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 fracture method for EM, image processing methods in microscopy.

Instrumentation

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, two-dimensional gel electrophoresis, Isoelectric focusing gels. ELISA, RIA, western blot, immunoprecipitation, flow cytometry.

Microbial Immunology

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, 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 AIDS & HIV.

Microbial Physiology and Biochemistry

Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.) Bioenergetics, glycolysis, oxidative phosphorylation, Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes. Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds). Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA). Stability of proteins and nucleic acids. Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins. Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps. Growth yield and characteristics of bacterial growth.

Microbial Genetics

Methods of genetic transfers – transformation, conjugation, transduction. Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis, deletion, duplication, inversion, translocation, Recombination: Homologous and non-homologous recombination including transposition. Gene mapping.

Molecular Microbiology

DNA replication, repair and recombination (Unit of replication, enzymes involved, replication origin and replication fork, DNA damage and repair mechanisms, homologous recombination). RNA synthesis and processing (transcription factors, 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, Signal transduction pathways, second messengers. and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods.

Recombinant DNA Technology

Tissue and cell culture methods. Molecular cloning of DNA or RNA fragments in bacterial 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 knock out in bacterial and DNA sequencing methods, strategies for genome sequencing. Methods for analysis of gene expression at RNA and protein level, such as microarray -based techniques RFLP, RAPD and AFLP techniques.

Industrial and Environmental Microbiology

Microbial fermentation and production of small and macro molecules. Bioremediation and phytoremediation.