

Biomedical Laboratory Techniques Course

INTEGRATED COURSE: HISTOLOGY, BIOLOGY, ANATOMY AND GENETICS

SSD: BIO/17, BIO/16, BIO/13, MED/03

CFU: 8

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MODULE: HISTOLOGY

SSD: BIO/17

CFU: 2

Professor: [Micol Massimiani](#) e-mail: micol.massimiani@unicamillus.org

MODULE: MEDICAL GENETICS

SSD: MED/03

CFU: 2

Professor: [Cinzia Ciccacci](#) e-mail: cinzia.ciccacci@unicamillus.org

MODULE: HUMAN ANATOMY

SSD: bio/16

Numero di CFU: 2

Professor: [Paolo Izzo](#) e-mail: paolo.izzo@unicamillus.org

MODULE: GENERAL AND CELLULAR BIOLOGY

SSD: BIO/13

CFU: 2

Professor: [Sabrina Lucchetti](#) email: sabrina.lucchetti@unicamillus.org

PREREQUISITES

There are no prerequisites, but it should be better if student already knows basic elements of biology, physics and chemistry

LEARNING OBJECTIVES

The Histology module aims to provide student with the skills necessary for the full understanding of the most important tissues of the human organism. The student must be able to acquire a correct terminology and develop skills of interpretation and application that, the graduate in Biomedical Laboratory Techniques, will have to use in the planning and management of work activities.

The Biology module aims at providing the students with the morphological and functional organization of prokaryotic and eukaryotic cells, focusing on both the descriptive aspects and the basic notions of biochemistry and cellular physiology required to understand the functions of the cell as a basic unit of living organisms.

The objective of the course is the learning of the constructive logic of the biological structures at the different levels of organization of living matter, the principles that govern

the functioning of the different biological systems, the learning of the experimental method and its applications to the study of biological phenomena.

Students will learn the unitary mechanisms that regulate cellular activities, gene expression and genetic material transmission.

The Anatomy module provides the student with the anatomical knowledge from a basic macroscopic point of view to understand the general organization of the human body.

The teaching objectives are the acquisition of the morphological knowledge and the topographic organization of the single systems, organs and apparatuses in order to acquire the basic notions for the subsequent integrated courses

The aim of the course of Medical Genetics is to provide to students the knowledge on the main notions on inheritance of monogenic, chromosomal and multifactorial diseases.

At the end of the course the student will be able to distinguish the main classes of genetic diseases, to recognize the modes of transmission of hereditary diseases and to describe their recurrence risk.

LEARNING OUTCOMES

Knowledge and understanding

At the end of the course the student should have acquired:

- The knowledge of the structures of the various tissues that compose the human organism
- The knowledge of the histological organization of the various human organs
- The ability to identify the morphology of the tissues, the cells that compose them, from a morphological and functional point of view
- The ability to synthesize and correlate the various topics.
- The classification principles of living organisms.
- The major structural differences between prokaryotic and eukaryotic cells.
- The knowledge of the cellular morphology.
- The knowledge the cellular compartments and their function.
- The knowledge of the general principles of cellular metabolism.
- The knowledge of the molecular basis of hereditary information.
- The knowledge of the differences between mitosis and meiosis.
- The knowledge of the location of anatomical structures in space using the appropriate terminology.
- The knowledge the structure of the organs that make up the devices studied.
- The knowledge the structural relationships between the organs of an apparatus.
- The knowledge of correct genetic terminology
- The knowledge of the main inheritance models of monogenic, chromosomal and multifactorial diseases
- The knowledge of the main biological mechanisms that cause hereditary diseases
- The knowledge of the main methods useful in genetic analysis
- The understanding of how to reconstruct family pedigrees and to calculate disease recurrence
- The understanding of the major kinds of genetic testing and their proper use.

Applying knowledge and understanding

At the end of the course the student should have acquired:

- The ability to apply the histology knowledge to understand other closely related branches of biology such as anatomy, cytology, physiology.
- the knowledge and methodological tools for the study of the biological bases of life, the knowledge of the experimental method and its applications to the study of fundamental biological phenomena
- Use the knowledge acquired for the in-depth study of aspects relating to the specific field to which the student will dedicate himself in the professional activity
- The capacity to analyse family history and to reconstruct pedigrees
- the ability to calculate disease recurrence risk

Communication skills

At the end of the course the student should:

- Use correct scientific terminology to identify, at a microscopic level, the different types of cells and tissues present in the human organism.
- to describe a biological phenomenon and demonstrate that they have learned an appropriate scientific language for the purposes of correct and rigorous communication.
- Use specific scientific terminology appropriately
- the ability to describe the main models of inheritance and the disease recurrence risk with correct use of terminology

Making judgements

At the end of the course the student should:

- Carry out rough assessments of the topics covered.
- acquire skills and methods of learning suitable for the deepening and updating of their proficiency in biology
- make general assessments of the topics covered
- have the ability to synthesize and correlate the various topics
- have a critical ability on the use of genetic tests for the molecular diagnosis of monogenic and chromosomal diseases or for the evaluation of genetic susceptibility to complex diseases

COURSE SYLLABUS

HISTOLOGY:

- PREPARATION OF TISSUES FOR HISTOLOGICAL ANALYSIS. Microscopy, preservation of biological structures, stainings.
- EPITHELIAL TISSUE. General characteristics of epithelia, junctions, polarity of epithelial cells, surface specializations, basal lamina, classification of epithelia, endothelium, absorbent epithelium, pseudostratified epithelium, transitional epithelium, epidermis, glandular epithelia (exocrine and endocrine glands).
- CONNECTIVE TISSUE. Histological organization: extracellular matrix (macromolecules of the ground substance, collagen and elastic fibers) and connective cells (fibroblasts, adipocytes, macrophages, plasma cells and mast cells). The different

types of connective proper: loose and dense (irregular and regular). The white and brown adipose tissue. Supportive connective tissues: cartilage (cells and extracellular matrix, hyaline, elastic and fibrous cartilage, growth and repair) and bone (cells and extracellular matrix, compact and spongy bone, osteogenesis, growth and repair). Blood: plasma and serum, cells (red blood cells, neutrophils, eosinophils, basophils, monocytes and lymphocytes), platelets, hematopoiesis.

Outline of the lymphatic system.

- MUSCLE TISSUE. Skeletal muscle: organization of muscle fibers, myofibrils and myofilaments, sarcomere, sarcoplasmic reticulum, neuromuscular junction, contraction mechanism, regeneration. Cardiac muscle: structure of cardiomyocytes (intercalated discs, sarcoplasmic reticulum, myofilaments), Purkinje fibers, regeneration. Smooth muscle: structure of smooth muscle cells, contractile apparatus, regeneration.
- NERVOUS TISSUE. The neuron. Myelinated and unmyelinated nerve fibers. General structure of the nerves. Synapses. Glial cells.

GENERAL AND CELLULAR BIOLOGY

- Characteristic of living cells: Cellular theory. Classification principles of living organisms.
- Cell Chemistry: Macromolecules: structure, shape and function
- Prokaryotic and eukaryotic cell models: classification and major structural differences.
- Plasma membrane: properties and functions.
- Internal organization of the cell: Cellular compartments. Cytoplasm and cytoplasmic organelles, ribosomes, smooth and rough endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes.
- The cytoskeleton. Microtubules, intermediate filaments and microfilaments. Cilia and flagella. Centrioles and centrosomes.
- Energy conversion: Glycolysis, fermentation, cellular respiration, photosynthesis. (outline). Mitochondria and Chloroplasts, structure and function.
- Nuclear envelope, nucleoli, chromatin and chromosomes. Molecular basis of hereditary information. DNA replication. DNA repair and its correlations with human pathologies.
- RNA, structure and function: Main types of cellular RNAs and differences with respect to DNA in terms of molecular size, stability and biological functions. Transcription and RNA maturation.
- Genetic Code and its properties. Protein synthesis: How cells read the genome. Main post-translational modifications of the polypeptide chains.
- Post-synthetic fate of proteins, endomembranes and membrane traffic: Endocytosis and exocytosis.
- Cell Cycle, Mitosis and Meiosis

HUMAN ANATOMY

1. HUMAN ANATOMY - GENERALITIES

- Introduction to anatomy, study of the structure of the human body, methodologies, tools and techniques of anatomical study.

2. LOCOMOTIVE APPARATUS

- Osteology: Analysis of the bones of the human body, their composition, shape, function and classification.

- Arthrology: Study of joints, including types of movement, connective tissue and cartilage.

- Myology: Description of muscles, classification, origin, insertion and function.

3. CARDIOVASCULAR SYSTEM

- Detailed description of the heart, chambers, valves, coronary arteries; structure and function of the great vessels.

4. CIRCULATORY, LYMPHATIC AND LYMPHOID ORGANS

- Exploration of circulatory systems, including blood vessels, lymphatics, lymphoid organs and immune functions.

5. RESPIRATORY SYSTEM

- Description of the respiratory tract, mechanism of respiration, structure and function of the lungs and pleurae.

6. DIGESTIVE SYSTEM

- Analysis of the digestive process, structure of the digestive organs, processes of absorption, secretion and motility.

7. URINARY SYSTEM

- Exploration of the urinary system, including the kidneys, ureters, bladder and urethra, and their role in waste filtration and elimination.

8. MALE AND FEMALE GENITAL SYSTEM

- Analysis of male and female sex organs, including gamete production, hormones and the reproductive cycle.

9. NERVOUS SYSTEM

- Exploration of the central and peripheral nervous system, neurons, synapses, motor and sensory functions, and organization of brain structures.

MEDICAL GENETICS

- Basic Genetics: Definitions of Key Terms: gene, locus, allele, genotype, phenotype, haplotype, homozygous, heterozygous, haploid, diploid, dominance, recessivity, codominance, mutation, polymorphism.
- Principles of Genetic Transmission: Mendel's Genetic Hypothesis, The Monohybrid and dihybrid Crosses, Segregation in Human Pedigrees, Blood groups Genetics
- Monogenic Inheritance Models: Autosomal inheritance, Autosomal recessive inheritance, X-linked inheritance
- Genetic Risk calculation and pedigrees. Hardy-Weinberg equilibrium
- Chromosomes: Structure and Analysis, Chromosomes Pathologies
- Genomic Imprinting and X-chromosome inactivation
- Mitochondrial inheritance: mitochondrial DNA, pattern of inheritance
- Multifactorial inheritance: polymorphisms, susceptibility genes, gene-environment interaction, association studies
- Pharmacogenomics and Personalised Medicine
- Old and new technologies in Genetics. Examples with clinical cases
- Genetic tests and Counselling. Outlines

COURSE STRUCTURE

The integrated course consists of 8 CFU, 2 CFU for each module, for a total of 80 hours. Attendance is mandatory.

The Histology course is structured in 10 hours of frontal teaching and 10 hours of lab practice (divided into lessons of 2 or 4 hours according to the academic calendar). During frontal teaching the Professor uses Power Point presentations and images of histological preparations obtained with an optical microscope and electronic and audio-visual media. In the hours of lab practice the student will be in the histology laboratory and will know the different instruments, such as microscopes, hoods, incubators, and will follow the activities of the laboratory. In the hours of lab practice the student will know laboratory instruments and techniques and will be able to observe histological preparations.

The Biology module is structured in frontal lectures, for a total of 20 hours. The teacher uses educational tools such as presentations organized in powerpoint files with explanatory diagrams, illustrations and images taken from micrographies to describe the various cellular structures and movies and animations to complement the processes described in class. The possibility of ongoing tests is provided for.

The Anatomy Teaching is structured in 20 hours of frontal teaching, divided into lessons of 2 or 3 hours according to the academic calendar. Lectures will include theoretical lessons on the topics covered.

The Genetics teaching is structured in 2 CFU with 20 hours of frontal lessons. Lectures will include theoretical lessons with power-point presentations and exercises (both in groups and alone).

COURSE GRADE DETERMINATION

The examination of the Integrated Course of Histology, Biology, Anatomy and Genetics consists of a written examination with 30 multiple choice questions for each of the module of Histology, Biology, Anatomy and Genetics, whose mark is an integral part of the evaluation of the examination of the teaching. Each correct answer corresponds to a score of +1 and the mark is expressed in thirtieths. All the contents in syllabus are subject to evaluation. The knowledge and ability to understand, the ability to apply knowledge and understanding and the autonomy of judgment will be evaluated. The grade earned by the student in each module contributes to the final score in proportion to the credits. The final grade will be assigned by the Commission, collectively.

The exam will be overall evaluated according to the following criteria:

- > < 18 Fail: important deficiencies and/or inaccuracies in the knowledge and understanding of the topics; limited capacity for analysis and synthesis, frequent generalisations.
- > 18-20: knowledge and understanding of topics just enough with possible imperfections; ability to analyze synthesis and independent judgment sufficient.
- > 21-23: knowledge and understanding of routine topics; correct analysis and synthesis skills with coherent logical argumentation.

- 24-26: good knowledge and understanding of the topics; good analytical and synthesis skills with rigorously expressed arguments.
- 27-29: complete knowledge and understanding of topics; remarkable skills of analysis, synthesis. Good autonomy of judgment.
- 30-30L: excellent level of knowledge and understanding of the topics. Remarkable capacity for analysis and synthesis and independent judgement. Arguments expressed in an original way.

OPTIONAL ACTIVITIES

HISTOLOGY In addition to the teaching activity, the student will be given the opportunity to take advantage of tutoring activities upon request.

ANATOMY In addition to the teaching activity, there are no seminars, research internships, departmental internships and monographic courses.

READING MATERIALS

The lessons will be provided to students in pdf format.

Reccomended books

HISTOLOGY:

- William Bloom, Don W. Fawcett, "Elementi di istologia", Il edizione a cura di V. Cimini, CIC Edizioni Internazionali.
- Adamo, Bernardini, Filippini, "Elementi di istologia e cenni di embriologia", Edizione 2019, Editore Piccin.

GENERAL AND CELLULAR BIOLOGY:

- Sadava, Hillis, Heller, Hacker. Elementi di Biologia e Genetica Zanichelli editore, V ed.
- Raven, Johnson, Mason, Losos, Singer. Elementi di Biologia e Genetica Piccin editore II ed.

HUMAN ANATOMY:

- Martini et al. Anatomia Umana, VII edizione - Edises;
- Seeley et al. Anatomia, II edizione - Idelson-Gnocchi
- Montagnani et al. Anatomia Umana Normale - Idelson-Gnocchi

MEDICAL GENETICS:

- Elementi di Genetica Medica, di Maurizio Clementi. Edizioni Edses
- Genetica umana. Concetti e applicazioni di Ricki Lewis. Edizioni Piccin