

Biomedical Laboratory Techniques Course

Integrated course: Histology, Human Anatomy, Cellular Biology and Genetics

SSD: BIOS-13/A, BIOS-12/A, BIOS-10/A, MEDS-01/A

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Total CFU: 8

Module: Histology

SSD: BIOS-13/A

Teacher: [Prof.ssa Federica Campolo](#)

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CFU: 2

Module: Human Anatomy

SSD: BIOS-12/A

Teacher: [Prof. Paolo Izzo](#)

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CFU: 2

Module: Cellular Biology

SSD: BIOS-10/A

Teacher: [Prof.ssa Sabrina Lucchetti](#)

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CFU: 2

Module: Genetics

SSD: MEDS-01/A

Teacher: [Prof. Antonio Novelli](#)

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CFU: 2

PRE-REQUISITES

There are no prerequisites. It would be desirable for the student to know the basic notions of biology, such as the organization and function of cells, the structure of a gene, DNA replication and the concepts of meiosis/mitosis.

LEARNING OBJECTIVES

The main educational objective of the integrated course of Histology, Human Anatomy, Cellular Biology and Genetics is to provide the student with basic knowledge of eukaryotic cells, with particular attention to the properties and functions of the cell as a basic unit of life. The student will learn the unitary mechanisms that regulate the processes and activities of the cell and the interactions between cells; the principles that govern the diversity of biological units, in relation to their structural and functional features and gene expression mechanisms. The Histology module aims to provide the student with the skills necessary for a full understanding of the primary tissues of the human organism. The student must be able to acquire a correct terminology and develop those interpretation and application skills that the graduate student in biomedical laboratory techniques must then use in the planning and management of work activities. The Human Anatomy module has as its specific training objective the acquisition of morphological knowledge and topographical organization of individual systems, organs and apparatuses in order to acquire the basic notions for subsequent integrated courses. The Cellular Biology module deals with the morphological and functional organization of prokaryotic and eukaryotic cells, taking care of both the descriptive aspects and the basic notions of biochemistry and cellular physiology necessary to

understand the functions of the cell as the basic unit of living organisms. The aim of the course is to learn the constructive logic of the fundamental biological structures at the different levels of organization of living matter, the general unitary principles that govern the functioning of the different biological units, the learning of the experimental method and its applications to the study of biological phenomena. The main educational goal of the Genetics module is to provide students with the main knowledge on the 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 describe their modes of transmission and the risk of recurrence.

LEARNING OUTCOMES

Knowledge and understanding: knowledge of the correct genetic terminology, knowledge of the main models of hereditary transmission of monogenic, chromosomal and multifactorial diseases, knowledge of the main biological mechanisms that cause hereditary diseases, knowledge of the main methods used for genetic analysis, understanding of how to construct family pedigrees and calculate the recurrence of the disease, understanding of the main types of genetic tests and their correct use, knowledge of the structures of the various tissues that constitute the human organism, knowledge of the histological organization of the different human organs, ability to identify the morphology of tissues, the cells that compose them, from a morphological and functional point of view, ability to synthesize and correlate the various topics, knowledge of the location of anatomical structures in space using the appropriate terminology, knowledge of the structure of the organs that make up the systems studied, knowledge of the structural relationships between the organs of an system, knowledge of the fundamentals of molecular and cellular biology: general and unitary principles that govern the functioning and behavior of living organisms including the mechanisms that operate in the transmission of hereditary characteristics, knowledge of the principles of classification of living beings, knowledge of the main cellular compartments and their function, knowledge of the general principles of cellular metabolism, knowledge of the molecular bases of the transmission of hereditary characteristics, knowledge of Mitosis and Meiosis processes.

Applying knowledge and understanding: the general objective of the integrated teaching of Histology, Human Anatomy, Cellular Biology and Genetics is the learning of the experimental method and its applications to the study of cells, the main tissues, organs and systems. At the end of the teaching the student will have acquired the ability to analyze family history and reconstruct pedigrees, and to calculate the risk of recurrence of the disease. He/she will also be able to apply the knowledge of histology to understand other closely related branches of biology such as anatomy and physiology. The training course aims to provide the student with the knowledge and methodological tools for the study of the biological bases of life, the learning of the experimental method and its applications to the study of fundamental biological phenomena.

Communication skills: the student will be able to adequately describe a biological phenomenon demonstrating that he/she has learned an appropriate scientific language for the purpose of correct and rigorous communication. He/she will also be able to describe the main models of inheritance and the risk of recurrence and to use correct scientific terminology to identify, at a microscopic level, the different types of cells and tissues present in the human organism.

Making judgements: At the end of the course, the student will have analyzed and learned the exemplary experiments of biology and will be able to independently develop the logical

procedures and strategies that allow to apply the experimental method and analyze and correctly interpret experimental data.

Learning ability: The student will have acquired skills and learning methods suitable for deepening and improving his/her skills in the field of biology, histology, human anatomy and medical genetics, also through the consultation of scientific literature.

COURSE SYLLABUS

HISTOLOGY

- **PREPARATION OF TISSUES FOR HISTOLOGICAL ANALYSIS.** Microscopy, preservation of biological structures, staining.
- **EPITHELIAL TISSUE.** General characteristics of epithelia, junctions, polarity of epithelial cells, surface specializations, basal lamina, classification of epithelia, endothelium, absorbent epithelia, 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 tissue proper: loose and dense (irregular and regular). White and brown adipose tissue. Supporting connective tissue: 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. Notes on 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 nerves. Synapses. Glial cells.

HUMAN ANATOMY

- **GENERALITIES:** Introduction to anatomy, study of the structure of the human body, methodologies, tools and techniques of anatomical study.
- **LOCOMOTOR SYSTEM:** Osteology: Analysis of the bones of the human body, their composition, shape, function and classification. Arthrology: Study of the joints, including types of movement, connective tissue and cartilage. Myology: Description of the muscles, classification, origin, insertion and function.
- **CARDIOVASCULAR SYSTEM:** Detailed description of the heart, chambers, valves, coronary arteries; structure and function of the large vessels.
- **CIRCULATORY SYSTEM, LYMPHATIC AND LYMPHOID ORGANS:** Exploration of the circulatory systems, including blood vessels, lymphatics, lymphoid organs and immune functions.
- **RESPIRATORY SYSTEM:** Description of the respiratory tract, mechanism of breathing, structure and function of the lungs and pleurae.
- **DIGESTIVE SYSTEM:** Analysis of the digestive process, structure of the digestive organs, absorption processes, secretion and motility.

- URINARY SYSTEM: Exploration of the urinary system, including the kidneys, ureters, bladder and urethra, and their role in filtering and eliminating waste.
- MALE AND FEMALE GENITAL SYSTEM: Analysis of the male and female sexual organs, including the production of gametes, hormones and the reproductive cycle.
- NERVOUS SYSTEM: Exploration of the central and peripheral nervous system, neurons, synapses, motor and sensory functions, and organization of brain structures.

BIOLOGY

- Properties and classification of living organisms.
- Cell theory, principles of classification and levels of organization of living matter.
- The cell as the basic unit of life.
- General characteristics of prokaryotic and eukaryotic cells, organization and differences.
- Macromolecules of biological interest. Role of water in the chemistry of life, carbohydrates, lipids, elements of structure and function of proteins and nucleic acids.
- Biological membranes. Structure and function
- 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.
- Notes on energy metabolism. Glycolysis, fermentation, cellular respiration, photosynthesis. Relationship between energy conversion processes and cellular structures. Mitochondria and chloroplasts.
- The nucleus. Nuclear envelope, nucleoli, chromatin and chromosomes
- Molecular bases of hereditary information. DNA structure and function. DNA repair and its correlations with human pathologies.
- RNA structure and function. The main types of cellular RNA, differences from DNA in terms of size, shape and biological function. Transcription and maturation of eukaryotic RNAs.
- Genetic code and translation. Reading and interpretation of the genetic code, protein synthesis and post-synthetic fate of proteins.
- Endomembranes and vesicular traffic. Exocytosis and Endocytosis
- Cell cycle, Mitosis and Meiosis.

GENETICS

- Basic concepts and terminology: gene, locus, allele, genotype, phenotype, haplotype, homozygous, heterozygous, haploid, diploid, dominance, recessiveness, codominance, mutation, polymorphism.
- Mendel's laws. Dominant and recessive traits
- Genetics of the main blood groups (ABO, Rh). Maternal-fetal incompatibility
- Transmission models of Mendelian (or monogenic) traits: autosomal recessive and dominant inheritance, sex-linked recessive and dominant inheritance.
- Risk calculations related to the aforementioned models and analysis of family trees. HW equilibrium.
- Concepts of penetrance, expressivity, epistasis, anticipation, consanguinity, genetic heterogeneity
- Chromosomes: structure and characteristics. Anomalies in the number and structure of chromosomes
- Genomic imprinting.
- X chromosome inactivation

- Mitochondrial inheritance
- Multifactorial inheritance. Inter-individual genetic variability. Association studies.
- Introduction to Pharmacogenetics and the Concept of Personalized Medicine
- Old and new methods for the study of Genetics: examples with clinical cases
- Genetic tests and their applications. Introduction to Genetic Counseling.

COURSE ORGANIZATION

Course attendance is mandatory. There is the possibility of ongoing tests.

The HISTOLOGY module is structured in 10 hours of classroom teaching and 10 hours of exercises (divided into lessons of 2 or 4 hours based on the academic calendar). During classroom teaching, the teacher uses Power Point presentations and uses images of histological preparations obtained with the optical and electronic microscope and audiovisual supports. During the hours of exercises, the student will learn about various laboratory instruments and techniques and will be able to observe histological preparations.

The ANATOMY module is structured in 20 hours of classroom teaching, divided into lessons of 2 or 3 hours based on the academic calendar. The classroom teaching includes theoretical lessons on the topics covered.

The BIOLOGY module is structured in 20 hours of classroom teaching, divided into lessons of 2 or 3 hours based on the academic calendar. The teacher uses teaching tools such as presentations organized in PowerPoint files with explanatory diagrams, illustrations and images taken from micrographs to describe the various cellular structures and films and animations to integrate the processes described in class.

The GENETICS module consists of 2 CFU and 20 hours of frontal lessons. The lessons include both theory lessons with PowerPoint presentations and interactive lessons with the completion of exercises in class (both individual and group).

LEARNING ASSESSMENT

The exam for the Integrated Course of Histology, Biology, Anatomy and Genetics consists of a written exam with 30 multiple choice questions for each of the modules of Histology, Biology, Anatomy and Genetics, the grade of which is an integral part of the evaluation of the exam of the teaching. Each correct answer corresponds to a score of +1 and the grade is expressed in thirtieths. All the contents indicated in the teaching programs are the subject of evaluation.

Knowledge and understanding, the ability to apply knowledge and understanding and independent judgment will be evaluated. The grade achieved by the student in each module contributes to the final score in proportion to the CFU. The final grade will be assigned by the Commission, collegially. The exam will be evaluated overall according to the following criteria:

- Not suitable: important deficiencies and/or inaccuracies in knowledge and understanding of the topics; limited analysis and synthesis skills, frequent generalizations.
- 18-20: knowledge and understanding of the topics just sufficient with possible imperfections; sufficient analysis, synthesis and independent judgment skills.
- 21-23: knowledge and understanding of routine topics; correct analysis and synthesis skills with coherent logical argumentation.
- 24-26: fair knowledge and understanding of topics; good analysis and synthesis skills with arguments expressed in a rigorous manner.
- 27-29: complete knowledge and understanding of topics; notable analysis and synthesis skills. Good independent judgment.

➤ 30-30L: excellent level of knowledge and understanding of topics. Notable analysis and synthesis skills and independent judgment. Arguments expressed in an original manner.

LEARNING SUPPORT

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

RECOMMENDED BOOKS

The lessons will be provided to students in pdf format.

Suggested books:

HISTOLOGY:

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

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

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 edizione

GENETICS:

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