



Università degli studi dell'Insubria – Insubria University  
BBHI – Master Sc. in Biotechnology for the Bio-based and Health Industry  
Basic background in Biotechnology required for access (REV-DEC2022)

### PLANT & ANIMAL BIOLOGY

- Plant general features and biology at a molecular (molecular basis of plant growth and development, plant biochemistry, main metabolism and secondary metabolites biosynthesis), cellular and structure level: structure, composition, and function
- Xylem and phloem transport
- *In vitro* plant tissue culture techniques
- Basic knowledge of Animal Biology

#### Recommended textbooks:

Metabolic engineering of plant secondary metabolism. Editors: Verpoorte, Robert, Alfermann, A. Wilhelm (Eds.)

Integrated Principles of Zoology, 17<sup>th</sup> edition. C. P. Hickman. Eds. Mc Graw Hill education

### BIOCHEMISTRY

- Biomolecules: Carbohydrates, lipids, amino acids/proteins, nucleic acids
- Protein synthesis, regulation and homeostasis.
- From structure to function: structural organization of proteins
- Protein functionality: enzymes (enzyme kinetics, cooperativity and allostery), antibodies, transporters.
- Bioenergetic and redox balance.
- Metabolism: catabolism of sugars, fatty acids, amido acids, nucleosides. Basic knowledge of biosynthesis.
- Signal, receptors and signal transduction.

#### Recommended textbook:

Nelson and Cox, Lehninger's principles of biochemistry. 7<sup>th</sup> edition. Freeman, 2017. ISBN-10: 1464126119.

### CELL BIOLOGY AND PHYSIOLOGY

- Cell compartments, organelles and membranes: structure and function
- Intracellular and extracellular matrix: cytoskeleton, transport, cell adhesion and motility
- Principles of bioelectricity and cell excitability
- Regulation of cell functions, the principles and mechanisms of homeostasis
- Cellular programs: growth, proliferation, differentiation, apoptosis

#### Recommended textbook:

Bruce Alberts et al. "Molecular Biology of the Cell" – 6<sup>th</sup> Ed. Garland Science, 2014

## GENETICS

- Mendelian heredity. Concepts of gene, alleles, genotype and phenotype
- Sex-linked traits. Genetic linkage and recombination
- Basis of population genetics: concepts of gene pool, genotype and allele frequencies, genetic diversity, Hardy-Weinberg equilibrium
- Chromosomal, genomic and gene mutations and their genetic and phenotypic consequences
- Gene structure in eukaryotes and splicing
- Basics of gene regulation in eukaryotes
- Molecular cloning and cloning vectors of widespread use
- Theoretical and practical aspects of PCR and hybridization assays
- Genomic and cDNA libraries
- Gene transfer assays in eukaryotic cells. Basic notions on transgenic models and gene knock-out or knock down approaches.

Recommended textbook:

Peter Russel "GENETICS: A MOLECULAR APPROACH". Pearson Education Inc.  
Watson et al., Molecular Biology of the Gene (Pearson Inc)

## MOLECULAR BIOLOGY

- DNA and RNA structure. Molecular mechanisms of transcription and translation; The genetic code
- Stability/dynamics (denaturation and renaturation) of the DNA double helix
- DNA replication: overview of DNA synthesis at the replication fork and the enzymes/proteins involved.
- RNA transcription, transcription regulation, operons, processing (capping, splicing and polyadenylation).
- DNA repair: Mismatch repair, nucleotide/base excision repair.
- Molecular Biology techniques: Southern and northern blot, Western blot, microarray hybridization, DNA sequencing (with basics of Next Generation Sequencing approaches), PCR, real-time PCR. Use of antibodies for immunoprecipitations.

Recommended textbook:

Bruce Alberts et al. "MOLECULAR BIOLOGY OF THE CELL". Garland Science

## BIOTECHNOLOGICAL PHARMACOLOGY

- Basic principles of pharmacokinetics (ADME)
- Molecular Drug-receptor interactions (drug affinity, efficacy, dose/response curves; agonists/antagonists)
- Basic knowledge of Biopharmaceuticals (vaccines, therapeutic antibodies, enzyme therapy, novel pharmaceutical drugs)

Recommended textbooks:

F. Clementi G. Fumagalli: General and Molecular Pharmacology: Principles of Drug Action. 1<sup>st</sup> English edition, 2015, Wiley

## BIOINFORMATICS

- Basic knowledge of common databases of biological sequences (e.g., UniProt, Genebank), molecular phylogenesis, structural databases (e.g., PDB).

## IMMUNOLOGY

- Hematopoiesis; leukocytes
- Innate versus acquired immunity
- Antibody structure and functions of IgM, IgG, IgA and IgE
- T helper and T cytotoxic lymphocytes

Recommended textbook

Abul K Abbas - Basic Immunology, Elsevier

## MICROBIOLOGY & FERMENTATION CHEMISTRY

- Microbial cell structure and function;
- Microbial growth and parameters influencing microbial growth;
- Catabolic pathways and microbial biodiversity;
- Bacterial genetics and taxonomy.
- Aerobic and anaerobic microbial metabolism
- Basic knowledge in microbiology
- Methods in applied microbiology and industrial microbiology
- Bioreactors, Batch, fed-batch and continuous processes
- Fermentation process upstream and downstream

Recommended textbook

Basic Biotechnology 2nd Ed - C. Ratledge, B. Kristiansen (Cambridge, 2001)

Brock Biology of Microorganisms Michael T. Madigan - John M. Martinko - David A. Stahl - Kelly S. Bender - Daniel H. Buckley