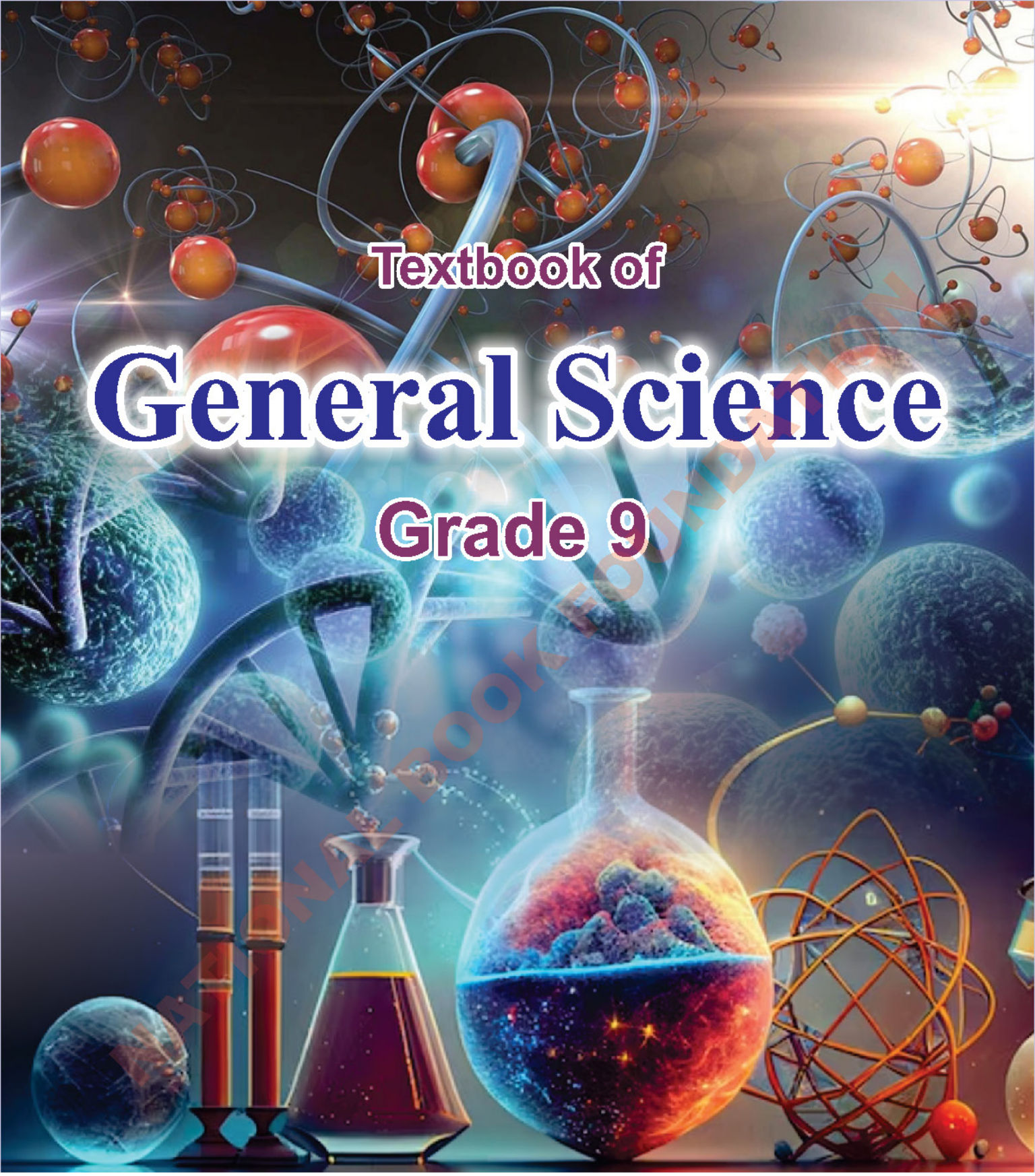

Textbook of

General Science

Grade 9

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Textbook of

General Science

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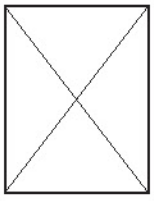
Model Textbook of **Biology**
for Grade 9



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PREFACE

بِسۡمِ اللّٰہِ الرَّحۡمٰنِ الرَّحِیۡمِ

اللہ کے نام سے شروع جو بڑا مہربان، نہایت رحم والا ہے

Contents

Chapter 1

NATURE OF SCIENCE

SLOs: After completing this lesson, the student will be able to:

1. Explain the nature of science.
2. Enlist the main branches of science and explain their applications.
3. Describe the relationship between different branches of science and name some interdisciplinary fields of science.
4. Justify with examples that science is a collaborative field that requires interdisciplinary researchers working together to share knowledge and critique ideas.

1.1 NATURE OF SCIENCE

Science comes from the Latin word *scientia* meant knowledge or learning. When you look at the sky at night you observe moon and stars. You wonder why moon and stars are not seen at the day time. Asking this type of question is the first step in doing science. Science is the process of collecting information about the world around us. Much of the time, the first step in collecting information is asking question. The study of science helps us answer how, what, where and why of our surroundings.

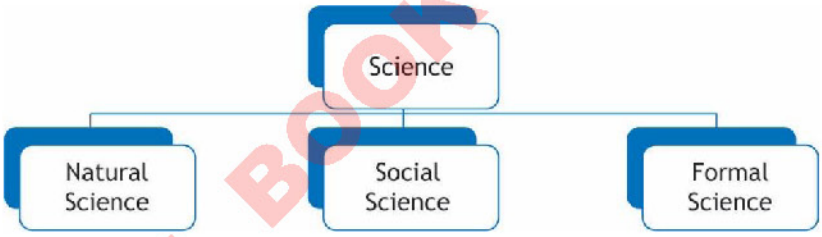
The conclusion of science is subject to change. In science, new studies utilize new techniques and equipment. These might modify or change the previous conclusion. The ultimate goal of science is to understand the natural world in terms of concepts based on conclusions of experiments and observations. Science is a human work. It is a growing and exciting search for what is true. In this sense science is a way of solving problems. For example how can we protect plants from diseases?

1.1.1 MAIN BRQANCHES OF SCIENCE AND THEIR APPLICATIONS

Science is a very vast subject. It has been divided it into some specific branches, so that its study can become simple and easier.

Branches of Science

Modern Science is mainly consists of three main branches. The three main branches of Science are:



1. Natural Sciences

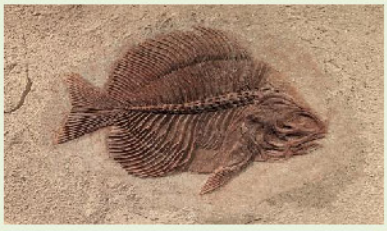
It is the study of the nature of our physical world and the universe.

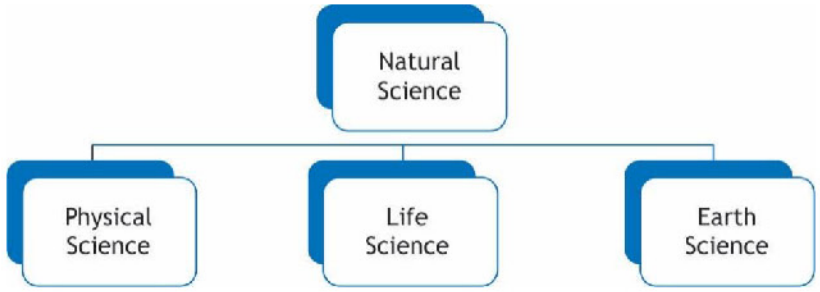
Branches of Natural Science

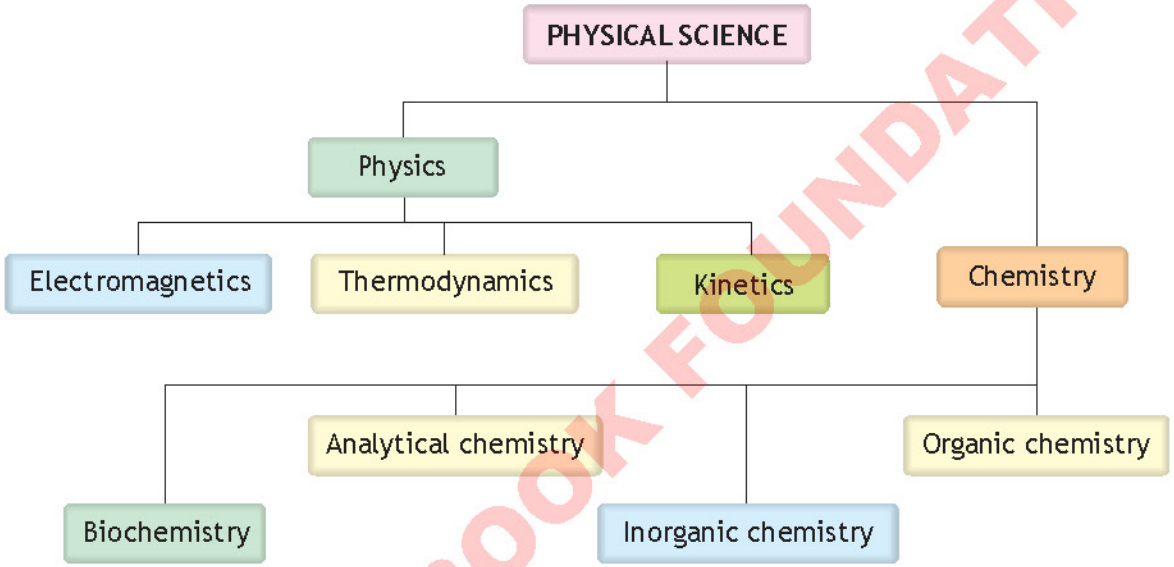
Modern scientific study is divided into three major branches, namely physical sciences, life sciences, and earth sciences. However, Earth Sciences are often included within physical sciences.

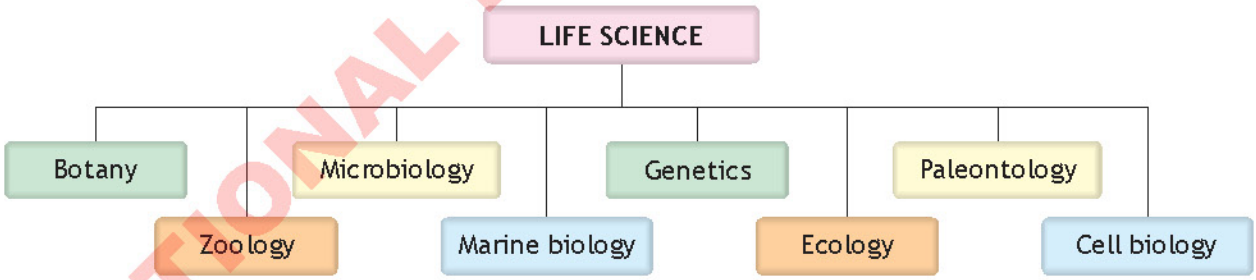
1. **Physical science**: It is the study of the universe.
2. **Life science**: It is the study of life and living organisms.
3. **Earth science**: It includes all fields of natural science related to the planet Earth.

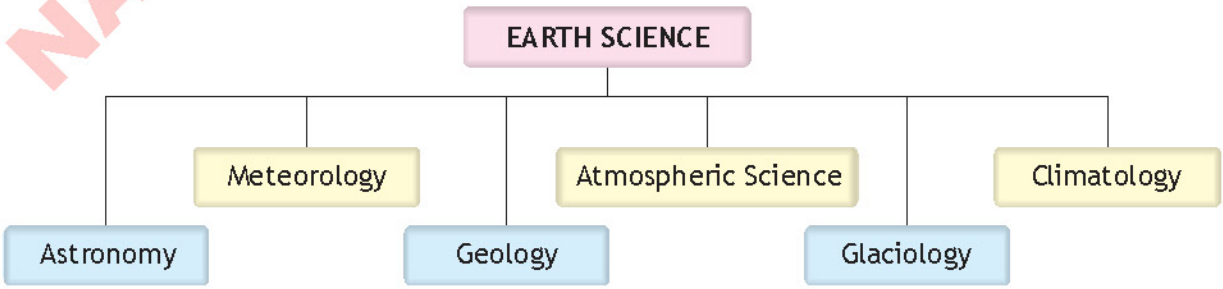
Table 1.1. List of Branches of Natural Sciences and Their Sub-Fields

Physical Sciences	Life Science	Earth Science
Physics: It involves the study of everything in physical existence, from the smallest subatomic particles to the entire universe. **Mechanics**: It is the relationships between force, matter and motion among physical object. **Electromagnetics**: It deals with the electromagnetic force that occurs between electrically charged particles. **Thermodynamics**: It deals with the energy and work of a system. **Kinetics**: It deals with the effects of forces upon the motions of material bodies. **Chemistry**: It deals principally with the properties of substances; the changes they undergo. **Organic chemistry**: It is the study of carbon and its compounds. **Inorganic chemistry**: It is the study of compounds that don't contain a C-H bond. **Physical chemistry**: It applies physics to the study of chemistry **Analytical chemistry**: It is the study of the chemistry of matter. **Biochemistry**: It is the study of chemical processes that occur inside of living organisms.	**Botany**: The branch of biology that deals with the study of plants. **Zoology**: It is the branch of biology that deals with the study animals and animal kingdom. **Microbiology**: It is the study of of microscopic organisms. **Marine biology**: It is the study of marine organisms. **Genetics**: It is the study of how genes and how traits are passed down from one generation to the next. **Ecology**: It is the study of organisms and how they interact with the environment around them. **Paleontology**: It is the study of the history of life on Earth as based on fossils. Fossils are the remains of plants, animals, fungi, bacteria, and single-celled living things that have been replaced by rock material or impressions of organisms preserved in rock.  Fig. 1.1 Fossil **Cell biology**: It (also called cellular biology or cytology) is a branch of biology that studies the structure, function, and behavior of cells.	**Astronomy**: It is the study of everything in the universe beyond Earth's atmosphere. It includes objects that we can see with our naked eyes, like the Sun, the Moon, the planets, and the stars, and objects we can only see with telescopes or other instruments, like faraway galaxies and tiny particles. **Meteorology**: It is the science of weather **Geology**: It means study of the Earth. Also known as geoscience or earth science. Geology is the primary Earth science and looks at how the earth formed, its structure and composition, and the types of processes acting on it. **Atmospheric science**: It is the study of weather analysis and predictability, climate and global change, the circulation of the atmosphere relating to weather systems and their impact on the Earth, air quality, and other atmospheric processes that affect us. **Glaciology**: It is the study of snow and ice. It also includes the study of movement and physical properties of glaciers. **Climatology**: It is the study of the atmosphere and weather patterns over time. It focuses on recording and analyzing weather patterns throughout the world.









Applications of Natural Science

It is applied in Engineering, Agricultural science, Medicine and Pharmacy. The natural sciences have been changing our living and thinking ways.

It promotes critical thinking: Critical thinking entails asking questions, examining evidence and information and later coming to a conclusion. All these factors are usually essential in all natural science.

Helps in developing analytical and organizational skills: Natural science develop excellent analytical skills. This is attributed to the use of existing theories to solve problems and also come up with inventions. Analytical skills help to draw valid conclusions from lab experiments conducted. Organizational skill is another skill that natural science students develop. This skill is not only essential in school but also benefit the students while in the professional world.

It is a great way to start a good career: Studying natural science acts as a good way to start a career in scientific research, scientific analysis and also in testing and investigation.

Helps to understand the natural world: Studying natural science is vital as it helps to acquire analytical skills, critical thinking skills and gives an understanding of the natural world.

Some common careers involving physical science are:

1. **Physicist**: Physicists are responsible for creating and testing theories in physics.
2. **Quantum physicists**: Quantum physicists are scientists who specialize in quantum physics, which involves the behaviour of the universe at an atomic and subatomic scale.
3. **Chemists**: Chemists are scientists who conduct experiments on molecular matter. They often test and create different chemicals for a variety of purposes.
4. **Astronomers**: Astronomers are scientists who study the universe outside of earth, including galaxies, planets and stars.
5. **Computer scientist**: Computer scientists can also benefit from a physics background. Computer scientists are responsible for finding ways to use computers to solve problems.

Some common careers involving life sciences science are:

1. **Marine biologist**: Marine biologists are scientists who study marine life.
2. **Pharmacologists**: Pharmacologists are scientists who study and develop medications to treat diseases.
3. **Forensic scientist**: Forensic scientists are responsible for analyzing crime scenes and evidence to help solve crimes. Often, forensic scientists examine evidence in laboratories.
4. **Agricultural scientist**: Agricultural scientists study and conduct experiments related to crops and farm animals to help improve the industry of farming.
5. **Virologist**: Virologists are scientists who study viruses to develop methods to prevent virus infections and outbreaks.

Some common careers involving life sciences science are:

1. **Meteorologist**: Meteorologists are responsible for analyzing the weather and preparing weather forecasts.
2. **Land planners**: Land planners can also use knowledge of earth science. Land planners are responsible for planning how to regulate and develop the land.
3. **Geologists**: Geologists are scientists who study rocks and other solid parts of the earth and other planets.
4. **Paleontologists**: Paleontologists are scientists who study the earth's history by examining **fossils**.
5. **Environmental scientist**: Environmental scientists are concerned with the earth's environment. They can use knowledge of earth science to come up with ways to protect the health of the earth and the health of humans

2. Social Sciences

Social Sciences study human societies from across the globe as well as the relationship of human beings with their social environment.

The main branches of social sciences are:

1. **Psychology**: It is the scientific study of the mind and behaviour.
2. **Sociology**: It is the study of social life, social change, and the social causes and its result on human behaviour.
3. **Anthropology**: It is the study of the origin and development of human societies and cultures.
4. **Economics**: It is the study of scarcity, the study of how people use resources and respond to incentives,
5. **Archaeology**: It is the study of the ancient and recent human past through material remains.
6. **History**: The study of past events, particularly in human affairs.
7. **Geography**: It is the study of Earth's landscapes, peoples, places, and environments.
8. **Law**: It is a rule of conduct developed by the government or society over a certain territory. Law follows certain practices and customs in order to deal with crime, business, social relationships, property, finance, etc.
9. **Politics**: It is the activity of government and those involved in the process of governing. It is closely related to the field of political science.

Applications of Social Sciences

1. Social scientists help us imagine alternative futures.
2. Social science can help us make sense of our finances.
3. Social scientists contribute to our health and well-being.
4. Social science might save your life.
5. Social science can make your neighbourhood safer.

6. We need social scientists as public intellectuals.
7. Social science can improve our children's lives and education.
8. Social science can change the world for the better.
9. Social science can broaden your horizons.
10. We need social science to guarantee our democracy.

3. Formal Sciences

It is quite a unique area of study in science. It uses formal systems to produce knowledge. It explores the nature of different disciplines ranging from mathematics, and logic to computer science and Information technology etc.

The most important branches of Formal Sciences are:

1. **Mathematics**: It is the science and study of quality, structure, space, and change.
2. **Logic**: It is the science of the formal principles of reasoning.
3. **Computer Science**: It focuses on the development and testing of software and software systems.
4. **Data Science**: It is the study of data to extract meaningful insights for business. It combines principles and practices from the fields of mathematics, statistics, artificial intelligence, and computer engineering to analyze large amounts of data.
5. **Statistics**: It is a mathematical body of science that pertains to the collection, analysis, interpretation or explanation, and presentation of data.
6. **System Science**: It is an interdisciplinary field that studies the complexity of systems in nature, social or any other scientific field.
7. **Artificial Intelligence**: It is a rapidly evolving technology. It tries to simulate human intelligence using machines, enabling them to perform a wide range of tasks, from simple to complex.
8. **Information Technology**: It is a set of related fields that encompass computer systems, software, programming languages and data and information processing and storage. It forms part of information and communications technology.

Applications of Formal Sciences

A "formal science" is an area of study that uses formal systems to generate knowledge. Formal sciences are important subjects because all of quantitative science depends on them. It is applied in computer science, Statistics, mathematics. The formal sciences aid the natural and social sciences by providing information about the structures used to describe the physical world.

For Your Information

Applied Sciences

In applied science it is study about how to theories of a subject apply for the humans' applications. Such as making inexpensive fuels for energy requirements. This branch is a significant branch of science. Because we want an application from science rather than knowing the theories. All of the industrial applications come with applied sciences studies. Also, all of the science subjects have an applied science area, for example, applied physics, applied mathematics, applied biology, etc.

1.3 RELATIONSHIP BETWEEN DIFFERENT BRANCHES OF SCIENCE

While branches of science may seem distinct, they are often interconnected. For example, natural science and social science may overlap in fields such as environmental science, where scientists study the impact of human behavior on the natural world. Similarly, formal science can be applied to the natural and social sciences to create mathematical models that help explain complex phenomena. Ultimately, all the branches of science are part of a broader effort to understand the world we live in and our place within it.

Examples of interdisciplinary fields of science

Biochemistry, Bioinformatics, Cognitive Science, Complex systems Physics, Artificial intelligence, Biomedical engineering, Chemistry and Ecology etc. are the few examples of interdisciplinary fields of science.

Cognitive science: It is the interdisciplinary, scientific study of the mind and processes with input from linguistic, psychology, neuroscience, philosophy, computer science, and artificial intelligence.

Complex system: Examples of **complex systems** are Earth's global climate, organisms, and the human brain, infrastructure such as power grid, transportation or communication systems.

Bioinformatics: **It** is an interdisciplinary field of science that develops methods and software tools for understanding biological data.

Biomedical engineering: It is the application of the principles and problem-solving techniques of engineering to biology and medicine.

1.4 SCIENCE IS A COLLABORATIVE FIELD

When two or more scientists work together to achieve a common goal, it is called scientific collaboration. This can be in the form of sharing data, working together on a research project. In science, collaboration is about sharing information, resources, and ideas.

Meaning of Collaboration in Science: The meaning of collaboration is to work with other people to solve major problems. Scientists can collaborate with each other on different levels. For example, one scientist may need help from another scientist to run an experiment or get a piece of equipment for the experiment. Scientists may also collaborate with people outside their field of study, such as historians or other scientists, who are studying different things but have information that could be helpful for a particular project.

Importance of Collaboration in Science: Due to collaboration scientists can make new discoveries, improve their work and share their findings with the world. When a group of scientists collaborates on a project, they can pool their resources. Thus they can do more work in less time. Collaboration also helps people learn from one another.

Public health combines information from medicine, sociology, and psychology. There's a special issue about research collaboration during the COVID era, showing how it's good for both science and society when we work together across borders, cultures, and different fields of study.

Example of Science Collaboration: One famous example of scientists working together is the International Space Station, where space agencies from Europe, the USA, Russia, and Japan all team up.

In order to keep moving science forward, we need everyone involved—from students to teachers—to collaborate and share ideas, data, and results.

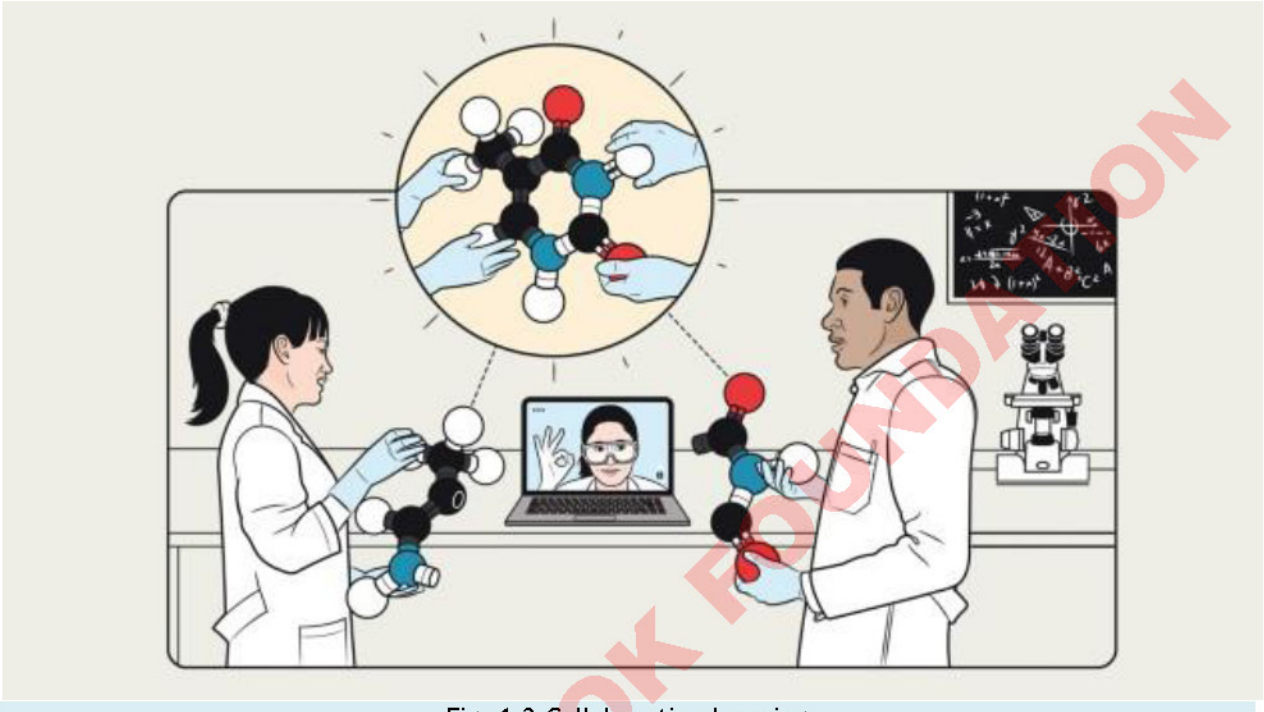


Fig. 1.2 Collaborative learning

Do you know?

A STEAM activity is a lesson that covers the core STEAM subjects: Science, Technology, Engineering Arts and Math.

STEAM ACTIVITY 1.1

Topic: CLIMATE CHANGE

The teacher will divide the students into three groups. Each group may comprise of 3-5 students. and give each group different subtopics related to climate change. The students will investigate or research on the topics given.

Group 1: Causes of climate change.

Group 2. Effects of climate change.

Group 3. To overcome the problem of climate change.

a. The students will be given five days to prepare their research work.
b. Each group will read their research paper in the classroom before the students.
c. Then the teacher will ask each group to work together and prepare a joint research paper on 'Climate change' and submit.

SUMMARY

1. Science means knowledge or learning.
2. Science is the process of collecting information about the world around us.
3. Science has been divided it into some specific branches, by so that its study can become simple and easier.
4. The three main branches of science are: Natural Sciences, Social Sciences, and Formal Sciences
5. Natural Sciences is the study the nature of our physical world and the universe.
6. The three major branches of science are: Physical Sciences, Life Sciences, and Earth sciences. However,
7. Physical science is the study of the universe.
8. Life science is the study of life and living organisms.
9. Earth science includes all fields of natural science related to the planet Earth.
10. The main branches of Physical Science are Physics and chemistry.
11. The main branches of physics are Mechanics, Electromagnetics, Thermodynamics and Kinetics.
12. The main branches of Chemistry are Organic chemistry, Inorganic chemistry, Analytical chemistry and Biochemistry
13. The main branches of Life science are Botany, Zoology, Microbiology, Marine biology, Genetics, Ecology, Paleontology and Cell biology
14. The main branches of Earth Science are Astronomy, Meteorology, Geology, Atmospheric Science, Glaciology and Climatology
15. Natural Science is applied in Engineering, Agricultural science, Medicine and Pharmacy.
16. Social sciences study human societies from across the globe as well as the relationship of human beings with their social environment.
17. The main branches of sciences are: Psychology, Sociology, Anthropology, Economics, Archaeology, History, Geography, Law and Politics
18. Social scientists help us to imagine alternative futures to, make sense of our finances. They contribute to our health and well-being. They might save your life. They can improve our children's lives and education. We need social science to guarantee our democracy.
19. Formal sciences use formal systems to produce knowledge. It explores the nature of different disciplines.
20. The most important branches of Formal sciences are Mathematics, Logic, Computer Science, Data Science, statistics, Systems science, Artificial intelligence and Information technology
21. Formal sciences are important subjects because all of quantitative science depends on them. It is applied in computer science, Statistics, mathematics.

22. Branches of science are often interconnected. For example, natural science and social science may overlap in fields such as environmental science. All the branches of science are part of a broader effort to understand the world we live in and our place within it.
23. Biochemistry, Bioinformatics, Cognitive science, Complex systems Physics, Artificial intelligence, Biomedical engineering, Chemistry and Ecology etc. are the few examples of interdisciplinary fields of science.
24. When two or more scientists work together to achieve a common goal, it is called scientific collaboration.

EXERCISE

Section I: Multiple Choice Questions

Select the correct answer:

1. Science means:

   A) knowledge B) observation C) experiment D) try and error

2. Which one is the study the nature of our physical world and the universe?

   A) natural science B) social science C) formal science D) applied science

3. Which one is the study of life and living organisms?

   A) physical science B) life science C) earth science D) soil science

4. Which one includes all fields of natural science related to the planet Earth?

   A) physical science B) life science C) earth science D) soil science

5. The study of how genes and how traits are passed down from one generation to the next is called .....

   A) cell biology B) genetics C) ecology D) microbiology

6. Which one is NOT a branch of chemistry?

   A) organic chemistry B) inorganic chemistry C) biochemistry D) mechanics

7. Meteorology is the science of .....

   A) weather B) rainfall C) earthquake D) earth life

8. Natural Science is applied in .....

   A) engineering B) agricultural science C) medicine D) all of these

9. Which one is the study of organisms and how they interact with the environment around them?

   A) cell biology B) marine biology C) genetics D) ecology

10. Why do we need social science? To guarantee our:

    A) democracy B) history C) freedom D) foreign policy

Section II: Short Answer Questions

1. Define the following branches of science and give at least one significance of studying these branches:

   a) Natural sciences b) Social sciences c) Formal sciences d) Physical science

2. Why do we divide science into branches?
3. What are the three main branches of science?
4. What are the three main branches of natural science?
5. List the branches of natural science and their subfield.
6. Give examples of interdisciplinary fields of science.
7. How science is a collaborative field?

Section III: Extensive Answer Questions

1. Write a note on:

   a) Natural sciences

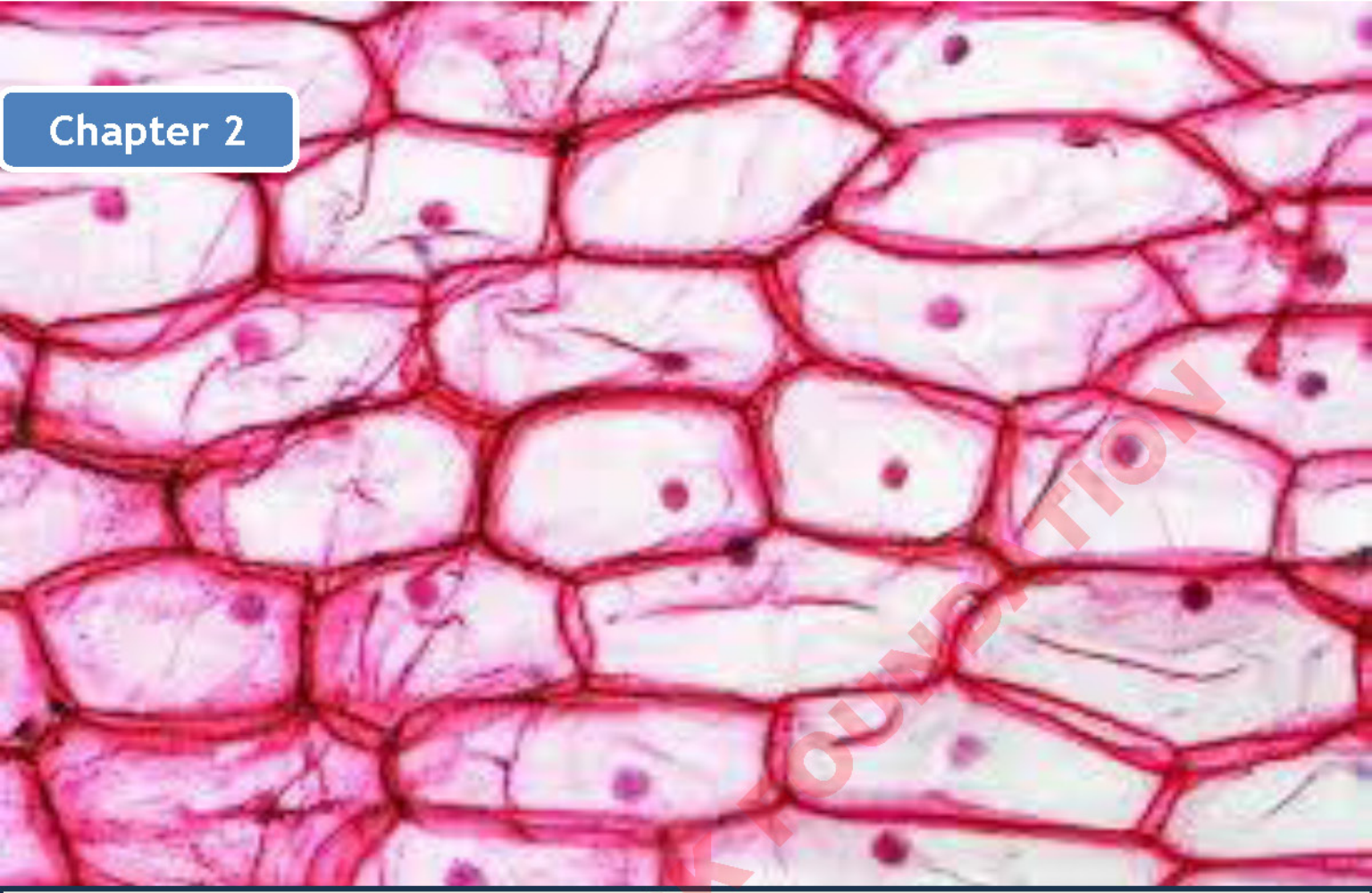
   b) Social sciences

   c) Formal sciences

2. What are the applications of?

   a) Natural sciences
   b) Social sciences
   c) Formal sciences

3. How branches of science are interrelated with each other?
4. Explain that science is a collaborative field.



Chapter 2

CELLS AND TISSUES

SLOs: After completing this lesson, the student will be able to:

1. Define cell as the basic unit.
2. Describe different organelles of a cell.
3. Differentiate between plant cell and animal cell.
4. Describe different types of tissues in plants (epidermal, xylem) and animals (epithelial, muscular and nervous).
5. Make a three -D model of plant and animal cell.

2.1 CELL

Rober Hooke was an English scientist. In 1665 he looked at the thin pieces of cork under a simple microscope. He observed that the cork was made of tiny empty spaces with walls around them. Under the microscope the cork looked like a honeycomb. The honeycomb like spaces reminded Hooke of small rooms called 'cells' in a monastery. So he called these spaces in the in the cork '**cells**'. Today we know that he saw the thick, outside cell walls of the cork. Organnisms are made of cells. All cells are produced from other cells through cellular division.

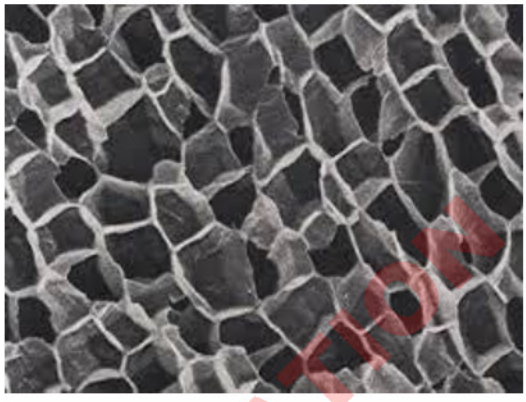


Fig.2.1 Cork cells

When you read, the contraction of muscle cells move your eyes. When you move your hand, nerve cells will transmit message from brain to the muscle cells of your hand.

The cells are defined as the structural and functional unit of all unicellular organisms e.g., Amoeba and multicellular organisms e.g., frog. Cells respond to environmental changes. Cell is the smallest unit and building block of living things. In every cell some of the basic functions take place, whether it is unicelluar or multicellula organisms. So the cells are called the functional unit of living things.

Cells are of various shape and sizes. Cells perform a wide range of activites such as movement, repiration, growth and reproduction etc.

Cellular strucutre and functions

The cell contains highly organized structure called **cell organelles**. There are some structures in the cell that are not organelles. These structures are cell wall, cell membrane, cytoplasm and cytoskeleton.

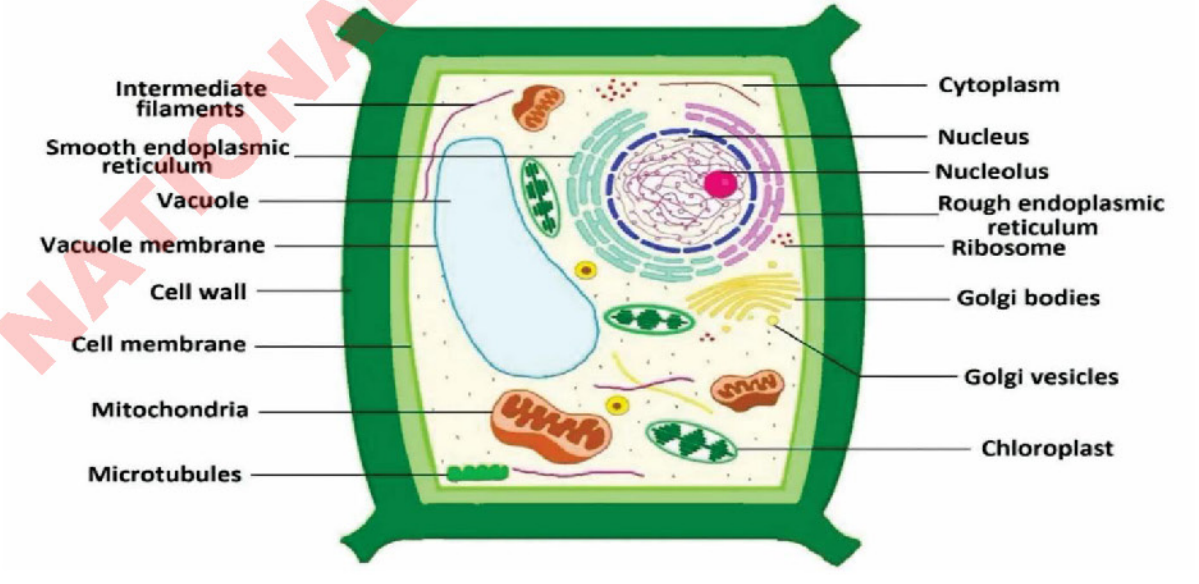


Fig.2.2 Plant cell (as seen under electron microscope)

a. Cell wall

The cell wall is present in plant cells, prokaryotes, fungi and some protists. Animal cells do not have cell walls. The cell wall is an extra cellular structure in plant cells. The cell wall protects the plant cell, maintains its shape. The cell wall is secreted by the cell. The cell wall is porous. It allows free passage of dissolved water and dissolved materials.

b. Cell membrane

The cell membrane is the covering of the cytoplasm. It is found in all living prokaryotic and eukaryotic cells. Cell membrane is a semipermeable membrane. It maintains the internal composition of cell.

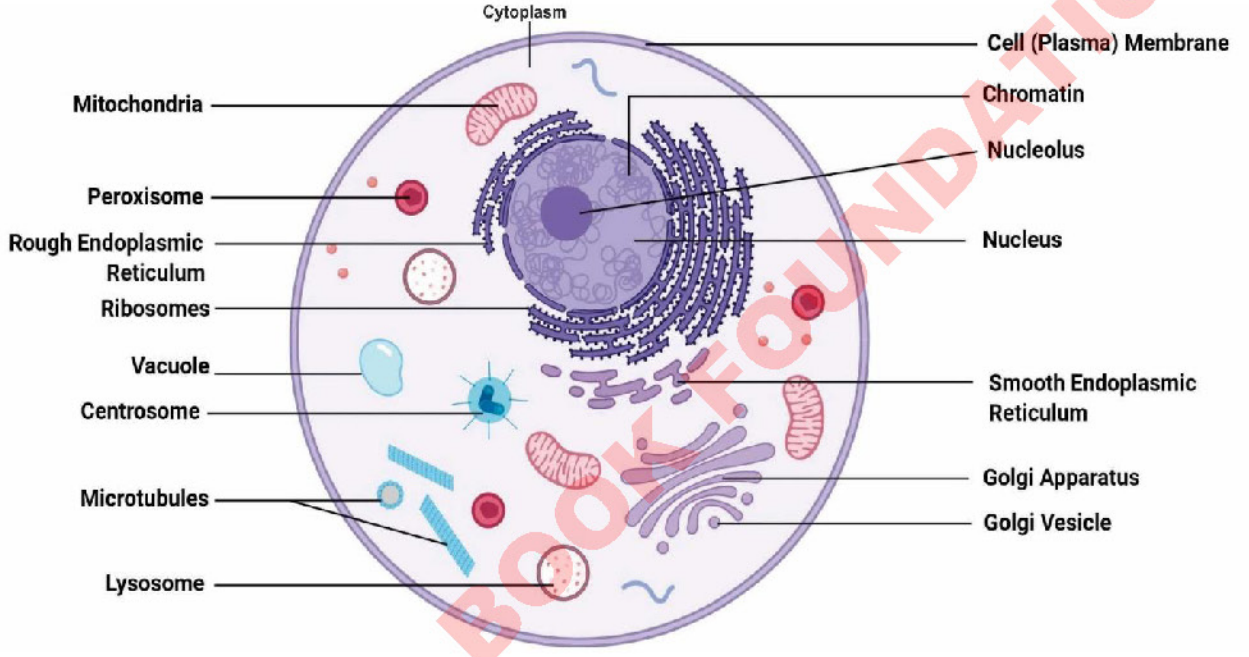


Fig.2.3 Animal cell (as seen under electron microscope)

c. Cytoplasm

It is present between plasma membrane and nuclear envelope. Cytoplasm is semi-viscous and semitransparent substance. It contains water in which proteins, carbohydrates, lipids and inorganic salts are dissolved. Cytoplasm provides space for the functioning of the organelles. Cytoplasm acts as the site for various biochemical reactions. For example, breakdown of glucose during cellular respiration takes place in cytoplasm.

d. Cytoskeleton

Cell contains a supportive network of the fine fibers, which are called cytoskeleton. **Microfilaments** are thinner and **macro-filaments** are thicker and **intermediate filament** is between the two. They are also major components of cilia and flagella. Cytoskeleton is responsible for the cell shape and movement.

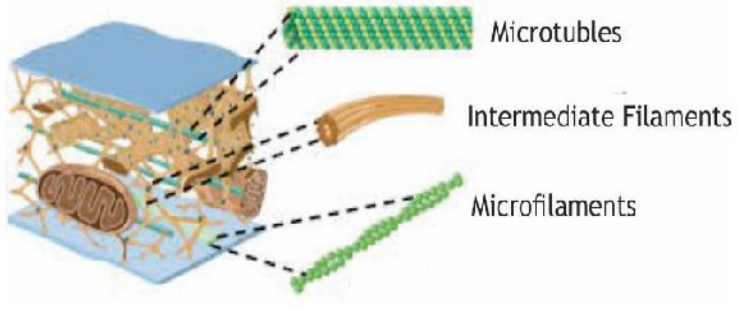


Fig. 2.4 Cytoskeleton

2.2 CELL ORGANEELLES: STRUCTURE AND FUNCTIONS

The term organelles literally means "little organs." Organelles are small organized structures within the cytoplasm of a cell. They have specific structure and functions. We will discuss here nucleus, ribosomes, endoplasmic reticulum, Golgi complex, lysosomes, mitochondria, centriole, vacuoles and plastids.

Nucleus

In eukaryotic cells a prominent nucleus occurs. Nucleus is bounded by a double membrane known as **nuclear envelope**. The nuclear envelope has many pores. The fluid inside the nucleolus is called **nucleoplasm**. The dark staining region in the nucleus is called **nucleolus**. The thread like structures in the nucleus are called **chromosomes**. Chemically chromosomes consist of deoxyribo nucleic acid (DNA) and protein. The **centromere** is a constriction in chromosome. A chromosome consists of two chromatids. Nucleus controls all the activities of the cell.

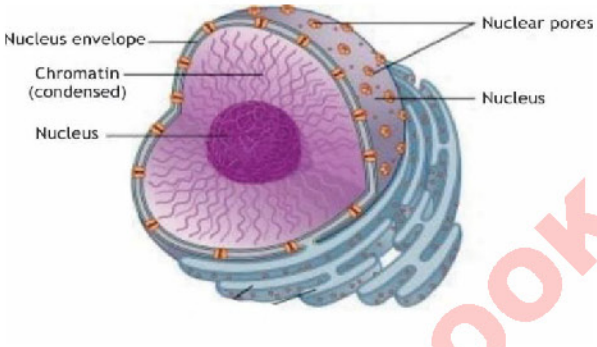


Fig. 2.5 Structure of nucleus

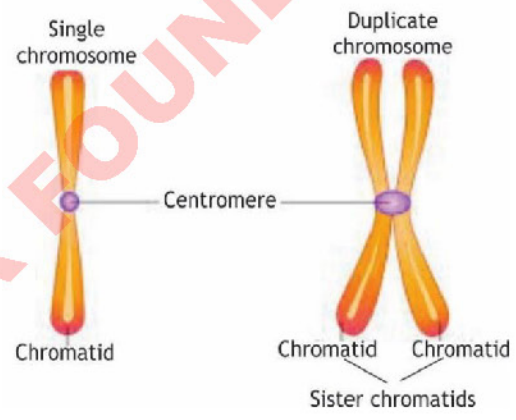


Fig. 2.6 Chromosome

Ribosomes

Ribosomes are granular bodies. They may exist in two forms:

(a) Attached with the endoplasmic reticulum (b) freely dispersed in the cytoplasm. Ribosomes are made of equal amount of ribonucleic acid (RNA) and proteins.

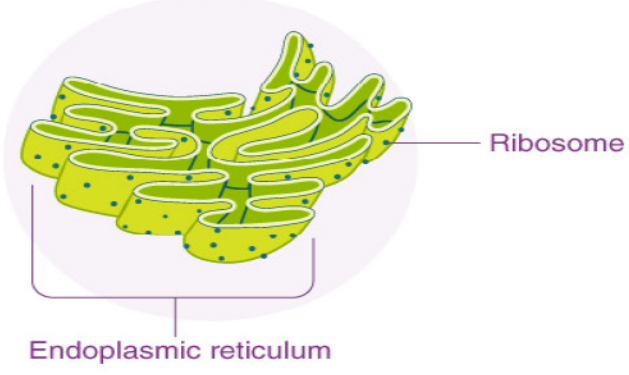


Fig. 2.7 Ribosomes

a. Endoplasmic reticulum

Endoplasmic reticulum (ER) is a network of inter connected channels. The ER is continuous with plasma membrane, nuclear membrane and Golgi apparatus. The two types of ER are smooth ER and rough ER. **Smooth** ER has no ribosomes attached with it. Smooth ER plays an important role in lipid formation. Smooth ER forms vesicles in which large molecules are transported to other parts of the cell. In liver it helps to detoxify drugs. **Rough ER** has ribosomes attached to it. Rough ER is involved in protein synthesis.

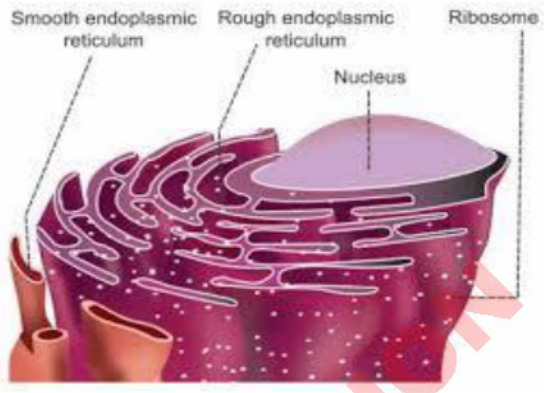


Fig.2.8 Endoplasmic reticulum

b. Golgi apparatus

It was discovered by Italian scientist Camillo Golgi in 1898. It is also known as Golgi bodies and Golgi complex. The electron microscope has revealed that it is a stack of flattened sacs formed of membranes. The inner (cis) face of the sac is directed towards the endoplasmic reticulum. The outer (trans) face of the stack is directed towards the plasma membrane. **Vesicles** are seen at the edges of the stack. Golgi apparatus receives vesicles that bud off from the ER and modify them. They store the secretion and finally release them in secretory cells. They also give rise to lysosomes.

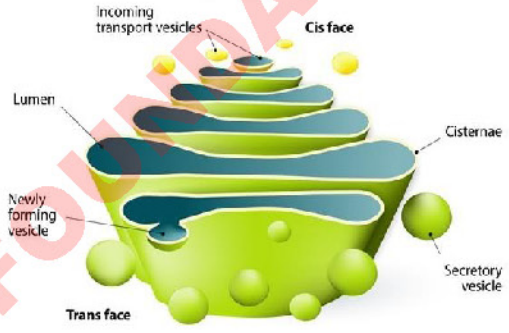


Fig. 2.9 Golgolgi apparatus

d. Lysosomes

Lysosomes are roughly spherical structures bounded by a single membrane. Lysosomes contains various **hydrolytic enzymes** which breakdown proteins, nucleic acids, lipids and carbohydrates. Lysosomes serve as recycling centers for damaged organelles.

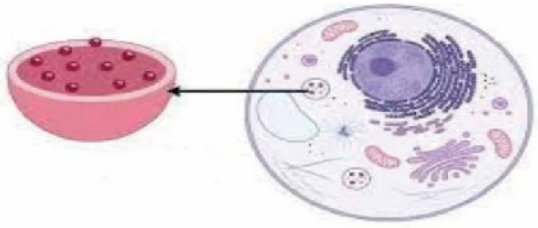


Fig 2.10 Lysosome

e. Mitochondria

Mitochondria (singular: mitochondrion) are special rod like or elongated tiny organelles. Under Electron Microscope a mitochondrion is a double membrane structure. The outer membrane is smooth. The inner membrane is folded to form **cristae**. Cristae provide a much greater area. Mitochondrial solution is called **matrix**. Mitochondria produce energy in form of Adenosine triphosphate (ATP).DNA, ribosomes and enzymes are present in mitochondria.

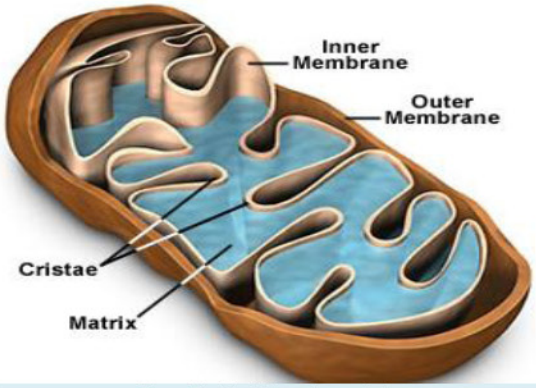


Fig. 2.11 Mitochondria

f. Centriole

In an animal cell a pair of centrioles is located near the outer surface of the nucleus. The two centrioles are usually placed at a right angle to each other in a structure called **centrosome**. Just before cell division the centrioles duplicate and each pair migrates to the opposite side of the nucleus. The spindle fibers are then formed between the two opposite pairs of centrioles.

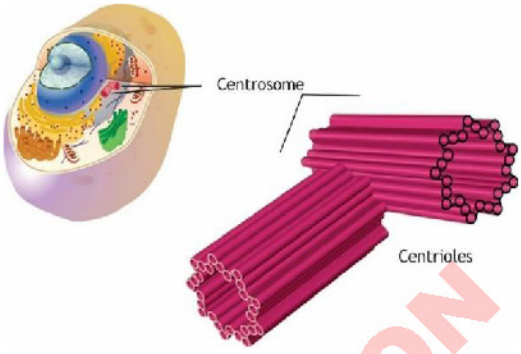


Fig.2.12 Centrioles

g. Vacuole

A vacuole is a sac like structure, bounded by a single membrane. It is filled with fluid. A mature plant cell have large central vacuole. An animal cells have many small vacuoles in their cytoplasm.

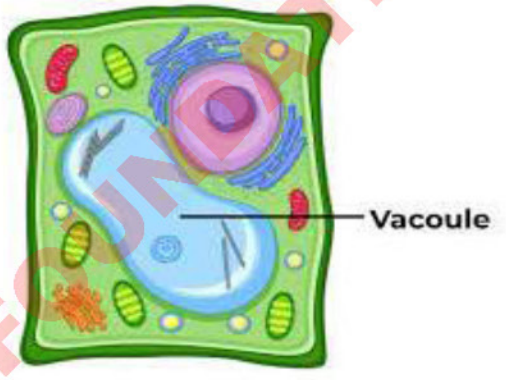


Fig.2.13 Vacuole in a plant cell

c. Plastids

Plastids are Plastids are present in plants. They are membrane bounded structures and contain different pigments. There are three types of plastids.

Leucoplasts are colorless. These are found in the underground parts of the plants e.g., roots, tuber. The store food.

Chromoplasts have color other than green. These are present in petals of flowers and ripened fruits. They help the plants in pollination.

There is no cell wall in animal cells as the presence of a cell wall would make it difficult or even impossible for animal animals to move.

Chloroplasts have green colored pigments called **chlorophyll**. These are located in the green parts of the plant. These are the site of photosynthesis. They are bounded by a smooth double membrane. The inner membrane is folded to form hollow coin like structures call **thylakoids**. The sacs of thylakoids are called **grana**. The fluid surrounding the grana is called **stroma**.

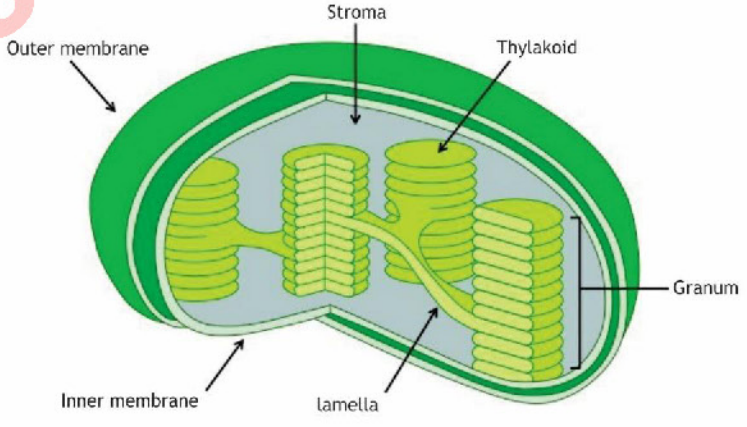


Fig.2.14 Chloroplast

2.3 DIFFERENCES BETWEEN ANIMAL CELL AND PLANT CELL

Cells are of various shapes and sizes, but all have the same parts. These are cytoplasm, nucleus, ribosomes, edoplasmic reticulum, Golgi apparatus and mitochondria. However animal and plant cells do not look exactly the same or have all the same organelles, since they have different needs. For example plant cells contain chloroplast since they need to perform photosynthesis but animal cell do not. In animal cell the cell membrane is the outer boudry. In plant cell there is a cell wall around the cell membrane. Plant cells have cell membrane but animal cells do not have cell wall. Both plant and animal cells have vacuoles. A plant cell contains a large, singular vacuole that is used for storage and maintaining the shape of the cell. In contrast, animal cells have many, smaller vacuoles.

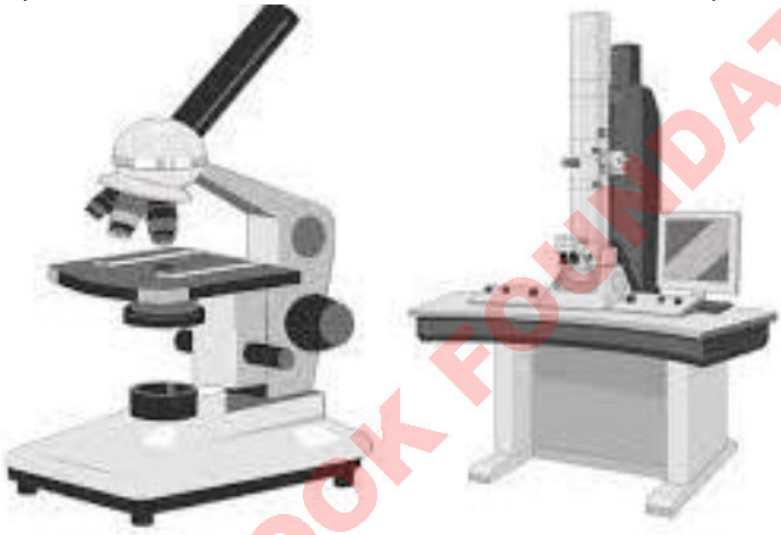


Fig. 2.15 Light microscope and Electron microscope

Electron microscopes differ from light microscopes in that they produce an image of a specimen by using a beam of electrons rather than a beam of light. Electrons have much a shorter wavelength than visible light, and this allows electron microscopes to produce higher-resolution images than standard light microscopes.

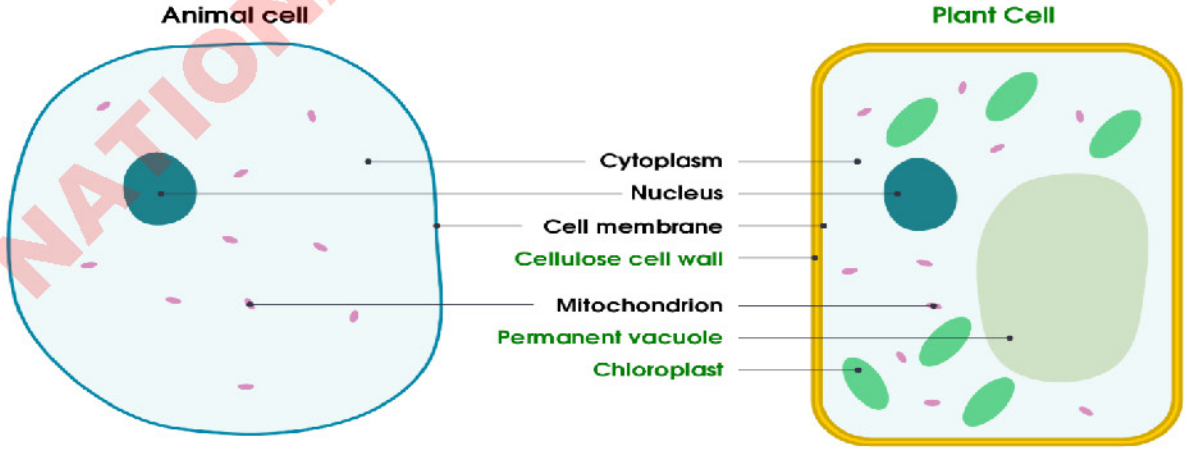


Fig.2.16 Animal cell and plant cell (as seen under light microscope)

Table 2.1 The difference between plant cell and animal cell.	
Plant cell	**Animal cell**
1. A plant cell is surrounded by a rigid cell wall.	1. An animal cell does not have a cell wall.
2. Presence of a large vacuole is seen in plant cells.	2. Whereas there are very small vacuoles as compared to plant cells are seen in animal cells.
3. Larger in size.	3. Smaller in size.
4. Plant cells have plastids.	4. Animal cells do not have plastids.
5. Centrosomes are absent in plant cells	5. Animal cells have centrosomes.
6. Plant cells do not have cilia.	6. Animal cells have cilia.
7. Lysosomes are very rare in plant cells.	7. Animal cells have lysosomes.

2.4 PLANT AND ANIMAL TISSUES

Tissues are group of cells that have similar structure and act together to perform a specific function. There are different types of tissues both in plants and animals.

Plant tissues

Plant tissues have been dived into two main groups:

a. Simple tissue b. Compound tissues

Simple tissues

Simple tissues are composed of only one type of cells having same function. The simple tissues consists of two main types:

a. Meristematic tissues b. Permanent tissues

Meristematic Tissues

Meristematic tissues are composed of cells having power of division. These are found at the apex of the root and shoot.

Permanent tissue

The cells of the permanent tissue do not divide. One of the type of permanent tissue is epidermal tissue.

Epidermal tissue

Epidermis is one cell thick layer. It covers the whole plant body i.e., root, stem and leaf. The cells of the epidermal tissue are living, thick walled and closely packed with no intercellular spaces. The epidermis of leaf has pores called stomata (singular stoma), for exchange of gases. Root and stem epidermal cells grow hair like extensions, which increase its surface area.

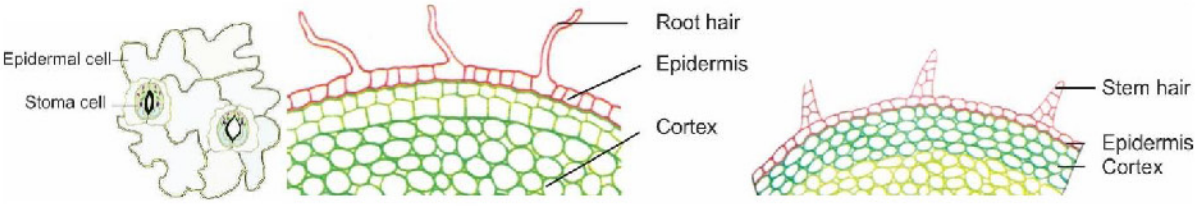


Fig. 2.17: Epidermal tissues, (Leaf Epidermis, Root Epidermis, Stem Epidermis)

Compound tissue

The two types of compound tissues in plants are xylem and phloem. Together they form **the vascular bundle**. Both xylem and phloem are composed of more than one type of cells. Thus the tissues, which are composed of different kinds of cells performing a common function are called compound tissue.

Xylem

Xylem has two main functions. They conduct water and mineral salts and provide structure and support in stem. Xylem consists of two main types of cells name **tracheids** and **vessels**. Tracheids are elongated cells having tapering end walls that overlap with adjacent tracheids. The cell wall is lignified and has pits. Tracheids are hollow and empty dead cells when mature and only their cell walls remain. Tracheids have mechanical strength and give support to the plant. Vessels are very long, tubular structures formed by the fusion of several cells end to end in a row. Each cell is called vessel element. It is a dead empty cell having dissolved end walls.

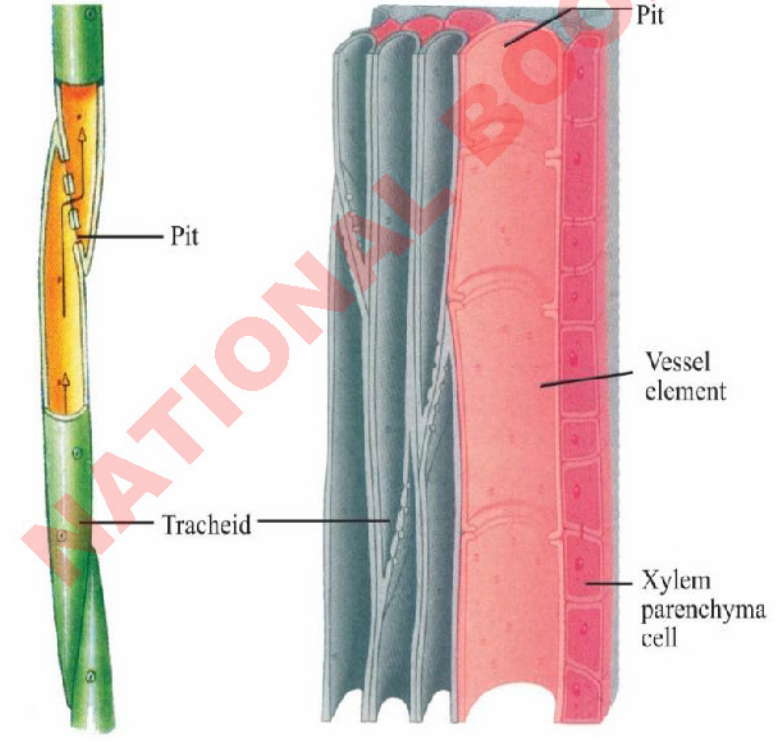


Fig. 2.18: Xylem

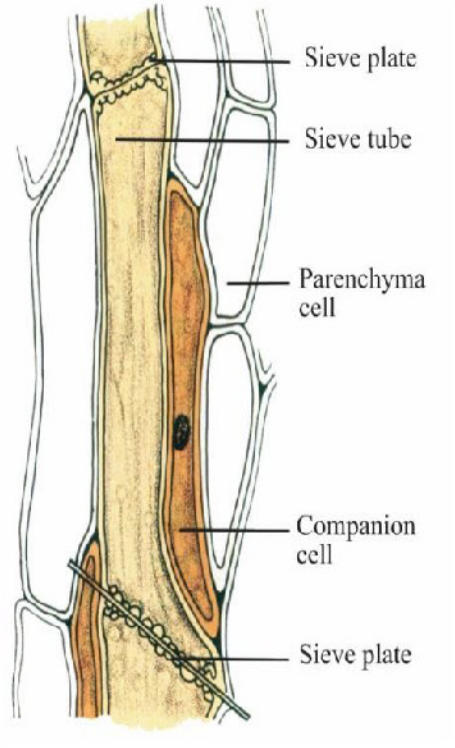


Fig. 2.19: Phloem

Phloem

It has a tubular structure. It conducts prepared food from leaves to stem and roots etc. Phloem tubes are composed of living cells and have no mechanical function.

There are two main types of cells in the phloem, namely sieve tube element and companion cells. Sieve **tubes** are formed by end to end fusion of cells called sieve tube elements. Sieve tube elements have porous end walls called sieve plates. They cytoplasm is continuous through sieve plate. The cells attached to the sieve tube elements are called companion cells. They regulate the movement of food through the sieve tube.

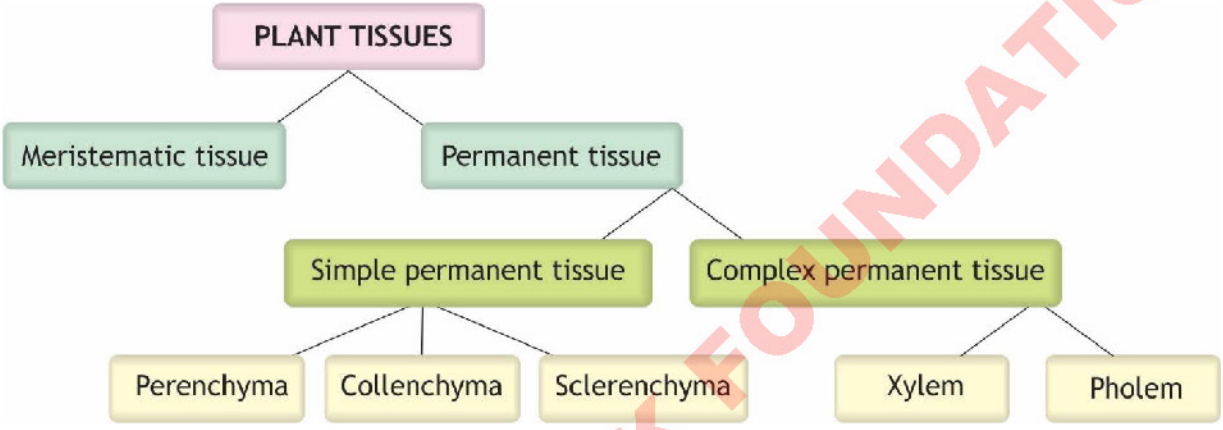


Fig. 2.20: Types of plant issues

Animal Tissue

Animal tissues are divided into four groups namely epithelial tissue, connective tissue, muscular tissue and nervous tissue.

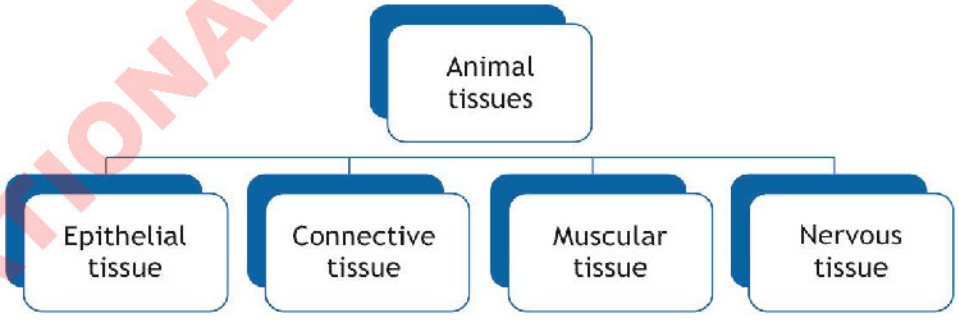


Fig.2.21 Types of animal tissues

1. Epithelial Tissue

Epithelial tissue is also called **epithelium**. It consists of tightly packed cells that form a continuous layer or sheet covering the entire body surface and lining most of the inner cavities. There are four types of epithelia.

a. Squamous Epithelium

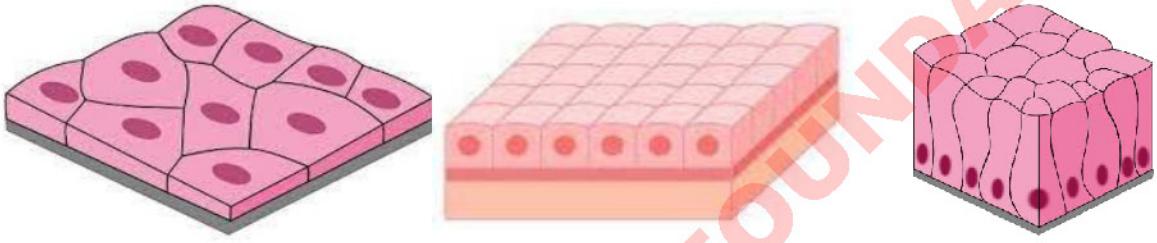
The cells are thin and flattened and arranged as single layer. It is present in the alveoli of lungs, cheek, blood vessels etc. Its function is passage of material by diffusion and filtration.

b. Cuboidal Epithelium

Cells are cube shaped, arranged in a single layer. It is present in tubes of kidney and ducts of glands etc. Its function is secretion and absorption.

c. Columnar Epithelium

These cells are long and narrow. It lines stomach, intestine etc. Its function is secretion, absorption and protection.



Squamous Epithelium | Cuboidal Epithelium | *Columnar Epithelum*

Fig.2.22 Epithelial Tissue

d. Ciliated Epithelium

Cells are columnar in shape but bear cilia at their free surfaces. These cells line the respiratory passages. It transports materials through tubes or passage way.

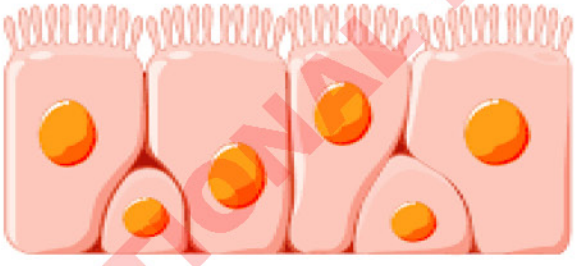


Fig. 2.23. (a) Ciliated epithelium

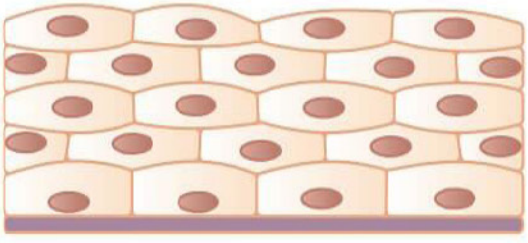


Fig 2.23 (b) Stratified epithelium

e. Stratified Epithelium

The tissue is made of a number of layers. It is present in oesophagus, skin etc. Its function is protection.

2. Connective Tissue

They connect and support the body's various tissues and organs. They include soft connective tissues as well as specialized forms such as cartilage, bone, adipose (fat) tissue, and blood. **Dense connective tissue** contains elastin fibers in addition to collagen fibers, which allows the tissue to return to its original length after stretching found in structures such as tendons and

ligaments. Adipose connective tissue is present through the body. It is found under the skin and between internal organs. The tissue is also known as body fat. It stores and release energy. It also provides insulation. **Areolar connective tissue** holds organs in place and attaches epithelial tissue to other underlying tissues.

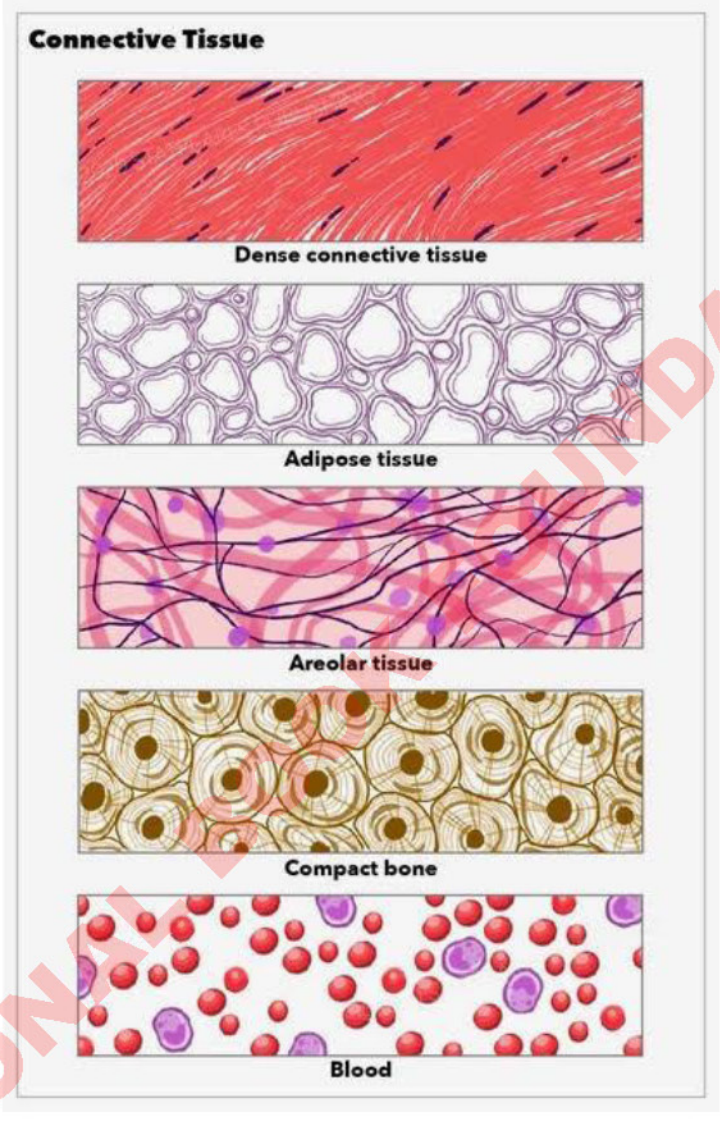


Fig. 2.24 Connective tissues

3. Muscular tissue

Muscle tissue is a type of contractile tissue composed of muscle cells. These cells are also described as muscle fibers because of their large size and elongated nature. Muscle fibers are of three types.

(i) Striated muscles

Striated muscle fibers are also called **skeletal muscles**. These muscles are elongated, unbranched and multinucleated. Moreover, these muscles are attached to the bones and helps in body movements.

(ii) Smooth muscles

Smooth muscles are also called **involuntary** or **un-striated muscles**. These muscles are present as a fusiform elongated sheet. A single nucleus is present in these muscles and myofibrils (contractile threads) are present longitudinally in these cells.

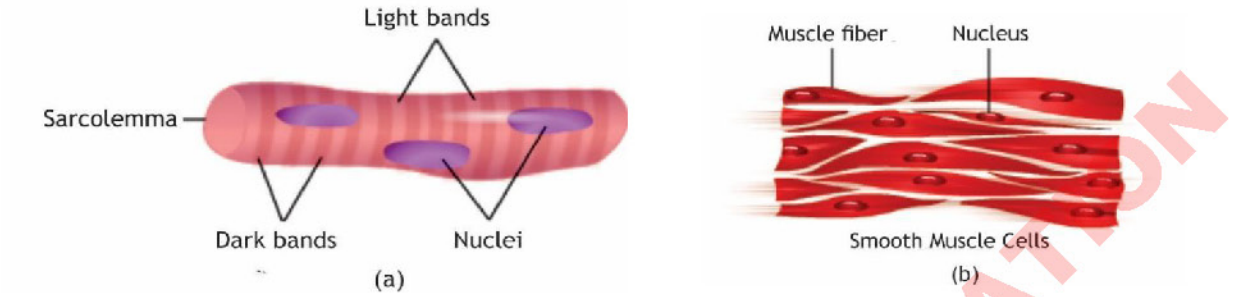


Fig. 2.25: Muscular Tissue: (a) Striated muscles (b) Smooth muscles

(iii) Cardiac muscles

Cardiac muscles are extensively branched and these branches join to form a compact network. Light and dark bands along with a single nucleus can be observed in the cells of these muscles. These muscles are found in the heart. Cardiac discs are the specialized junction between cardiac muscle fibres. These allow electrical transmission. Intercalated discs are important because cause cells in the heart to beat as one.

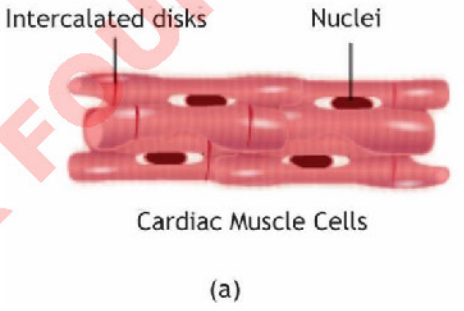


Fig. 2.26 Cardiac muscles

Muscle Type	Description	Function	Location
Smooth muscle	Has elongated, spindle shaped cells. It does not appear striated, or striped, and each cell has one nucleus	Controls involuntary movement	Intestine, bladder, stomach, uterus
Cardia muscle	It is striped, or striated, with light and dark bands of cell with	Controls involuntary movement of the heart	Heart
Skeletal muscle	It is long, thin fibers with striation. It is also multinucleated fibers are crossed with a regular pattern of fine red and white line, giving it a unique appearance.	Controls the voluntary movement of the body	Attached to bones by tendons

4. Nervous Tissue

Neurons are the cells of nervous system. They are responsible for coordination in the animal bodies. To accomplish this job their structure is very unique. A neu ron cell has a **cell body** and two types of cytoplasmic fibres. One of them are **dendrites** which conduct nerve impulses to the cell body. Others are **axons** which conduct messages away from the cell body. The dendrites and axons make it possible for neurons to communicate with far away cells of the body.

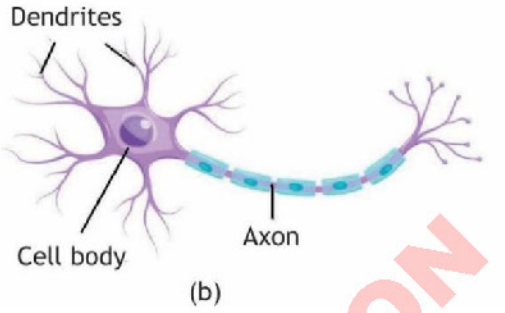


Fig. 2.27 Nervous tissue

2.5 MAKING A THREE -D MODEL OF PLANT AND ANIMAL CELL

1. By Using Gelatine

A. Materials needed

a. **Cytoplasm**: Clear gelatin will work as the cytoplasm, which is present in both animal and plant cells.
b. **Nucleus**: For the nucleus, nucleolus and nuclear membrane: Purchase a pitted fruit, such as a plum or peach. The pit is the nucleolus, the fruit is the nucleus, and the skin is the nuclear membrane. (If you are not expected to deliver this level of complexity, a simple round food item will do). You'll need this for either a plant or animal cell.
c. **Centrosomes**: These are only present in animal cells, are supposed to be spiky, try putting bits of toothpick through a gumdrop or other small gummy item.
d. **Golgi apparatus**: It is present in both plant and animal cells, using cut-out pieces of cardboard, wafers, crackers, sliced bananas or, perhaps best yet, a fruit roll-up stacked like an accordion.
e. **Lysosomes**: In either type of cell, use small, round candies or chocolate chips.
f. **Mitochondria**: Which are also present in both animal and plant cells, are somewhat oblong, so try using certain types of un-shelled nuts.
g. **Ribosomes**: You will need something small. Try sprinkles, peppercorns, or plain pepper. These are present in both plant and animal cells.
h. **Rough endoplasmic reticulum**: Which is present in both animal and plant cells. It looks much like the Golgi apparatus, in that it is a structure of flat, folded sections clumped together; though unlike the Golgi apparatus it has a rough-looking surface. You could use similar materials for it, but try to find a way to stick something rough or textured to it (perhaps sprinkles) in order to make the two distinct.
i. **Smooth endoplasmic reticulum**: Looks more like a tangled and irregularly sized series of connected tubes. For this, you will need something smooth and bendy. Use cooked spaghetti.
j. **Vacuoles**: You will choose different shapes for animal versus plant cells. For an animal cell, use a few moderately sized pieces of plastic or rubber having same color. Vacuoles in plant cells are much, much larger.
k. **Microtubules**: It can be modeled using uncooked pieces of spaghetti or straws.

l. **Chloroplasts**: (plant cell only), use peas, green jelly beans, or green beans cut in half. Keep them green.

B. Get a gelatin mold. You'll need a mold to make your cell. Animal and plant cells have different shapes and will require different molds.

a. For a plant cell, the first thing you'll need is a rectangular baking dish, preferably made out of porcelain. The dish itself will be your cell wall and membrane, in your model.

b. For an animal cell, you'll want a round or oblong baking dish. This dish can be your cell membrane.

C. Make the gelatin. Cook the gelatin by boiling water on the stovetop, and then mixing the gelatin in. Carefully pour the hot liquid into the baking pan. Let the pan cool for about half an hour until it's almost hardened. **Do not wait until the gelatin has completely settled**.

D. Procedure

Add your cell parts: Start putting your cell parts into the gelatin. Here's how you might want to arrange the pieces:

a. Put the nucleus near the middle (unless you are modeling a plant cell).

b. Place the centrosome near the nucleus. This is only present in animal cells.

c. Put the smooth endoplasmic reticulum near the nucleus. This is present in both animal and plant cells.

d. Place the Golgi body, which is present in both animal and plant cells, near the nucleus (though farther away than the endoplasmic reticulum).

e. Add the rough endoplasmic reticulum onto the other side of the smooth endoplasmic reticulum (away from the nucleus). This is present in both plant and animal cells.

f. Arrange everything else wherever you have room. Try not to crowd too much into one space. In a real cell, there are a few structures that float all around the cytoplasm. These can be mixed in almost randomly.

Put the model into the refrigerator. Allow the gelatin to settle for an hour or two until it is completely solidified.

Make a table or key that defines each part. After you've added your cell pieces, write up a list of what part of a cell each item corresponds to (e.g., "Gelatin = Cytoplasm," "Licorice = Rough ER"). You'll probably need to be able to tell people about the parts of your cell later on.





2. By Using Craft Item

1. **Materials needed**: Here are a few options:
   a. You can use a styrofoam cell base. Craft or art stores and will have styrofoam balls (if making an animal cell) roughly the size of a basketball or a styrofoam rectangular cube (if making a plant cell).
   b. Cardstock can be used to form a number of cell structures, such as the Golgi apparatus or rough endoplasmic reticulum.
   c. Straws can be used to form tube-like structures. The microtubules could be constructed out of stirring straws, while flexible straws or tubes can be used to model the smooth endoplasmic reticulum.
   d. Use beads of various sizes and shapes as other cell structures, such as mitochondria or chloroplasts. Try to keep them on an appropriate scale compared to the other structures in the model cell.
   e. Modeling clay can be used to create any structure that is difficult to replicate using preexisting materials.
   f. Paint can be used to fill in the cytoplasm and differentiate between it and the exterior of the cell. You can also paint any clay structures you have created.
2. **Cut out a 1/4 section of the styrofoam base.** Measure the base and make dots at the points that equal half the length of a side. Draw lines showing where to cut. Then use a knife or scissors to cut and remove a 1/4 section.
   a. For the plant cell, do this by drawing the center line on any two adjoining sides and continue those lines all the way around until they circle back.
   b. If doing this for the animal cell, draw the lines like you were making the equator and the meridians on a globe.
3. **Paint it.** Paint the inside of the 1/4 section in order to help your cell parts stand out. You can also paint the outside in a different color to contrast it with the cytoplasm.
4. **Make the cell parts.** Create them from the craft items listed above.

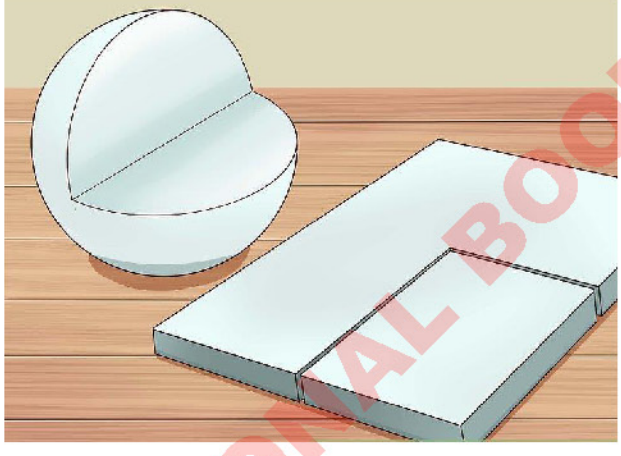
The trickiest of these will be the parts that you must model out of clay. Keep these structures as simple as possible while remaining true to the basic structure you are modeling. It may be best to only make the simplest of structures out of clay and leave more complex parts--say, the smooth endoplasmic reticulum--to be replicated using tubes or some other item.

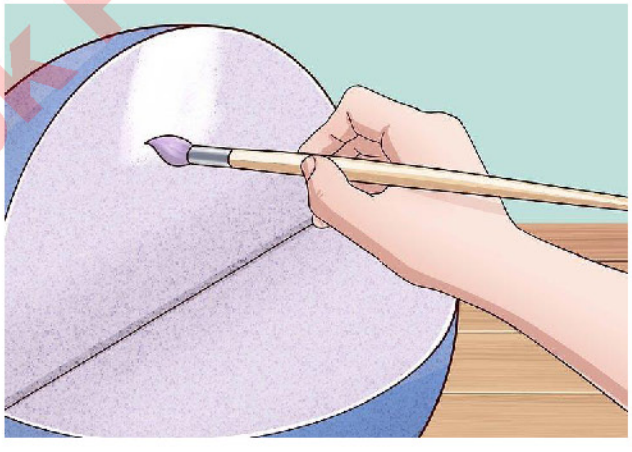
5. Add the cell parts. Add the parts to your cell base (the styrofoam). This can be done by using hot glue, regular glue, toothpicks, pins, staples, or a number of other methods. In some cases you may also need to literally dig or carve out space in the styrofoam to fit in the parts.

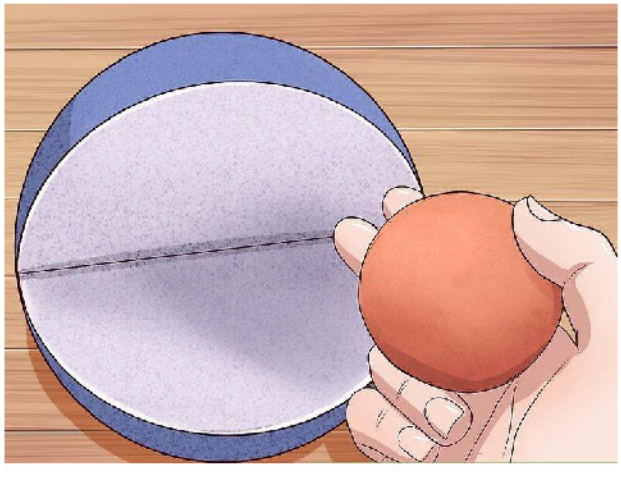
The Golgi apparatus and rough endoplasmic reticulum can be shaped out of cardstock using your hands. In this case, make slices into the styrofoam and slide pieces of cardstock in to form the folded shapes of these structures.

Make a table or key that defines each part. After you've added your cell pieces, write up a list of what part of a cell each item corresponds to. You'll probably need to be able to tell people about the parts of your cell later on.

It depends, because plant cells have more functions, but it is easier to distribute the organelles onto a flat, rectangular surface. The animal cell has less functions, but it is more difficult to distribute it, since it is circular.







Tips

1. You'll be able to add parts more quickly if you have a friend or parent help.
2. Make sure the gelatin has enough time to solidify after you have added the "organelles." Try to keep it in the fridge overnight.
3. You might want to papier-mâché the styrofoam for safety reasons. Add extra layers for good measure.

SUMMARY

1. In 1665 Rober Hooke observed that the cork was made of tiny empty spaces with walls under a simple microscope, He named them as 'cells'.
2. Cellse the smallest unit and building block of living things.
3. Cells are the functional unit of living things.
4. Every cell is surrounded by a cell memrane.
5 Cells perform a wide range of activites such as movement, repiration, growth and reproduction etc.
6. Organelles are small organized structures within the cytoplasm of a cell.
7. The cell wall is present in plant cells. Animal cells do not have cell walls.Il protects the plant cell, maintains its shape. It allows free passage of dissolved water and dissolved materials.
8. The cell membrane is the covering of the cytoplasm. It is found in all living cells. It maintains the internal composition of cell.
9. Cytoplasm is semi-viscous and semitransparent substance, present between plasma membrane and nuclear envelope.
10. Cytoskeleton is a supportive network of the fine fibers in the cell.
11. Organelles are small organized structures within the cytoplasm of a cell.
12. Nucleus is bounded by a double membrane nuclear **envelope** having many pores. A nucleus has nucleoplasm, nucleolus and chromosomes. Nucleus controls all the activities of the cell.
13. Chemically chromosomes consists of DNA and protein. It consists of centromere and two chromatids.
14. Ribosomes are the site of protein synthesis.
15. The endoplasmic reticulum is a series of internal membranes with many functions e.g., protein synthesis and transport.
16. Golgi apparatus are a series of flattened membrane sacs that process, sort and modify proteins synthesized on the endoplasmic reticulum and transport proteins to the plasma membrane, to the outside the cell and lysosome.
17. Lysosomes are spherical and bounded by a single membrane. The breakdown organic molecules like proteins into simpler compounds that can be used by the cell.
18. Mitochondrion is a double membrane structure. Mitochondria provides energy in the form of Adenosine triphosphate (ATP).
19. A pair of centrioles are located near the outer surface of the nucleus in an animal cell.
20. A vacuole is a sac like single membrane structure that stores substances.
21. Plastids are membrane bound structures and are of three types. Leucoplasts are colorless. Chromoplasts have color other than green. Chloroplasts are green colored.

22. Tissues are a group of cells with similar structure and specific functions. The four groups of animal tissues are epithelial tissue, connective tissue, muscular tissue and nervous tissue.
23. *Epithelium or epithelial tissue is* a thin, continuous, protective layer of compactly packed cells with a little intercellular *matrix*.
24. The five types of epithelia are squamous epithelium, cuboidal epithelium, columnar epithelium, ciliated epithelium and stratified epithelium.
25. Connective tissues, support and connect different tissues and organs of the body. They are widely distributed in every part of the body.
26. Muscle tissue is characterized by properties that allow movement. Muscle cells are excitable; they respond to a stimulus.
27. The plant epidermis is a protective tissue that covers the entire surface of the plant. The epidermis protects the plant from infection and water loss.
28. Xylem is a type of vascular tissue present in plants, which primarily transports water and nutrients from roots to stem and leaves. They also provide mechanical support.
29. The phloem is composed of living tissue that actively transports sugars to plant organs such as the fruits, flowers, buds, and roots

EXERCISE

Section I: Multiple Choice Questions

Select the correct answer:

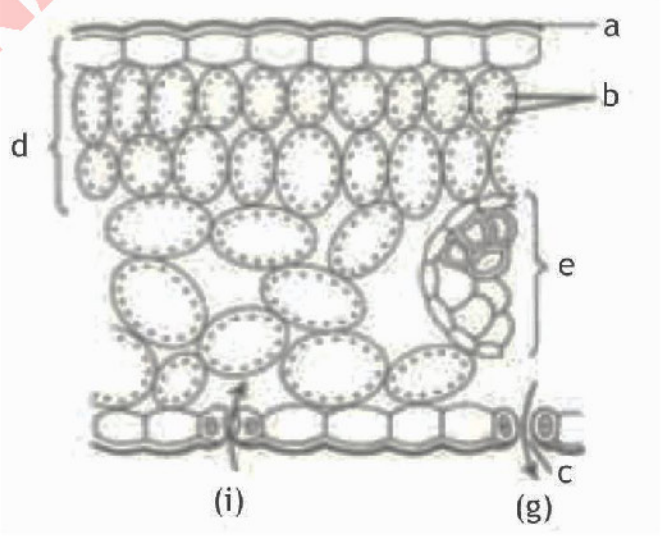
1. A network of channels extending from cell membrane to nuclear membrane is called:

   A) centriole B) ribosomes C) centrosome D) endoplasmic reticulum

2. The site of enzyme synthesis in cell is :

   A) lysosomes B) ribosomes C) Golgi aparatus D) endoplasmic reticulum

3. The diagram shows cells in paert of the leaf of a green plant. Which region contains cells which are responsible for transport of water and food?



4. What are the functions of xylem and phloem in green plants?

	Xylem	Phloem
A)	support and transport of sugars	transport of water
B)	transport of sugar	support and transport of water
C)	support and transport of water	transport of sugar
D)	transport of water	support and transport of sugars

5. What are the functions of mitochondria?

A) lipid synthesis B) protein synthesis

C) photosynthesis D) cellular respiration

6. Which of the following is present in all eukaryotic cells?

A) cell wall B) cilia C) membrane bound organelles D) flagellum

7. Which of the following cell organelles does not contain DNA?

A) Nucleus B) Lysosomes C) Chloroplast D) Mitochondria

8. Which of the following statements describes a way in which plants cells and animal cells are similar?

A) They have cell walls B) They both make sugars from Sunlight

C) They both contain mitochondria D) They both are prokaryotic

9. Which of the following statement correctly represents ribosomes?

A) They are present only in eukaryotic cell

B) They are produced in the nucleus then migrate to the cytoplasm where they synthesize proteins.

C) They are covered by single membrane

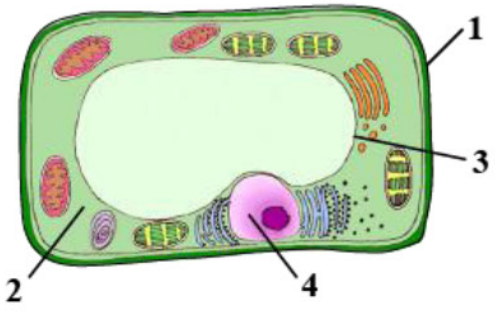
D) All ribosomes are attached to the inner surface of RER

10. The thin extensions of the inner mitochondrial membrane are known as:

A) stroma B) thylakoid C) cristae D) matrix

Section II: Short Answer Questions

1. Following diagram shows a plant cell.



Keeping in view the parts labeled 1 to 4, answer the following questions:

a. Give the number indicating the structure which controls the cell activities?
b. Name a biochemical process taking place in part 2.
c. What will happen to cell if part 1 is removed?
d. What will happened if part 3 is overfilled with water?

2. Differentiate between:
   a. Organ and organelles
   b. Cytoplasm and cytoskeleton
   c. Nucleus and nucleolus
   d. Chromosome and chromatids
   e. Rough and smooth endoplasmic reticulum
   f. Permanent and meristematic tissue
   g. Chromoplast and chromoplast
   h. Simple and compound tissue

3. Write the functions of:
   a. Nucleus
   b. Ribosomes
   c. Endoplasmic reticulum
   d. Golgi apparatus
   e. Mitochondria
   f. Lysosomes
   g. Centriole
   h. Vacuole
   i. Leucoplast
   j. Chromoplast
   k. Chloroplast
   l. Cell wall
   m. Vacuole
4. List the functions of cells.
5. How is a cell wall different from a plasma membrane?
6. Why animals have no cell wall?

Section III: Extensive Answer Questions

1. Describe the structure and functions of the following with diagram.
   a. Cell wall
   b. Cell membrane
   c. Nucleus
   d. Ribosomes
   e. Endoplasmic reticulum
   f. Golgi apparatus
   g. Mitochondrion
   h. Centriole
   i. Vacuole
   j. Chloroplast
2. Explain the differences between an animal cell and plant cell

3. What is a tissue? Describe the following types of tissues in plants:
   a. Epidermal tissue b. Xylem c. Phloem
4. What are the types of animal tissue? Describe epithelial tissue.
5. What is a connective tissue? Explain.
6. Describe the three types of muscular tissue.
7. Describe the structure and function of nervous tissue.
8. Construct a 3-D model of plant cell and animal cell by using Gelatin or using craft items to represent cell organelles.
9. Draw and label:
   a. An animal cell b. A plant cell c. Xylem tissue
   d. Phloem tissue e. Striated muscle f. Smooth muscle
   g. Cardiac muscle

Chapter 3

BIODIVERSITY

SLOs: After completing this lesson, the student will be able to:

1. Define biodiversity.
2. Identify importance of biodiversity.
3. Discuss the impact of human beings on biodiversity.
4. Describe ways of conservation of biodiversity.
5. Discuss and describe the classification.
6. Compare the two kingdom system, three kingdom system and five kingdom system of classification.

3.1 DEFINITION AND INTRODUCTION TO BIODIVERSITY

The similarity among living organisms is that they share all the characteristics of life, i.e., movement, respiration, sensitivity, nutrition, excretion, reproduction and growth. At the same time these living things differ from one another and their variety is enormous.

Biodiversity

If you look around you will find variety of various kinds of organisms. The term biodiversity comes from 'biological diversity'. Biodiversity has ecological and economic importance. It provides us with nourishment, housing, fuel, clothing etc. Biodiversity is defined as "the variation in the species of plants, animals, and other organisms"

3.1 Biodiversity

STEAM ACTIVITY 3.1

Take a chart paper. Cut pictures of various plants and animals from old newspapers or magazines and paste on the chart paper. You have placed all the organisms together at one place. What is it? This is biodiversity.

3.2 IMPORTANCE OF BIODIVERSITY

The natural biodiversity provides us oxygen, clean water and air. They help carbon cycle and fix nutrients. They enable the plants to grow. Pests are controlled by organisms such as by insects, birds and fungi. They help protect against flooding and regulate climate. They help in pollination and crop production. Biodiversity provides our food stuff and medicines derived mainly from plants. The industrial materials such as building materials, fibres, dyes, resins, gums, adhesives, rubber and oil etc., are derived directly from plants.

Since it provides us with several economic and ethical benefits and adds aesthetic value, it is very important to conserve biodiversity.

3.3 IMPACT OF HUMAN BEINGS ON BIODIVERSITY

Humans are part of the natural environment. Population growth leads to the natural habitat. Deforestation causes loss of species plants and animals, oxygen production and carbon dioxide elimination. Ozone layer depletion, water pollution, global warming, desertification, increased erosion of land, is directly caused by human activities such as use of nuclear fuel, urbanization, transportation etc.

Let us see effect of human activities on biodiversity:

a. **Overpopulation**: The overpopulation of humans on earth has resulted in a huge loss of our biodiversity, it leads to increased resource consumption.
b. **Habitat destruction**: Excessive human interference leads to the destruction of the habitat in which animals live, which results in their extinction.
c. **Pollution**: The pollution caused by humans is drastically damaging our biodiversity and causing the species to die.
d. **Poor waste management**: It is the dumping of toxic chemicals dangerously on land.
e. **Global warming**: Increasing natural carbon dioxide and methane levels causing the sun to heat or atmosphere more.
f. **Land**: Land is being damaged for construction of Dams, buildings, airports etc., casing reduction of animals and pants.

Human use land in various ways. Farms, towns and cities are located on land, Agricultural land quality is threatened by soil erosion, which can lead to desertification.

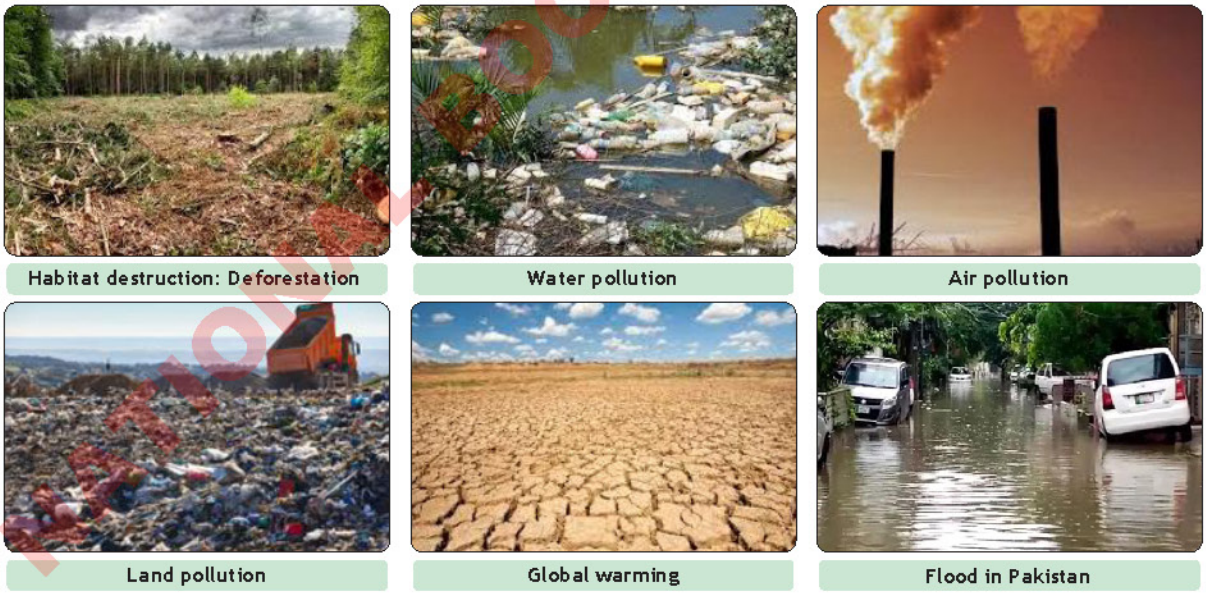


Fig. 3.2: Effect of human activities on biodiversity

3.4 CONSERVATION OF BIODIVERSITY

Biodiversity conservation is the protection and management of biodiversity. Biodiversity refers to the variability of life on earth. It can be conserved in the following ways:

a. In-situ Conservation

b. Ex-situ Conservation

Deosai National Park is a high-altitude alpine plain and National park in Gilgit-Baltistan. Deosai Plains are situated at an average elevation of 4,114 metres (13,497 ft) above sea level and considered as the second highest plateaus in the world.

In-situ Conservation

In-situ conservation of biodiversity is the conservation of species within their natural habitat. In this method, the natural ecosystem is maintained and protected.

The in-situ conservation has several advantages. Following are the important advantages of in-situ conservation:

a. It is a cost-effective and convenient method of conserving biodiversity.

b. A large number of living organisms can be conserved simultaneously.

c. Since the organisms are in a natural ecosystem, they can evolve better and can easily adjust to different environmental conditions.

d. Certain protected areas where in-situ conservation takes place include national parks, wild life sanctuaries and biosphere reserves.

National Parks: These are small reserves maintained by the government. Its boundaries are well demarcated and human activities such as grazing, forestry, habitat and cultivation are prohibited. Pakistan has 36 national parks. The oldest national park is Lal Sunhanra in Bhawalpur district.

Wildlife Sanctuaries: These are the regions where only wild animals are found. Human activities are allowed here as long as they do not interfere with the conservation project.

Biosphere Reserves: Biosphere reserves are multi-purpose protected areas where the wildlife, traditional lifestyle of the inhabitants and domesticated plants and animals are protected.

Ex-situ Conservation

Ex-situ conservation of biodiversity involves the breeding and maintenance of endangered species in artificial ecosystems such as zoos, nurseries, botanical gardens, gene banks, etc.

Ex-situ conservation has the following advantages:

a. The animals are provided with a longer time and breeding activity.

b. The species bred in captivity can be reintroduced in the wild.

c. Genetic techniques can be used for the preservation of endangered species.

Strategies for Biodiversity Conservation

Following are the important strategies for biodiversity conservation:

1. Poaching and hunting of wild animals should be prevented.
2. The reserves and protected areas should be developed carefully.
3. The levels of pollutants should be reduced in the environment.
4. Deforestation should be strictly prohibited.
5. Public awareness should be created regarding biodiversity conservation and its importance.

3.5 CLASSIFICATION

Classification is the process of arranging things in groups or classes according to their resemblances and affinities and gives expression to the unity of attributes that may exist amongst a diversity of individuals.

STEAM ACTIVITY 3.2

Write the names of the organisms in their respective groups on the basis of having similar characteristics.

Rose, guava, fowl, pigeon, mango, sparrow, snake, crocodile, sunflower, lizard, cat, tiger, cow, tortoise, goat, dove. For example, rose, fowl, snake and goat have been placed in separate groups.

Group 1	Groups 2	Group 3	Group 4
Rose, ...	Fowl, ...	Snake, ...	Goat, ...

Why did you put rose and mango in one group whereas, fowl and pigeon in another group?

You placed the organisms of similar characteristics in groups. For example, you made a group of flowering plants with Rose, mango, guava and sunflower. You made another group of fowl, pigeon, dove, and sparrow. All of them have the similar characteristics in each group.

You have separated the organisms into groups on the basis of similarities and differences. Thus, you have classified the organisms.

To put organisms into separate groups on the basis of similarities and differences is called classification.

Need of classification

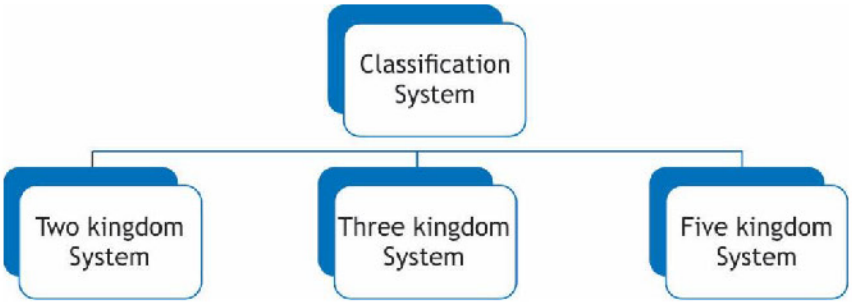
Biologists have devised ways of grouping organisms. The grouping of organisms is called **classification**. **Taxonomy** is the branch of biology concerned with identification, naming and classification of organisms. Suppose you were asked to classify the living organisms of your surroundings. What criteria would you use to classify the organisms? The scientific study of diversity of organisms and their evolutionary relationship is called **systematics**.

The Greek philosopher Aristotle was the first person who classified the living organisms. In 700s, Abu Usama Aljahiz described 350 species of animals. In the end of 15th century many biologists worked Classification method.

The main aims and objectives of classification are: (1) To determine similarities and differences between organisms. (2) To arrange organisms on the basis of similarities and differences. (3) Identify the organisms to study them systematically. (4) To find out evolutionary relationships among organisms.

3.6 SYSTEMS OF CLASSIFICATION

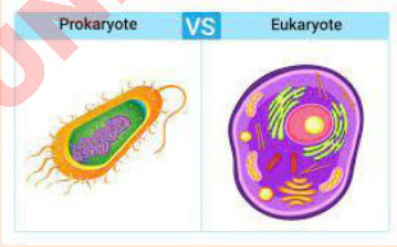
According to earlier classification system, organisms were classified into two kingdoms, then three-kingdom and then five-kingdom system.



1. **Two-kingdom classification system**: It is the oldest system and classifies organisms into two kingdoms, the Plantae and Animalia. The kingdom Plantae includes the autotrophs. Bacteria, fungi and algae were also included in the kingdom. The organisms which depend on autotrophs or other heterotrophs are included in the kingdom Animalia.

Many unicellular organisms like *Euglena* have both plant like (presence of chlorophyll) and animal like (heterotrophic mode of nutrition in darkness and lack of cell wall) characteristics. So separate kingdom was introduced for such organisms.

The organisms which lack nucleus in their cells are called **prokaryotes** while the organisms which have nucleus in their cells are called **eukaryotes.**



2. **Three-kingdom classification system**: The German scientist Ernst Haeckel proposed a third kingdom, Protista to accommodate *Euglena* like organisms and to separate unicellular microscopic organisms from multicellular ones.

3. **Five-kingdom classification system**: In 1937 E-Chatton suggested the terms '**Procariotique**' to describe bacteria and '**Eucariotique**' to describe plant and animal cells. In 1967 Robert Whittekar introduced five-kingdom classification system. The five kingdoms are: Monera, Protista, Fungi, Plantae and Animalia. In the five kingdom system bacteria and archaea were combined in a single kingdom Monera, because they shared the prokaryotic form of cell structure.

SUMMARY

1. The variation in the species of plants, animals, and other organisms is called biodiversity.
2. The natural biodiversity provides us oxygen, clean water and air.
3. Population growth leads to the natural habitat.
4. Deforestation causes loss of species plants and animals, oxygen production and carbon dioxide elimination.
5. Ozone layer depletion, water pollution, global warming, desertification, increased erosion of land, is directly caused by human activities such as use of nuclear fuel, urbanization, transportation etc.
6. Biodiversity conservation is the protection and management of biodiversity.
7. Biodiversity conservation can be conserved by In-situ conservation and ex-situ conservation.
8. In-situ conservation of biodiversity is the conservation of species within their natural habitat.

9. Ex-situ conservation of biodiversity involves the breeding and maintenance of endangered species in artificial ecosystems such as zoos, nurseries, botanical gardens, gene banks
10. National parks are small reserves maintained by the government. Its boundaries are well demarcated
11. Wildlife Sanctuaries are the regions where only wild animals are found.
12. Biosphere reserves are multi-purpose protected areas where the wildlife, traditional lifestyle of the inhabitants and domesticated plants and animals are protected.
13. Poaching and hunting of wild animals should be prevented.
14. The reserves and protected areas should be developed carefully.
15. The levels of pollutants should be reduced in the environment.
16. Deforestation should be strictly prohibited.
17. Public awareness should be created regarding biodiversity conservation and its importance.
18. Taxonomy is concerned with identification, naming and classification of organisms.
19. The scientific study of diversity of organisms and their evolutionary relationship is called systematics.
20. According to earlier classification systems organisms were classified into two kingdoms, three kingdoms and then five kingdom system.
21. Two-kingdom classification system classifies organisms into two kingdoms the Plantae and Animalia.
22. Three system classification system introduced the third kingdom Protista to separate unicellular microorganisms from multicellular ones.
23. Five-kingdom classification system includes the kingdoms Monera, Protista, fungi, Plantae and Animalia.

EXERCISE

Section I: Multiple Choice Questions

Select the correct answer:

1. Into which kingdom you place a multicellular land organism that performs photosynthesis:
   A) monera B) protista C) plantae D) animalia
2. Which kingdom is mismatched with the characteristics?
   A) fungi - usually saprotrophic B) animalia - rarely ingestive
   C) protista - various modes of nutrition D) plantae - photosynthetic
3. The kingdom to which the algae belongs is:
   A) animalia B) protista C) plantae D) fungi
4. _____ is a non-renewable resource.
   A) crude oil B) uranium C) hot spring D) Silica
5. _____ is an example of an ex-situ conservation.
   A) sacred groves B) wildlife sanctuary
   C) seed bank D) national park

6. Global warming can significantly be controlled by _____

   A) increasing solid waste
   B) reducing water wastage
   C) burning human-generated waste
   D) reducing fossil fuel consumption

7. The most important cause of loss of biodiversity is:

   A) habitat loss B) over grazing C) climate change D) hunting

8. Major cause of extinction of different plants and animals is:

   A) habitat loss
   B) hunting
   C) pollution
   D) all of the above

9. The branch of biology that deals with the classification of organisms is called.....

   A) systematics
   B) taxonomy
   C) taxa
   D) taxonomic hierarchy

10. Which kingdom includes prokaryotic organisms?

    A) protista B) animalia C) monera D) fungi

Section II: Short Answer Questions

1. Why are the following scientists famous for?

   a) Aristotle b) Usama Al jaziz c) E-Chatton
   d) Robert Whittekar e) Ernst Haekel

2. Define:

   a) Biodiversity b) Classification c) Taxonomy
   d) Systematics e) Biodiversity conservation

3. Can you differentiate between? :

   a) Bacteria and Protists b) Fungi and Plants c) Plants and animals.

4. What are the advantages of in-situ biodiversity conservation?

5. What are the advantages of ex-situ biodiversity conservation?

6. What are the strategies for biodiversity conservation?

7. What is the need of classification?

Section III: Extensive Answer Questions

1. What is biodiversity? Write the importance of biodiversity.
2. What is the impact of human on biodiversity?
3. How biodiversity can be conserved?
4. Describe classification. How are the organisms classified?
5. What are the main aims and objectives of classification?
6. Compare the two-kingdom, three kingdom and five-kingdom system of classification.

Chapter 4

STRUCTURE OF ATOM

SLOs: After completing this lesson, the student will be able to:

1. describe the structure of an atom including the location on electric charges of proton, electron and neutron.
2. Draw atomic structure of the first twenty elements of the periodic table.
3. Determine the number of protons, neutrons, and electrons in different isotopes of hydrogen carbon oxygen chlorine and uranium.
4. Describe Rutherford's experiment leading to the discovery of atomic nucleus.
5. Describe the defects of Rutherford's atomic model.
6. List the main postulates of Bohr's atomic model.

4.1 ATOM

Everything in the world is made of tiny things called atoms. An atom is like a building block of stuff. The word 'atom' comes from Greek and means 'indivisible' because atoms are the smallest bits of stuff and can't be broken into smaller pieces.

Atoms are made of even smaller parts called protons, neutrons, and electrons.

Each element has its own atoms, and they all have the same number of protons and electrons, which makes them neutral.

The center of the atom is called the nucleus. It has the protons, which are positive, and the neutrons, which have no charge.(Table 4.1) Around the nucleus, there are regions called electronic shells, where the electrons, which are negative.

Atoms have different characteristics depending on how their parts are arranged and how many of each part they have.

DO YOU KNOW

Empty Space: Despite appearances, atoms are mostly empty space. If you removed all the empty space from the atoms in the human body, the entire world population could fit into an apple.

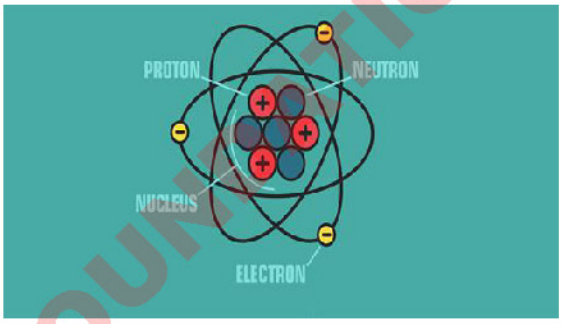


Fig. 4.1 Structure of an atom

Table4.1Protons, Neutrons, and Electrons

	Charge	Mass (amu)	Location
Proton	+1	1	Nucleus
Neutron	0	1	Nucleus
Electron	-1	0	Orbitals

4.2. ARRANGEMENT OF FIRST 20 ELEMENTS IN THE PERIODIC TABLE

The periodic table is like a list of all the elements, organized by their number of protons. The number of protons in an atom is also called the atomic number. For example, hydrogen (H) is the first element on the list.

Atomic structure is like a picture that shows where electrons are inside an atom. Electrons move around in different layers called shells, named with letters like K, L, M, and so on.

The atomic number and symbols are important in chemistry. Symbol is a one- or two-letter abbreviation of the name of the

For your Information:

Tiny Yet Massive: If an atom were magnified to the size of a football field, the nucleus would be about the size of a pea, but the pea would contain 99.9% of the atom's mass.

Interesting Information

Electron Dance: Electron move so quickly and unpredictably that their precise location can only be described as a probability cloud, leading to the concept of the electron dance the nucleus

element. While writing long chemical equations, we need to write a short form of the compounds and elements that time these symbols are very useful. The atomic number of elements gives an idea about the atomic structure of elements, such as how many electrons and protons that particular element has. The first 20 elements of the periodic table are given in the figure below.

Fun Facts:

Lithium - Lithium is one of the lightest metals on the periodic table. ...

Beryllium - Beryllium has a high melting point and an amazing ability to dissipate heat. ...

Sodium - The production of paper uses sodium hydroxide to separate fibers. ...

Magnesium - Magnesium is light weight metal.

Each shell can hold a certain number of electrons. You can find out how many electrons a shell can hold by using a simple formula: $2n^2$, where 'n' is the number of the shell. (Table 4.2)

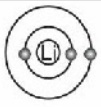
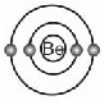
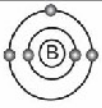
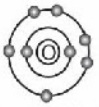
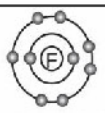
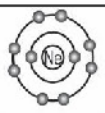
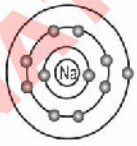
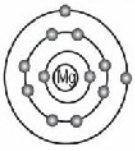
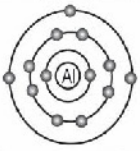
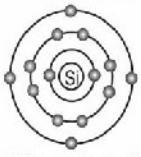
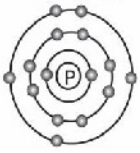
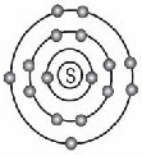
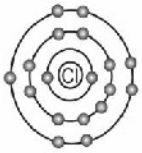
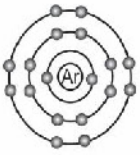
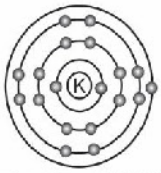
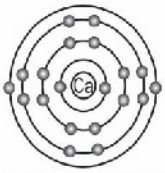
Do you know?

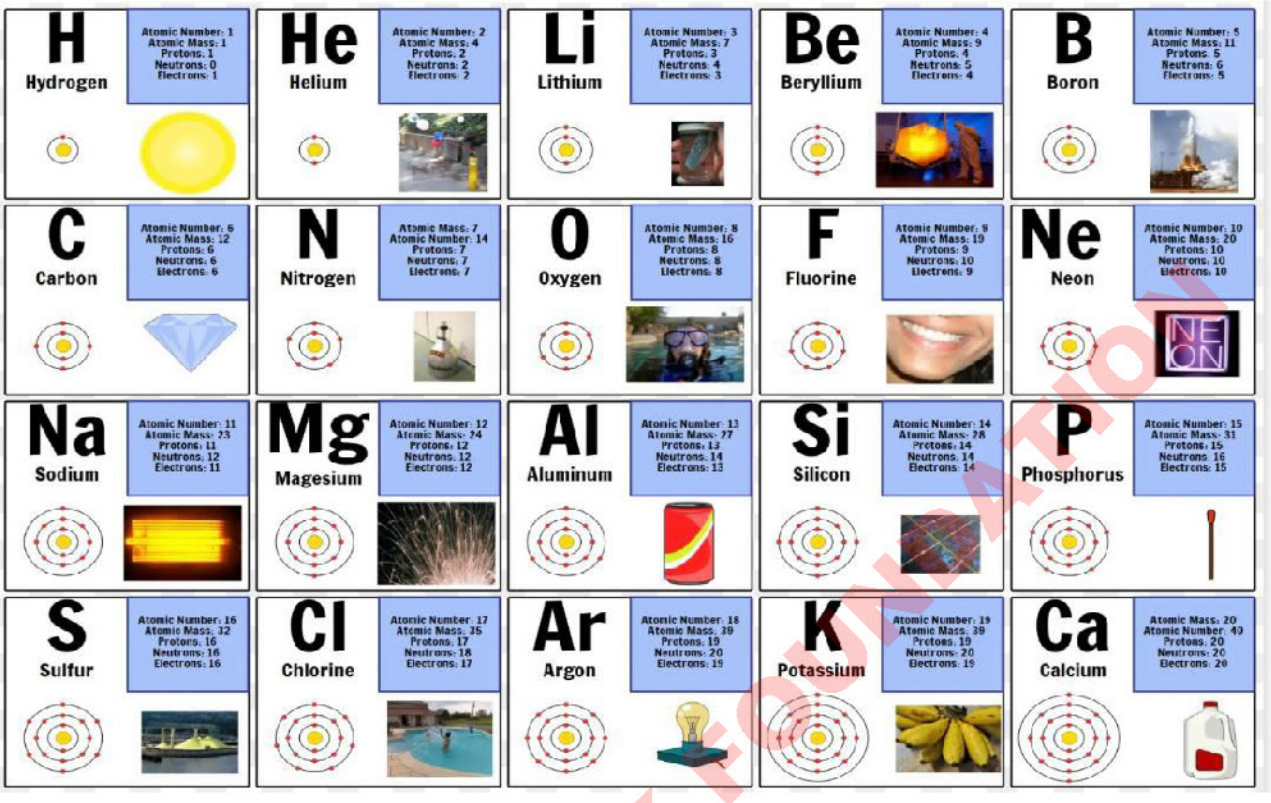
What special about first twenty elements

The first 20 elements provide a great overview of the various element groups. They can also be found in more common chemical processes.

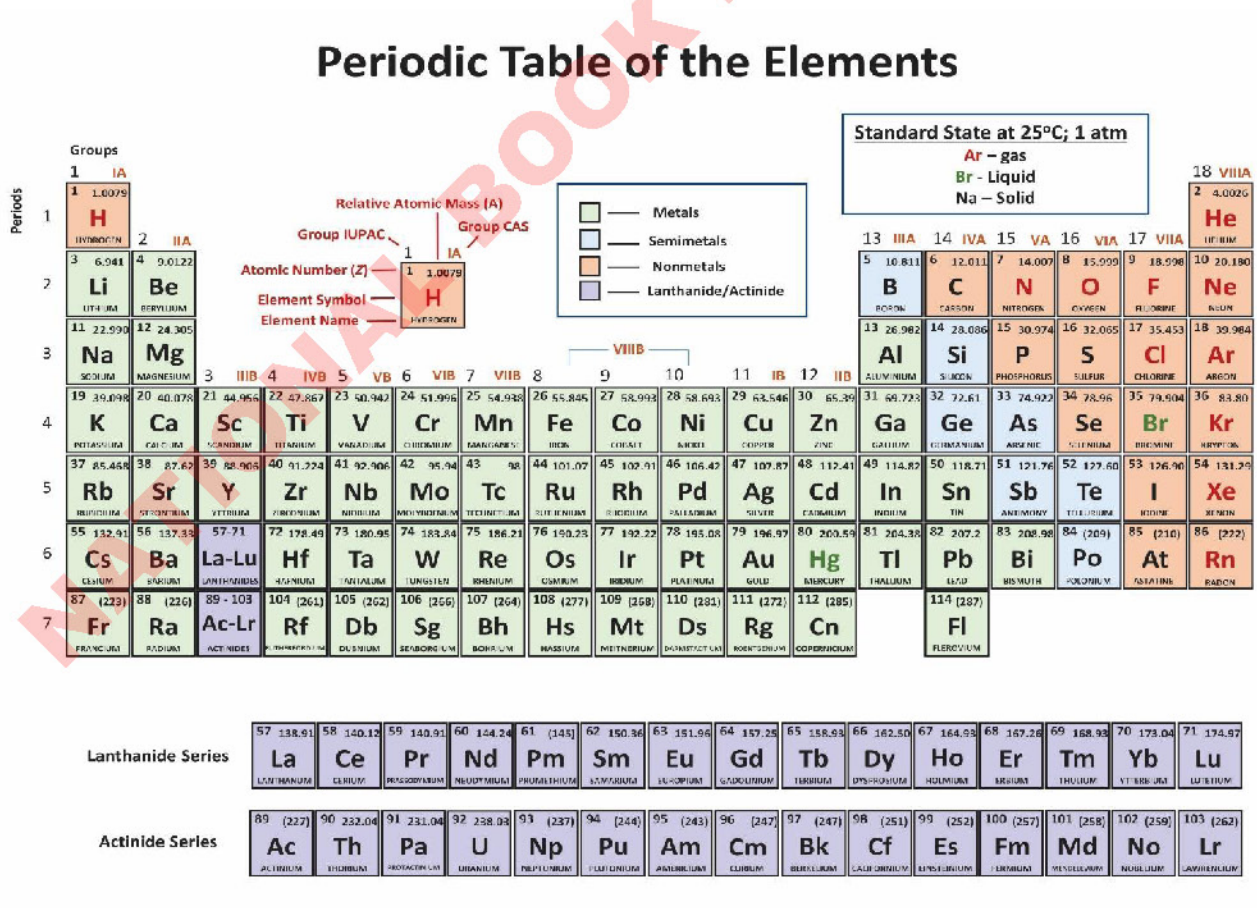
knowing about the first twenty elements of the periodic table is the basic step in order to gain knowledge about all the elements. The atomic number of an element tells us how many protons are in its nucleus and how many electrons orbit around it. For instance, sodium has an atomic number of 11, meaning its nucleus holds 11 protons and it's orbited by 11 electrons. Because an atom's atomic number equals its electron count, we can figure out its electron arrangement simply by knowing its atomic number.

Table4.2 Electron arrangements of the first 20 elements in the Periodic Table

 Hydrogen (1)	 Helium (2)	 lithium (2.1)	 Beryllium (2.2)	 Boron (2.3)
 Carbon (2.4)	 Nitrogen (2.5)	 Oxygen (2.6)	 Fluorine (2.7)	 Neon (2.8)
 Sodium (2.8.1)	 Magnesium (2.8.2)	 Aluminium (2.8.3)	 Silicon (2.8.4)	 Phosphorus (2.8.5)
 Sulphur (2.8.6)	 Chlorine (2.8.7)	 Argon (2.8.8)	 Potassium (2.8.8.1)	 Calcium (2.8.8.2)



Periodic Table of the Elements



4.3. ISOTOPE

Every atom of an element has the same number of protons and electrons, which makes it balanced and gives it a neutral charge. The number of protons in an atom is called its atomic number, like its ID card that tells us where it belongs in the periodic table.

Atoms can have different numbers of neutrons. When this happens, we get isotopes, which are just different versions of the same atom. Isotopes might have the same number of protons, but they have different numbers of neutrons.

Do You Know

Like a person has a skeleton, muscles, and skin, an atom has its construction. If you look at the illustrations of its structure, you will see:
centre or nucleus;
so-called cloud that surrounds the centre.

The total number of protons and neutrons in an atom adds up to its mass number. And since isotopes can have slightly different mass numbers, scientists calculate the atomic mass by finding the average mass number of all the isotopes of an element.

Fact about Isotopes:

All elements have isotopes. There are two main types of isotopes: stable and unstable (radioactive). There are 254 known stable isotopes. All artificial (lab-made) isotopes are unstable and therefore radioactive; scientists call them radioisotopes.

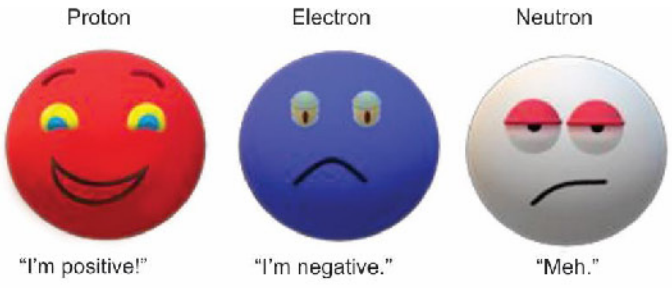
Atomic Number

Every atom of an element has the same number of protons and electrons, which makes it balanced and gives it a neutral charge. The number of protons in an atom is called its atomic number, like its ID card that tells us where it belongs in the periodic table.

Atoms can have different numbers of neutrons. When this happens, we get isotopes, which are just different versions of the same atom. Isotopes might have the same number of protons, but they have different numbers of neutrons.

Mass Number

An element's mass number (A) is the total of its protons and neutrons. To calculate number of neutron of an element can be done by subtracting the number of protons from its mass number. Protons and neutrons both weigh about the same, which is one atomic mass unit (amu).



Isotopes of the same element have the same number of protons but different numbers of neutrons. Isotopes are different types of atoms of the same element. So, they have the same atomic number but different mass numbers. For example, elements like hydrogen, oxygen, carbon and uranium have different types of isotopes as given in table 4.3

For example, carbon has two common isotopes: carbon-12 and carbon-14.

Table 4.3 Mass of some Isotopes				
Element	Isotope	Protons	Neutrons	Mass Number (Amu)
Carbon	Carbon-12	6	6	12
Carbon	Carbon-12	6	8	14

Element	Isotope	Atomic Mass (Amu)	Isotopic Mass (Amu)	Isotope Mass Number	Percent Abundance (%)
Hydrogen	Hydrogen 1	1.007825	1.007825	1	99.985
Hydrogen	Deuterium	2.014102	2.014102	2	0.015
Boron	Bron-10	10.012937	10.012937	10	19.9
Boron	Boron-11	11.009305	11.009305	11	80.1
Carbon	Carbon-12	12.000000	12.000000	12	98.89
Carbon	Carbon-13	13.003355	13.003355	13	1.11
Oxygen	Oxygen-16	15.994915	15.994915	16	99.76
Oxygen	Oxygen-18	17.999160	17.999160	18	0.04
Chlorine	Chlorine-37	36.965903	36.965903	37	24.23
Iron	Iron-56	55.934939	55.934939	56	91.72
Iron	Iron-57	55.935939	55.935939	57	2.2
Iron	Iron-58	57.933273	57.933273	58	0.28
Uranium	Uranium 238	238.050786	238.050786	238	99.2745
Uranium	Uranium 235	235.043929	235.043929	235	0.7200
Uranium	Uranium 234	234.040948	234.040948	234	0.0055

The **chemical properties** of an element tell us how it will behave when it reacts with other elements. These properties are determined by the number of electrons in the atom, which is the same as the atomic number. That means isotopes of the same element have the same chemical properties. However, even though isotopes have the same chemical properties, they can have different numbers of neutrons whereas **physical properties**, like boiling and freezing points ,densities depend on nucleon number. So, isotopes of the same element might have different physical properties.

Examples of Isotopes

Carbon: Carbon-12: 6 protons, 6 neutrons, 6 electrons
Carbon-13: 6 protons, 7 neutrons, 6 electrons
Carbon-14: 6 protons, 8 neutrons, 6 electrons

Oxygen: Oxygen-16: 8 protons, 8 neutrons, 8 electrons
Oxygen-17: 8 protons, 9 neutrons, 8 electrons
Oxygen-18: 8 protons, 10 neutrons, 8 electrons

Fluorine: Fluorine-17: 9 protons, 8 neutrons, 9 electrons
Fluorine-18: 9 protons, 9 neutrons, 9 electrons
Fluorine-19: 9 protons, 10 neutrons, 9 electrons

Chlorine: Chlorine-35: 17 protons, 18 neutrons, 17 electrons
Chlorine-37: 17 protons, 20 neutrons, 17 electrons
Uranium: Uranium-235: 92 protons, 143 neutrons, 92 electrons
Uranium-238: 92 protons, 146 neutrons, 92 electrons

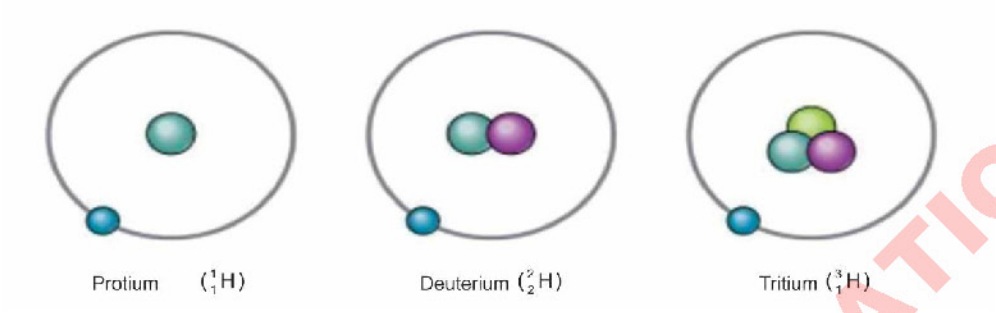


Fig 4.2. Isotopes of Hydrogen

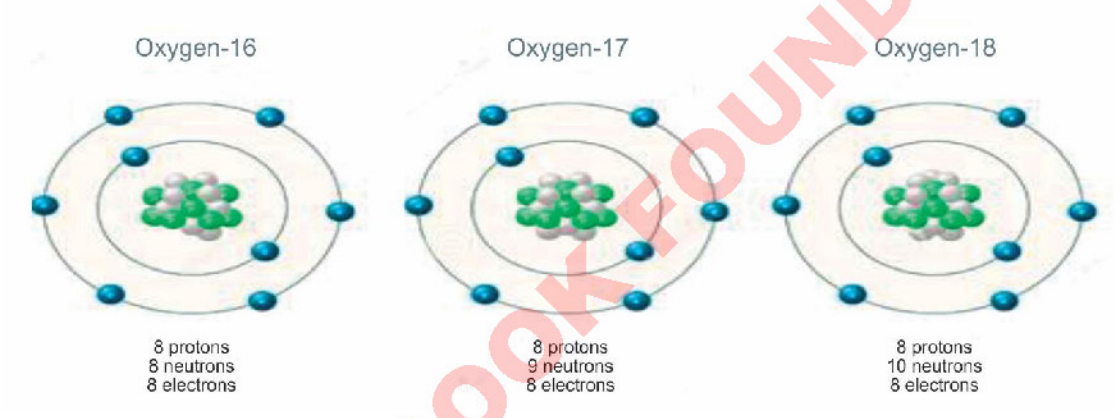


Fig 4.3. Isotopes of Oxygen

Uses of Isotopes

1. Carbon-14: This is a special kind of carbon that is found in the air. Scientists use it to learn about fossils
2. Uranium isotopes (like U-235): These are important for making something called nuclear energy.
3. Arsenic-74: It helps to find tumors in our bodies.
4. Sodium-24: It helps to find blood clots.
5. Cobalt-60: This is another kind of isotope. It's used to help treat cancer.

4.4. RUTHERFORD'S EXPERIMENT

Ernest Rutherford was a scientist from Britain who did an important experiment with tiny particles called alpha particles. He shot these particles at a very thin piece of gold and watched what happened. Some of the particles bounced back, which surprised him.

Rutherford thought about this and came up with a new idea about atoms. He said atoms have a middle part called the nucleus, which is heavy and has a positive charge. Around the nucleus,

there are small, light particles called electrons, which move around like planets around the sun. This idea is called Rutherford's Atomic Model. In his experiment, Rutherford found that most alpha particles passed straight through the gold foil. This discovery showed that atoms are mostly empty space. He realized that the centre of the atom, called the nucleus, is very tiny but heavy. Around this nucleus, tiny electrons move in orbits, kind of like planets around the sun.

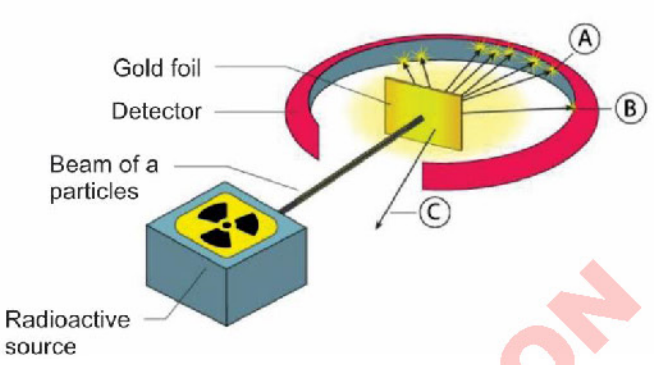


Fig. 4.4: Rutherford's Experiments

The observations made by Rutherford

Rutherford made some important discoveries about atoms:

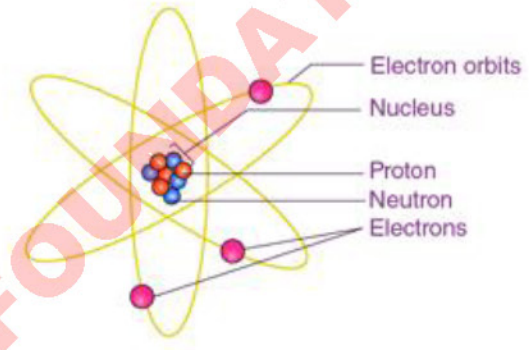


Fig. 4.5: Fig. 9.4 Rutherford Atomic Model

1.Most of an atom is empty space: He found that many tiny particles called alpha particles could pass through a gold sheet without changing direction much. This showed that most of an atom is like empty space.

2.Positive charge isn't spread out: Some alpha particles were deflected slightly, showing that the positive charge in an atom isn't spread out evenly. Instead, it's concentrated in a small area.

3.Atom's positively charged part is tiny: Only a few alpha particles bounced straight back. This meant that the space taken up by the positively charged part of an atom is very small compared to the whole size of the atom.

So, Rutherford's experiments helped us understand that atoms have mostly empty space, their positive charge is concentrated in a small area, and their positively charged part is very tiny.

Postulates of Rutherford's model of an atom:

RutherFord had following ideas about atom

1. **Nucleus**: Most of the atom's mass is in a small, dense part called the nucleus.

2. **Positive Nucleus**: The nucleus has a positive charge, while the rest of the atom is mostly empty space.

3. **Electrons Orbit**: Tiny, negatively charged particles called electrons move around the nucleus in fixed paths called orbits or energy levels.

4. **Electron Movement**: Electrons can move between these orbits, but they can only exist in certain allowed energy levels.

5. **Outer Orbit:** The number of electrons in the outer orbit of an atom decides its chemical behavior and how it connects with other atoms.

6. **Electron Space:** Even though electrons are much smaller than the nucleus, they take up a lot of space around the nucleus, which gives the atom its size.

So, Rutherford's model told us about the nucleus in the center, electrons moving around it, and how atoms interact with each other.

4.5 LIMITATIONS OF RUTHERFORD MODEL OF THE ATOM

Rutherford's model of the atom had some limitations:

1.**Stability Issue:** Rutherford's model couldn't explain why atoms stay together without collapsing.

2.Electron Movement: It didn't say exactly how electrons move in their circular paths around the nucleus. According to Rutherford, electrons move quickly around the nucleus in circles, but this model didn't explain why moving electrons don't lose energy and fall into the nucleus.

3.Energy Emission: Any particle moving in circles should give off energy, but Rutherford's model didn't talk about this.

4.Arrangement of Electrons: Rutherford's model didn't describe how electrons are arranged in these circular orbits, leaving some important details out. Later, a scientist named Niels Bohr suggested a better way of arranging electrons in atoms.

So, while Rutherford's model was a big step forward, it still had some unanswered questions. Later scientists, like Niels Bohr, helped to fill in these gaps and improve our understanding of atoms.

4.6. BOHR'S ATOMIC MODEL

According to the Bohr Atomic model, a compact nucleus with a positive charge is encircled by orbiting electrons carrying negative charges in fixed paths. Bohr deduced that electrons possess greater energy when situated farther from the nucleus, while their energy decreases when they are closer to it.

Bohr improved upon Rutherford's model of the atom. In Rutherford's model, the nucleus is positively charged and surrounded by negatively charged electrons. According to Bohr, electrons move in fixed paths called orbits and reside in specific energy levels within these orbits. While Rutherford focused on the nucleus, Bohr expanded the model by detailing the behavior of electrons and their distinct energy levels.

Postulates of Bohr Atomic Model

1. **Nucleus:** Atoms have a tiny center called the nucleus, where all the atom's mass is found.

2.**Electron Movement:** Electrons move around the nucleus in circular paths called orbits or shells. These paths are also called energy levels and are named with letters like K, L, M, N, or numbers like 1, 2, 3, 4, and so on.

3.Stationary Orbits: These paths, called "stationary orbits," are like set pathways where electrons stay without gaining or losing energy. Each orbit has a specific amount of energy.

4. Energy Levels: Different orbits have different amounts of energy, which are marked by numbers called quantum numbers, like n=1, 2, 3, and so on. The lower energy levels are named K, L, M, and N. The lowest energy level is called the ground state.

5. Energy Changes: When an electron moves between these orbits, its energy changes. It gains energy when it moves to a higher orbit and loses energy when it moves to a lower one.

So, atoms have a small nucleus in the center, and electrons move around it in specific paths called orbits, with each orbit having its own energy level.

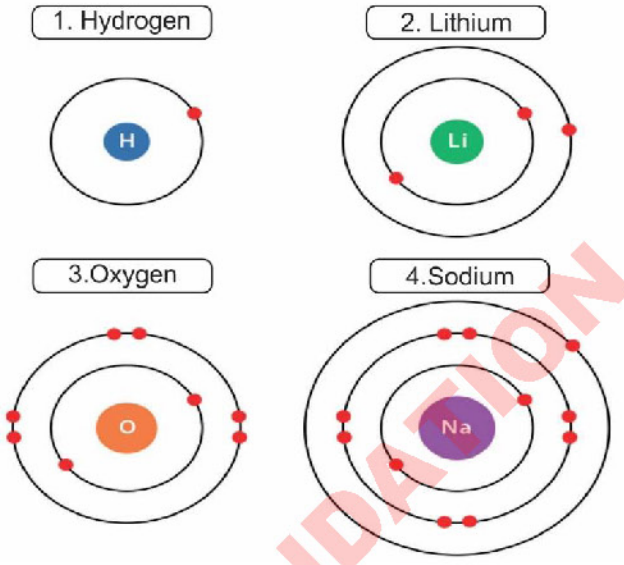


Fig. 4.6. Examples of Bohr's Atomic Model

Therefore,

1st orbit (energy level) is represented as K shell and it can hold up to 2 electrons.

2nd orbit (energy level) is represented as L shell and it can hold up to 8 electrons.

3rd orbit (energy level) is represented as M shell and it can contain up to 18 electrons.

4th orbit (energy level) is represented as N Shell and it can contain maximum 32 electrons.

The orbits continue to increase in a similar manner.

SUMMARY

1. The atomic number is the number of protons in an element, while the mass number is the number of protons plus the number of neutrons.
2. The number of neutrons is variable, resulting in isotopes, which are different forms of the same atom that vary only in the number of neutrons they possess.
3. Together, the number of protons and the number of neutrons determine an element's mass number.
4. Since an element's isotopes have slightly different mass numbers, the atomic mass is calculated by obtaining the mean of the mass numbers for its isotopes.
5. Isotopes are atoms of the same element that contain an identical number of protons, but a different number of neutrons.
6. Despite having different numbers of neutrons, isotopes of the same element have very similar physical properties.
7. Rutherford conducted an experiment by bombarding a thin sheet of gold with α-particles and then studied the trajectory of these particles after their interaction with the gold foil.

   Rutherford described the atom as having a tiny, dense, and positively charged core called the nucleus.
8. Rutherford established that the mass of the atom is concentrated in its nucleus.

9. The light, negatively charged, electrons circulated around this nucleus, much like planets revolving around the Sun.
10. Main Points of the Bohr Model
    a) Electrons revolve around the nucleus in a fixed circular path termed "orbits" or "shells" or "energy level."The orbits are termed as "stationary orbit."
    b) Every circular orbit will have a certain amount of fixed energy
    c) The different energy levels are denoted by integers such as n=1 or n=2 or n=3 and so on. These are called quantum numbers.
    d) The different energy levels or orbits are represented in two ways such as 1, 2, 3, 4... or K, L, M, N..... shells. The lowest energy level of the electron is called the ground state.
    e) The change in energy occurs when the electrons jump from one energy level to other. In an atom, the electrons move from lower to higher energy level by acquiring the required energy. However, when an electron loses energy it moves from higher to lower energy level.

EXERCISE

Section I: Multiple Choice Questions

Select the correct answer:

1- An atom becomes negatively charged by.

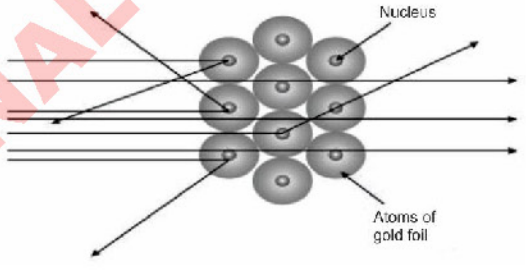
A) Gaining an electron B) Losing an electron

C) Losing a proton D) Gaining a neutron

2- How many neutrons does an atom of hydrogen contain?

A) 3 B) 1 C) 0 D) 2

3- The diagram represents Rutherford's Gold Foil experiment. Which statement is a conclusion that came from this experiment?



A) Electrons orbit the nucleus in rings at set distances.

B) The nucleus of an atom is made of protons and neutrons.

C) The probable location of electrons can be predicted using a cloud model.

D) Most of an atom is empty space and its mass is concentrated in its center.

4- The space surrounding the nucleus is called the

A) Electron cloud B) Ionic field

C) Nucleus field D) Proton cloud

5- What does atomic number of an element indicate indicates?

A) Neutron plus number of protons in the nucleus B) Electron in the nucleus

C) Neutron in the nucleus D) Proton in the nucleus

6- How many neutrons are there in an atom of potassium

A) 19 B) 20 C) 39 D) 58

7- The neutral atoms of all of the isotopes of the same element have

A) Different numbers of protons B) Equal numbers of neutrons

C) The same number of electrons D) The same mass numbers

8- Which of the following determines the atomic number of an atom?

A) Number of electrons. B) Number of protons.

C) Number of electrons and protons. D) Number of protons and neutrons.

9. Rutherford carried out experiments in which a beam of alpha particles was directed at a thin piece of metal foil. From these experiments he concluded that:

A) Electrons are massive particles.

B) The positively charged parts of atoms are moving about with a velocity approaching the speed of light.

C) The positively charged parts of atoms are extremely small and extremely heavy particles.

D) The diameter of an electron is approximately equal to that of the nucleus.

10. Which of the following statements you think is wrong regarding α particle scattering effect?

A) A particles mostly move through the gold foil having zero deflection

B) A small fraction are deflected

C) One in Twenty Thousand turns 180°

D) The thickness of the gold foil is about 100μm

Section II: Short Answer Questions

1. What are subatomic particles?
2. Why is the atomic nucleus important?
3. How do the atomic structures of isotopes vary?
4. What is inside an atomic nucleus?
5. What are the shortcomings of Rutherford's atomic model?
6. How can the total number of neutrons in the nucleus of a given isotope be determined?
7. What is structure of an Atom?
8. Draw structure of carbon atom?
9. Name three subatomic particles?
10. How big is an atom?

Section III: Extensive Answer Questions

1. Write features of Bohr's atomic theory?
2. What is the brief review of the atomic structure of an atom?
3. What is the basic concept of atomic structure?
4. Why did Rutherford use alpha particles?
5. Why was Rutherford's model rejected?
6. Why did Rutherford use gold foil?
7. Draw electronic structure of Sodium, Chlorine and Nitrogen?
8. How many atoms of nitrogen are in the formula NH_4OH?
9. How many atoms of oxygen are in Sn(SO4)2?
10. Differentiate between Rutherford Model and Bohr Atomic model?

Approved by National Curriculum Council, Secretariat
Ministry of Federal Education & Professional Training
vide letter No. , Dated:

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