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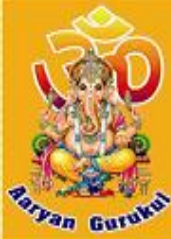
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AARYAN GURUKUL
HIGHER SECONDARY SCHOOL

STUDY MATERIAL
FOR FOUNDATION COURSE – 2020

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SUMMER COURSE

Biology a branch of **Science** that deals with the study of living things.

Science : The term science is derived from Latin word *scientia* which means knowledge. So, the term 'science' is used for knowledge gained by actual observation, found correct on verification and put in a systematic manner or science provides us information based on facts. There are several branches of science, each dealing with a specific subject.

Biology : It is the combination of two Greek words *bios* and *logos*. *Bios* means life and *logos* means study. Thus, biology is the branch of science which deals with the study of life. The first major biological observations were made by ancient Greek naturalist Aristotle (384-322 B.C.). Aristotle has been designated as Father of biology. The term biology was given by French naturalist Lamarck (1744-1829).

Branches of Biology :

Biology has been further classified into following major branches :

- (1) **Botany** : The science of plants is called Botany. The word botany has been derived from Greek word *botane* which means pasture or plants. Technically, botany is called Phytology (Gk. *phyto* = plants; *logos* = study). Theophrastus (370-287 B.C.) is known as Father of botany.
- (2) **Zoology** : Zoology is the study of animals (Gk. *zoon* = animals; *logos* = study). **Aristotle** is called Father of zoology. Being broad-based and with multi-disciplinary approach, the term biology has been replaced by Life Sciences or Biological Sciences.
- (3) **Microbiology** : It is the branch of biology which deals with different aspects of microorganisms. **Leeuwenhock** (1632-1723) is called Father of microbiology.

Fundamental Branches Of Biology :

- (1) **Morphology** : Branch of biology that deals with the study of external form or structure of an organism.
- (2) **Anatomy** : Branch of biology that deals with the study of internal organization or viscera of an organism through dissection.
- (3) **Cytology** : Branch of biology that deal with the study of structure of cell.
- (4) **Physiology** : Branch of biology that deal with the study of life processes.
- (5) **Taxonomy** : Branch of biology that deal with the study of identification, nomenclature and classification of organisms.
- (6) **Embryology** : Branch of biology that deal with the study of formation and development of embryo.
- (7) **Ecology** : Branch of biology that deal with the study of reciprocal relationship between organisms and environment.
- (8) **Genetics** : Branch of biology that deal with the study of heredity and variation of organisms.
- (9) **Pathology** : Branch of biology that deal with the study of nature, cause, prevention and control of diseases.

- (10) Molecular Biology** : Branch of biology that deal with the study of physico-chemical organization of biomolecules like carbohydrates, lipids , proteins, nucleic acids etc.
- (11) Biochemistry** : Study of chemistry of living matter (i.e., chemical composition, nature, mode of formation, functioning) in relation to life activities.
- (12) Evolution** : Study of the origin of life and the gradual differentiation or descent of species.
- (13) Histology** : Study of tissues by microscopy.
- (14) Immunology** : Study of resistance of organisms to infection.
- (15) Algology** : Study of algae.
- (16) Mycology** : Study of fungi.
- (17) Phycology** : Study of algae.
- (18) Virology** : Study of viruses.

Scope of Biology :

Biology creates an awareness of vast array of forms of life which normally goes unseen. Biology offers a large scope and provides a large field for study.

- (1) Helps us to understand ourselves better** : It unfolds different queries of life alongwith its cultural, social, philosophical and economical aspects. So it helps in understanding the life better.
- (2) Biology and inter-relationship of living beings** : Study of biology helps us in understanding the wonderful phenomenon and laws of nature which finally tell us to predict the behaviour of different living beings under changed conditions.
- (3) Biology and resources** : Biology helps us to know how to tap and conserve the resources available to us e.g. fishes, birds, forests etc.
- (4) Biology and literature** : Knowledge of Natural Biology has greatly enriched the literature with their references in stories and poems etc. Poets and other authors have been inspired by the beautiful and interesting plants and animals and frequently figure them in stories, poems and dramas.
- (5) Study of nature is a rewarding experience** : Many plants like *Narcissus*, *Dahlia*, *Gloriosa*, *Roses*, *Marigold*, *Aster*, etc. are used for ornamental purposes. The variety available in animals is widely enjoyed in zoological parks. Students enjoy excursions to remote places watching never seen before plants and animals.
- (6) Solving problems** : Biology makes us to understand the present day problems such as population growth, pollution, conservation of wildlife and survival of man etc. The future directions of biotechnology, conservation of biodiversity, maintenance of environment and human welfare remain in the hands of biologists.
- (7) Biology-Medicinal aspect** : Several plants like *Atropa belladonna*, *Cinchona* are sources of atropine, quinine etc. Many members of fungi such as *Penicillium* and *Streptomyces* give rise to antibiotics like penicillin and streptomycin. Plants are the major source of vitamins. Drugs are first tested on animals before being used for treating man. Animals provide scientific hints for the production and use of medicines. Animals are widely used for scientific research and results thus obtained are finally applied to man. The study of animal play an important role in health, nutrition and control of pests. Many diseases like malaria are caused and transmitted by animals.

- (8) Solving approach of biology** : Knowledge for eradication of diseases like malaria, small pox, etc. have been achieved by scientists basically due to desire and determination to solve the problem.
- (9) Ecosystem and living organisms** : Biology helps us in understanding the various ecosystems. The living community and non-living environment interact with each other and exchange of material in them takes place.
- (10) Biotechnology** : Biotechnologists have produced many genetically modified (GM) crops. Plenty of studies are being made by geneticists, evolutionists and cytologists to fudge the efficacy of biotechnology.

LIVING WORLD

Living beings are called organisms. Living organisms are similar to non-living objects in being – formed of similar elements which combine in similar way to form similar molecules (called biomolecules in living organisms) and follow similar physical and chemical laws like gravitation, magnetism, action and reaction etc. living organisms show a great biodiversity and are classified into different kingdoms-Monera, Protista, Fungi, Plantae and Animalia. But all of these share the following properties :

- (1)** They have definite organisation.
- (2)** They always have cellular nature so are either unicellular (e.g. *Amoeba*, *Paramecium* etc.) or multicellular (e.g., *Hydra*, man etc.).
- (3)** They show co-ordination between different parts of body to maintain homeostasis (constant internal environment) inside the body.
- (4)** They have the ability of movements and locomotion.
- (5)** They show metabolic functions in the presence of energy.
- (6)** These have the ability of intussusceptional (internal) growth and development.
- (7)** These have specific receptors (e.g., sense organs to receive external and internal stimuli) and specific effectors (e.g., muscles and glands to give specific response).
- (8)** These have regulatory mechanisms (e.g., nerves and hormonal in animals, and only hormonal in plants) to maintain homeostasis inside the body.
- (9)** These show adaptations to their environment to increase their chances of survival.
- (10)** These show variations which help in speciation and evolution.
- (11)** These have reproductive powers for continuity of their race.
- (12)** These have definite life span (period from birth to death).
- (13)** These undergo ageing after adulthood and then natural death.

BIODIVERSITY

We observe a large number of different kinds of organisms around us, such as grass, herbs, shrubs trees, insects, frogs, lizards, birds and human.

The variety of life forms existing in nature is termed as 'biological diversity' or 'biodiversity'. Broadly speaking, it is the "richness of the living species or the variation of life at all levels of biological organization. In a finer meaning, it refers to genetic diversity, i.e. a diversity of genes among individuals of a species and also among different species of organisms.

The term 'Biological Diversity' was first used by Jenkins and Lovejoy (before 1975), but W G Rosen (1985) cut short the usage, Biological Diversity and coined the term 'Biodiversity'. EO Wilson (1988) first used the term in one of his publications.

BIOLOGICAL CLASSIFICATION

Definition:- "Biological classification is the scientific procedure of arranging organisms into groups on the basis of their similarities and differences and placing them in different taxonomic categories."

Objectives Of Classification:- (1) To describe and identify all the possible types of species. (2) It helps in easy identification of organisms. (3) To arrange the species in various categories on the basis of their similarities and dissimilarities.

TWO KINGDOM SYSTEM OF CLASSIFICATION:-

This system of classification was given by **Carolus Linnaeus** in his research paper " *Systemae Naturae*" first published in 1735. He classified all living organisms into two kingdoms on the basis of their nutrition and locomotion.

(i) **Kingdom Plantae** or Plant Kingdom (ii) **Kingdom animalia** or Animal Kingdom.

KINGDOM PLANTAE:-

In plant kingdom, chlorophyll containing green plants like algae, mosses, ferns, many colourless and coloured unicellular organisms fungi, lichens, bacteria and sea weeds were included. The plants have following distinguishing feature.

- (1) Form and size are variable.
- (2) Plants move their parts only because they are mostly rooted and incapable of locomotion.
- (3) The growing point shows unlimited and continuous growth.
- (4) Nutrition: Plants are generally **autotrophic** some are saprophytic. Plants show photosynthesis.
- (5) Plants store food in the form of starch.
- (6) Plants take carbon dioxide and release oxygen during day time.
- (7) Reproduction mostly vegetative and asexual means plants require external agencies like air, water and insects in sexual reproduction.

Cell Structure:

- Plant cells are bounded by thick, rigid cell wall.
- Plant cell lacks centrosome.
- Plant cell contains plastids/chloroplast.
- Contains large vacuole.

KINGDOM ANIMALIA:- This kingdom includes protozoans, insects, sponges, fishes, lizards, birds, mammals.

- (1) Form and size is almost constant.
- (2) Movements: animals can often move.
- (3) Growth: Growth takes in all parts of the body. It is limited and stops after the size fixed for the species is reached.
- (4) Nutrition: Nutrition is mostly holotrophic/holozoic.
- (5) Animals store food mainly as glycogen.
- (6) Reproduction: Most animals reproduce sexually but they do not depend on external agencies.

Cell Structure:

- Lacks rigid cell wall.
- Contains centrosome.
- Only small vacuole are present instead of large central vacuole.
- Mostly without plastids.

This approach of classification was not found to be satisfactory because of some new information and due to large diversity among living organisms.

MERITS

- (1) Plants and animals were divided into two kingdoms not abruptly but based upon specific characters.
- (2) It initiated a systematic methods to classify the living organisms. More and more characters were, later, taken into consideration in order to develop better methods.

DEMERITS

- (1) This system of classification has not dealt upon the status of microorganisms in the living world
Example – Viruses, Bacteria. The reason may be the organisms were not properly known by that time.
- (2) Certain organisms like slime molds and Euglena have certain characters similar to plants and animals. Slime molds are tiny plants without cell walls whereas Euglena are minute animals with green pigment system. Hence, their position in the living world was uncertain.
- (3) The position of the prokaryotes was completely ignored.

FIVE KINGDOM SYSTEM OF CLASSIFICATION:-

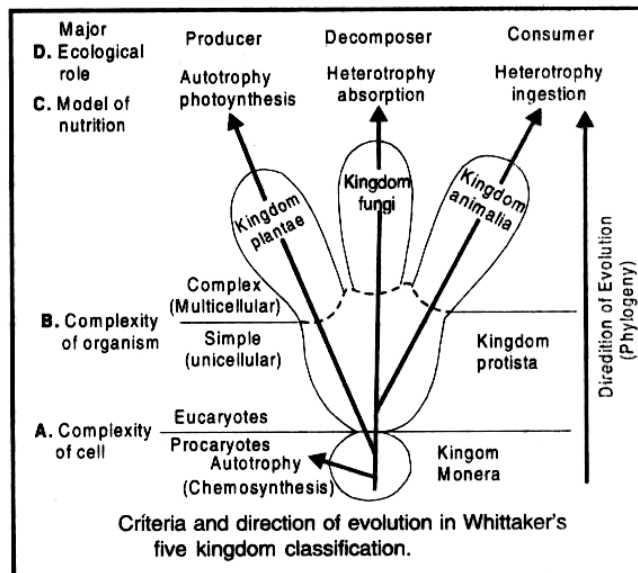
This system of classification was proposed by **Robert. H. Whittaker** an American ecologist. He made an attempt to solve taxonomic problems. “Whittaker” divided the living world into five kingdom: Monera, Protista, fungi, plantae and animalia.

Basis of five kingdom classification:- Five kingdom system of classification is based on **four factors**:

- (i)Complexity of cell structure.
- (ii) Complexity of body organization.
- (iii) Mode of nutrition.
- (iv) Phylogenetic relationship.
- (v) Ecological role.

Characteristics of the five kingdoms

Character	Five kingdoms				
	Monera	Protista	Fungi	Plantae	Animalia
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Non-cellular (Polysaccharide + amino acid)	Present in some	Present (without cellulose)	Present (cellulose)	Absent
Nuclear membrane	Absent	Present	Present	Present	Present
Body organisation	Unicellular	Unicellular	Multicellular/ loose tissue	Tissue/ organ	Tissue/organ/ organ system
Mode of nutrition	Autotrophic (chemosynthetic and photosynthetic) and Heterotrophic (Saprophytic/ parasitic)	Autotrophic (Photosynthetic) and heterotrophic	Heterotrophic (Saprophytic/ parasitic)	Autotrophic (Photosynthetic)	Heterotrophic (Holozoic/ Saprophytic etc.)

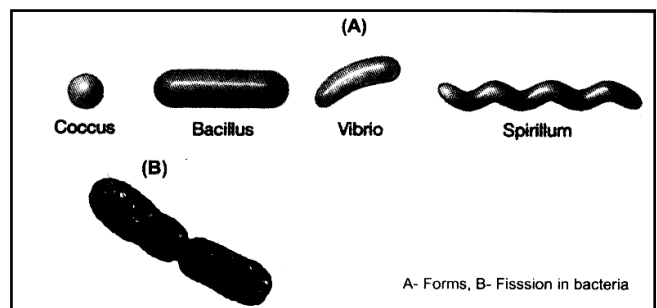


(1) KINGDOM MONERA: (Kingdom Of Prokaryotes) Monera includes all **prokaryotes**.

Example: Mycoplasmas, Bacteria and blue – green algae. They are most **primitive** organisms.

Characters:

- (1) They are microscopic. Unicellular, Prokaryotes.
- (2) They are unicellular.
- (3) Motile or non-motile. (which have movement)
- (4) Prokaryotic organisms.
- (5) The genetic material DNA is **circular and double stranded nuclear material lies called near centre called nucleoid** .
- (6) Ribosome are 70s type (30s + 50s).
- (7) Membrane bound cell organelles like Golgi apparatus, ER, Mitochondria are absent.
- (8) Cell wall is made up of **peptidoglycan**.
- (9) Flagella if _____ is made up of flagellin protein.
- (10) Respiratory enzymes are present in cell membrane is called **Mesosome**.
- (11) Nutrition may be autotrophic, saprotrophic paramitic of symbiotic
- (12) Reproduction is by asexual method: Binary fission and Budding.
- (13) They are important decomposers in biosphere.

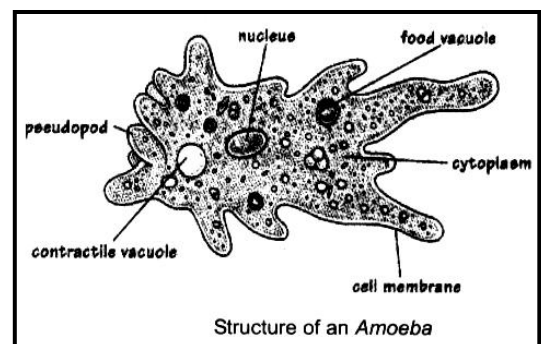


(2) KINGDOM PROTISTA:-(Kingdom of unicellular/Colonial Eukaryotes)

Examples: Algae, Slime moulds and protozoans.

Characters:

- (1) They are unicellular, eukaryotic, mostly aquatic organisms.
- (2) Genetic material is linear, double stranded, enclosed by nuclear envelope. **(with histone protein)**
- (3) Ribosomes are **80s** type → 40s + 60s.
- (4) Golgi apparatus, ER, Mitochondria are present.
- (5) Cell wall is made up of **cellulose**.
- (6) Flagella is made up of **tubulin** protein.
- (7) Cell membrane does not contain respiratory enzyme. It occurs in mitochondria.
- (8) Nutrition may be photosynthetic, holotrophic, saprotrophic and parasitic.
- (9) Reproduction may be asexual or sexual.
- (10) Mitotic cell division is present.



(3) KINGDOM FUNGI:-

The kingdom fungi includes **yeast, moulds, mushrooms and other fungi.**

Characters:-

- (1) They are **multi cellular eukaryotic decomposers without chlorophyll.**
- (2) The body of fungus is filamentous called Mycellium. Its filaments are termed as **hyphae.** The hyphae may be divided into uninucleate or multinucleate cells.
- (3) Cell wall is generally composed of **chitin.**
- (4) Nutrition is **heterotrophic** due to lack of chlorophyll. It may be parasitic, saprophytic and few are symbiotic.
- (5) Reserved food material is **glycogen.**
- (6) These are primarily **non-motile**, some reproductive cells may be motile.
- (7) Reproduction is both asexual and sexual.

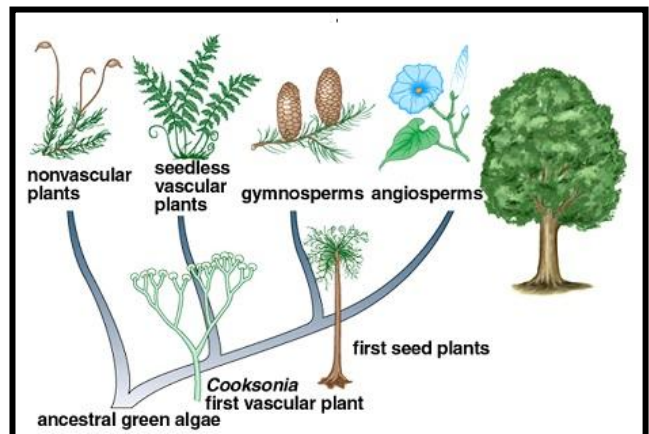


(4) KINGDOM PLANTAE :-(Kingdom of multicellular producers)

Kingdom plantae includes green, brown and red Algae, Mosses, Ferns and Seeds plants with or without flower.

Character:

- (1) They are multicellular eukaryotic with chlorophyll.
- (2) Cells have large central vacuole and rigid cell wall.
- (3) They are composed of vascular tissue and organ like structure except the algae and bryophytes.
- (4) Nutrition is **autotrophic** type. Some are parasitic and some are insectivorous.
- (5) Reproduction may be asexual and sexual or both.
- (6) Life cycle consists of alternating haploid gametophyte and diploid sporophytic generation.
- (7) Plants are mostly non-motile.

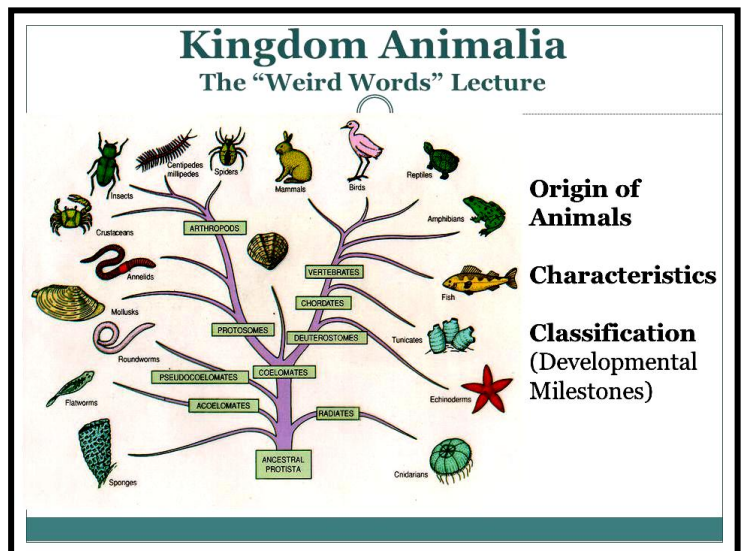


(5) KINGDOM ANIMALIA:-

This kingdom includes sponges, worms, insects, snail, starfish, fishes, lizards, snakes, birds and mammals.

Characters:

- (1) They are multi-cellular eukaryotic without chlorophyll.
- (2) Most animals have organ level of organisms.
- (3) Their cell lacks cells wall, central vacuole and plastids but have centrioles and small scattered vacuoles.
- (4) Nutrition is typically holotrophic. Digestion within an internal cavity. Many animals are parasitic.
- (5) Sensory nervous system is present.
- (6) Life cycle is dominated by diploid phase and haploid stage is represented by gametes.



Merits of five kingdom system:-

- (1) Separation of the prokaryotes from the plants into an **independent kingdom “Monera”** is fully justified because they differ from all other organisms in their morphological and physiological organizations.
- (2) Better placement of some controversial group like cyanobacteria and Euglena.
- (3) **Separation of fungi** from plants is fully correct because they fungi differ in morphology and physiology and biochemistry.
- (4) Plant and animal kingdoms are now more homogenous than they were in the earlier two kingdom system.
- (5) Five kingdom system of classification is based on cellular organization and modes of nutrition.
- (6) It reflects better evolutionary trend in indication of gradual evolution of complex organisms from simpler organisms. So, it seems **more phylogenetical reasonable**.

Drawbacks of five kingdom system:

- (1) The kingdom monera and protista are still heterogenous groups. Both include photosynthetic and non-photosynthetic forms and organisms with cell wall and without cell wall.
- (2) Phylogenetic relationship of lower organisms are not clear. Ex: Certain green algae and some photosynthetic bacteria.
- (3) The slime moulds are quite different from the protists with which they have been combined.
- (4) **Position of virus** is not cleared in Whittaker’s five kingdom system.
- (5) It is difficult to differentiate between the unicellular protistan algae and green algae. He placed algae in 3 kingdoms BGA in monera unicellular algae in protista, multicellular algae in kingdom plantae.

Despite of all these demerits Whittaker’s five kingdom system of classification is **much accepted** to day with little modification.

CELL

Cell Theory and Organisation of cell

Basic unit of life.

Cell Theory

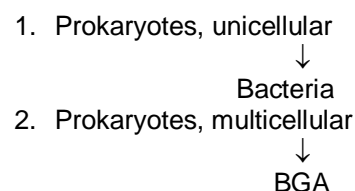
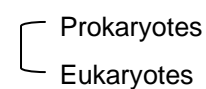
1. All living organism → Cell
2. Co-ordination
3. Genetic material – cell division
4. Chemical composition
5. Pre-existing cell

Characteristics of Cell

1. Basic structural and functional unit of life
2. Protoplasm
3. Chemical composition
4. Plasma membrane
5. Cell wall
6. Regulation of vital processes
7. Genetic material
8. DNA replication, protein syn^s
9. Totipotency – Plant cell
10. Self regulation
11. Response to stimuli

No of cells present in organisms

1. Unicellular – Amoeba, paramecium, Chlamydomonous, euglena
2. Multicellular



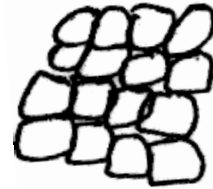
- 3. Eukaryotes, unicellular
 - ↓
 - Amoeba
- 4. Eukaryotes, multicellular
 - ↓
 - Human, Plant, Animals

Cell

→ Cell is the building block of all living organisms.

Discovery of cell

- Robert Hooke (1665) discovered 'cell'
- Self – designed microscope.
- On viewing thin cutting of cork, he discovered empty spaces contained by walls.
- Resembled Honey –comb structure.
- Termed these spaces as –cells (small rooms)



Evolution of cell theory

- Robert Hooke (1665) discovered 'cell'
- Robert Brown (1833) discovered nucleus in a cell.
- Schleiden and Schwann (1839) proposed cell theory

Cell theory

- Cell is the structural and functional unit of life
- Virchow (1855) → Cells arise from pre-existing cells.
- Cells are structural and functional unit of life.
- All organisms are made up of cells.
- All cells arise from pre-existing cell.
- Nucleic acid is the genetic material in all cells.
- Cells interact with each other which results in the organisms function.
- Basic chemical compositions are more or less same in all cells.

Overview of cell.

Organisation with in the cell.

Compartmentalization of cell → Cell organelles.

Cell –types

Based on internal complexity in cell structure two types.

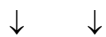
- 1. → Pro karyotic cell



Primitive Nucleus

- Membrane bound cell organelles are absent
- Seen in bacteria, Archaeobacteria

- 2. Eu karyotic cell



True nucleus

- Membrane bound organelle are present.
- Seen in plants, animals, fungi, protista.

◆ So compartmentalization is seen in only eukaryotic cell, not in prokaryotic cell.

Size of Cell

- Cells exist in a variety of shapes and size
- Cell size is measured in terms of centimeters (cm) and millimeter (mm) but in micro-organisms the measurement is made in terms of microns (μ) or micrometer ($m\mu$), nanometer (nm) and angstrom ($^{\circ}A$)
- 1 cm = 10 mm = 10, 000 μ m
- 1 mm = 1000 μ m
- 1 μ m = 1000 nm
- 1 nm = 10 $^{\circ}A$
- Cell size varies greatly in different organisms.
- Smallest cell → coccid bacterium → 2 μ m diameter
- Largest animal cell → an ostrich egg → 20 cm diameter
- Size of plant fibres larger than 60 cm
- Human nerve cell → longest → 1-2 m

Shape of cell

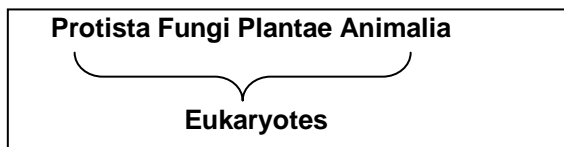
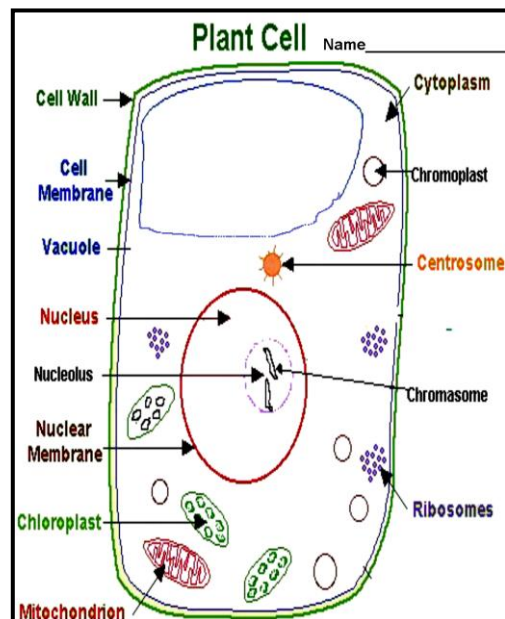
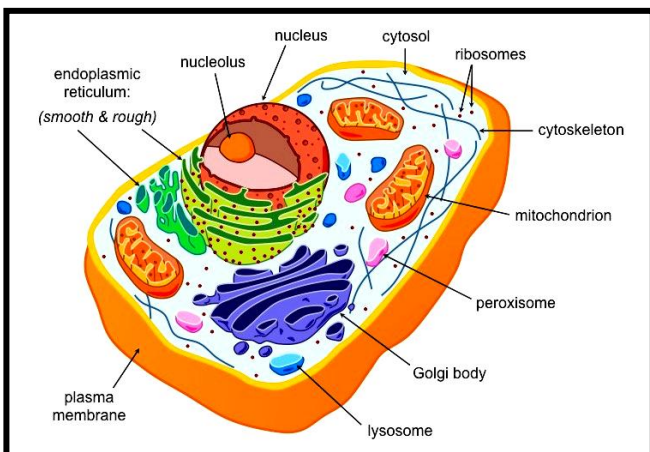
- Shapes of cells vary with the functions they perform.
- E.g – elongated, round, concave oval, cuboidal circular, spherical

Classification of organisms based on numbers of cell

- Unicellular → Single celled → Chlamydomonas, paramecium bacteria
- Multicellular → More than 1 cell

Eukaryotic cell – Characteristics

1. Membrane bound organelles are present
2. Cell compartmentalization is present.
3. Membrane bound nucleus is present
4. Locomotory and cyto skeletal structures are present
5. Genetic material is well organised.



What are cell organelles

→ A cell is made up of components called cell organelles

Cell organelles because of these cell is able to perform various functions.

- | | |
|---------------------------------------|--------------------------------------|
| 1. Nucleus | 2. Ribosome |
| 3. Vesicles | 4. RER – Rough endoplasmic reticulum |
| 5. SER – Smooth endoplasmic reticulum | 6. Golgi apparatus |
| 7. Cytoskeleton | 8. Mitochondria |
| 9. Vacuole | 10. Cytosol |
| 11. Chloroplast | 12. Lysosome |
| 13. Centrioles with centrosome | 14. Cell membrane |

Are all eukaryotic cells identical. ???

Ans → No , depending upon their function they differ.

Plant Cell	Animal Cell
Cell wall present	Absent
Vacuoles are large or big and lesser in number.	Vacuoles are small and more in number. (but not all cell will have it)
Plastids present	Absent
Simpler distributed golgi apparatus called dictyosomes	Single prominent golgi apparatus present
Centrioles absent	Present

EUKARYOTIC CELL	PROKARYOTIC CELL
Well defined nuclear memb	No nuclear memb
Distinct nucleus	No distinct nucleus
Cell organelles are present	Many cell organelles are absent
Region bounded by nuclear memb. contains DNA and Protein	Undefined region with nucleic acids is termed as nucleoid.
e.g: Plant and animal cells	e.g bacteria and blue green algae cells.

Prokaryotic Cell

Characteristics of prokaryotic cell

1. Membrane bound organelles are absent
2. Cell compartmentalization is absent
3. Membrane. bound nucleus is absent.
4. Genetic material is present.

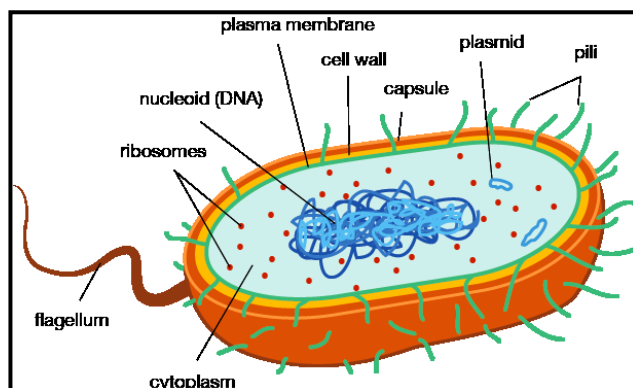
Structure of prokaryotic cell

◆ **Cell envelope**

- Glycocalyx are present
- Cell wall
- cell membrane

◆ **Cytoplasm**

- Fluid filled space
- Contains enzyme. Cell components and organic material



◆ Genetic material

→ Single and Circular DNA carrying genetic information

◆ Plasmids

→ Circular DNA structure

→ Carry gene

→ Helps in reproduction.

◆ Ribosomes

→ 70 s ribosome

→ Responsible for protein synthesis.

Inclusion bodies

→ Not membrane. bound

→ Store reserve material

Pili

→ Hair like structure on cell surface

→ Help to attach to host bodies.

Cell envelope – or glycocalyx layer

→ Can be lose sheath, Slime layer or Thick and tough Capsule

→ Ensure protection against other organism.

Cell wall

→ Provides structural support

→ Maintain shape of the cell

Cell membrane

→ Semi permeable membrane

→ Similar to eukaryotes.

→ Mesosome is unique to prokaryotes which are formed by extensions of all membrane.
