CSIR NET LIFE SCIENCE SYLLABUS

1. CSIR NET Syllabus Unit 1 – MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY

Topic	Description
Structure of Atoms, Molecules, and Chemical Bonds	Basic structure of atoms, molecular bonding types.
Composition, Structure, and Function of Biomolecules	Carbohydrates, lipids, proteins, nucleic acids, vitamins.
Stabilizing Interactions	Van der Waals forces, electrostatic interactions, hydrogen bonding, hydrophobic interactions, etc.
Principles of Biophysical Chemistry	pH, buffers, reaction kinetics, thermodynamics, colligative properties.
Bioenergetics	Glycolysis, oxidative phosphorylation, coupled reactions, group transfer, biological energy transducers.
Principles of Catalysis	Enzymes, enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes.
Conformation of Proteins	Ramachandran plot, secondary structure, domains, motifs, folds.
Conformation of Nucleic Acids	Helical structures (A, B, Z), t-RNA, micro-RNA.
Stability of Proteins and Nucleic Acids	Factors affecting stability of proteins and nucleic acids.
Metabolism of Biomolecules	Carbohydrates, lipids, amino acids, nucleotides, vitamins.

CSIR NET Syllabus Unit 2 – CELLULAR ORGANIZATION

Unit 2 of the CSIR NET Life Science syllabus focuses on the structural and functional aspects of cellular organization. Understanding these topics is crucial for comprehending the complexities of cellular processes and functions.

Topic	Description
Membrane Structure and Function	Structure of model membrane, lipid bilayer, membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting, regulation of intracellular transport, electrical properties of membranes.
Structural Organization and Function of Intracellular Organelles	Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton, its role in motility.
Organization of Genes and Chromosomes	Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons.
Cell Division and Cell Cycle	Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle.
Microbial Physiology	Growth yield and characteristics, strategies of cell division, stress response.

CSIR NET Syllabus Unit 3 – FUNDAMENTAL PROCESSES

Unit 3 of the CSIR NET Life Science syllabus covers the fundamental processes of DNA replication, RNA synthesis, protein synthesis, and the control of gene expression. Understanding these processes is crucial for unraveling the molecular mechanisms underlying cellular functions.

Topic	Description
DNA Replication, Repair, and Recombination	Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination.
RNA Synthesis and Processing	Transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport.
Protein Synthesis and Processing	Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post-translational modification of proteins.
Control of Gene Expression	Regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing.

CSIR NET Syllabus Unit 4 – Cell communication and cell signaling

Unit 4 of the CSIR NET Life Science syllabus covers cell communication, signaling, host-parasite interactions, cancer biology, and the innate and adaptive immune systems. Understanding these topics is crucial for understanding the complex mechanisms underlying cell behavior and the immune response.

Topic	Description
Host-Parasite Interaction	Recognition and entry processes of pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.
Cell Signaling	Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.

Topic	Description
Cellular Communication	Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, 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 adaptive immunity, antigens, antigenicity and immunogenicity, B and T cell epitopes, structure and function of antibody molecules, generation of antibody diversity, monoclonal antibodies, antibody engineering, 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, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines.

CSIR NET Syllabus Unit 5 – DEVELOPMENTAL BIOLOGY

Unit 5 of the CSIR NET Life Science syllabus covers developmental biology, including basic concepts of development, gametogenesis, fertilization, early development, morphogenesis, organogenesis in animals and plants, and programmed cell death, aging, and senescence. Understanding these topics is essential for comprehending the processes underlying the development and growth of organisms.

Topic	Description
Basic Concepts of Development	Potency, commitment, specification, induction, competence, determination, differentiation, morphogenetic gradients, cell fate, cell lineages, stem cells, genomic equivalence, cytoplasmic determinants, imprinting, mutants, transgenics in analysis of development.
Gametogenesis, Fertilization, and Early Development	Production of gametes, cell surface molecules in sperm-egg recognition in animals, embryo sac development, double fertilization in plants, zygote formation, cleavage, blastula formation, embryonic fields, gastrulation, formation of germ layers in animals, embryogenesis, establishment of symmetry in plants, seed formation, germination.

Topic	Description
Morphogenesis and Organogenesis in Animals	Cell aggregation, differentiation in Dictyostelium, axes, pattern formation in Drosophila, amphibians, chick, organogenesis – vulva formation in Caenorhabditis elegans, eye lens induction, limb development, regeneration in vertebrates, differentiation of neurons, post-embryonic development, larval formation, metamorphosis, environmental regulation of normal development, sex determination.
Morphogenesis and Organogenesis in Plants	Organization of shoot, root apical meristem, shoot, root development, leaf development, phyllotaxy, transition to flowering, floral meristems, floral development in Arabidopsis, Antirrhinum.
Programmed Cell Death, Aging, and Senescence	Processes of programmed cell death, aging, senescence in organisms.

CSIR NET Syllabus Unit 6 – SYSTEM PHYSIOLOGY – PLANT

Unit 6 of the CSIR NET Life Science syllabus focuses on the physiological processes in plants, including photosynthesis, respiration, nitrogen metabolism, plant hormones, sensory photobiology, solute transport, photoassimilate translocation, secondary metabolites, and stress physiology. Understanding these topics is crucial for understanding how plants function and respond to their environment.

Topic	Description
Photosynthesis	Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways.
Respiration and Photorespiration	Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.
Nitrogen Metabolism	Nitrate and ammonium assimilation; amino acid biosynthesis.
Plant Hormones	Biosynthesis, storage, breakdown, and transport; physiological effects and mechanisms of action.

Topic	Description
Sensory Photobiology	Structure, function, and mechanisms of action of phytochromes, cryptochromes, and phototropins; stomatal movement; photoperiodism, biological clocks.
Solute Transport and Photoassimilate Translocation	Uptake, transport, and translocation of water, ions, solutes, and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.
Secondary Metabolites	Biosynthesis of terpenes, phenols, and nitrogenous compounds and their roles.
Stress Physiology	Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature, salt) stresses.

CSIR NET Syllabus Unit 7 – SYSTEM PHYSIOLOGY – ANIMAL

Unit 7 of the CSIR NET Life Science syllabus focuses on the physiological processes in animals, including blood and circulation, cardiovascular system, respiratory system, nervous system, sense organs, excretory system, thermoregulation, stress and adaptation, digestive system, and endocrinology and reproduction. Understanding these topics is crucial for understanding how animals function and respond to their environment.

Topic	Description
Blood and Circulation	Blood corpuscles, haemopoiesis, formed elements, plasma function, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.
Cardiovascular System	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.
Respiratory System	Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

Topic	Description
Nervous System	Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.
Sense Organs	Vision, hearing, tactile response.
Excretory System	Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.
Thermoregulation	Comfort zone, body temperature regulation – physical, chemical, neural regulation, acclimatization.
Stress and Adaptation	Physiological responses to stress and mechanisms of adaptation.
Digestive System	Digestion, absorption, energy balance, basal metabolic rate.
Endocrinology and Reproduction	Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation.

CSIR NET Syllabus Unit 8 – INHERITANCE BIOLOGY

Unit 8 of the CSIR NET Life Science syllabus covers inheritance biology, including Mendelian principles, concepts of genes, extensions of Mendelian principles, gene mapping methods, extra chromosomal inheritance, microbial genetics, human genetics, quantitative genetics, mutation, structural and numerical alterations of chromosomes, and recombination. Understanding these topics is crucial for understanding the principles of inheritance and genetic variability.

Topic	Description
Mendelian Principles	Dominance, segregation, independent assortment.
Concept of Gene	Allele, multiple alleles, pseudoallele, complementation tests.

Topic	Description
Extensions of Mendelian Principles	Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex-limited and sex-influenced characters.
Gene Mapping Methods	Linkage maps, tetrad analysis, mapping with molecular markers, mapping using somatic cell hybrids, development of mapping population in plants.
Extra Chromosomal Inheritance	Inheritance of mitochondrial and chloroplast genes, maternal inheritance.
Microbial Genetics	Methods of genetic transfers – transformation, conjugation, transduction, sexduction, mapping genes by interrupted mating, fine structure analysis of genes.
Human Genetics	Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.
Quantitative Genetics	Polygenic inheritance, heritability and its measurements, QTL mapping.
Mutation	Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants, insertional mutagenesis.
Structural and Numerical Alterations of Chromosomes	Deletion, duplication, inversion, translocation, ploidy and their genetic implications.
Recombination	Homologous and non-homologous recombination including transposition.

CSIR NET Syllabus Unit 9 – DIVERSITY OF LIFE FORMS

Unit 9 of the CSIR NET Life Science syllabus covers the diversity of life forms, including principles and methods of taxonomy, levels of structural organization, outline classification of plants, animals, and microorganisms, natural history of the Indian subcontinent, organisms of health and agricultural importance, and organisms of conservation concern. Understanding these topics is crucial for understanding the diversity and classification of living organisms.

Topic	Description
Principles & Methods of Taxonomy	Concepts of species and hierarchical taxa, biological nomenclature, classical & quantitative methods of taxonomy of plants, animals, and microorganisms.
Levels of Structural Organization	Unicellular, colonial, and multicellular forms. Levels of organization of tissues, organs, & systems. Comparative anatomy, adaptive radiation, adaptive modifications.
Outline Classification of Life Forms	Important criteria used for classification in each taxon. Classification of plants, animals, and microorganisms. Evolutionary relationships among taxa.
Natural History of Indian Subcontinent	Major habitat types of the subcontinent, geographic origins, and migrations of species. Common Indian mammals, birds. Seasonality and phenology of the subcontinent.
Organisms of Health & Agricultural Importance	Common parasites and pathogens of humans, domestic animals, and crops.
Organisms of Conservation Concern	Rare, endangered species. Conservation strategies.

CSIR NET Syllabus Unit 10 – ECOLOGICAL PRINCIPLES

Unit 10 of the CSIR NET Life Science syllabus covers ecological principles, including the environment, habitat and niche, population ecology, species interactions, community ecology, ecological succession, ecosystem ecology, biogeography, applied ecology, and conservation biology. Understanding these topics is crucial for understanding the interactions between organisms and their environment, as well as for developing strategies for conservation and sustainable management of ecosystems.

Topic	Description
The Environment	Physical environment; biotic environment; biotic and abiotic interactions.
Habitat and Niche	Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

Topic	Description
Population Ecology	Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.
Species Interactions	Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.
Community Ecology	Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.
Ecological Succession	Types; mechanisms; changes involved in succession; concept of climax.
Ecosystem Ecology	Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (freshwater, 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 approaches.
Conservation Biology	Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

CSIR NET Syllabus Unit 11 – EVOLUTION AND BEHAVIOUR

Unit 11 of the CSIR NET Life Science syllabus covers evolution and behavior, including the emergence of evolutionary thoughts, origin of cells, unicellular evolution, paleontology and evolutionary history, molecular evolution, the mechanisms of evolution, and the relationship between brain, behavior, and evolution. Understanding these topics is crucial for understanding the evolutionary processes that have shaped life on Earth, as well as the behaviors that organisms exhibit as a result of these processes.

Topic	Description
Emergence of Evolutionary Thoughts	Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness, and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.
Origin of Cells and Unicellular Evolution	Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis, and aerobic metabolism.
Paleontology and Evolutionary History	The evolutionary time scale; Eras, periods, and epoch; Major events in the evolutionary time scale; Origins of unicellular and multicellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo.
Molecular Evolution	Concepts of neutral evolution, molecular divergence, and molecular clocks; Molecular tools in phylogeny, classification, and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence.
The Mechanisms	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; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.
Brain, Behavior, and Evolution	Approaches and methods in the 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; Mating systems, Parental investment, and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation, and navigation; Domestication and behavioral changes.

CSIR NET Syllabus Unit 12 – APPLIED BIOLOGY

Unit 12 of the CSIR NET Life Science syllabus covers applied biology, including microbial fermentation, immunological principles and applications, transgenic animals and plants, genomics and its applications, bioresource and uses of biodiversity, breeding in plants and animals, bioremediation and phytoremediation, and biosensors. Understanding these topics is crucial for applying biological principles to various fields such as medicine, agriculture, and environmental science.

Topic	Description
Microbial Fermentation and Production	Production of small and macro molecules through microbial fermentation.
Immunological Principles and Applications	Application of immunological principles in vaccines, diagnostics. Tissue and cell culture methods for plants and animals.
Transgenic Animals and Plants	Creation and application of transgenic animals and plants. Molecular approaches to diagnosis and strain identification.
Genomics and its Applications	Study of genomics and its application to health and agriculture, including gene therapy.
Bioresource and Uses of Biodiversity	Study of bioresources and uses of biodiversity.
Breeding in Plants and Animals	Breeding techniques in plants and animals, including marker-assisted selection.
Bioremediation and Phytoremediation	Techniques and applications of bioremediation and phytoremediation.
Biosensors	Study and application of biosensors.

CSIR NET Syllabus Unit 13 – METHODS IN BIOLOGY

Unit 13 of the CSIR NET Life Science syllabus covers methods in biology, including molecular biology and recombinant DNA methods, histochemical and immunotechniques, biophysical methods, statistical methods, radiolabeling techniques, microscopic techniques, electrophysiological methods, and methods in field biology. Understanding these methods is crucial for conducting research in various biological disciplines.

Topic	Description
Molecular Biology and Recombinant DNA Methods	Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods. Analysis of RNA, DNA, and proteins by one and two-dimensional gel electrophoresis, isoelectric focusing gels. Molecular cloning of DNA or RNA fragments in bacterial

Topic	Description
	and eukaryotic systems. Expression of recombinant proteins using bacterial, animal, and plant vectors. Isolation of specific nucleic acid sequences. Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC, and YAC vectors. In vitro mutagenesis and deletion techniques, gene knockout in bacterial and eukaryotic organisms. Protein sequencing methods, detection of post-translation modification of proteins. DNA sequencing methods, strategies for genome sequencing. Methods for analysis of gene expression at RNA and protein level, large-scale expression, such as microarray-based techniques. Isolation, separation, and analysis of carbohydrate and lipid molecules. RFLP, RAPD, and AFLP techniques.
Histochemical and Immunotechniques	Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry, and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.
Biophysical Method	Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR, and ESR spectroscopy. Molecular structure determination using X-ray diffraction and NMR. Molecular analysis using light scattering, different types of mass spectrometry, and surface plasmon resonance methods.
Statistical Methods	Measures of central tendency and dispersal; probability distributions (Binomial, Poisson, and normal); Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance; Regression and Correlation; t-test; Analysis of variance; X2 test; Basic introduction to Multivariate statistics, etc.
Radiolabeling Techniques	Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.
Microscopic Techniques	Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.

Topic	Description
Electrophysiological Methods	Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT.
Methods in Field Biology	Methods of estimating population density of animals and plants, ranging patterns through direct, indirect, and remote observations, sampling methods in the study of behavior, habitat characterization: ground and remote sensing methods.