

BIOLOGY

- The word biology means, "the science of life", from the Greek bios, life, and logos, word or knowledge. Therefore, Biology is the science of Living Things. That is why Biology is sometimes known as Life Science.
- Generally, biology is classified into 2 categories. Those are: Botany (Study of Plants) and Zoology (Study of Animals).

Fathers of Different Fields in Biology:

Field	Scientist
Biology and Zoology	Aristotle
Botany and Ecology	Theophrastus
Anatomy	Andreas Vesalius
Taxonomy and Nomenclature	Carolus Linnaeus
Plant Physiology	Stephen Hales
Plant Pathology	de Bary
Paleontology	Leonardo da Vinci
Genetics	Gregor Johann Mendel
Medicine	Hippocrates
Cytology	Robert Hooke
Modern Embryology	Von Baer
Immunology	Edward Jenner

Modern Paleontology	Cuvier
Antibiotic	Alexander Fleming
Blood Circulation	William Harvey
Blood Groups	Karl Landsteiner
Green Revolution	Norman E. Borlaug
Indian Green Revolution	M. S. Swaminathan
Indian Palaeobotany	Birbal Sahni
Experimental Genetics	T. H. Morgan
Birdman of India	Salim Ali
Ornithology (science devoted to birds)	A O Hume
Founder of Embryology	C. F. Wolff

Q. The scientific study of a cell is called:

SSC CGL 07/03/2020 (Morning)

- (a) Cytology
- (b) Histology
- (c) Physiology
- (d) Taxonomy

Ans: a

Cytology refers to the scientific study of cells, their structure, functions, and interactions with one another.

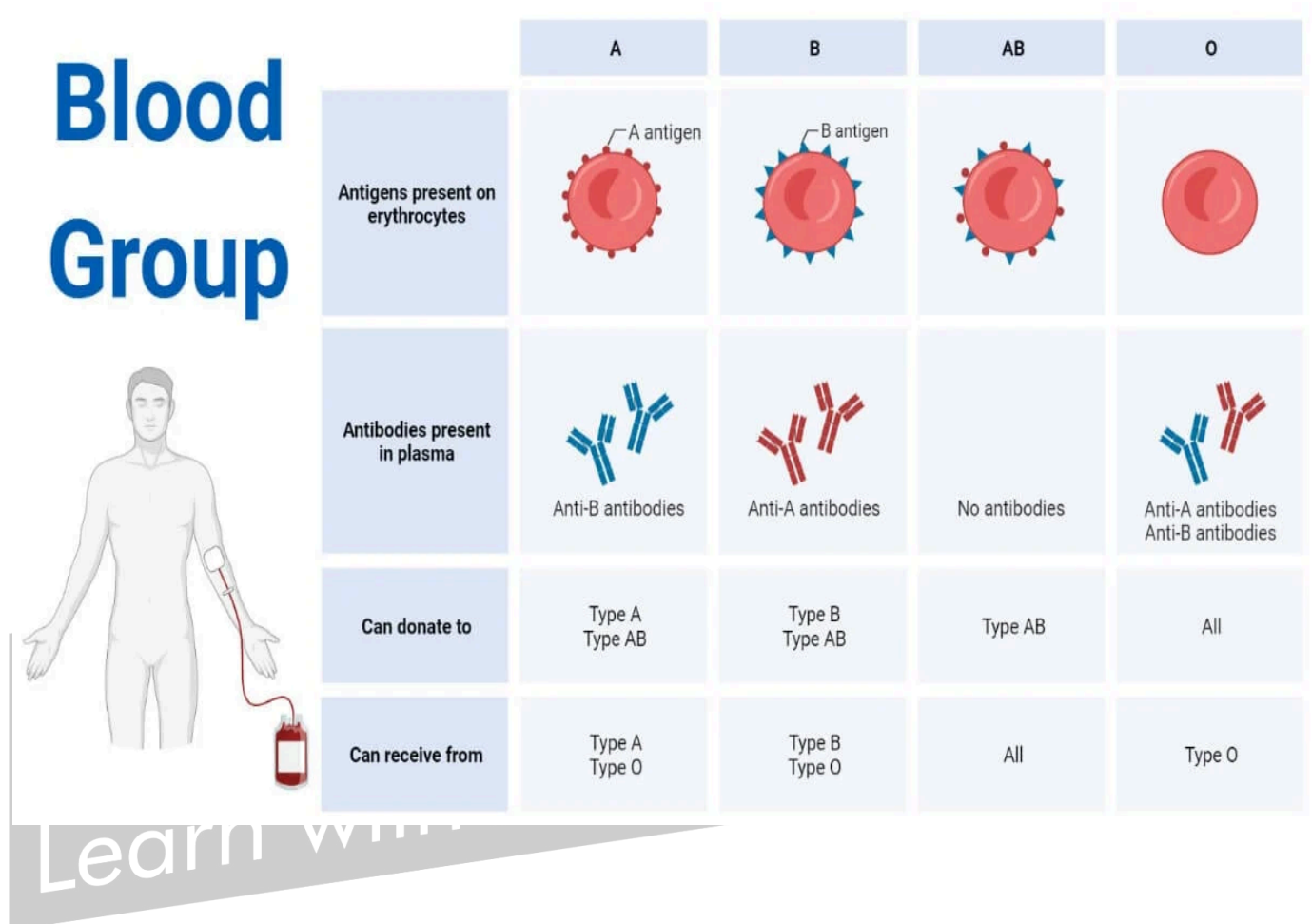
It involves examining cell physiology, cell pathology, and the understanding of cell behavior in various biological processes.

Histology is the scientific study of the microscopic structure of tissues, including cells and their organization within tissues.

Physiology is the branch of biology that deals with the normal functions and processes of living organisms and their parts.

Taxonomy is the science of naming, defining, and classifying organisms based on shared characteristics.

Terms	Meaning
Agroforestry	A land use management system in which combinations of trees or shrubs are grown around or among crops or pastureland. एक भूमि उपयोग प्रबंधन प्रणाली जिसमें पेड़ों या झाड़ियों का संयोजन फसलों या चरागाहों के आसपास या उनके बीच उगाया जाता है।
Silviculture	The development and care of forests. वनों का विकास एवं देखभाल।
Sericulture	The cultivation of silkworms to produce silk. रेशम उत्पादन के लिए रेशम के कीड़ों का पालन।
Pisciculture	The process of growing fish. मछली पालने की प्रक्रिया।
Apiculture	Beekeeping is the care and management of honey bees. मधुमक्खी पालन शहद मधुमक्खियों की देखभाल और प्रबंधन है।
Olericulture	Vegetable Farming सब्जी की खेती
Pomoculture	Fruit Farming फलों की खेती
Viticulture	Cultivation of Grapes अंगूर की खेती
Vermiculture	Artificial rearing or cultivation of worms (Earthworms)



BIOLOGICAL EVOLUTION

- It is the process through which the characteristics of organisms change over successive generations, by means of genetic variation and natural selection.

Fundamental Properties of Life

- Cellular organization : All organisms consist of one or more cells—complex, organized assemblages of molecules enclosed within membranes.
- Sensitivity : All organisms respond to stimuli— though not always to the same stimuli in the same ways.
- Growth : All living things assimilate energy and use it to grow, a process called metabolism.
- Development : Multicellular organisms undergo systematic gene-directed changes as they grow and mature.
- Reproduction : All living things reproduce, passing on traits from one generation to the next.
- Regulation : All organisms have regulatory mechanisms that coordinate internal processes.
- Homeostasis : All living things maintain relatively constant internal conditions, different from their environment.
- Heredity: All organisms on earth possess a genetic system that is based on the replication of a long, complex molecule called DNA. This mechanism allows for adaptation and evolution over time, also distinguishing characteristics of living things.

Theories on Evolution of Life

Lamarckism (Lamarckian inheritance)

Jean-Baptiste Lamarck was a French scientist who developed an alternative theory of evolution in 1801 and 1809. His theory involved two ideas:

1. A characteristic which is used more and more by an organism becomes bigger and stronger, and one that is not used eventually disappears



2. Any feature of an organism that is improved through use is passed to its offspring.

Darwinism

The theory of evolution by natural selection, first formulated in Darwin's book "On the Origin of Species" in 1859, is the process by which organisms change over time as a result of changes in heritable physical or behavioral traits.

Mendelian Inheritance

- It is an inheritance of biological features that follows the laws proposed by Gregor Johann Mendel in 1865 and 1866 and re-discovered in 1900.
- The 19th Century ideas of natural selection by Charles Darwin and Mendelian genetics by Gregor Mendel were united by Ronald Fisher, one of the three founders of population genetics, along with J. B. S. Haldane and Sewall Wright, between 1918 and 1932.

THE CELL and ITS STRUCTURE

Discovery of Cells

- 1665 : Robert Hooke looks at a cork under a microscope. Calls the chambers he see "cells"
- 1665 - 75 : Anton van Leeuwenhoek, credit for the invention of the microscope.
- 1830 : German scientists Schleiden and Schawann summarize the findings of many scientists and conclude that **all living organisms are made of cells**. This forms the basis of the Cell Theory of Biology.

All organisms are composed of cells

- The cell is the structural unit of life - units smaller than cells are not alive.
 - Cells can be cultured to produce more cells
 - in vitro = outside organism or cell
 - in vivo = inside organism or cell
-
- The **ovum**, or egg cell, is the largest cell in the human body.
 - It is considerably larger than most other human cells, visible to the naked eye.
 - The ovum is the female reproductive cell, and it is involved in fertilization when it combines with a sperm cell to form a zygote.
 - **Sperm cells** are among the **smallest human cells**, designed for fertilizing the ovum.

Cell types	Prokaryotes	Eukaryotes
<i>Typical organisms</i>	bacteria, archaea	protists, fungi, plants, animals
<i>Typical size</i>	~ 1–5 μm	~ 10–100 μm
<i>Type of nucleus</i>	nucleoid region; no true nucleus	true nucleus with double membrane
<i>DNA</i>	circular (usually)	linear molecules (chromosomes) with histone proteins
<i>RNA/protein synthesis</i>	coupled in the cytoplasm	RNA synthesis in the nucleus protein synthesis in the cytoplasm
<i>Ribosomes</i>	50S and 30S	60S and 40S
<i>Cytoplasmic structure</i>	very few structures	highly structured by endomembranes and a cytoskeleton
<i>Mitochondria</i>	none	one to several thousand
<i>Chloroplasts</i>	none	in algae and plants
<i>Organization</i>	usually single cells	single cells, colonies, higher multicellular organisms with specialized cells
<i>Cell division</i>	binary fission	mitosis and meiosis
<i>Chromosomes</i>	single chromosome	more than one chromosome
<i>Membranes</i>	cell membrane	Cell membrane and membrane-bound organelles

Learn with Aman & Barkha

Animal cell

- All animals are **multicellular**.
- All animal cells are **eukaryotic**, and do not have a cell wall.
- **Eukaryotes** are organisms whose cells contain a nucleus and other membrane-bound organelles. There is a wide range of eukaryotic organisms, including all animals, plants, fungi, and protists, as well as most algae. Eukaryotes may be either single-celled or multicellular.
- The components of animal cells are centrioles, cilia and flagella, endoplasmic reticulum, Golgi apparatus, lysosomes, microfilaments, microtubules, mitochondria, nucleus, peroxisomes, plasma membrane and ribosomes.

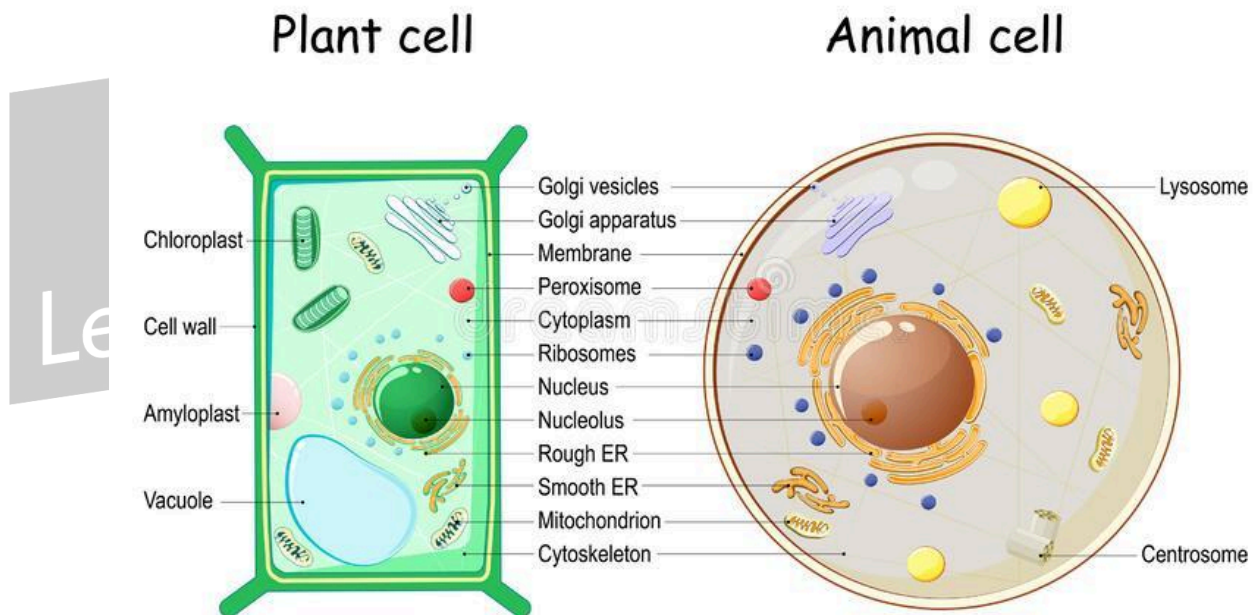


किसी भी कोर्स की जानकारी के लिए सम्पर्क करें | 894 8808 438

- The **ovum, or egg cell**, is the largest cell in the human body.
- The ovum is the female reproductive cell, and it is involved in fertilization when it combines with a sperm cell to form a zygote.

Plant cell

- Plant cells are eukaryotic cells, they are membrane bound organelles. They are surrounded by a rigid cell wall.
- Generally, plant cells are larger than animal cells and are mostly similar.
- Plant cell contains a few distinctive features like a cell wall, large vacuole and plastids.



Cell Organelles

Cell membrane

The cell membrane also known as the plasma membrane is **semipermeable**. It allows only specific molecules to pass through and block others.

The plasma membrane forms the boundary between the outer environment and living systems.

It acts as a selectively permeable membrane by allowing the entry of only selected substances into the cell.

Cell wall

Plant cell walls are primarily made up of cellulose. It is located outside the cell membrane whose main function is to provide rigidity, tensile strength, protection against mechanical stress and infection.

Structural layer surrounds the algal, fungal and plant cells.

Cytoplasm

It is the fluid substance that fills the cell. The cytoplasm maintains the osmotic concentration of the cells and prevents them from bursting or shrinking.

Nucleus

It is a membrane bound organelle, spherical in shape. All the cells in an animal have one complete set of genes in its nucleus. The genetic material DNA helps in protein formation.

Chromosome and Genes are both present in the Nucleus

Nucleolus

It is darkly stained in the nucleus, it aids in protein formation and RNA synthesis.

Nuclear membrane

It is the porous double membrane layer surrounding the nucleus. It allows passage of substances and is a distinctive characteristic of the eukaryotic cell.

Nucleoplasm

It is the semi-fluid substance inside the nucleus.

Mitochondria

Mitochondria is one of the largest organs of the cell and is known as the 'powerhouse of the cell'. The mitochondria aids in conversion of glucose to high energy molecules (ATP) for the cell.

They play a major role in breaking down nutrients and generating energy-rich molecules for the cell.

They are found inside the cytoplasm and essentially function as the cell's "digestive system."

Apart from Nucleus, they also contain DNA arranged in **Chromosomes**

Ribosomes

Ribosomes are found on the endoplasmic reticulum. Together they help in **manufacturing proteins** for the cell following instructions of the nucleus.

Lysosomes

Lysosomes are membrane bound organelles, they contain digestive enzymes. They break down the **waste products** and **detoxify the cell**. It is also called "**Suicide Bag**" of cell.



किसी भी कोर्स की जानकारी के लिए सम्पर्क करें |  **894 8808 438**

Centrosome

- A centrosome is a cell organelle that consists of two centrioles.
- A centrosome is variable in size but always larger than a centriole.
- The centrosome forms near the core and, after replication, on the inverse sides of the core.

Functions of Centrosome:

- Keeping chromosome number constant during cell division.
- Stimulating changes in cell membrane shape during phagocytosis.
- Assisting in cell division

Endoplasmic reticulum

It is a large network of interconnecting membrane tunnels. It is composed of both **rough endoplasmic reticulum** and **smooth endoplasmic reticulum**. The rough endoplasmic reticulum is covered with ribosomes hence appears rough. It transports material through the cell and produces and digests lipids and membrane proteins.

(a) **Rough Endoplasmic Reticulum (RER)**: with ribosomes attached on its surface for synthesising proteins.

(b) **Smooth Endoplasmic Reticulum (SER)**: which is without ribosomes and is meant for secreting lipids.

Golgi apparatus

They are flattened stacks of membrane bound sacs. They function as the packaging unit, the proteins formed by the endoplasmic reticulum are packed into small membrane sacs called vesicles.

They responsible for processing and packaging proteins. It receives proteins from the endoplasmic reticulum (ER) and modifies them by adding sugars, lipids, and other molecules. These modifications are essential for the proper function of the proteins and their delivery to the correct location within the cell

Vacuoles

They are organelles for storage. Small membrane bound vacuoles filled with fluids and water are present in animals. In plant cells the vacuoles perform functions of secretion, excretion and storage.

Chloroplasts

It is an elongated or disc-shaped organelle containing chlorophyll. It is the site for photosynthesis in a plant cell.

Cytoskeleton

It is a network of fibers.

They maintain the shape and gives support to the cell.

Plasmodesmata

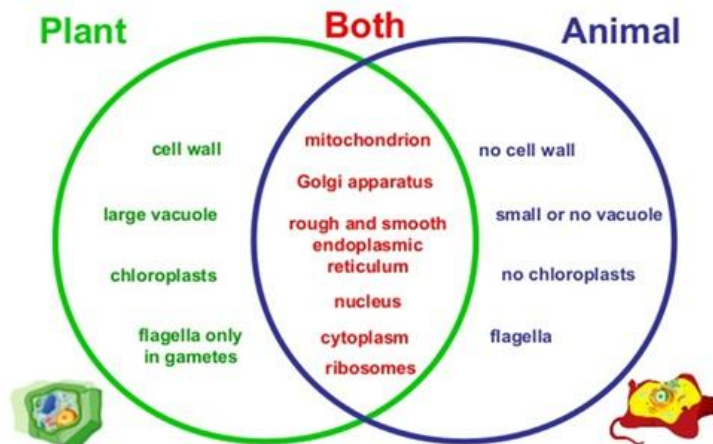
They are microscopic channels which traverse the cell walls of plant cells and enable transport and communication between them.

Plastids

Plastids are storage organelles. They **store products like starch** for synthesis of fatty acids and terpenes. They are only present in the plant cell.



किसी भी कोर्स की जानकारी के लिए सम्पर्क करें | 894 8808 438



History of research in Cell

- 1632–1723: **Antonie van Leeuwenhoek** teaches himself to make lenses, constructs basic optical microscopes and draws protozoa, such as Vorticella from rain water, and bacteria from his own mouth.
- 1665: Robert Hooke discovered cells in cork, then in living plant tissue using an early compound microscope.
- 1839: Theodor Schwann and Matthias Jakob Schleiden elucidate the principle that plants and animals are made of cells.
- 1855: Rudolf Virchow states that new cells come from pre-existing cells by cell division.
- 1931: Ernst Ruska built the first transmission electron microscope (TEM) at the University of Berlin. By 1935, he had built an Electron Microscope with twice the resolution of a light microscope.
- 1953: Watson and Crick made their first announcement on the double helix structure of DNA on February 28.