

REV: 2025

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 (AY 2025/2026)

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 th edition. C. P. Hickman. Eds. Mc Graw Hill education

BIOCHEMISTRY

Keywords of background knowledge

- Biomolecules: Carbohydrates, lipids, amino acids, proteins, nucleic acids.
- From structure to function: structural organization of proteins, enzymes, enzyme kinetics, cooperativity and allostery.
- Bioenergetic and redox balance.
- Metabolism: Catabolism of sugars, fatty acids, amido acids, nucleosides. Basics of biosynthesis.
- Signal, receptors and signal transduction.
- Protein homeostasis.

Recommended textbook:

Nelson and Cox, Lehninger - principles of biochemistry. 7th edition. Freeman, 2017. ISBN-10: 1464126119.

CELL BIOLOGY AND PHYSIOLOGY

- Cell compartments and organelles: structure and function
- Cell membranes: composition and functions
- 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
- Mendelian heredity. Concepts of gene, alleles, genotype and phenotype

Recommended textbook:

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

GENETICS

The keywords for the background knowledge are the following:

- 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
- DNA structure. Molecular mechanisms of transcription and translation
- The genetic code
- Gene structure in eukaryotes and splicing
- Bases 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.

MOLECULAR BIOLOGY

- DNA, RNA and proteins: the main structures.
- Stability/dynamics of the DNA double helix – denaturation and renaturation (important for understanding some of techniques of molecular biology).
- Replication: overview of DNA synthesis at the replication fork and the enzymes/proteins involved.
- Transcription: overview of transcription in prokaryotes and its regulation. Organization of transcription units in operons. Lac-operon as paradigm of transcriptional regulation in prokaryotes.
- RNA processing: how is the eukaryotic mRNA matured? Capping, splicing, poly-adenylation.
- Translation: overview of the process of protein synthesis.
- DNA repair: Mismatch repair, nucleotide/base excision repair.
- Techniques: Northern, southern, western, microarray, DNA sequencing, PCR, real-time PCR. Use of antibodies for immunoprecipitations.

Recommended textbook:

Watson et al., Molecular Biology of the Gene (Pearson Inc)

BIOTECHNOLOGICAL PHARMACOLOGY

- Basic principles of pharmacokinetics (routes of administration, absorption, distribution, metabolism, excretions, drug interactions)
- Molecular Drug-receptor interactions (drug affinity, efficacy, dose/response curves; agonists/antagonists)
- Basic knowledge of Biopharmaceuticals (vaccines, therapeutical antibodies, enzyme therapy, novel pharmaceutical drugs)

Recommended textbooks:

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

D.E. Golan, E.J. Armstrong, A.W. Armstrong: Principles of Pharmacology - The Pathophysiologic Basis of Drug Therapy. 4th Edition, 2016, Wolters Kluwer.

BIOINFORMATICS

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

IMMUNOLOGY

Hematopoiesis; leukocytes

Innate versus acquired immunity

Antibody structure

Functions of IgM, IgG, IgA and IgE antibodies

T helper and T cytotoxic lymphocytes

Recommended textbook

Tak W Mak - Primer to The Immune Response, Elsevier

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