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All the Best!! TEAM OSWAAL



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SYLLABUS

- The Living World : What is 'living'?, Three domains of life, Biodiversity, Need for classification, Taxonomy and systematics, Binomial nomenclature, Concept of species and taxonomical hierarchy, Tools for study of taxonomy – Botanical gardens, Herbarium, Zoological parks, Biological Museums and Taxonomic Keys.
- Biological Classification : Five kingdom classification, Salient features and classification of Monera, Protista and Fungi into major groups, Lichens, Viruses and Viroids.
- Plant Kingdom : Salient features and classification of plants into major groups, Algae, Bryophyta, Pteridophyta, Gymnospermae, Angiospermae (three to five salient and distinguishing features and at least two examples of each category), Angiosperms – classification upto class, characteristic features and examples
- Animal Kingdom : Salient features and classification of animals non-chordates up to phyla level, Chordates up to class level (three to five salient features and at least two examples of each category).
- Morphology of Flowering Plants : Morphology and modifications: Internal morphology of different parts of flowering plants, Root, stem, leaf, inflorescence, flower, fruit and seed
- Anatomy of Flowering Plants : Anatomy and functions of different tissues, Secondary growth in dicot stem and dicot root.
- Structural Organisation in Animals : Animal tissues: epithelial, connective, muscular and nervous tissues, Morphology, anatomy and functions of different systems (digestive, circulatory, respiratory, nervous and reproductive) of an insect (cockroach).
- Cell-The- Unit of Life : Cell theory and cell as the basic unit of life: Structure of prokaryotic and eukaryotic cells, Plant cell and animal cell, Cell envelope: Cell membrane, cell wall, Cell organelles: Structure and function, endoplasmic reticulum, golgi bodies, lysosomes, vacuoles; mitochondria, ribosomes, plastids, microbodies; cytoskeleton, cilia, flagella, centrioles (ultrastructure and function), Nucleus, nuclear membrane, chromatin, nucleolus
- Biomolecules : Chemical constituents of living cells: biomolecules, Structure and function of proteins , Carbohydrates, Lipids, Nucleic acids, Enzymes: types, properties, enzyme action
- Cell Cycle and Cell Division : Cell cycle, Mitosis, Meiosis and its significance
- Transport in Plants: Movement of water, gases and nutrients, cell to cell transport, diffusion, facilitated diffusion, active transport, Plantwater relations, imbibition, water potential, osmosis, plasmolysis, Long distance transport of water Absorption, apoplast, symplast, transpiration pull, root pressure and guttation, Transpiration, opening and closing of stomata, Uptake and translocation of mineral nutrients transport of food, phloem transport, mass-flow hypothesis.
- Mineral Nutrition : Essential minerals, Macro and micronutrients and their role, deficiency symptoms, Mineral toxicity, Elementary idea of hydroponics as a method to study mineral nutrition, Nitrogen metabolism, nitrogen cycle, biological nitrogen fixation.

- Photosynthesis in Higher Plants : Photosynthesis as a means of autotrophic nutrition, Site of photosynthesis, pigments involved in photosynthesis (elementary idea), Photochemical and biosynthetic phases of photosynthesis, Cyclic and non-cyclic photophosphorylation, Chemiosmotic hypothesis, Photorespiration, C₃ and C₄ pathways, Factors affecting photosynthesis.
- Respiration in Plants : Exchange of gases, Cellular respiration – glycolysis, fermentation (anaerobic), TCA cycle and electron transport system (aerobic), Energy relations – number of ATP molecules generated, Amphibolic pathways, Respiratory quotient.
- Plant growth and Development : Conditions of growth; Differentiation, dedifferentiation and redifferentiation, Seed germination; Phases of plant growth and plant growth rate, Sequence of developmental processes in a plant cell, Growth regulators – auxin, gibberellin, cytokinin, ethylene, ABA, Seed dormancy, Photoperiodism, Vernalisation,
- Digestion and Absorption : Alimentary canal and digestive glands, Role of digestive enzymes and gastrointestinal hormones, Peristalsis, digestion, absorption and assimilation of proteins, carbohydrates and fats, Calorific values of proteins, carbohydrates and fats, Egestion; Nutritional and digestive disorders – PEM, indigestion, constipation, vomiting, jaundice, diarrhoea.
- Breathing and Exchange of gases : Respiratory organs in animals (recall only), Respiratory system in humans, Mechanism of breathing and its regulation in humans – exchange of gases, transport of gases and regulation of respiration, respiratory volume, Disorders related to respiration – asthma, emphysema, occupational respiratory disorders.
- Body Fluids and Circulation : Composition of blood, blood groups, coagulation of blood, Composition of lymph and its function, Human circulatory system – structure of human heart and blood vessels, Cardiac cycle, cardiac output, ECG, Double circulation, Regulation of cardiac activity, Disorders of circulatory system – hypertension, coronary artery disease, angina pectoris, heart failure.
- Excretory Products and Their Elimination : Modes of excretion – ammonotelism, ureotelism, uricotelism, Human excretory system – structure and function, Urine formation, osmoregulation, Regulation of kidney function - renin angiotensin, atrial natriuretic factor, ADH and diabetes insipidus, Role of other organs in excretion, Disorders uraemia, renal failure, renal calculi, nephritis; dialysis and artificial kidney, kidney transplant.
- Locomotion and Movement : Types of movement ciliary, flagellar, muscular, Skeletal muscle – contractile proteins and muscle contraction, Skeletal system and its functions, Joints, Disorders of muscular and skeletal system - myasthenia gravis, tetany, muscular dystrophy, arthritis, osteoporosis, and gout.
- Neural Control and Coordination : Neurons, Generation and conduction of nerve impulse, Nervous system in humans – central nervous system, peripheral nervous system and visceral nervous system, Reflex action, sensory perception, Sense organs, Elementary structure and functions of eye and ear.

.....Contd Syllabus

- Chemical Co- Ordination and Integration : Endocrine glands and hormones, Human endocrine system – hypothalamus, pituitary, pineal, thyroid, parathyroid, adrenal, pancreas, gonads, mechanism of hormone action, Role of hormones as messengers and regulators, Hypo and hyperactivity of hormones and related disorders dwarfism, acromegaly, cretinism, goiter, exophthalmic goiter, diabetes, Addison's disease.
- Reproduction in Organisms : Reproduction, a characteristic feature of all organisms for continuation of species, Modes of reproduction – asexual and sexual reproduction, Asexual reproduction – binary fission, budding, sporulation, gemmule formation, fragmentation, Vegetative propagation in plants.
- Sexual Reproduction in Flowering Plants : Flower structure, Development of male and female gametophytes, Pollination - types, agencies and examples, Outbreeding devices, Pollen-pistil interaction, Double fertilization, Postfertilization events – development of endosperm, embryo, and seed, formation of fruit, Special modes of reproduction apomixis, parthenocarpy, polyembryony, Significance of seed dispersal and fruit formation.
- Human Reproductive System : Male and female reproductive systems, Microscopic anatomy of testis and ovary, Menstrual cycle, Gametogenesis – Spermatogenesis and Oogenesis, Fertilisation, Embryo development upto blastocyst formation, Implantation, Pregnancy and Placenta formation (elementary idea), Parturition (elementary idea), Lactation (elementary idea).
- Reproductive Health : Need for reproductive health, Birth control - need and methods, contraception and medical termination of pregnancy (MTP); prevention of Sexually Transmitted Diseases (STDs), Amniocentesis, Infertility and assisted reproductive technologies – IVF, ZIFT, GIFT (elementary idea for general awareness).
- Principles of Inheritance and Variation : Heredity and variation: Mendelian inheritance, Deviations from Mendelism – Incomplete dominance, Co-dominance, Multiple alleles, Inheritance of blood groups, Pleiotropy, Elementary idea of polygenic inheritance, Chromosome theory of inheritance, Chromosomes and genes, Sex determination in humans, birds and honey bee, Linkage and Crossing over, Sex linked inheritance - Haemophilia, Colour blindness, Mendelian disorders in humans -Thalassaemia, Chromosomal disorders in humans, Down's syndrome, Turner's and Klinefelter's syndromes.
- Molecular Basis of Inheritance : Search for genetic material and DNA as genetic material, Structure of DNA and RNA, DNA packaging,DNA replication, Central dogma, Transcription, Genetic code, Translation, Gene expression and regulation – Lac operon, Genome and Human and Rice genome projects, DNA fingerprinting.
- Evolution : Origin of life, Biological evolution and evidences for biological evolution (paleontology, comparative anatomy, embryology and molecular evidences), Darwin's

contribution, modern synthetic theory of evolution, Mechanism of evolution – variation (mutation and recombination) and natural selection with examples, types of natural selection, Hardy – Weinberg's principle, Gene flow and genetic drift, Adaptive radiation; human evolution.

- Human Health and Diseases : Pathogens, Parasites causing human diseases (Malaria, Dengue, Chickengunia, Filariasis, Ascariasis, Typhoid, Pneumonia, Common cold, Amoebiasis, Ringworm) and their control, Basic concepts of immunology – Vaccines; Cancer, HIV and AIDS, Adolescence - Drug and alcohol abuse.
- Strategies for Enhancement in Food Production : Improvement in food production: Animal husbandry, Apiculture, Plant breeding, Single cell protein, Tissue culture, Biofortification.
- Microbes in Human Welfare : In household food processing, industrial production, sewage treatment, energy generation and microbes as biocontrol agents and biofertilizers, Antibiotics, Production and judicious use.
- Biotechnology Principles and Processes : Genetic Engineering (Recombinant DNA Technology)
- Biotechnology and its Applications : Application of biotechnology in health and agriculture: Genetically modified organisms – Bt crops, Human insulin and vaccine production, Stem cell technology, Gene therapy, Transgenic animals, Biosafety issues, Bio piracy and patents.
- Organisms and Populations : Organisms and environment: Habitat and Niche, Population and ecological adaptations, Population interactions: Mutualism, Competition, Predation, Parasitism, Population attributes: Growth, Birth rate and Death rate, Age distribution.
- Ecosystem : Ecosystems: Components, Patterns, Productivity and Decomposition, Energy flow, Pyramids of Number, Biomass, Energy, Ecological Succession, Nutrient cycles (Carbon and Phosphorous), Ecological services – Carbon fixation, Pollination, Seed dispersal, Oxygen release (in brief).
- Biodiversity and its Conservation : Biodiversity Concept, patterns, and importance, Loss of Biodiversity, Hotspots, Endangered organisms, Extinction, Red Data Book, Biosphere Reserves, National Parks, Sanctuaries and Ramsar sites, Biodiversity conservation.
- Environmental Issues : Air pollution and its control, Water pollution and its control, Agrochemicals and their effects, Solid waste management,Radioactive waste management, Greenhouse effect and climate change impact and mitigation, Ozone-layer depletion,Deforestation, Any one case study as success story addressing environment^{al} issue(s).

BIOLOGY MNEMONICS

Class - 11, Unit-I

1. Life processes

GReat Mother Could Rest

Growth, Reproduction, Metabolism, Cellular Organization, Responsiveness

2. Taxonomic Categories

(i) Donald King Phoenix Chose Olive Fried Greek Salad

Kingdom, Division/Phylum, Class, Order, Family, Genus, Species

(ii) Mneconomics Key Protected Documents,

Copies & Folders Got Stolen

Kingdom, Phylum/Division, Class, Family, Genus, Species

3. Suffixes used for Taxonomic Categories

Doctor Came in OPD and Suggested
 For Sterilisation : Patient Observed At
 ICU and Operated

Taxonomic category: Suffix used Division : Phyta; Class : Opsida; Order : Ales; Suborder : incae; Family : Aceae; Subfamily : Oidae

4. Taxonomical Aids

Hey Brother, Mom and Me went to
 Zoological park and Flat Keys Found
 Missing

Herbarium, Botanical gardens, Monograph Manuals, Zoological parks, Flora, Keys, Fauna, Museums

5. Nomenclature Types

Holotype, Isotype, Syntype, Paratype, Lectotype, Epitype and Neotype

6. Characteristics of Living Beings

$\mathbf{GENR}_{3}\mathbf{M}_{2}$

Growth, Excretion, Nutrition, Reproduction, Responsiveness, Respiration, Movement, Metabolism

7.	Some Major Groups of Eubacteria	and
	Characteristics	

ACCount Get PRESented

Groups : Key characteristic

Actinomycetes, Chemoautotrophs, Cyanobacteria Gliding bacteria, Pseudomonas, Rickettsias, Enterobacteria, Spirochaetes

8. Types of Arrangement in Bacterial Flagella AMALP : 0122n

Type of Arrangement : Number of Flagella or its characteristic

Atrichous : 0 (absent)

Monotrichous : 1 (single polar flagellum)

Amphitrichous : 2 (one at each end of bacterial cell) Lophotrichous : 2 or more

Peritrichous : Numerous distributed over the entire cell

9. Types of Classification System

American Nuclear Power Plant : Let

Both Enganged in Show

Artificial classification system: Linnaeus

Natural classification system : Bentham and Hooker Phylogenetic classification system : Engler and Prantl

Phenetic classification system : Sneath and Sokal

10. Classification of Kingdom Protista

- Pineapple Cheese Pineapple :
 - Dragonfruit Starfruit Cranberry Classification of Protists : Examples Photosynthetic protist (Plant like protists): Dinoflagellates, Diatoms and Euglenoids Consumer protists (Animal like protists) : Slime

moulds or Myxomycetes

Protozoan protists : Ciliata, Sporozoa, Sarcodina, Zooflagellata

11. Systems of Classification of Organisms

Two Thieves Found Fighting : Car Engine Cooled With water

Two Kingdom classification system : Carlous Linnaeus

Three Kingdom classification system : Ernst Haeckel

Four Kingdom classification system : Copeland Five Kingdom classification system : Whittaker R H

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12.	Classification of Kingdom Fungi		Class - 11, Unit-II
Ĩ	PASsing By Dam : Looking So Calm and Interesting Phycomycetes : Lower fungi : <i>Rhizopus, Mucor,</i> <i>Albugo</i>	1. T	Leaf Modification Total Smoke Production Bolstered Pollution.
	Ascomycetes : Sac Fungi : Neurospora, Yeast,		Tendril, Spine, Phyllode, Bulb, Pitcher
	Basidiomycetes : Club fungi Agaricus, Ustilago, Polyporous Deuteromycetes : Imperfecti fungi : Fusarium , Cercospora, Trichoderma	2.	Placentation Football Club Barcelona Missed Approach Point.
10	Fire Kingdom Closeffication has		Free Central, Basal, Marginal, Axile, Parietal,
13. T	Monks Pray For Public's Amity.	3.	Animal tissues EMUCON
	Monera, Protista, Fungi, Plantae, Animalia	•	Epithelial, Muscular, Connective, Nervous
14.	Kingdom Fungi Multicelluar decomposers Pay And Book Date	4. T	Loose Connective Tissue AreA Areolar and Adipose
	Phycomycetes, Ascomycetes, Basidiomycetes, Deuteromycetes	5. P	Dense Connective Tissue Rler
15. 	Algae Great Britain Round		Regular and Irregular
Ŧ	Chlorophyceae : Green algae Phaeophyceae : Brown algae Rhodophyceae : Red algae	6. T	Supportive Connective Tissue CarBon Cartilage and bone
16	Animal Kingdom Classification		
10.	Prince Charle's Cousin Assorted Plums.	7.	Fluid Connective Tissue Live Boldly
	Porifera, Coelenterata, Ctenophora, Aschelminthes, Platyhelminthes,		Lymph, blood
17.	Animal Kingdom Classification Aunt Molly Asked Edwin to Have CHocolates.	8. T	Muscular SSC Smooth, Skeletal, Cardiac
	Annelida, Mollusca, Arthropoda, Echinodermata, hemichordata, Chordata.		Class - 11, Unit-III
18.	Chordates	1	Endomembrane system
Ħ	Ultra Clean Vehicle	 (ff)	George Earned Legendary Vehicle.
•	Urochordata or Tunicata, Cephalochordata, Vertebrata	Ŧ	Golgi apparatus, Endoplasmic reticulum, lysosomes, vacuoles

2.	Bacterial Shapes Battle Construction Vehicle Services Bacillus, Coccus, Vibrio, Spirillum.	4.	Micronutrient IZCN Might Classify Mammalian Birds.
3. ••	Classification of Enzymes HILL Of Tibet		Iron, Zinc, copper, nickel, molybdenum, chlorine, manganese, boron
¥	Hydrolases, Isomerases, Ligases, Lyases, Oxidoreductases, Transferases	5.	Macronutrients HONorable PM Started PC. Hydrogen, Oxygen, Nitrogen, Phosphorus,
4.	Primary Metabolites NASAL Nucleic acids, sugars, amino acids, lipids	6. 99	Magnesium, Sulphur, Potassium, calcium. Pigments Involved in Photosynthesis Charles Also Booked Xan's Car
5.	Secondary Metabolites PATE Pigments, Alkaloids, Terpenoids, Essential oils	7.	Chlorphyll a, b, Xanthophyll, Carotenoid C3 or Calvin cycle Cash Reserve Ratio
6. T	Cell Cycle And Mitosis I Played Myself A Trick	8.	Carboxylation; reduction; regeneration Cyclic Photophosphorylation Cyprus Passed In Arabic
	Interphase, Prophase, Metaphase, Anaphase, Telophase	٩	Cylic Photophosphorylation PS I, ATP
7.	Meiosis Lazy Zebra Portrayed Depiction of Death Leptotene, Zygotene, Pachytene, Diplotene, Diakinesis	10.	Coronary artery bypass grafting Chlorophyll a bright or blue green algae : CABG Chlorophyll b Collage Based Youth Grant Chlorophyll b yellow green algae : CBYG
-	Class - 11, Unit-IV	11.	Proteins Catabolism PAPA
I.	USA		Protein Amino Acids, Pyruvic Acid, AcetylCoA
2.	Uniport, Symport, Antiport The Fate of Nitrogen RAT	12. T	Glucose Catabolism ginny Gony Fried Dried Garlic Potato Avocado
2	Reductive amination, Transamination		Glucose 6-P, Fructose 1,6 BP, Dihydroxy acetone phosphate, Glyceraldehyde 3-phosphate, Pyruvic acid, Acetyl CoA
.	Red Algae And Kangaroo Arrived after Green Algae	13.	Fats Catabolism Find Files And Go Away
	Alpha-ketoglutaric acid + Ammonia -> Glutamic acid		Fatty Acids, Glycerol, Acetyl CoA

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14.	Citric Acid Cycle Account Cheque AKA Service Money Order	4.	Gastric Glands Mutual Protection Pact/My Power Point
	Acetyl CoA, Citric acid, Alpha Ketoglutaric Acid, Succinic acid, Malic Acid, OAA		Mucus neck cell, Peptic cells, Parietal cells
15.	Conditions of Growth Won ONe True Last Game Water, Oxygen, Nutrients, Temperature, Light, Gravity	5.	GI hormones Global Education School Called Volunteer Services. Gastrin, Enterogastrone, Secretin, Cholecystokinin,
16. •	(a) Photoperiodism Dedicated To Day neutral plant – Tomato	6.	Gills File Transfer Protocol Fishes, Tadpoles, Prawn
T	(b) Photoperiodism Supreme Court Short Day plant- <i>Chrysanthemum</i>	7.	Tracheal Tube Integrated Crop Management Insects, centipede, millipede
Ĩ	(c) Photoperiodism Little Red Button Long Day Plant- Radish, Barley	8.	Body Surface Standard Cubic Feet Sponges, Coelenterate, Flatworm
17.	Plant Growth Regulators (Phytohormones) All Girls Called Executive Assistant Before Assessment	9. T	Plasma A ssume Good Faith Albumin, Globulin, Fibrinogen
	Auxin, Gibberellin, Cytokinin, Ethylene, ABA	10.	Granulocytes Gram Negative Enteric Bacteria
1	Class - 11, Unit-V	-	Granulocytes : Neutrophil, Eosinophil, Basophil
I. T	PaSS Parotid, Sublingual, Submandibular	11.	Agranulocytes All Luggage Missing
2.	Histology of Alimentary Canal	12.	Agarnulocytes : Lymphocytes, Monocytes Heart valves
Ţ	SMS Me Serosa, Muscularis, Sub-mucosa, Mucosa		Text Book Solutions
3.	SMS Me Serosa, Muscularis, Sub-mucosa, Mucosa Alimentary Parts	12	Text Book Solutions Tricuspid valve, Bicuspid valve, Semilunar valve Circulatory Pathways
3.	SMS Me Serosa, Muscularis, Sub-mucosa, Mucosa Alimentary Parts MP Of State Sikkim Lost Revenue Account	13.	Text Book Solutions Tricuspid valve, Bicuspid valve, Semilunar valve Circulatory Pathways (a) On A Mission or (b) Operation And Maintenance

MNEMONICS

14.	Urine Formation	22.	Outer Ear
f	Grand Trunk Road Time Slot	Ŷ	PET
	Glomerular filteration, Tubular Reabsorption, Tubular secretion	•	Pinna, Ear canal, Tympanic membrane
15.	Disorders of the Excretory System	23.	Inner Ear
(H	Ultra Rapid Fire Restored Coffee	Ŷ	United States Court
	Grouds	-	Utriculus, Sacculus, Cochlea
	Glomerulonephritis	24.	Pancreas
16.	(a) Modes of Excretion		Blg AGency
f	Urban Mass Transport Agency		Beta Insulin Alpha Glucagon
-	Ureotelism: Mammals, Terrestrial Amphibian	25.	Adrenal Cortex
	(b) Modes of Excretion	Ŷ	American College of Medical
	Animals Best Friends Are Always	-	G enetics
Ŧ	Ideal		Adrenal Cortex: Mineralocorticoids, Glucorticoids
	Ammonia: Bony Fishes, Aquatic Amphibian,		Adrenal Medulla
	Insects		AMAN/ All Missing As Negative
16.	(c) Modes of Excretion	H	Adrenal Medulla: Adrenaline and Noradrenaline
Ĩ	User Address Book		
•	Uric Acid: Birds	27.	Hormones of Heart, Kidney and
17.	Joints		Korala Boal Estato Company
f	Skin Cancer Foundation		Kidnov-Ponin Enthromycin Calcitriol
-	Synovial, Cartilaginous, Fibrous		Runey Renar, Erythomycu, Calculot
			Class - 12, Unit-I
18.	Synovial (Movable)	1	(a) Vegetative Reproduction
Ħ	Best Soldier Hid Packed Gun System	Positive Example Based Learning	
₹	Ball and Socket, Hinge, Pivot, Gliding, Saddle	H	Potato-Eves Bryonbyllum - Leaf buds
			(b) Venetetive Berreduction
19.	Axial (80 bones)		
	Careless Team Learnt Self Care		
•	Cervical, Thoracic, Lumbar, Sacral, Coccygeal		Ginger: Rhizome, Agave: Bulbil
20	Fore Brain		(c) Vegetative Reproduction
20.	Chance To Hit/ Contract To Hire		WHO
ii -	Chance To Huy Contract To Hue		Water hyacinth : Offset
	Cerebrum, Thalamus, Hypothalamus	2.	Formation of Fruit
21	Uind Prein	Ĩ	Too Many Fake Acronyms
21.	nuu oraun		True Fruit= Mango, False Fruit=Apple
1	(PCPI) Physics, Chemistry, Maths	3.	(a) Pollination
	Pons, Cerebellum, Medulla	f	Weight Gain
		-	Wind Pollinated : Grasses

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Ŧ	 (b) Pollination World association for Visually Handicapped Water Pollinated: Vallisneria, Hydrilla (c) Pollination 	12.	Barrier Methods CDC Volunteered Student's Junior Fellowship Condoms, Diaphragm, Cervical caps, vaults, Spermicidal creams, jellies, foams
	Integral Yoga Insect Pollinated : Yucca	13.	Chromosomal Disorders Driver Knowledge Test
4.	Dicot embryo Personal Care Heals Rare Remorse Plumule, Cotyledon, Hypocotyl, Radicle, Rootcap	14.	Non-Mendeliam Inheirtance I Can Manage Physics Incomplete dominance, Codiminance, MUltiple
5.	L.S. of Monocot Embryo Stem Cell Storage Enable Regenerative Repair of Cancer. Scutellum, Coleoptile, Shoot apex, Epiblast, Radicle, Rootcap, Coleorhiza	15.	Genetic Code Tuesday Night Dinner Club Union Triplet, Non-ambiguous, Degenerate, Commaless, Universal
6.	(a) Accessory Ducts in Females Our United Villages		Class - 12, Unit-II Factors Affecting
Ĩ	(b) Accessory Ducts in Females Infection And Immunity Infundibulum, Ampulla, Isthmus	1.	Grand Mother, Grand Daughter Meet Great Royals Near Society Gene Migration, Genetic Drift, Mutation, Genetic Recombination, Natural Selection
7.	External Genitalia in Females Mobile's Light Led Him Crazy Mons pubis, Labia major, Labia minor, Hymen, Clitoris		Class - 12, Unit-III Detection & Diagnosis Book Reader Club Manager
8.	Accessory Glands in Males Simple Play Back / Saint Peters Burg Seminal vesicle , prostate, Bulbourethral gland	2.	Biopsy, Radiography, CT, MRI (a) Lymphoid Organs Profit Before Tax
9.	Accessory Ducts in Males Revise Via Elementary Volume Rete testis, vasa efferentia, Epididymis, Vas deferens	Ţ	Primary : Bone marrow, Thymus (b) Lymphoid Organs Sea Surface Level Temperature Secondary : Spleen, Lymph node, Tonsils
10. T	STDs Haryana Govt. Heads Girl's School Hepatitis B, Genital herpes, HIV, Gonorrhoea, Syphilis	3.	Type of Non-communicable or Non- Infectious Diseases 3A 2M HD
11. T	Birth Control Methods S wiss National Bank's Indian Office Surgical, Natural, Barrier, IUD, Oral contraceptive		Allergic diseases, Addition disorders Ageing disorders, Mental illness Malfunctioning of Organs, Hormonal diseases Deficiency diseases

4. Types of Hepatitis

ABCDE : Example Shows No ConsideratioN : RD 3R

Type of virus : Common name : Characters Hepatitis **A** : **E**pidemic hepatitis : SS **R**NA Hepatitis **B** : Serum hepatitis : Ds **D**NA Hepatitis **C** : Non-A, Non-B, Transfusion Hepatitis : SS**R**NA, enveloped Hepatitis **D** : **C**o-infection Hepatitis : SS **R**NA Hepatitis **E** : Non-A, Non-B, Transfusion Hepatitis : SS **R**NA , non- enveloped

5. Short forms of National programmes to eradicate major communicable diseases CC LC FC ME SE

National Cholera Control Programme (NCCP) National Leprosy Control Programme (NLCP) National Filaria Control Programme (NLCP) National Malaria Eradication Programme (NMEP) National Smallpox Eradication Programme (NSEP)

6. Types of Immunoglobulins GAMED : Chess Soccer Cricket

Hockey Basketball

Type of Immunoglobulin: Function

Immunoglobulin **G** : Stimulation of **C**omplement system and Phagocytic reactions

Immunoglobulin ${\bf A}$: In ${\bf S} {\rm ero-mucous}$ secretion for Inhibition of various Infections

Immunoglobulin ${\bf M}$: Activation of ${\bf C} {\rm omplement}$ system

Immunoglobulin **E** : **H**ypersensitivity reactions

Immunoglobulin ${\bf D}$: Activation of ${\bf B}$ cells Antibody secretion

7. (a) Fisheries

Fresh Civil Right Center

Freshwater fishes- Catla, Rohu, common carp

(b) Fisheries

Marked High Speed Machine

Marine fishes - Hilsa, Sardines, Mackerel,

Class - 12, Unit-IV

- 1. Enzymes Used in Biotechnology
 - LILY Rose Scent : Rose Daisy Carnation Sunflower

Enzymes : Uses

DNA Ligase : DNA **R**epair enzyme Lyases : **D**issolve cell wall Restriction enzymes : **C**leaves DNA Synthetase : In-vitro DNA **S**ynthesis

2. Important Tools in Biotechnology HEL3G : 40 VGGRH

Tools : Characters Heat Shock : Sudden temperature raised to **40°**C Electroporation: High **v**oltage pulse Liposomes : Genes to cells in vivo Gene gun : Gold particles Genetic marker : R plasmid Gene synthesis : Hormone somatostatin

3. Animal Clones

NDN : GSG : India Scotland USA

Clone name : Species : Developed by Noori : Pashmina **G**oat : Veterinary Science, Kashmir, India

Dolly : **S**heep : Wilmut and Kampbell, Roslin institute, **S**cotland

Noah : Asian Gaur (endangered species) : 2002 ACT researchers, **USA**

4. Scientists to Remember

Please, Come Here SMith : GAMED Scientist : About

Paul Berg : Father of Genetic Engineering Cohen and Boyer : First to isolate Antibiotic resistant gene

Hans Spemann : Father of Modern embryologySmith and Nathans: First to isolate EndonucleasesMichelson: First to synthesize Dinucleotide

Class - 12, Unit-V

1. Achievement through Transgenic crops or GM crops

Please Get Biology Notes : How Chemistry Take Flex

Achievement of : Example

Protein of interest : Hirudin

Production of desired **g**enotype : **C**ry protein (crystal protein) Modification of existing **b**iosynthetic pathway : **T**ransgenic rice (higher content of vitamin A)

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Masking of expression of $\mathbf{n}ative$ gene : $\mathbf{F}lavr$ savr Tomato

Biological Weapon Agents She Added Questions But Encouraged To Practice Hard

Smallpox, Anthrax, Q-fever, Botulinum, Encephalitis, Tularemia, Plague, Haemorrhagic fever

3. Gene Inserted in Transgenic Animals and Their Benefits

Stop Gossiping! Come Prepare Food : IX Tofu Left Broken and Heated : Hot Tomato Chilli Paste Mashed

Transgenic animal : Gene inserted : Benefits

1. **S**heep : Anti- haemophilic factor **IX** : Treat **h**aemophilic patient

2. **G**oat : **T**PA gene (blood clot dissolving) : **T**reat coronary thrombosis

3. Cow : Lactoferrin : Treat cystic fibrosis

4. **P**igs : **b**GH (bovine growth hormone) : **P**roduction of leaner pork

5. **F**ish : **h**GH (human growth hormone): Increased **m**eat production

4. Shape of Pyramid : Population growth type

Three Books Used : Eric Stop Daydreaming

Triangular shaped : Expanding or Growing Bell shaped: Stable Urn shaped: Declining

5. Population Interaction

Competition Always Muffle Politics : Rivalry Has Fabulous Benefits

Type of interaction : Relationship Competition : Rivalry Antagonism : Harmful Mutualism : Favourable but not Obligatory Proto-cooperation : Beneficial to both

6. Classification of organisms into four

temperature groups

3MH : TSTA

Group of Organisms : Temperature zone Megatherms : Tropical zones Mesotherms : Sub-tropical zones Microtherms : Temperate Zones Hekistotherms : Artic zones

7. Some Important Laws to Remember

- **3/2 BAG** : **P**opulation **d**ensity of
- Birds and Mammals in Cooler Area is Abundant

3/2 thinning law : Aspects of growth of **p**opulation are **d**ensity related

Bergman's law : Birds and mammals of colder areas are larger in size

Allen's law : Animals in cooler areas have shorter extremities

Gloger's law : **A**bundance of melanin pigment in animals from hot areas

8. Measurement of Productivity and Related Ecosystem

HALL : Come On And Grab Desert : 210.2<0.2

Ecosystem : Example : Net productivity (kg/m2/yr) High productive ecosystem : Coral reef /Ocean/ tropical forest : 2-4

Average productive ecosystem : Agricultural crops : 1-2

Less productive ecosystem : Grassland ecosystem : 0.2-1

Least or Low productive ecosystem : **D**esert/Deep sea : Less than 0.2

9. Steps in General Process of Succession

NIght Candle Rays Shined

Nudation, Invasion, Competition, Reaction, Stabilisation

10. Nitrogen Cycle Processes

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Among Ninety Denominators Nine
```

fixed : **O**NAM **F**OR **R**ED **A**TNAM

Steps : Conversion

- 1 Ammonification : Organic N to ammonia
- 2 Nitrification : Formation of nitrites and nitrates
- 3 Denitrification : Reduction of nitrates

4 Nitrogen fixation : Atmospheric Nitrogen to ammonia



CHAPTER

THE LIVING WORLD

Chapter Objectives

What is 'living'?, Three domains of life, Biodiversity, Need for classification, Taxonomy and systematics, Binomial nomenclature, Concept of species and taxonomical hierarchy, Tools for study of taxonomy – Botanical gardens, Herbarium, Zoological parks, Biological Museums and Taxonomic Keys.

STUDY MATERIAL

I. Concept Clarified

1. WHAT IS LIVING?

- The origin of life from the simplest unit known as 'cell' and a world of living components was introduced by a branch of science i.e., 'Biology'.
- > The word "*Biology*" is derived from the Greek words—*bios*, meaning life and *logos* meaning study and is defined as the science of life forms and living processes.
- An organism is a form of life that may be unicellular or multicellular. Biological science deals with the study of molecular mechanism in cells, the classification of organisms, their behaviour, origin, evolution and distribution of species, and the interaction between organisms and their environment.
- The diversity of the living world can be recognised through the five unifying principles of modern biology : cell theory, evolution, genetics, energy and homeostasis. The term *biology* in its modern sense was introduced independently by Karl Friedrich Burdach (1800), Treviranus (1802) and Lamarck (1802).
- > The characteristics which we observe commonly in all living begins are growth, reproduction, ability to sense environment and mount a suitable response. Some more features that can be added to this list are metabolism, ability to self-replicate, self-organise, interact, etc.
- Living organisms show some unique and distinctive characteristics which help us in recognising and differentiating them from other non-living things.

2. UNIQUE FEATURES OF LIFE

- (a) All living organisms grow and divide:
 - Growth is regarded as an intrinsic property of living organisms through which there is an increase in mass and increase in number of individual.
 - Unicellular organisms being composed of a single cell grow by simple cell division. Growth in multicellular organisms follows a complex cell division, as they are composed of different types of cells. In plants, growth by cell division occurs continuously throughout life-span but in animals, it is seen only up to certain age.
 - The growth of living organism is from inside the body which is different from non-living things which grow by the accumulation of materials from outside the body.
- (b) Reproduction A progressive characteristic of living organism:
 - There are two modes of reproduction in living organisms, one is **asexual reproduction** and the other is **sexual reproduction**.

- Asexual reproduction is uniparental multiplication that occurs through binary fission, multiple fission, spore formation, fragmentation and vegetative multiplication etc. For example, **Hydra** and **Yeast** reproduce by **buddings**. Algae, fungi and bryophytes can reproduce by **fragmentation**. In all the above methods the progenies resemble their parent in all respects.
- Sexual reproduction is biparental, in which both parents are involved and offsprings show some variations from the parents. Two types of gametes are formed during this reproduction, one is male gamete known as 'sperm' and the other is female gamete known as 'egg'. The two fuse during fertilization to produce zygote. Zygote gives rise to new offsprings. But, there are organisms which cannot reproduce, for example a mule or worker bee. Some human-couples are also infertile. Hence, all living organisms are not capable of reproduction. Non-living objects on the other hand are incapable of reproducing or replicating by itself.
- (c) Metabolism A characteristic feature of living organism:
 - All living organisms are made up of a variety of chemicals which are continuously being converted into other molecules. These **conversions of molecules** follow a sequence of reactions called as **metabolic reactions**.
 - The **process of all the chemical reactions** taking place in the body of an organism is called **metabolism**. All plants, animals, fungi and microbes exhibit **metabolism**. Thus, metabolism is a defining feature of living organisms. It does not occur in non-living objects.
 - Metabolism occurs through two basic steps catabolism and anabolism. Catabolism involves breakdown of complex substances into simpler ones and anabolism involves joining of simpler substances into larger one.
- (d) Consciousness An interactive property of living organism:
 - Living organisms are, **self-replicating**, **evolving**, **self-regulating** and **interactive** system capable of sensing their surroundings or environment and responding to these environmental stimuli which could be physical, chemical or biological. **Consciousness** can be considered as an interactive **property of life** because interactions at one level generate the properties at a higher level of organization.
 - It can be seen in the property of **tissue** which is the result of assemblage and co-ordination of constituent cells, and not the properties of cell.

3. **BIODIVERSITY**

Species Diversity in the Living World:

- The living world is characterised by a huge range of biodiversity which is the number and type of organisms present on the earth as a result of the continued evolution of life and natural selection acting on the living organisms for millions of years.
- In unicellular organisms like bacteria, unicellular algae or Amoeba, reproduction is synonymous with growth, i.e., increase in number of cells.
- The number of species that are known and described ranges between 1.7-1.8 million. This includes the following approximate numbers for some of the groups: plants: 2,90,000; Insects: 7,40,000; Fungi: 1,00,000; Monera: 4,600. Many more are yet to be identified. A conservative estimate is that there may be between 13-14 million species in the living world.

4. NEED FOR BIOLOGICAL CLASSIFICATION

It is impossible to study every organism/species individually. Thus, there is the need of biological classification. The art of identifying distinctions among organisms and placing them into groups that reflect their most significant features and relationship is called biological classification.

TAXONOMY AND SYSTEMATICS

- 5. TAXONOMY
 - The process of classifying organisms into different taxa based on their characteristics is called taxonomy. The term 'Taxonomy' was coined by A.P.de. Candolle in his book "Theories elementaire de la botanique" (Elementary Theory of Botany). Carolus Linnaeus is considered as the Father of taxonomy.
 - > The basic processes in taxonomy are characterization, identification, classification and nomenclature.

For more details, scan the code

6. SYSTEMATICS

It is the branch of biology which categorizes the plants, animals and other organisms. The term 'Systematics' was coined by Sir Carolus Linnaeus (1751). The word systematics is derived from the :Latin word 'systema' which means systematic arrangement of organisms. Linnaeus used the term in the title of his book "Systema Naturae"

Systematics is more wider field of science as with identification, nomenclature and classification, it also takes into account evolutionary relationships between various organisms.

7. HISTORY OF BIOLOGICAL CLASSIFICATION

- The earliest known system of classification is that of the Greek philosopher and scientist Aristotle, who classified all living organisms known at that time either as a plant or an animal. He further classified animals based on their means of transportation (air, land, or water) and also, according to criteria such as mode of reproduction and possession or lack of red blood.
- Aristotle's pupil Theophrastus (370-285 BC), classified plants according to their uses and method of cultivation. He used habit (*i.e.*, tree, shrub) as the main character and further subdivided them into cultivated and wild types. He described 840 plants in *Historia Plantarum*.
- > John Ray coined the term 'species' and described 18,000 plants and animals in *Historia Generalis Plantarum*.
- Carolus Linnaeus is referred to as the "Father of Taxonomy". He introduced a system of nomenclature of plants and animals known as the **Binomial Nomenclature**.

8. BASIC PROCESSES IN CLASSIFICATION

Taxonomic studies consider external and internal structure along with the structure of cell, developmental process and ecological information of the organisms. Therefore, the basic processes **in taxonomy** are **characterization**, **identification**, **classification** and **nomenclature**.

- (a) Characterization: The description of an organism based on external and internal structure, along with the development processes and ecological information is known as characterization.
- **(b) Identification:** It is the finding of correct name and place of an organism in a system of classification. Identification is done with the help of **keys**.
- (c) **Classification**: It is the process by which organisms are grouped into different categories on the basis of their affinities of relationship.
- (d) Nomenclature: Nomenclature (L., nomen-name, calare-call) is the science of providing distinct and proper names to organisms so that they can be easily recognized and differentiated from others. It is of following two types:
 - Common names or vernacular names: They are local names which are given to organisms in a particular region and language by local persons. So that they can be properly identified. E.g., Onion in English is "Pyaz" in Hindi and Bengali, "Vengayam" in Tamil, "irulli" in Kannada, "ganda" in Punjabi, "Kanda" in Marathi, "ulli" in Malayalam, "poora" in Assamese etc.
 - Scientific or Technical names: A scientific name is the one which is given by biologists and is understood to represent a particular organism in every part of the world. Scientists ensure that a name being given by them had not been used earlier for any other organism.

9. BINOMIAL NOMENCLATURE

Through nomenclature, each organism is given two word names—generic and specific name. This system of providing a name with two components is called Binomial nomenclature. This system was proposed and used by Carolus Linnaeus. For example, *Triticum aestivum* is the scientific name of wheat, where *Triticum* is the genus and *aestivum* is the species name.

10. THE UNIVERSAL RULES OF NOMENCLATURE

The original scientific names were taken from Latin and Greek languages. New names are now derived from Latin language or are Latinized. As Latin language is dead, it will not change in form of spelling with passage of time.

- > Each organism is given two names, one represents the genus while the other denotes the specific name.
- > The name when handwritten should be separately underlined or printed in italics to indicate their Latin origin.
- The first word denoting genus should always start with capital letter while species name starts with a small letter.
- > The name of the author is written in an abbreviated form after the species name and is printed in Roman.

11. FRAMING OF NOMENCLATURE RULES

- 1. ICBN : International Code of Botanical Nomenclature
- 2. ICZN : International Code of Zoological Nomenclature
- 3. ICBN : International Code of Bacteriology Nomenclature
- 4. ICVN : International Code of Viral Nomenclature

12. CONCEPTS OF SPECIES AND TAXONOMIC HIERARCHY

- Classification is a step by step process. A taxonomist places an organism into categories. Sequence of categories from lower to higher rank in an ascending order is known as taxonomic hierarchy or Linnaean hierarchy.
- ➤ It was first given by Sir Linnaeus. The hierarchical categories from the lowest to the highest are of seven types. These are species → genus → family → order→ class → division or phylum → kingdom. Each such category is known as taxon.
- Taxon is a unit in classification which represents any level of grouping or ranking of organisms. It was introduced by Adolf Meyer (1926) for animal groups. H.S. Lam first proposed the term 'taxon' for plants. Mayer (1964) defined taxon to be a taxonomic group of any rank that is sufficiently distinct to be worthy of being assigned to a definite category.

13. INTERMEDIATE CATEGORIES

Taxonomic categories, introduced in between the seven obligate categories for accommodating characteristics of certain groups with more precision are called intermediate categories. They are designated by using prefix super or sub–to the obligate category, e.g., sub-class, super-class. A new category of tribe has also been raised in between sub-family and genus.

Category

A category is a rank or level in the hierarchical classification of organisms. There are seven obligate categories and some intermediate categories. The obligate categories are as follows:

Species: It is a group of fundamentally similar and potentially inter-breeding populations that are reproductively isolated from other such groups due to the morphological features. It is the lowest taxonomic category in classification given by John Ray in 1693. Examples: *Solanum nigrum, Panthera leo and Homo sapiens,* here *nigrum, leo* and *sapiens* are the species epithets.

Concept of species:

- (a) Dynamic concept: Proposed by Sir Lamarck who advocated that species is mutable and dynamic.
- (b) **Typological concept:** It is the most simply and widely held species concept. According to it, individuals of species match the type as closely as possible. Variations, if any, are due to imperfection of physical world.
- (c) Nominalistic concept: Species have no existence, only the individuals do so.
- (d) Static concept: As proposed by Sir Linnaeus, members or species are fixed and immutable.
- (e) Biological concept: Proposed by Sir Ernst Meyer. According to the is concept, species is the fundamental unit of classification. It is a group of organisms which are closely related structurally & functionally sharing a common gene pool and which can interbreed freely in nature producing offspring.
- Genus: It was given by John Ray in 1693. It is the group or assemblage of related species which resemble one another in certain correlated characters. The genera which have only one species are called monotypic, whereas those which have many species under a single genus are called polytypic. The genus *Solanum* has

many species like *S. tuberosum, S. melongena, S. nigrum* etc. *Panthera leo,* (lion) *P. tigris* (tiger) *P. pardus* (leopard) are put under the genus *Panthera. Homo sapiens* is monotypic (only one species).

- Family: It was given by John Ray in 1693. It consists of one or more related genera, e.g., the genera like Solanum, Withania, Datura, Petunia, Nicotiana etc., come under the family Solanaceae. Genus Panthera and Felis are put under the family Felidae.
- Order: It was given by Linnaeus in 1735. This category includes one or more related families which exhibit a few similar characters. Thus, the family Solanaceae is placed in the order Polymoniales along with Convolvulaceae, Boraginaceae, Hydrophyllaceae and Polymoniaceae. The order Carnivora includes the family Felidae (the cat family) and Canidae (the dog family).
- Class: It was given by Linnaeus in 1735. It is an assemblage of related orders. For example, the class Dicotyledoneae contains the orders Rosales, Polymoniales, Passiflorales, Sapindales, Ranales etc. Carnivora, Primata, Rodentia, Chaetoptera and other orders are included in class Mammalia.
- Phylum: It was given by Cuvier in 1829. It is a category above the class. The term Phylum is used for animals while Division is commonly employed for plants. This category is formed of one or more classes. e.g., the division Spermatophyta contains the classes monocotyledons and dicotyledons. All animals with dorsal neural system and notochord like fishes, amphibia, aves, mammalia are put under the Phylum Chordata.
- Kingdom: It is the highest taxonomic category. All plants are included in the Kingdom Plantae while all animals belong to Kingdom Animalia.

14. TOOLS FOR STUDY OF TAXONOMY

Taxonomists have developed a variety of taxonomic aids to facilitate identification, naming and classification of organisms. A **collection of** actual **specimens of plant and animals** is the **primary requirements** for the **taxonomical studies**. Hence, scientists established some techniques and procedures for preserving or storing information and specimens. Some of these are discussed below:

(a) **Botanical Garden :** It is a place for growing, plants for flowers, fruits or vegetables and also is an educational institution for scientific workers and general public or layman to cultivate an interest in plant life.

List of some Botanical Gardens:

- (a) Royal Botanical Garden, (1759) Kew, England,
- (b) National Botanical Research Institute, Lucknow.
- (c) Garden of the Indian Agricultural Research Institute, New Delhi.
- (d) Indian Botanical Garden, Kolkata (Largest Botanical Garden of India as well as Asia).
- (e) Lloyd Botanical Garden, Darjeeling.
- **(b) Herbarium:** It is a **collection of plants**, which have been **dried**, **pressed** and **mounted on herbarium sheets**, identified and classified according to some approved system of classification.
 - The greatest herbarium of the world is at the Royal Botanical Garden, Kew, England.
 - The biggest herbarium of our country is at the **Indian Botanic Garden**, **Calcutta**, possessing about one million specimens.
 - Generally, herbarium techniques involves several steps like:
 - (a) **Collection:** The specimens must be collected in every stage of their growth and reproduction, and from different habitats.
 - (b) **Drying & Pressing:** The specimens are pressed before their wilting and dried with the help of blotting papers, newspapers and artificial heat.
 - (c) Mounting & Poisoning: The dried specimens are mounted on the sheets.
 - (d) Labelling & Deposition: The sheet is labelled with all essential data, such as date and place of collection, English, local and botanical names, family, collectors name etc. The sheet is then placed in a protective case. The herbaria serve as a quick referral aid in taxonomical studies.

Some Herbaria of our Country:

- Central National Herbarium, Kolkata (15,00,000 specimens)
- Forest Research Institute, Dehradun (3,40,000 specimens)
- (c) Zoological parks: These are public institutions where wild animals are kept in protected environments for promoting interest, love and awareness among the people. The conditions provided to them are almost similar to their natural habitats. A scientific purpose of the zoo is to breed the animals that are otherwise under threat in their natural habitats. There are more than 300 zoological parks in India. The main aim of such parks is to increase public interest and understanding of wild life. It also provides recreation and education. Now-a-days zoos are also involved in the conservation of endangered species.
- (d) Museums : Museums have collection of preserved plants and animals for study and reference. Specimens are preserved in containers or jars in preservative solutions, insect boxes or as dry specimens. Objects exhibited in museums include stuffed animals, stuffed heads, preserved animals, skeleton, beaks, eggs of rare species or extinct birds, shells, tusks, fossils etc.

Some important Museums:

- (i) Natural History Museum, London (England)
- (ii) United States National Museum, Washington DC
- (iii) National Museum of Natural History (NMNH), New Delhi
- (iv) Prince of Wales Museum, Mumbai.
- (e) Manuals and monographs of flora: Monographs contain information on any one taxon and manuals provide the complete listing and description of the plants growing in a particular area.

Flora is a book containing information about plants found in a particular area. It gives the actual account of habitat and distribution of a various plants of a given area.

Some important flora:

- (i) Flora Simlensis by H. Collet.
- (ii) Flora of Delhi by J.K. Maheshwari.
- (iii) Flora of British India by J.D. Hooker.
- (iv) Flora Indica by William Roxburgh.

15. TAXONOMIC KEY

It is a device used by biologists for identifying unknown organisms. Keys are constructed so that the user is presented with a series of choices about the characteristics of the unknown organisms; by making the correct choice at each step of the key, the user is ultimately led to the identity of a specimen.

Types of Keys:

Two types of keys are commonly used indented (or yolked) and bracketed.

(i) Indented key (Yolked key): It provides sequence of choices between two or more statements of characters of species. The user has to make correct choice for identification.

(ii) **Bracketed key:** In this key, the pairs of contrasting characters are written one below the other in the same line and each character is given a number in brackets for identification purpose. For example,

Six vertebrate species are to be identified–Dog fish, Tree-frog, Cobra, Pigeon, Bat and Dog. Distinguishing charactersarerecorded for each group such as presence or absence of external ears (mammalian or non-mammalian character), ability or inability to fly (flight is trait of both birds and bats), presence and absence of limbs (tetrapods except snakes, and non-tetrapods like fishes), presence and absence of gills (character of fishes, absent in adults of others) :

Indented Key

- 1. External ears present
- 2. Wings present Bat

Bracketed Key

- (1) External ears present (2)
- (1) External ears absent (3)





- 2. Wings absent Dog
- 1. External ears absent
- 2. Wings present Pigeon
- 2. Wing absent
- 3. Limbs Present Tree-frog
- 3. Limbs absent
- 4. Gills presentDog fish
- 4. Gills absent Cobra

II. Know the Facts

- A family tree based on numerical of phenetic taxonomy is called *dendrogram*. Numerical taxonomy is same as *phenetic taxonomy*.
- > **Phylogeny** was introduced by **Haeckel**.
- > Cladistics is the hierarchical classification of species based on evolutionary ancestry.
- > A cladogram graphically represents a hypothetical evolutionary process.
- > A **monophyletic** group (that includes the most recent common ancestor and all of its descendents) is a clade.
- Binomial System was not given by Linnaeus, it was, in fact, Gaspard Bauhin (1623), who developed the binomial system of nomenclature-system of making use of two names Genus and Species that led to the development of modern binomial system of nomenclature. However, Bauhin did not follow the system scrupulosly.
- Roughly a century after Bauhin, Linnaeus extensively adopted the binomial system. Hence, the name of Linnaeus became familiar in *connection with the binomial system of nomenclature*. Botanists regard the date of publication of Species Plantarum (1753) by Linnaeus as the beginning of the present system of binomial nomenclature of most groups of plants-mainly angiosperms, gymnosperms and pteridophytes.
- Scientific names with same species and subspecies are called **autonym** e.g., *Corvus splendens*.
- > A particular name for two different plants are called **homonyms** e.g., Prunus dulcis (Almond & Plum)
- Sibling species True species which do not interbreed but are otherwise difficult to separate on the basis of morphological characters alone.
- > Allopatric species Species having exclusive areas of geographic distribution.
- **Sympatric species** Species having overlapping areas of geographic distribution.
- **Keystone species** A species that plays a central role in the ecology of a place.
- > In case of animal kingdom , for family suffix used is idae while for tribe it is ini.
- In case of plant kingdom in accordance with International Code of Botanical Nomenclature, the names of different species must end in the standard suffixes like for division–Phyta, for class phyceae or-opsida or –ae, for order ales, for family aceae while for tribe it is –eae.

- (2) Wings present Bat
- (2) Wings absent Dog
- (3) Wings present Pigeon
- (3) Wing absent (4)
- (4) Limbs present tree-frog
- (4) Limbs absent (5)
- (5) Gills present Dog-Fish
- (5) Gills absentCobra



2 BIOLOGICAL CLASSIFICATION

Chapter Objectives

Five kingdom classification, Salient features and classification of Monera, Protista and Fungi into major groups, Lichens, Viruses and Viroids.

CHAPTER

STUDY MATERIAL

I. Concept Clarified

1. INTRODUCTION

- Biological classification relates to the categorising of plants, animals and other organisms. It is otherwise called taxonomy or systematics.
- ARISTOTLE was the earliest who attempted a more scientific basis for classification. He classified plants into trees, shrubs and herbs. He also divided animals into those with RBC (Red Blood Cell) and without RBC.
- > In 18th century LINNAEUS proposed the Two Kingdom system of classification.

2. FIVE KINGDOM CLASSIFICATION:

According to Five-Kingdom concept proposed by **R.H. Whittaker** (1969), the organisms are divided into five kingdoms namely **Monera**, **Protista**, **Fungi**, **Plantae** and **Animalia**, on the basis of the following criteria :

- (a) Complexity of cell structure: prokaryotic or eukaryotic organization of cells.
- (b) Complexity of body organization: unicellular or multicellular.
- (c) Mode of nutrition: Autotrophic or heterotrophic (parasitic or saprophytic or ingestive organisms).
- (d) Reproduction
- (e) Phylogenetic or evolutionary interrelations.

3. KINGDOM MONERA

- > The Kingdom Monera includes all prokaryotes. Monerans are the most primitive forms of life, originating from more ancient living stock termed **progenote**.
- > The Kingdom Monera includes eubacteria and archaebacteria.

Classification of Monera:

- Carl Woese separated the archaebacteria from eubacteria on the basis of some major differences such as the absence of peptidoglycan in the cell walls of the former and occurrence of branched chain lipids (a monolayer instead of a phospholipid bilayer) in the membrane.
- > Therefore, 6 kingdom given by **Carl Woese** are:

Archaebacteria, Eubacteria, Protista, Fungi, Plantae and Animalia

Salient Features of Monera:

- These are unicellular, colonial, multicellular prokaryotic organisms without nuclear membrane, nucleolus, chromatin and histone proteins.
- > Cell wall is made up of peptidoglycan (exceptions are archaebacteria and mycoplasma).
- > Membrane bound organelles are absent.
- > Cyclosis is absent and ribosomes are of 70S type.

- > Respiratory enzymes are found associated with plasma membrane.
- Nucleoid or genophore or incipient nucleus or prochromosome is composed of naked DNA, RNA and nonhistone proteins.
- > Reproduction by asexual method.
- > Cell division is amitotic type and lacks spindle formation.
- (a) Eubacteria

Bacteria are cosmopolitan and occur in every habitat wherever living or dead organic matter is present.

Shapes of Bacteria:

Bacteria occur in four basic forms or shapes. These are-spherical (**cocci**), rod shaped (**bacilli**), Comma-shaped vibrium (**Plural-vibrio**) and **spiral spirillum**.

Bacterial Cell Structure:

Bacterial cell **structure is very simple** although they are **very complex in behaviour**. They show **most extensive metabolic diversity**. Electron microscope can reveal the detailed structure of bacterial cell. It consists of following structures :

Glycocalyx:

- It is outermost part of cell envelope (glycocalyx, cell wall, plasma membrane)
- Represented by either **slime layer** or **capsule**:
 - (a) **Slime layer** is composed of dextran, dextrin and lavan sugars and protect the cell against desiccation and loss of nutrients.
 - (b) **Capsule** is made up of polysaccharides and D-glutamic acid. It provides gummy or sticky character and virulent property to the cell.

Cell wall:

- It is present outside the cell membrane and is a rigid structure. Due to its rigidity, it protects the internal structures of the cell and provides shape to the cell.
- The cell walls of almost all the eubacteria (true bacteria) are made up of **peptidoglycan**, also called **murein** or **mucopeptide**. Peptidoglycan is found **only in prokaryotes**.
- The cell walls of Gram-negative bacteria are much more complex. Christian Gram (1884) developed a staining method for bacteria, using Gram-stain (crystal violet). On the basis of stainability with Gram Stain, bacteria are classified into two groups: Gram-positive and Gram-negative.

Protoplast:

- Cell wall encloses the protoplast, the living matter. It includes (i) cell membrane (ii) cytoplasm (iii) nucleoid and may have plasmid and episome.
 - (i) Cell membrane:
 - It lies inner to the cell wall, actually representing the outermost layer of the protoplast. It is living and semipermeable; controlling the movements of various dissolved substances in and out of the cells.
 - Functionally, the cell membrane of bacteria resembles mitochondria of eukaryotic cell as respiratory ETS (electron transport system) enzymes and succinate dehydrogenase (Kreb's Cycle) are associated with the membrane.
 - The cell membrane gets invaginated and folded to form a structure called **mesosome** (chondroid) in some bacteria, particularly in the Gram-positive bacteria.
 - (ii) Cytoplasm:
 - It is homogenous colloidal mass of carbohydrates, fats, proteins, lipids, nucleic acids, minerals and water.
 - Typical membrane bound organelles of eukaryotic cells like endoplasmic reticulum, mitochondria golgi complex and plastids are absent.
 - The cytoplasm **appears granular due to the presence of ribosomes.** –70S type.

• **Ribosomes** lie scattered freely in the cytoplasm, sometimes may form a small chain of 4-6 ribosomes attached to m-RNA constituting **polyribosomes** or **polysomes**.

(iii) Nucleoid:

- Bacterial cells lack a well-organized nucleus. It consists of a long double stranded DNA molecule repeatedly folded with the help of RNA to form a circular ring. DNA has no free ends and not associated with histone proteins (**polyamines present**).
- Circular DNA ring, is often termed as **bacterial chromosome**. **Plasmids** are small, **extrachromosomal**, **non-essential**, **circular**, **double stranded**, **free**, **naked DNA molecules**. If plasmids temporarily integrate with bacterial chromosome, then they are called **episomes**.

Bacterial Life Processes:

Discussion of bacterial life processes revolves around the study of the prominent metabolic activities like **respiration** and **nutrition**.

- (A) **Respiration:** On the basis of mode of respiration, bacteria are divided into two main groups *i.e.*, **aerobes** and **anaerobes**. Each group is further of two types: **strict** or **obligate** and **facultative**.
- **(B)** Nutrition: Nutrition in bacteria is of two types: autotrophic and heterotrophic. Bacteria having autotrophic mode of nutrition may be **photoautotrophs** and **chemoautotrophs**, carrying out photosynthesis and chemosynthesis, respectively.

Reproduction:

Bacteria reproduce mainly by asexual method and also show sexual recombination (True sexual reproduction is absent).

- (A) Asexual Reproduction: Bacteria produce several types of asexual spores like sporangiospores, oidia, conidia and endospores. However, the most common mode of asexual reproduction is *binary fission*.
 - (a) Binary fission: It is the most common method under favourable conditions of temperature, moisture and availability of nutrients. Mature bacterial cell divides into two daughter cells. The binary fission of a bacterial cell involves mainly 3 steps:
 - (b) Endospores: Cells of certain bacteria, e.g., *Bacillus, Clostridium* etc. form thick-walled, highly resistant bodies within the cell, called endospores. The endospores may be spherical or oval in shape and are terminal or central in position.
- (B) Sexual Recombination (Genetic Recombination) : The bacteria exhibit a primitive form of sexual reproduction which differs from eukaryotic sexual reproduction because there is **no gamete formation and fusion.** However, the essential feature of sexual reproduction, *i.e.*, exchange of genetic material does take place and called **genetic recombination**.

Three methods are known by which genetic recombination is achieved by bacteria. In the order of their discovery, these are transformation, conjugation and transduction.

(b) Cyanobacteria

Cyanobacteria are Gram-negative photosynthetic prokaryotes, and are the most primitive organisms to have **oxygenic photosynthesis.** They add oxygen to the atmosphere. They are also known as (Blue-green algae) **BGA**.



Structural Organization

These may be unicelled or multicelled. The latter may be filamentous or colonial. Filamentous forms consist of one or more cellular strands, called **trichomes**, surrounded by mucilaginous sheath. Cyanobacteria are characterised by the **absence of flagellum throughout life cycle**.

Cell structure:

- The cell structure in cyanobacteria is typically prokaryotic. The cell lacks a well-defined nucleus and the chromatin material is centrally located, resembling the bacterial chromosome.
- The cell wall is 4-layered and is invariably covered by mucilaginous sheath, composed largely of mucopeptides.

- Similar to the mesosome of bacteria, a group of coiled membrane called **lamellasome** is found which connects nucleoid to the cell membrane. It helps in respiration and replication of DNA.
- The characteristic photosynthetic pigments present in the thylakoids are **chlorophyll** *a* and **phycobilins** *i.e.*, phycocyanin (blue coloured), phycoerythrin (red coloured) and allophycocyanin (light blue coloured).

Reproduction

Cyanobacteria reproduce asexually. Typical sexual reproduction is absent.

Asexual reproduction occurs by binary fission, fragmentation, heterocysts, hormogonia and akinetes.

(c) Mycoplasma

Mycoplasma infects animals (e.g., dog, sheep, mice and man) and plants (e.g., potato, corn, brinjal etc.). They are generally found in soil, sewage water, plants and animals.

Structure:

- These are unicellular, simplest free living prokaryotes. They do not have cell wall so they are **highly pleomorphic** and can assume various shapes like spherical, filamentous, coccoid etc.
- Cell membrane is the outermost limiting layer. It is **trilamellar** unit membrane structure.
- The cells are generally **non motile**, but a few are gliding type.
- The protoplasmic matrix contains ribosomes (70 S type), fatty substances and proteins. Organized nucleus, endoplasmic reticulum, plastids, mitochondria, golgi bodies, lysosomes, centrioles, flagella, etc. are absent.
- Mycoplasma has both **RNA** and **DNA**. **RNA** is **single stranded**, present in both ribosomes and cytoplasm whereas **DNA** is **double stranded**, long, coiled thread extending almost throughout the cell.

Reproduction : Much is not known about reproduction of *Mycoplasma* but they mainly reproduce by means of elementary bodies.

(d) Archaebacteria:

- They are believed to have evolved immediately after the origin of life on the earth, as even now these are living under extremely adverse conditions such as, extreme salty areas (halophiles), hot springs (thermoacidophiles) and marshy areas (methanogens).
- These possess introns in DNA, their ribosomal proteins are highly acidic. These prokaryotes possess histone proteins like eukaryotes. **These are the most primitive bacteria**.
- Archaebacteria differ from other bacteria in having a different cell structure and this feature is responsible for their survival in extreme conditions.
- The cell wall in archaebacteria contains proteins and non-cellulosic polysaccharides. It lacks **peptidoglycan**, the characteristic cell wall material in bacteria and cyanobacteria.
- The cell membrane contains **branched chain lipids** (phytanyl side chains) which decrease membranefluidity. This chemical composition of the cell membrane enables these organisms to withstand extremes of temperature and pH.

4. KINGDOM PROTISTA

- > All unicellular because eukaryotes of their mode of nutrition, are included in the kingdom **Protista**.
- This kingdom forms a link between kingdom Monera on one hand and other three kingdoms *i.e.*, Plantae, Fungi and Animalia on the other hand. Protistans are ancestors of all multicellular eukaryotes (plants, fungi and animals).

General Characteristics of Protista

Unicellular, eukaryotic organisms. Some are colonial without much cellular differentiation. Body organisation at tissue level is absent.

- Mostly aquatic organisms.
- Cell structure is eukaryotic type, having all kinds of membrane bound organelles and 80S cytoplasmic ribosomes and cells may possess cellulosic cell wall.
- > Flagella and cilia have (9+2) pattern of microtubule organization consisting of **tubulin** protein.

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- Movement by pseudopodia, flagella or cilia where ciliary mode of movement is the fastest amongst all.
- Mode of nutrition may be photosynthetic (holophytic), holozoic (ingestive), saprobic or parasitic (absorptive).
 Some have mixotrophic nutrition (photosynthetic and saprobic) as in *Euglena*.

Reproduction occurs by asexual and sexual means.

(i) Photosynthetic Protists

These are popularly called protistan algae. Protistan algae constitute the major portion of the phytoplanktons.

A. Chrysophytes

These are golden-brown photosynthetic protists and are called Chrysophytes (**including both diatoms and desmids**). They are both aquatic and terrestrial. Some are marine. They support much of marine life.

B. Dinoflagellates:

- Dinoflagellates are **golden-brown photosynthetic protists**, belonging to class **Dinophyceae** (**Pyrrophtya**). They are mainly marine, though few are fresh water forms. They may appear red, yellow, green, brown or blue depending upon the main pigment present in cell.
- These are mostly marine and photosynthetic. The cell wall has stiff cellulose plates on the outer surface.

C. Euglenoid (Euglena-like):

- It is a group of chlorophyllous and non-chlorophyllous flagellate protists. Largest genera being *Euglena* amongst them.
- Euglenoids are unicellular, flagellate protists found in water or damp soil. Majority of them are freshwater organisms found in stagnant water.
- Body is spindle-shaped with blunt anterior end and pointed posterior end.
- **Cell wall is absent** but a covering periplast or **pellicle** is present which is proteinaceous (elastic) in structure. Locomotory organs are flagella. There are two flagella, a short and a long one.
- A **contractile vacuole** occurs in the cell just below the reservoir, meant for osmoregulation and excretion. Single large nucleus lies near the centre of the protoplast.
- Nutrition in *Euglena viridis* is photoautotrophic. However, it is capable of getting nourishment from dead and decaying organic matter from the substrate by secreting digestive enzymes (saprophytic nutrition) in the absence of light. This dual mode of nutrition is termed as **mixotrophic**.
- Photosynthetic pigments are **chlorophyll** *a*, **chlorophyll** *b*, xanthophyll and β-carotene.
- Under favourable conditions, they mainly reproduce by longitudinal **binary fission**. During unfavourable conditions, **palmella stage** and **cysts** are formed for permeation.

(ii) Slime Moulds or Consumer-Decomposer protists

Slime moulds are saprophytic protists.

General Characteristics of the Slime Moulds:

- They are usually free-living, creeping over debris like fallen leaves and rotting logs of wood.
- Under suitable conditions, they form an aggregation called plasmodium.
- They lack chlorophyll and have **saprophytic** or **phagotrophic** mode of nutrition.
- During unfavorable conditions the plasmodium differentiates and forms fruiting bodies bearing spores at their tips.
- Spores are extremely resistant and survive for many years, even under adverse conditions. The spores are dispersed by air currents.
- Reproduction is both asexual and sexual.

This group is represented by two separate types of organisms *i.e.*, **acellular** e.g., *Physarum* and **cellular** e.g., *Dictyostelium*.

5. PROTOZOANS

All protozoans are heterotrophs and live as parasites or predators. They are believed to be primitive relatives of animals.