** Clothes keep humans warm. It also protects humans from injury, dust, insect bites and so on.
3. **Stones:** Stones are used to make concrete for building houses.
4. **Wood:** Wood is a solid material used in building houses.
5. **Rocks:** Rocks are used to construct roads, bridges, gutters etc.
6. **Metals:** Some metals such as gold, platinum and silver are used as jewelry and ornaments.
7. **Leather:** Leather is used for making footwear.
8. **Fertilizers:** Plants get nutrients from fertilizers.
9. **Wools:** Wool is used for making carpets and blankets.
10. **Glasses:** Glasses are used to make plain mirrors, lenses, sliding doors, windows, drinking containers etc.

### **How to Preserve Solid Materials**

The need to preserve solid materials is very necessary to humans and their environment. For example, it is important to take good care of trees in the environment. This is because we get the wood for making houses from trees. Also, solids such as Gold are used to make ornaments such as jewelry, money in the form of coins, statues etc.

Therefore, the useful solid materials in the environment can be preserved in the following ways:

1. Solid materials that have metal parts should be oiled. This will help to prevent them from rusting.
2. Solid materials such as plastics should be kept away from sources of fire and be handled with care.
3. Wood as a solid material should be polished to keep it smooth and be kept in a dry place. This helps it not to be decayed.
4. Leather as a solid material must be polished. This helps to keep the surface of the leather smooth.

### **The Need to Preserve Useful Solid Materials in the Environment for Life**

There is always the need to preserve solid materials. The reasons are as follows:

1. Solid materials need to be preserve to keep them for future use.
2. Solid materials such as clothes need to be worn to protect the body from adverse weather conditions.

3. Some solid materials make the body clean and healthy. For example, soap and sponges help keep the body clean and kill germs on the body.
4. Solid foods we eat contain nutrients that provide the body with energy, repair worn-out tissues and make the body healthy,
5. Most of the solid materials help us to carry out daily activities without stressing ourselves. For example, the phone helps us to communicate with people far from us without walking to where they may be.
6. Solid materials such as pens and pencils make writing easier and faster. Also, scissors and cutlasses make cutting easier and faster.

### **Group Activity 1.2**

1. Model two objects from solid materials that can be useful to humans and other life forms and present your work to the class.

## **The Orderly Arrangement of Metals, Non-Metals and Noble Gases in the Periodic Table**

### ***Chemical Elements and their Symbols***

**An element** is a substance that is made up of the same kind of atoms. Elements cannot be broken down into simpler substances. Elements may be thought of as the basic chemical building blocks of matter.

**Examples of elements are:** nitrogen, phosphorus, potassium, hydrogen, helium, sodium, iron, carbon, copper, gold, mercury and lead.

### **Properties of a Chemical Element**

1. A chemical element is made of one kind of atom
2. A chemical element is found on the periodic table
3. All elements are made of atoms
4. Atoms of the same element are alike.

### **Chemical Symbols**

Elements are represented by chemical symbols. These are one or two letters, usually the first letter of the English, Latin or Greek names of the element. For example, H is the symbol for hydrogen and C is the symbol for carbon.

Also, the symbol may be the first two letters of the element; the second letter being small. For example, Li is the symbol for lithium and Al is the symbol for aluminium.

Again, the chemical symbols of some elements are obtained from their Latin or Greek names. For example, the chemical symbol for sodium is Na, Natrium in Latin.

**NOTE:** The elements, their symbols and atomic numbers have been placed in a table called the **periodic table**.

### The Periodic Table

The Periodic Table was discovered by a Russian Chemist called Dmitri Mendeleev in 1869. Mendeleev designed the periodic table to systematically categorize elements according to their atomic weight.

The **Periodic Table** is a tabular chart of the chemical elements arranged according to their atomic number so that elements with similar properties are in the same group.

**Table 1.4: The First Twenty (20) Elements and their Chemical Symbols with their Atomic Numbers and Electronic Configuration**

Element	Chemical Symbol	Atomic Number	Electronic Configuration
Hydrogen	H	(z) 1	(e) 1
Helium	He	2	2
Lithium	Li	3	2, 1
Beryllium	Be	4	2,2
Boron	B	5	2,3
Carbon	C	6	2,4
Nitrogen	N	7	2,5
Oxygen	O	8	2,6
Fluorine	F	9	2,7
Neon	Ne	10	2,8
Sodium	Na	11	2,8,1
Magnesium	Mg	12	2,8,2
Aluminum	Al	13	2,8,3
Silicon	Si	14	2,8,4
Phosphorus	P	15	2,8,5
Sulphur	S	16	2,8,6
Chlorine	Cl	17	2,8,7
Argon	Ar	18	2,8,8
Potassium	K	19	2,8,8,1
Calcium	Ca	20	2,8,8,2

**Table 1.5: Some Elements, their Latin Names and Chemical Symbols**

Element	Latin Name	Chemical Symbol
Sodium	Natrium	Na
Potassium	Kalium	K
Iron	Ferrum	Fe
Tin	Stannum	Sn
Lead	Plumbum	Pb
Mercury	Hydragrum	Hg
Copper	Cuprum	Cu
Silver	Argentum	Ag
Gold	Aurum	Au

### Arrangements of Elements on the Periodic Table

On the table, elements are arranged in Periods and Groups.

The **columns (vertical)** arrangement constitutes the **groups**. For example, Sodium and Lithium are both found in Group 1 because both of them have one electron in their outermost shells.

The **rows (horizontal)** arrangement constitutes the **period**.

#### NOTE:

- ✓ Elements in the same group have the same number of valence electrons or common chemical properties.
- ✓ Elements in the same period have the same number of shells.

Knowing the position of an element on the periodic table reveals the characteristics of that element. It can also be used to predict the properties of elements.

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Period 1	1 H Hydrogen							2 He Helium
Period 2	3 Li Lithium	4 Be Beryllium	5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
Period 3	11 Na Sodium	12 Mg Magnesium	13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulphur	17 Cl Chlorine	18 Ar Argon
Period 4	19 K Potassium	20 Ca Calcium						

The position of an element on the periodic table determines whether it is a metal, non-metal or semi-metal (metalloid).

### **Classifications of Elements**

Elements have been classified into metals, non-metals and semi-metals (metalloids) according to their chemical and physical properties.

### **Identifying Metals, Non-metals and Noble Gasses or Rare Gasses and Semi-metals (Metalloids)**

#### **Metals**

Metals are elements that form ions by losing electrons. They are elements on the left of the periodic table (from groups 1 to 3) except **Boron**.

**Examples of metals are:** sodium, magnesium, aluminum, zinc, copper, lead, iron, silver, gold, mercury, potassium, calcium etc.

#### **Physical Properties of Metals**

1. Metals are malleable: that is, can be beaten into thin sheets.
2. Metals are ductile: that is, can be stretched into wire.
3. Metals are good conductors of heat and electricity.
4. Metals have a shinny appearance (metallic luster).
5. Metals are solid at room temperature.
6. Metals have high density.
7. Metals have high melting point.
8. From the 20 elements, all metals end with “lum” except Helium.  
For example Sodium, Lithium, Beryllium etc.

#### **Uses of Metals**

Metals are used in our everyday life. Among the uses are:

1. Kitchen utensils and water boilers are made from metals due to their high conductivity
2. Metals are also used for making coins
3. Metals are used for making wires and sheets for roofing buildings and wiring of buildings
4. Parts of devices such as automobiles, machinery, water boilers, industrial gadgets etc. are made from metals.

#### **Non-metals**

Non-metals are elements that form ions by gaining electrons. They are the elements on the right of the periodic table (from groups 4 to 8) except **Silicon**.



**Examples of non-metals are:** oxygen, nitrogen, carbon, iodine, sulphur, helium, neon, chlorine, argon, fluorine, phosphorus etc. Non-metals are solids and gases but only Bromine is liquid.

### Physical Properties of Non-metals

1. Non-metals are poor conductors of heat and electricity
2. Non-metals are brittle if solid
3. Non-metals do not possess metallic lustre
4. Non-metals are non-ductile
5. Non-metals are solids, liquids or gases at room temperature
6. Non-metals have low densities
7. Non-metals have a low melting point.

### Uses of Non-metals

1. Non-metals such as Nitrogen and Phosphorus are used in making fertilizer
2. Non-metals like Sulphur is useful in crackers
3. Non-metals such as Chlorine and Fluorine are mostly used in water purification
4. Non-metals such as Chlorine, Sulphur, Iodine etc. are useful in medicine preparation
5. Non-metals such as oxygen are used to generate energy for life activity.

**Table 1.6: Differences between Metals and Non-metals**

S/N	Metals	Non-metals
1.	Metals have high density	Non-metals have low density
2.	Metals are malleable	Non-metals are not malleable
3.	Metals are good conductors of heat and electricity	Non-metals are poor conductors of heat and electricity
4.	Metals have a high melting point	Non-metals have a low melting point in the solid state
5.	Metals have shiny surfaces	Non-metals have dull surfaces
6.	Metals are ductile	Non-metals are brittle.

### Semi-metals/Metalloids

Semi-metals/Metalloids are the elements that show properties of both metals and non-metals.

**Examples of Semi-metals/Metalloids are:** for the first twenty (20) elements, Boron and Silicon are semi-metals (metalloids). Other examples of semi-metals (metalloids) include germanium, arsenic, antimony, tellurium, polonium etc.

## Physical Properties of Semi-metals/Metalloids

1. Semi-metals/Metalloids are usually malleable
2. Semi-metals/Metalloids can gain and lose electrons in a reaction
3. Semi-metals/Metalloids are usually ductile
4. Semi-metals/Metalloids could be dull or shiny
5. Semi-metals/Metalloids conduct heat and electricity but not as well as metals.

## Some Other Groups in the Periodic Table

1. **Noble Gases:** Noble gases are elements in **group 8** on the periodic table. They are noble because they are stable elements because their outermost shells are fully filled with electrons. They are mostly colourless, odourless and non-reactive in nature. They are also called **inert gases**.

**Examples of noble gases are:** Helium, Neon, Argon and Krypton.

2. **Alkali Metals:** Alkali metals are elements in **group 1** on the periodic table.

**Examples of Alkali metals are:** Hydrogen, Lithium, Sodium and Potassium.

3. **Alkali-earth Metals:** Alkali-earth Metals are elements in **group 2** on the periodic table.

**Examples of Alkali-earth Metals are:** Beryllium, Magnesium and Calcium.

4. **Halogens:** Halogens are elements in the **group 7** on the periodic table.

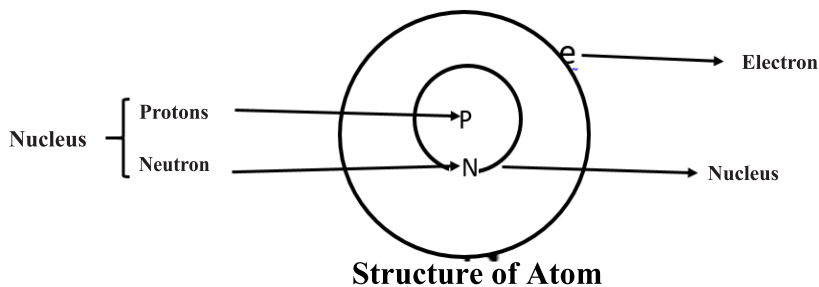
**Examples of Halogens are:** Fluorine and Chlorine.

## Atom

An atom is the smallest particle of an element that can take part in a chemical reaction.

### Structure of an Atom

- ✓ An atom is made up of protons, electrons and neutrons.
- ✓ The nucleus of an atom is made up of protons and neutrons.
- ✓ Protons are positively charged particles and neutrons have no charge.
- ✓ The negatively charged electrons orbit around the nucleus.
- ✓ The protons, neutrons and electrons are the sub-atomic particles.



## The Atomic Structure

The difference among the three sub-atomic particles of an atom

Sub-Atomic Particle	Relative Mass	Relative Charge
Proton	1	+1
Neutron	1	0
Electron	$\frac{1}{1840}$	-1

### Atomic Number


The atomic number or the proton number symbol (Z) of a chemical element is the number of protons in the nucleus of every atom of that element.

Atoms of different elements have different atomic numbers and hence have different electron numbers. The atomic number uniquely identifies a chemical element.

**For example:** from table 8 are various atomic numbers for the first twenty (20) elements. For example, the atomic number of hydrogen (H) is 1, the atomic number of Lithium (Li) is 3 etc.

### Note the Following:

- ✓ In a neutral atom, the number of protons is equal to the number of electrons. This makes the atom electrically neutral.
- ✓ An orbital is a volume of space around the nucleus where there is a high probability of finding an electron.
- ✓ The shells or energy levels are labelled K, L, M, N, O etc. These letters represent the principal quantum number (n).
- ✓ The maximum number of electrons that can be accommodated in a shell is determined using the formula,  $2n^2$ , where  $n$  is the principal quantum number for that particular shell
- ✓ Electrons in different shells have different energies.

Principal Quantum Number (n)	1	2	3	4	5	etc
Name Of Shell	K	L	M	N	O	
Maximum number of electrons	2	8	18	32	50	
Energy						

## Electronic Configuration

Electronic configuration is the way electrons are distributed or arranged in the shells of an atom. Elements with different electronic arrangements have different properties and elements with similar electron arrangements have similar properties.

Look at the **examples of atoms** and the maximum number of electrons they can accommodate.

**Hydrogen atom:**  ${}_1\text{H}=1$

**Lithium atom:**  ${}_3\text{Li}=2:1$  or 2, 1

**Neon atom:**  ${}_{10}\text{Ne}=2:8$  or 2, 8

**Argon atom:**  ${}_{18}\text{Ar}= 2:8:8$  or 2, 8, 8

**Calcium atom:**  ${}_{20}\text{Ca}=2:8:8:2$  or 2, 8, 8, 2

**Potassium atom(K)** =  ${}_{19}\text{K} = 2:8:8:1$  or 2, 8, 8, 1

**NOTE:** The valence electrons are responsible for the chemical properties of the atom.

## Mass Number

Mass number is the total number of protons and neutrons in the nucleus of an atom.

Mass number = Proton number + Neutron number

A = P + N

**Example:** An atom has 11 protons and 12 neutrons. Calculate:

i. mass number    ii. number of electrons

**Solution:**

i. Mass number = proton number + neutron number  
=  $11+12 = 23$

ii. Number of electrons = number of protons  
= 11 electrons

## SELF-ASSESSMENT TASK

**Exercise 1- Objective Type Questions**                      **Date:...../...../20.....**

**Answer the following questions by circling the correct answer**

1. Which of the following is **not** a liquid?

A. Water

B. Kerosene

C. Petrol

D. Naphthalene ball

2. When a piece of candle is heated, it changes from

A. liquid to gas      B. liquid to flame      C. solid to liquid      D. solid to gas

3. Which of the following properties is common to both liquids and gases?

- A. Fixed shape      B. Fixed volume  
C. No definite shape      D. No definite volume

4. An example of a noble gas is?

- A. Chlorine      B. Nitrogen      C. Neon      D. Oxygen

5. The atom of an element has 4 protons and 5 neutrons in its nucleus. How many electrons have the atom?

- A. 1      B. 2      C. 3      D. 4

**Exercise 2– Essay Type Questions**

**Date:...../.....20.....**

**Answer All the Questions**

1. Classify the following substances as solid, liquid or gas: palm oil, soap, carbon dioxide, corn flour, smoke, pen, pencil, fire extinguisher and water.

2. How can water be a solid, a liquid and a gas?

3. Mention **four** importance of liquids in the life of humans

4. Mention **four** properties of each of the following substances:

- i. Metals      ii. Non-metals      iii. semimetals      iv. Noble gases

5. a. What is an atomic number?

b. State the atomic numbers of each of the following elements:

- i. Potassium      ii. Sodium      iii. Mercury      iv. Magnesium      v. Calcium

**PROJECT WORK**

1. a. With the help of the internet, draw a labelled diagram to show the arrangement of all the particles in the atom.

b. Give the chemical symbols of the following elements:

- i. Oxygen      ii. Chlorine      iii. Potassium      iv. Calcium

**HOME LEARNING**

1. a. Explain why atoms are electrically neutral.

b. Why a Carbon and Silicon are in the same Group on the periodic table?

## Sub-Strand 2: Living Cells

**Content Standard:** This sub-strand will be guided by the following content standard:

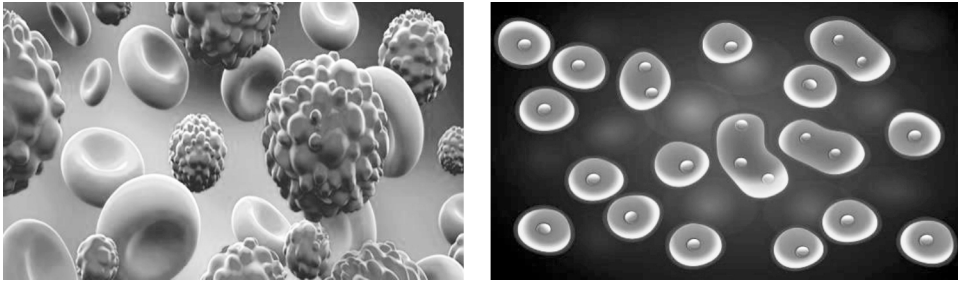
1. Demonstrate understanding of the structure of organisms and functions of cells in living systems.

**Indicators:** By the end of this section, you should be able to:

1. Describe the structure and function of the living cells of an animal
2. State the functions of each organelle in a plant cell.

### **WARMER**

*We have learnt that matter is made up of tiny particles (atoms, molecules or ions). These tiny particles form the basic unit of matter. For living things, their basic functional unit is the **CELL**.*



### **Meaning of Living Cells**

A living cell is the smallest unit of a living organism. Or a living cell is a building block of life. It is the cell within the organism that performs all the life processes, including respiration, growth, digestion, excretion, absorption, nutrition etc.

All living things are made up of cells. Some living things consist of only one cell and are called **unicellular organisms**. **Examples of unicellular organisms** are amoeba, paramecium, euglena etc.

Also, other living things are made up of many cells and they are called **multicellular organisms**. **Examples of multicellular organisms** are humans, goats, sheep, monkeys, rabbits, rats, plants, cocoa etc.

### **Animal and Plant Cells**

A living cell could be an **animal cell** or a **plant cell**.

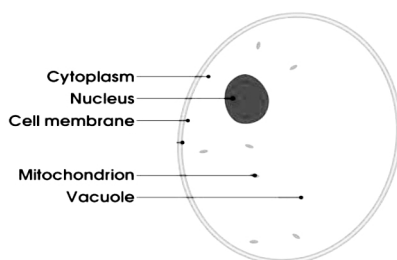
### ***Meaning of Animal Cell***

Animal cells are cells with a membrane-bound nucleus. In addition to having a nucleus, animal cells also contain other membrane-bound organelles, or tiny cellular structures, that carry out specific functions necessary for normal cellular operation.

**Examples of animal cells** are sperm cells, nerve cells, ovum, red blood cells, and white blood cells.

### **The Structure of an Animal Cell**

An animal cell is the basic structural and functional unit of animal tissues and organs. It consists of **three** main parts: the **cell membrane**, the **nucleus** and the **cytoplasm**.



**Figure 1.1: The Structure of Animal Cell**

### **Organelles**

Organelles are structures within a cell that perform specific functions that are necessary for the survival of the cells like controlling cell growth, producing energy, making new proteins, getting rid of waste and so on. Examples of organelles include Nucleus, Cell Membrane, Cytoplasm, Mitochondria, Vacuoles, Ribosomes, Chloroplast etc.

### **Functions of the Organelles in Animal Cells/Parts of the Animal Cells and their Functions**

#### ***Cell Membrane***

Cell membrane is a thin layer that surrounds the cell. It is semi-permeable which means it allows certain substances to pass through it. The cell membrane is made of **protein** and **lipids** (fats and oil).

#### **Functions of Cell Membrane**

1. Cell membrane supports the cell and gives it shape
2. Cell membrane protects the cell
3. Cell membrane separates the cell from the outer environment
4. Cell membrane regulates the transport of materials in and out of the cell
5. Cell membrane acts as a receptor.

### ***Cytoplasm***

The cytoplasm contains all the living structures or materials in a cell. It consists of a mixture of jelly-like portions of the cell.

#### **Functions of Cytoplasm**

1. Cytoplasm is responsible for giving a cell its shape
2. Cytoplasm contains salts or sugars (food)
3. Cytoplasm is the site where all chemical reactions take place
4. The cytoplasm expels waste materials through the cell membrane
5. Within the cytoplasm are many distinct structures called organelles.

### ***Nucleus***

The nucleus is a small spherical structure in the cytoplasm. It is surrounded by its own membrane called the nuclear membrane. The nuclear membrane controls the movement of substances in and out of the nucleus. The nucleus is the largest organelle.

#### **Functions of Nucleus**

1. The nucleus controls live activities of the cell, for example, growth and metabolism
2. The nucleus controls heredity or it contains heredity units called genes
3. The nucleus is responsible for cell division
4. The nucleus controls protein synthesis
5. The nucleus controls cell reproduction.

### ***Vacuoles***

Vacuole is a bag or sack-like structure containing fluid within the cell. The fluid is a watery solution which consists of dissolved food substances such as sugar, salt and other chemical substances. Vacuoles are small and temporary in animal cells.

#### **Functions of Vacuole**

1. Vacuole stores dissolved food substances such as sugar and salt in the cell
2. Vacuole gets rid of harmful toxins in the cell
3. Vacuole isolates materials that might be harmful or a threat to the cell
4. Vacuole helps maintain water balance
5. Vacuole stores waste products.

### ***Mitochondria***

Mitochondria are sausage-shaped organelles in the cytoplasm. They are membranous structures with their inner parts folded inwards to form layers called **cristae**.






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