



IMBS

International Master Program
in Biomedical Sciences



Program Objectives and Training Schedule Year 1 *(requirements for the Summer School)*

www.biomedmaster.org

www.ffyb.uba.ar

Content

Module 1: Biophysics: Bioenergetics and biological oxidations (Buenos Aires) /
Materials and Microsystems for the Life Sciences (Freiburg)

Module 2: Pathology

Module 3: Pharmacology/ Toxicology

Module 4: a: Microbiology
b: Virology
c: Cellular and Molecular Immunology

Module 5: Neurobiology

Module 6: Molecular Biology incl. Modell Systems and Special Research Tools

Module 7: Internal Medicine and the Mechanistics of Illness

Module 8: Molecular Oncology

Methods

■ Module 1:

Biophysics: Bioenergetics and biological oxidations (Buenos Aires) / Materials and Microsystems for the Life Sciences (Freiburg)

■ Course Abbreviated Program*

- Biochemistry and chemistry, biomolecular structure, specially related to protein structure, structure-activity relationships
- Cell membranes
- Protein folding
- Bioenergetics
- Transport processes. Simulation of models
- Enzyme kinetics
- Computational chemistry - Molecular dynamics simulation, Molecular docking
- Bioinformatics - sequence alignment, structural alignment, Protein structure prediction
- Biophysical techniques

■ References

1. Biological Physics updated edition by *Philip Nelson*
2. Biophysics an introduction by *Roland Glaser*
3. Module Ib (Freiburg) Biomaterials: Biomaterials an introduction by *Joon Park* and *R.S Lakes*
4. Module Ic (Freiburg) Biostatistics: Intuitive Biostatistics by *Harvey Motulsky*

*(Students should have been already in contact with these contents)

■ Module 2:

Pathology

■ Course Abbreviated Program*

- Methods of study in Molecular Pathology
- Cardiovascular pathology
- Renal pathology
- Digestive diseases
- Neoplasia (Morphological, immunohistochemical and molecular analyses)
- Molecular genetics of renal tumors
- Cellular adaptations, cell injury, and cell death
- Acute and chronic inflammation
- Tissue renewal and repair : regeneration, healing, and fibrosis
- Hemodynamic disorders, thromboembolic disease, and shock
- Genetic disorders
- Diseases of immunity

■ References

1. Basic Concepts of Molecular Pathology by *Timothy Craig Allan*
2. Molecular Pathology: The Molecular Basis of Human Disease by *Coleman and Gregory J. Tsongalis*

*(Students should have been already in contact with these contents)

■ Module 3:

Pharmacology/ Toxicology

■ Course Abbreviated Program*

- Pharmacokinetics: The Dynamics of Drug Absorption, Distribution, Metabolism and Elimination
- Pharmacodynamics: Molecular Mechanisms of Drug Action
- Drug Toxicity and Poisoning
- Membrane Transporters and Drug Response
- Drug Metabolism
- Pharmacogenetics
- Alcohol and Drugs interaction in Liver and Brain
- Portal hypertension
- Hippocampal Mitochondrial Dysfunction
- Epidemiology view of Cancer markers
- Multidrug resistance & Paracetamol metabolic pathways

■ References

1. Goodman & Gilman's Manual of Pharmacology and therapeutics
2. Module IIIb Toxicology: Casarett & Doull's Essentials of Toxicology by *Curtis Klaassen* and *John B. Watkins*
3. Lu's Basic Toxicology: Fundamentals, Target organs and Risk Assesment, 4th Edition by *Frank C. Lu* and *Sam Kacew*

*(Students should have been already in contact with these contents)

■ Module 4:

a: Microbiology b: Virology c: Cellular and Molecular Immunology

■ Course Abbreviated Program*

- Bacterial structure and function
- Bacterial mechanisms of pathogenicity and virulence factors
- From bacterial taxonomy and identification to molecular epidemiology
- Bacterial genetics and transmission of mobile genetic elements
- Antibiotics: Mechanism of action and resistance to microbial agents
- Principles of Virology: Taxonomy and Phylogenetic classification. Viral replication strategies. Replication of DNA and RNA viruses.
- Virus evolution. Molecular mechanisms of genetic variation of viruses. Virus evolution and disease prevention.
- Virus-cell relationship. Innate and adaptive immune response to viruses. Pathogenesis of viral infections.
- Diagnostic virology. Molecular epidemiology and emergence of viral disease.
- Immunization against viral diseases. Antiviral agents.

■ References

1. Module IVa Microbiology: Review of Medical Microbiology and Immunology by *Warren Levinson*
2. Module IVb Virology: Principles and Applications by *Dr. John Carter* and *Prof. V. Saunders*
3. Module IVc Immunology: Janeway's immunobiology by *Kenneth Murphy*
4. Basic immunology Updated Edition: Functions and Disorders of Immune System with Student Consult by *Abbas* and *Andrew Lichtman*
5. Cellular and Molecular Immunology Updated Edition 2010 by *Abbas, Lichtman* and *Pillai*

*(Students should have been already in contact with these contents)

Module 5:

Neurobiology

Course Abbreviated Program*

- Developmental and morphologic aspects of the nervous system:
Embryology and development, Morphology and ultrastructure, Neurogenesis in the embryonic, fetal and adult brain.
- Chemical signalling in the nervous system:
Neurotransmitters and neuromodulators, cholinergic neurotransmission, changes of chemical signalling.
- Neuronal plasticity and the response of the nervous system to injury and ischemia. Plasticity, Injury.
- Aging of the nervous system:
Theories of brain aging, Molecular mechanisms and neurobiology of brain aging, genes involved in Alzheimer's disease, animal models of Alzheimer's disease. Transgenic animals. Pharmacological basis of the treatment of Alzheimer's disease.
- Neurodegeneration and demyelinating diseases:
Molecular basis of neurodegeneration. Mechanisms of cell death in neurodegenerative diseases.
Apoptotic and non-apoptotic pathways. Neurochemistry, neurobiology and cellular basis of Parkinson's disease.
- Use of animal models for understanding and treatment of neurodegenerative diseases.
- Principles of gene therapy and viral vectors for the treatment of CNS diseases.
- In situ hybridization techniques for analysis of gene expression at the cellular level
- Quantitative analysis of gene expression using real time PCR.
- Use of immunofluorescence and confocal microscopy to determine protein

References

1. Neurobiology by *Gordon M. Shepherd*
2. Principles of Neural Science by *Eric R. Kandel, James H. Schwartz, Thomas M. Jessell*

*(Students should have been already in contact with these contents)

■ Module 6:

Molecular Biology incl. Modell Systems and Special Research Tools

■ Course Abbreviated Program*

- Methods Manipulating proteins, DNA, and RNA
- Internal organization of the cell
- Intracellular components and protein sorting
- Cell communication: signal transduction
- Cells in their social context, cell junctions, cell adhesion and the extracellular matrix
- The cell cycle and programmed cell death
- Cancer: Control of gene expression
- Protein translocation across the ERm and secretory protein sorting
- Energy conversion in mitochondria

■ References

1. Molecular biology of the cell by *Bruce Alberts*
2. Essentials of Molecular Biology by *G. Malacinski*
3. Cell and Molecular biology study guide by *Gerald Karp*
4. Yeast: Molecular and Cell Biology by *Horst Feldmann*

*(Students should have been already in contact with these contents)

■ Module 7:

Internal Medicine and the Mechanistics of Illness

■ Course Abbreviated Program*

- Molecular and genetic bases of illnesses. Genic regulation.
- Alterations in body structure and composition. Carbohydrates, lipids and proteins function and body composition.
- Cardiac Electrophysiology.
- Metabolism of carbohydrates, lipids and adipose tissue.
- Sepsis.
- Renal Physiology and alterations.
- Digestive physiology
- Blood gases. Respiratory function. Ventilatory mechanics.
- Hypoxia. Ischemia. Mitochondria and cell responses.
- Endothelial physiology and dysfunction. Adhesion molecules. Clotting system.
- Hypophysis and hypothalamus. Growth and development.
- Thyroid function, growth, cardiovascular regulation and oxygen utilization.
Adrenal function, hydrocarbon metabolism and electrolytic homeostasis.

■ References

1. Symptoms and signs of clinical medicine *by David Gray*
2. Color Atlas and text of clinical medicine *by Charles Forbes and William Jackson*

*(Students should have been already in contact with these contents)

■ Module 8:

Molecular Oncology

■ Course Abbreviated Program*

- What is cancer? - Causes of cancer, inherited susceptibility to cancer
- DNA repair and cancer
- Epigenetic events in cancer
- Molecular cytogenetics of cancer
- Oncogenes
- Tumour suppressor genes
- The cancer cell cycle
- Cellular immortalization and telomerase activation in cancer
- Growth factors and their signalling pathways in cancer
- Apoptosis : molecular physiology and significance for cancer therapeutics
- Mechanisms of viral carcinogenesis
- Cytokines and cancer
- Hormones and cancer
- The spread of tumours
- Tumour angiogenesis
- Stem cells, haemopoiesis, and leukaemia
- Animal models of cancer
- The immunology of cancer
- Monoclonal antibodies and therapy

■ References

1. Molecular Biology of Cancer by *Lauren Pecorino*

*(Students should have been already in contact with these contents)

■ **Methods**

Students should be familiarized with the theory of these methods

- Cell culture
- Western Blot
- PCR
- qPCR
- Gene transduction
- FISH
- Microarray gene expression analysis
- Confocal Microscopy
- Flow Cytometry
- Mass Spectrometry

■ **References**

1. At the Bench: A Laboratory Navigator Updated Edition by *Kathy Barker*