

## **01 Molecules and their Interaction**

- Composition, structure and function of biomolecules (Carbohydrates, Lipids-Proteins, Nucleic acids and Vitamins).
- Bioenergetics, Glycolysis, Krebs' cycle, oxidative phosphorylation, coupled reaction, group transfer.
- Principles of catalysis, enzymes and enzyme' kinetics, enzyme action and regulation. Coenzyme. Factors influencing enzyme action.
- Protein structure (Primary, Secondary, Tertiary and Quaternary structure), A, B, Z DNA; tRNA, mRNA & rRNA.
- Metabolism of carbohydrates, lipids, Proteins & nucleotides.

## **02. Cellular organization and processes**

- Cell Membrane structure and functions Different models to explain structure of cell membrane. Membrane proteins diffusion, osmosis, ion channels, active transport, ion pumps,, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.
- Structural organization and functions of cell wall, nucleus, mitochondria, golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, ,plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.
- Organization of genes and chromosomes: interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin- euchromatin, transposons.
- Mitosis and meiosis cell division, their regulation, steps in cell cycle, and control of cell cycle.
- DNA replication. Unit of replication, enzymes involved replication, DNA damage and repair mechanism.
- RNA synthesis and processing, Transcription factors and machinery, transcription activators and repressors, RNA polymerases, capping- elongation and termination, Protein synthesis and its regulations, Prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.

## **03 Cell Communication and cell signaling**

- Host parasite interactions, Recognition and entry processes of different- pathogens like bacteria, viruses into Animal host cells, alteration of host cell behavior, by pathogens virus & induced cell transformation, pathogen bacteria induced diseases in animals.
- Cell signaling, Hormones and their receptors, cell surface receptor, signalling through protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways.
- Cellular communication. Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gapjunctions, extracellular matrix, integrins, neurotransmission and its regulation.
- Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus & induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.
- Innate and adaptive immune system: Cells and, molecules involved in innate and acquired immunity, antigens, antigenicity and immunogenicity, B and T cell epitopes, structure and function of antibody molecules, generation of antibody diversity, monoclonal antibodies, antigen & antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of

B and T cells, B and T cell receptors, humoral and cell mediated immune responses, primary and secondary immune modulation, the complement system, cell mediated effectors functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiency, vaccines.

#### **04 Developmental Biology**

- Basic concepts of development: Potency, commitment, specification, induction competence, determination and differentiation, morphogenetic development, cell fate and cell lineages; stem cells, genomic equivalence and the cytoplasmic determinants, imprinting, mutants and transgenic in analysis of development.
- Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm & egg recognition in animals, zygote formation, cleavage, blastula formation, embryonic fat map, gastrulation and formation of germ layers in animals, embryogenesis.
- Morphogenesis and organogenesis in animals: axes and pattern formation in *Drosophila*, Amphibia and chick organogenesis, eye lens induction, limb development and regeneration in vertebrates, differentiation of neurons, post embryonic development & larval formation, metamorphosis; environmental regulation of normal development, sex determination.
- Programmed cell death, aging and senescence.
- Formation of extra Embryonic membranes in vertebrate, placenta, its types and functions in vertebrates.

#### **05 Structure and function of Invertebrates**

- Origin of metazoa, organization of coelom (Acoelomates, Pseudocoelomates and Coelomates) Amoeboid, flagellar and ciliary movement in protozoa, different methods of Locomotion in Coelentrata, Annelida and Echinodermata.
- Patterns of feeding and digestion in lower invertebrates and in Arthropoda, Mollusca, Echinodermata, Filter feeding in Polychaeta.
- Respiration Organs: Gills, lungs and trachea, respiratory pigments, mechanism of respiration. Excretion in lower and higher invertebrates. Osmoregulation.
- Nervous system: primitive and advanced nervous system.
- Larval forms and their evolutionary significance in Helminthes, Arthropods, Molluscs and Echinodermates. Structure, affinities and life history of Rotifera, Entoprocta, Phoronida and Ectoprocta.

#### **06 Structure and functions of Vertebrates**

- Blood and circulation: Blood corpuscles, haemopoiesis, plasma function, blood volume, blood volume regulation, blood groups, hemoglobin. Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of heart beat.
- Comparison of respiratory organs in different vertebrates, transport of gases, exchange of gases, neural and chemical regulation of respiration.

- Comparative anatomy of brain and spinal cord, Central and Peripheral Nervous system, neural control of muscle tone and sensory organs- eye and ear.
- Comparative anatomy of kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, electrolyte balance, acid & base. Thermoregulation of body temperature- physical, chemical, neural regulation. Alimentary canal, Digestion, Absorption in vertebrates, BMR. (Basic Metabolism Rate)
- Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive organs and their functions, neuroendocrine regulation.

## **07 Inheritance Biology**

- Mendelian principles. Dominance, segregation, independent assortment, deviation from Mendelian inheritance. Concept of gene; Allele, multiple alleles, pseudo-allele, complementation tests. Extensions of Mendelian principles: dominance, incomplete dominance, linkage and crossing over, sex linkage, sex limited and sex influenced characters.
- Extra chromosomal inheritance: Inheritance of mitochondrial and chloroplast genes, maternal inheritance.
- Human genetics: Pedigree analysis, karyotypes, genetic disorders.
- Mutation: Types, causes and detection, loss of function, gain of function, germline versus somatic mutation. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.
- Recombination: Homologous and non homologous recombination, Recombinant DNA Technology

## **08 Diversity of life forms and applied Zoology**

- Principles and methods of taxonomy: concepts of species and hierarchical tax, binominal nomenclature, classical and quantitative methods of taxonomy of animals. Important criteria used for classification.
- Levels of structural organization: Unicellular, colonial and multicellular forms; levels of organization of tissues, organs and systems.
- Natural history of Indian subcontinent: Major habitat types of the subcontinent, geographic origins and migrations of species; common Indian mammals, birds.
- Common parasites and pathogens of humans and domestic animals.
- Culture of fresh water fishes and prawn, Fisheries resources in M.P., Sericulture, Bee culture.

## **09. Ecological Principles**

- The Environment: Physical environment, biotic environment, biotic and abiotic Interactions.  
Habitat and niche: Concept of habitat and niche,. Population ecology;  
Characteristics of a population; population growth curves, population regulation, concept of metapopulation, demes and dispersal, interdemec extinctions, age structured populations.
- Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, symbiosis.  
Community ecology: Nature of communities, community structure and attributes, levels of species diversity and its measurement, edges and ecotones.

Ecosystem: Structure and function, energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine).

- Biogeography: Major terrestrial biomes, theory of island biogeography, biogeographical zones of India.
- Applied ecology: Environmental pollution; global environmental change, biodiversity status, monitoring and documentation; major drivers of biodiversity change; biodiversity management.
- Conservation biology: Principles of conservation, major approaches to management, Wild life conservation, Project Tiger, Biosphere reserves, National parks and National Sanctuaries of M.P.

## **10. Evolution and Behavior**

- Emergence of evolutionary thoughts: Lamarck, Darwin concepts of variation/adaptation, struggle, fitness and natural selection, Mendelism; Modern Synthetic Theory of Evolution; Micro, Macro and Mega evolution.
- Origin of basic biological molecules, concept of Oparin, Origin of cells and unicellular evolution; abiotic synthesis of organic monomers and Haldane, experiment of Miller (1953); the first cell, evolution of prokaryotes; origin of eukaryotic cells, evolution of unicellular eukaryotes.
- Paleontology and evolutionary history: The evolutionary time scale, eras, periods and epochs, major events in the evolutionary time scale, stages in evolution of Homo sapiens. (Man), Fossil Park in M.P.
- Population genetics & populations, gene pool, gene frequency: Hardy-Weinberg law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift, adaptive radiation and modifications, isolating mechanisms, speciation, and its types.
- Brain Behavior and Evolution; Ethology and its branches Approaches and methods in study of behavior, proximate and ultimate causation: altruism and evolution & group selection, kin selection, reciprocal altruism: neural basis of learning, memory, cognition, sleep and arousal; biological clocks, development of behavior, social communication, social dominance; use of space and territoriality: parental care, aggressive behavior; habitat selection and migration, orientation and navigation.