

BIOLOGY

Biology (coined by **Lamarck** and **Treviranus** 1802), is a branch of science which deals with study of living organisms. It mainly includes Botany (Study of plants) and Zoology (Study of animals). The scientist who gave this thoughts for the first time about the life of plants and animals was Aristotle, that's why he is known as the father of Biology. He is also known as the father of Zoology.

LIVING WORLD

In 18th Century, **Carolus Linnaeus** developed **binomial nomenclature** for living organisms, i.e., scientific name consisting of **genus** and **species**

- **Whittaker** (1969) classified living organisms into five kingdoms— Monera, Protista, Fungi, Plantae and Animalia.
- Monera includes bacteria and Mycoplasma, while Protista includes Protozoa (unicellular Eukaryotes).
- **Viruses** are sub-microscopic, obligate, intracellular parasites consisting of nucleoprotein. **WM Stanley** first crystallised TMV (Tobacco Mosaic Virus).
- **Viroids** are the smallest infectious single stranded RNA molecules discovered by **TO Diener**.

THE CELL

- According to cell theory proposed by **Schleiden** and **Schwann** (1838) , the cell is the structural and functional unit of living organisms.
- An organism may be composed of a single cell (unicellular) or many cells (multicellular).
- Cells are of two types i.e., **prokaryotic** (which lacks nucleus and membrane bound organelles) and **eukaryotic** (which have nucleus and membrane bound organelles).
- Prokaryotic cell is found in bacteria, mycoplasma and blue-green algae while eukaryotic cell in plants, animals and fungi.

Nucleic Acids

- These contain the genetic instructions used in the development and functioning of all known living organisms. These are of two types namely DNA and RNA. **Deoxyribo Nucleic Acid** (DNA) It is a long polymer made from repeating units called nucleotides. It has four bases i.e. adenine, guanine, cytosine and thymine.
- **Ribo Nucleic Acid** (RNA) It is also made up of a long chain of nucleotides. It contains uracil in place of thymine.

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HUMAN SYSTEMS

The cells of human and other multicellular animals are organised into **tissues**. Two or more tissues grouped together to form organs. An organ system is a group of organs that function together to carry out the principal activities of the body.

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Digestion

Digestion is the process by which complex food is converted into simple components with the help of digestive enzymes, i.e. hydrolysis process.

Respiratory System

Respiration is an oxidative process involving oxidation of food substances such as carbohydrate, fat and proteins to form CO_2 , water and to release energy. Respiration may be anaerobic, (i.e. without O_2) and aerobic (i.e. with O_2).

Respiratory Organs of Animals

Organ	Animal
Lungs	Reptiles and mammals
Skin	Frog, earthworm and leeches
Gills	Fishes, tadpoles and prawns
Tracheae	Insects, centipedes and millipedes
Body surface	Protozoans, porifera and coelenterates
Book lungs	Spider and scorpion
Book gills	King crab, prawn, cray fish and Daphnia
Mental	Mollusca (Unio)

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Air bladder	Long fish and bony fishes (e.g. Labeo)
Airsacs/lungs	Birds

Vitamins

Fat Soluble Vitamins

Vitamin (Name)	Rich Food Source	Function	Deficiency Disease
A (Retinol)	Fish liver oils, dairy products, liver, most leafy vegetables and carrots contain carotene that can be converted into retinol	Needed for healthy epithelial cells and regeneration of rhodopsin in rod cells of the eye	Dry skin and night blindness (Nyctalopia)
D (Calciferol)	Fish oils, egg yolk and butter. It can be made by the action of sunlight on skin	Promotes absorption of calcium from intestines. Necessary for formation of normal bone and reabsorption of phosphate from urine	Rickets in children ('soft' bones that bend easily) Osteomalacia (painful bones) in adults
E (Tocopherol)	Vegetable oils, cereal products and many other foods	Formation of red blood cells, affects muscles and reproductive system	Mild anaemia and sterility . Deficiency is rare in humans
K (Phylloquinone)	Fresh and dark green vegetables. Also made by gut bacteria	Formation of prothrombin (involved in blood clotting)	Delayed clotting time. May occur in new-born babies before their gut bacteria become established

Water Soluble Vitamin

Vitamin (Name)	Rich Food Source	Function	Deficiency Disease
B ₁ (Thiamine)	Yeast, cereals, nuts, seeds and pork	Co-enzyme in cell respiration, necessary for complete release of energy from carbohydrates	Beri-beri (muscular dystrophy, stunted growth and nerve degeneration)
B ₂ (Riboflavin)	Liver, milk, eggs and green vegetables	Co-enzyme in cell respiration. Precursor of FAD	Cracked skin and blurred vision

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B ₃ (Niacin)	Liver, yeast, whole cereals and beans	Co-enzyme in cell respiration. Precursor of NAD/NADP	Pellagra (severe skin problems, diarrhoea and dementia)
B ₅ (Pantothenic acid)	Animal tissue, whole grain cereals and legumes	Needed to manufacture adrenal hormone	Pellagra, Dermatitis and Diarrhoea
B ₆ (Pyridoxine)	Meat, fish, eggs, cereals bran and some vegetables	Interconversion of amino acids.	Skin problems and nerve disorder
B ₁₀ (Folic acid)	Liver, raw green vegetables, yeast and gut bacteria	Formation of nucleic acids and red blood cells	Anaemia (especially during pregnancy)
B ₁₂ (Cyanocobalamin)	Liver, milk, fish and yeast. None in plant foods	Maturation of red blood cells in bone marrow. Maintenance of myelin sheath of nerves	Pernicious anaemia and nerve disorders
C (Ascorbic acid)	Blackcurrants, peppers, sprouts and citrus fruits	Formation of collagen and intercellular cement	Scurvy and poor wound healing

Major Enzymes of Digestion

Enzyme	Source	Where Active	Substrate	Main Breakdown Product
Carbohydrate Digestion				
Salivary amylase	Salivary glands	Mouth	Polysaccharides	Disaccharides
Pancreatic amylase	Pancreas	Small intestine	Polysaccharides	Disaccharides
Disaccharidases	Small intestine	Small intestine	Disaccharides	Monosaccharides (e.g., glucose)
Protein Digestion				
Pepsin	Stomach mucosa	Stomach	Proteins	Peptide fragments
Trypsin and chymotrypsin	Pancreas	Small intestine	Proteins and polypeptide	Peptide fragments

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Carboxypeptidase	Pancreas	Small intestine	Peptide fragments	Amino acids
Amino peptidase	Intestinal mucosa	Small intestine	Peptide fragments	Amino acids
Fat Digestion				
Lipase	Pancreas	Small intestine	Triglycerides	Free fatty acids and monoglycerides
Nucleic Acid Digestion				
Pancreatic nucleases	Pancreas	Small intestine	DNA and RNA	Nucleotides
Intestinal nucleases	Intestinal mucosa	Small intestine	Nucleotides	Nucleotides bases and monosaccharides

Blood (Lymphatic System)

- Fluid connective tissue composed of plasma and blood cells.
- An adult person has 5-6 litre blood.
- It is slightly alkaline having pH 7.3-7.4.
- Plasma is pale yellow transparent and constitutes about 60% volume of blood.
- Plasma is composed of 90-92% water, 7% organic substances (albumin, globulin and fibrinogen protein) and 1% inorganic substances.
- Red blood corpuscles (Most abundant) are non-nucleated and contains haemoglobin (the respiratory pigment).
- White blood cells are colourless, nucleated and granular or agranular.
- **Eosinophils** are also called acidophils. (2-8%) are phagocytic granulocytes and play an important role in hypersensitivity.
- **Basophils** (2%) are non-phagocytic granulocytes and increase during chickenpox.
- **Neutrophils** (65%) are phagocytic granulocytes and increase during bacterial infection

Blood Groups, Genotypes and their Transfusion Possibility

Blood Group (phenotype)	Antigen in Red Blood Cells	Antibodies in Plasma	Can Give Blood to Groups	Can Receive Blood from Group
O	None	Anit- <i>a</i> , Anit- <i>b</i>	O, A, B and AB	O
A	A	Anit- <i>b</i>	A and AB	O and A
B	B	Anit- <i>a</i>	B and AB	O and B
AB	A and B	None	AB	O, A, B and AB

- **Monocytes** (0.5%) are agranulocytes called policemen of blood and increase during tuberculosis.
- **Lymphocytes** (26%) are agranulocytes producing antibodies and increase during viral infection
- **Platelets** (thrombocytes) are non-nucleated. Platelets have a lifespan of about 8 to 10 days
- **Rh factor** discovered by **Landsteiner** and **Veiner** in **Rhesus** monkey, which is responsible for **erythroblastosis foetalis disease**
- Important components of blood clotting are fibrinogen, prothrombin, thromboplastin, calcium ions and Vitamin-K.



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Heart

- Human heart is **myogenic** i.e., contraction is initiated by a pulse produced by the Sino-atrial **node** (SA node) located in the right atrium. It is also called a pacemaker. First heart sound is **lub** and the second heart sound is **dub**.

- Contraction of the heart is called **systole**. 120 mm Hg, while relaxation is called **diastole** (80 mm Hg).

Excretion

- It is the process elimination of harmful waste products from the animal body to regulate the composition of the body fluids and tissues.

- Human excretory system is composed of two kidneys. **Nephron** is the structural and functional unit of kidneys.

- Colour of urine is pale yellow. It is due to pigment **urochrome**.

- Human urine contains about 95% water, 2% salts, 2.6% urea and 0.3% uric acid.

Main Excretory Organs

Excretory Organ	Animal
Contractile vacuole	Amoeba
Flame cells/solenocytes	Tapeworm
Renette cell	Ascaris
Nephridia	Earthworm
Malpighian tubules	Cockroach
Coxal glands	Scorpion
Green glands	Prawn

- pH of urine is about 6.0 (mildly acidic).
- The urine on standing gives a pungent smell. It is due to the conversion of urea into ammonia.
- Specific gravity of urine is 1.015-1.025.
- Volume of urine is 1 to 2 L per day

Main Excretory Products

Product	Animal
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Ammonia	Most invertebrates, fishes etc
Urea	Ascaris, earthworm, cartilaginous fishes, amphibian and mammals
Uric acid	Insects, land reptiles and birds

Central Nervous System

The brain is the organising and processing centre of the body. It is the site of consciousness, sensation, memory and intelligence.

The brain receives impulses from the spinal cord and from 12 pairs of cranial nerves coming from it and extending to the senses and to other organs. In addition, the brain initiates activities without environmental stimuli.

Three major portions of the brain are recognised as the **hindbrain**, **midbrain** and the **forebrain**

Important Functions of Brain

Olfactory region	Smell
Cerebrum	Thinking, intelligence, memory, ability to learn from experience, will power, skilled work, reasoning knowledge, consciousness and speech.
Control	Laughing, weeping, micturition (passing of urine), defecation voluntary forced breathing and voluntary muscular co-ordination
Diencephalon (sensation of)	Heat, cold and pain control centre of autonomic nervous system, control hunger, thirst, sweating, sleeping and sex.
Hypothalamus	Regulated body temperature so 'thermostat' of body. Appetite and safety control emotions like love, anger, pleasure and satisfaction. Control metabolism of carbohydrate, fat and water.
Midbrain and Hindbrain	Reflex centre of visual and auditory sensation
Cerebellum	Involuntary muscular co-ordination, maintain posture, orientation and equilibrium of the body.
Medulla oblongata	Regulate heart rate, involuntary breathing, respiratory centre, blood pressure, (vasoconstriction and vasodilation) gut peristalsis, food swallowing and vomiting gland secretion.

Some Human Diseases Caused by Viruses and Bacteria

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<i>Disease</i>	<i>Pathogen</i>	<i>Incubation</i>	<i>Symptoms</i>	<i>Prevention/ Vaccine</i>
Chickenpox (Varicella)	Herpes zoster virus	12-20 days	Dark red coloured rash or pox changing into vesicles, crusts and falling	Varicella vaccine
Smallpox	Variola virus	12 days	Appearance of rash changing into pustules, scaps and falling pockmarks are left	Smallpox vaccine
Poliomyelitis	Polio virus	7-14 days	Damages motor neurons causing stiffness of neck, convulsion, paralysis of limbs generally legs	Salk vaccine and Oral Polio Vaccine (OPV)
Measles (Rubella disease)	Rubella virus	10 days	Rubella (skin eruptions), coughing, sneezing, etc	Measles-mumps-rubella-Varicella Combo (MMRV vaccine)
Mumps	Mumps virus	12-26 days	Painful enlargement of parotid and salivary glands	Mumps-vaccine, isolation
Rabies (Hydrophobia)	Rabies virus	10 days to 1-3 months	Spasm in throat and chest muscles, fears from water, paralysis and death	Immunisation of dogs
Tuberculosis	M tuberculosis	2-10 weeks	Coughing, chest pain and bloody sputum with tuberculin	BCG vaccine
Diphtheria	C diphtheriae	2-6 days	Inflammation of mucosa of nasal chamber, throat, etc, respiratory tract blocked	DPT vaccine
Cholera	Vibrio cholerae	6 h to 2-3 days	Acute diarrhoea and dehydration	Sanitation, boiling of water and oral cholera vaccine
Leprosy	Mycobacterium leprae	2-5 years	Skin hypopigmentation, nodulated skin,	BCG also offers variable amount of protection

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			deformity of fingers and toes.	against leprosy. Lepromin skin tests
Tetanus (Lock jaw)	Clostridium tetani	3-21 days	Degeneration of motor neurons, rigid jaw muscles, spasm and paralysis	ATS and DPT vaccines
Typhoid	Salmonella typhi	1-3 weeks	Classic typhoid fever	TAB vaccine and screening of food and water
Plague	Pasteurella pestis	2-6 days	Bubonic plague affects, lymph nodes, pneumonic plague affects lungs and septicemic plague causes anaemia	Killing of rats and rat fleas, plague vaccine
Gonorrhoea	Neisseria gonorrhoeae	2-10 days	Inflammation of urinogenital tract	Avoid prostitution
Pneumonia	Streptococcus pneumoniae	1-3 days	Decrease in respiratory efficiency	PCV 13

Important Vaccines Discoverer

Vaccine	Discovered By
Small pox	Edward Jenner (1786)
Cholera	Louis Pasteur (1880)
Diphtheria and Tetanus	Emil Adolf Von Behring and Shibasaburo Kitasato
Tuberculosis	Leon Calmette and Camille Guerin (1992)
Polio	Jonas E Salk (1954)
Oral polio	Albert Bruce Sabin (1995)
Measles	John F Enders (1960)
Rabies	Charles Nicolle (1909)

Some largest in their categories

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Mammal (on land)	African elephant (<i>Loxodonta africana</i>)
Mammal (in the biosphere)	Blue whale
Flower	Rafflesia
Flower in India	Sapria
Vertebral	Lumbar vertebrae
Bone	Femur
Bone (in frog)	Tibia-fibula
Muscles	Gluteus maximus (buttock muscle of hip)
Tooth	Tusk of elephant (upper incisor modification)
Tallest angiosperm	Eucalyptus
Tallest gymnosperm	Sequoia sempervirens (<i>Sequoia gigantea</i>)
Coral reef	In Australia, great barrier reef
Egg or cell	Ostrich
Vein	Inferior vena cava
Artery	Abdominal aorta
Cell of the body	Neuron or nerve cell
Virus	Parrot fever virus

Some Important Branches of Biology

Branch	Concerned Field
Agriculture	Study of producing crops from the land
Anatomy	Study of the animal forms with an emphasis on human bodies
Anthology	Study of flowers
Anthropology	Study of apes and man
Apiculture	Honey industry (Bee keeping)
Biochemistry	Deals with the study of chemical reactions in relation to life activities
Cardiology	Study of heart

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Cryogenics	Study concerning with the application and uses of very low temperature
Cytology	Study of cells
Dermatology	Study of skin.
Floriculture	Study of flower yielding plants.
Genetics	Study of heredity and variations
Gerontology	Study of growing old.
Horticulture	Study of garden cultivation
Myology	Study of muscles.
Nephrology	Study of kidneys
Obstetrics	Branch of medicine dealing with pregnancy
Ornithology	Study of birds
Phycology	Study of algae
Pedology	Study of soils
Pathology	Study of disease causing organisms
Physiology	Science dealing with the study of functions of various parts of organisms.
Pisciculture	Study of fish
Sericulture	Silk industry (culture of silk moth and pupa).
Serpentology	Study of snakes
Taxonomy	Study of classification of organisms
Virology	Study of virus

Some Important Discoveries

Discovery	Made by	Country
Antibiotic	Alexander Flemming (1928)	Scotland
Antiseptic	Joseph Lister (1867)	Scotland
Blood circulation	William Harvey (1628)	Britain

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Blood transfusion	Jean-Baptiste Denys (1625)	France
Cholera and TB germs	Robert Kock (1883)	Germany
Electrocardiogram (ECG)	William Einthoven (1903)	Dutch
CT Scan	Godfrey Hounsfield (1973)	England
Sphygmomanometer	Scipione Riva-Rocci (1898)	Italy
Stethoscope	Rene Laennee (1819)	France
Thermometer	Sir Thomas Aelburt (1867)	England
Ultrasound	Ian Donald (1950)	Ireland
X-ray	WC Roentgen (1895)	Germany
Electroencephalogram (EEG)	Hans Berger (1929)	Germany

