LIFE OF CELLS, TISSUES AND MICROBES (A001938)

1. language

English

2. course contents

Coordinator: Prof. SANGUINETTI MAURIZIO
Year Course: I
Semester: 1st semester
CFU/UFC: 10
Modules and lecturers:
- CELLULAR BIOLOGY 1 (MZ000052) – 3 CFU - SSD BIO/13 Prof. Ornella Parolini, Prof. Andrea Papait
- CELLULAR BIOLOGY PRACTICALS (MZ000053) – 0,50 CFU - SSD BIO/13 Prof. Andrea Papait
- GENERAL MICROBIOLOGY (MZ000054) – 2 CFU - SSD MED/07: Prof. Maurizio Sanguinetti, Prof. Margherita Cacaci
- GENERAL MICROBIOLOGY PRACTICALS (MZ000055) – 0,50 CFU - SSD MED/07: Prof. Ivana Palucci, Prof. Margherita Cacaci
- GENERAL HISTOLOGY/EMBRIOLOGY (MZ000056) – 2 CFU - SSD BIO/17 Prof. Luca Tamagnone, Prof. Ilaria Marrocco, Prof. Luigi Balasco
- GENERAL HISTOLOGY/EMBRIOLOGY PRACTICALS (MZ000057) – 1 CFU - SSD BIO/17 Prof. Luigi Balasco
- PHYSIOLOGY EXCITABLE CELLS (MZ000058) – 1 CFU - SSD BIO/09 Prof. Cristian Ripoli

BIBLIOGRAPHY

CELLULAR BIOLOGY I

Karp G, "Cell and Molecular Biology – Concepts and Experiments" 8th edition (or latest available), Wiley, 2016 (or latest available)

For additional consultation: Alberts B, et al. Essential Cell Biology, 5th edition (or latest available), Garland Science - Taylor & Francis Group, 2013 (or latest available).

PHYSIOLOGY OF EXCITABLES CELLS

Walter F. Boron; Emil L. Boulpaep. "Medical Physiology", 2nd Edition Elsevier. ISBN: 978-1-4377-1753-2; ISBN: 978-0-8089-2449-4;

Eric R. Kandel, James H. Schwartz, Thomas M. Jessell, Steven A. Siegelbaum, A. J. Hudspeth "Principles of Neural Science" 5th edition - McGraw-Hill - ISBN: 978-0-07-139011-8

GENERAL MICROBIOLOGY

Madigan MT, et al. "Brock Biology of Microorganisms" 13th edition - Pearson Global Edition.

Murray PR, Rosenthal KS, Pfaller MA. Medical Microbiology. 10th ed. Elsevier; 2025. ISBN: 978-0443261336

HISTOLOGY AND GENERAL EMBRYOLOGY

Wojciech Pawlina, "Histology- A Text and Atlas with Correlated Cell and Molecular Biology", 7th , 8th or 9th edition, Wolters Kluwer.

- *For additional consultation: Young, B and others - Wheather's Functional Histology, Churchill Livingstone Elsevier, 2013.*

Moore, KL – Persaud, TVN – Torchia, MG. "The Developing Human. Clinically Oriented Embryology", 9th edition, Elsevier Saunders 2012.

Or, as an alternative: Shoenwolf, GC and others – "Larsen's Human Embryology", Churchill Livingston, 2008.

Additional material (i.e. scientific articles and appropriate electronic sources) will be also provided by the instructors to complete, elaborate and update the contents discussed in each module.

4. LEARNING OBJECTIVES

The whole course is aimed at giving the student a sound understanding of the structures and functions of cells, of the intercellular communications and organization into human tissues, of the basic biology of microorganisms and of their translational relevance.
The course comprises highly integrated teaching modules, having the following specific aims: illustrating the mechanical, morphological and functional properties of cells; describing the mutual interaction occurring between different biomolecules inside the main cell compartments or between cells inside different tissues and organs; describing the basic molecular mechanisms acting inside the cells and mediating their interactions with the external environment; characterizing the interaction between human cells and different microorganisms such as virus and bacteria; describing the basics of cell physiology, with specific regards to the ionic and molecular mechanisms underlying remarkable properties of excitable cells, such as the action potential and synaptic transmission.
At the end of the integrated course the student must demonstrate that he/she has fulfilled the following objectives:

***Knowledge and understanding abilities** – demonstrate the know-how on the different levels of organization of living matter and cellular structures, the main cellular functions and the basic physiological mechanisms, embryo formation, the organization of tissues, and the general concepts of microbiology and of bacterial pathogeny.*

***Applied knowledge and understanding skills** – demonstrate to adequately interpret the importance of knowledge of the mechanisms underlying the organization of higher organisms and their interactions with pathogenic microorganisms, in order to understand the relative applicative implications of the basic biomedical sciences in the diagnostic and therapeutic field.*

***Personal judgement** – the student must properly integrate the knowledge and skills learned to develop autonomous abilities to identify the fundamental structures for the organization of cells and tissues and the associated physiological mechanisms, relevant for the application in the medical field.*

***Communication skills** – be able to communicate scientific and applicative content in a clear and unambiguously way, using an appropriate technical language and explaining their personal conclusions, as well as the knowledge and rationale underlying them, to specialists and non-specialist interlocutors.*

***Learning ability** – be able to keep up-to-date and expand their knowledge by autonomously drawing on scientific texts and articles, and scientific databases (NCBI/PubMed, MedLine, etc).*

5. prerequisites

Knowledge of high school mathematics, chemistry, and biology is recommended, as they are vital for understanding most of the topics taught in the course's modules.

6. TEACHING METHODS

The course is organized into lectures and practical sessions covering the topics included in all the teaching modules to provide the basic elements of Cell Biology, Electrophysiology, General Microbiology, Histology and Embryology. The teaching methods implement active learning activities, such as problem-based learning, self-learning, case studies, flipped classrooms, and experimental activities.
The adopted teaching methods allow students to pursue the learning objectives:

***Knowledge and understanding** – all the topics listed in the program will be treated during frontal lectures and carefully explained with tutorials and exhaustive explanations, in order to provide the students with the appropriate knowledge and learning methods.*

***Applied knowledge and understanding** – the interactive teaching methods, including "case study", practical examples and laboratory practice exercises, and light microscopy training sessions, will allow students to learn the applicative potential of the treated topics.*

***Making judgements** – the active learning modalities will enable students to independently formulate ideas and use critical reasoning.*

***Communication skills** – the active learning modalities will stimulate active and constant interaction with the instructors, towards the progressive development of focused communication skills for the presentation of treated topics through a correct scientific language.*

***Learning skills** – additional material (i.e. scientific articles and appropriate telematics sources) will support students in their individual and autonomous study.*

Should the instructors deem it necessary, a limited amount of lectures could be performed online in live streaming sessions using the web platform (Blackboard) in use at the Università Cattolica S. Cuore. This may apply to any unpredictable emergency that may prevent the standard teaching delivery methods.

7. OTHER INFORMATIONS

The instructors are available for further clarifications and discussions regarding the learning modules' topics and any possible related issue, also beside the classes timetable by appointment previously arranged by e-mail communication.
Please DO NOT refer to instructors for seeking technical assistance on class attendance or exam registration as they could not help with these issues, which are rather to be checked with the administrative offices.
To arrange an appointment, you can contact them by email:

GENERAL MICROBIOLOGY

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PHYSIOLOGY EXCITABLE CELLS

Prof Cristian Ripoli *cristian.ripoli@unicatt.it*

NOTE ON STUDENTS' RESPONSIBILITY

The responsibility for learning falls increasingly on students, as they advance through the course; hence, ultimately, the commitment and the dedication to learn must come from them. As members of the Università Cattolica S. Cuore learning community, students are expected to respect the intellectual property of course instructors. All course materials presented to students are the copyrighted property of the course instructors and are subject to the following conditions of use:

1) Students may not record nor reproduce lectures or any other classroom activities, unless differently specified by the instructor; however, they may use the recordings for their own course related purposes only.

2) Students may not reproduce and/or post any course material provided by the instructors online or distribute them without the advance written permission of the course instructor and, if applicable, of any students whose voice or image is included in the recordings. 3) Any students violating the conditions described above may face academic disciplinary sanctions. As members of a learning community, students are expected to respect the time and efforts of their fellow classmates. Therefore, the use of social media and other electronic distractions that can disrupt the concentration of other students in the classroom is NOT allowed.

NOTE ON ACADEMIC INTEGRITY AND CHEATING POLICY

The principles of truth and honesty are fundamental to the educational process and the academic integrity of the University. All students have a right to expect fair and honest evaluation of their work. CHEATING UNDERMINES THIS EXPECTATION AND WILL NOT BE TOLERATED. Students must avoid the following misconduct behaviors that are considered as cheating:

DO NOT exchange ID badges to collect presence among classmates who cannot attend a lecture.

DO NOT share answers of quizzes during exams.

Any student found by the instructors to be cheating will receive a failing grade for the exam or other graded work, and will be reported to the Course's Coordinator and Instructors' Committee. The instructors may, at their discretion, decide to give a failing grade for the course in severe cases of academic dishonesty.

8. METHODS FOR VERIFYING LEARNING AND FOR EVALUATION

The final examination consists of a written test and, when required, an oral recovery exam.
1. Written Test
The written test evaluates all four modules of the course and is composed of:
16 multiple-choice questions for each topic
Only one correct answer per question

Each module contributes proportionally to the total number of questions.
The assessment of Histology competences will also include a preliminary test at the microscope, analyzing one of the specimens illustrated during the professional training. This practical test is mandatory. It will be scheduled at the end of the Histology Practicals series and will contribute 40% to the final Histology/Embryology score, with the remaining 60% derived from the subsequent MCQ; the practical test can be repeated before a following exam date in case of unsatisfactory results.

Scoring

- *Correct answer: +1 point*
- *Wrong or blank answer: 0 points*

The written test is scored on a 30-point scale (minimum passing grade: 18/30).
Top grades (30/30 or 30/30 with honors) are assigned exclusively to tests without errors.

2. Recovery by Oral Examination (if needed)

If a student does not achieve a sufficient score in one single module, they may take an oral examination limited to that module in order to recover it.
The oral examination is not required for students who pass all modules through the written test.

Evaluation Objectives
The exam assesses the following learning outcomes:
Knowledge and understanding of key concepts from all modules.
Applied knowledge, including interpretation of histological slides (Histology module).
Ability to integrate information across different areas of the course.
Accuracy and clarity in scientific reasoning and communication.

9. program

< CELLULAR BIOLOGY I>
The concept of biological order applied to living organisms. Prokaryotes and eukaryotes. Autotrophs and heterotrophs. Structure and function of biological molecules. Cell theory and basic properties of cells. General structure of the eukaryotic cell. Structure and function of the plasma membrane. Transport across cell membranes. The extracellular matrix. Cell-cell and cell-extracellular matrix interactions. Structure and function of the mitochondria. Energy metabolism. Structure and function of the endomembrane system: rough endoplasmic reticulum and smooth endoplasmic reticulum; Golgi apparatus; transport vesicles; lysosomes; peroxisomes. Endocytosis, exocytosis, vesicles transport. The cytoskeleton and its functions: cellular motility, cellular contractility, intracellular transport, the axoneme structure in cilia and flagella, structure and properties of the primary cilium. The nucleus: nuclear envelope, nuclear lamina, nuclear pore

complex, nucleolus, DNA assembly into chromatin and chromosomes. The cell cycle and its regulation. Meiosis and mitosis. Cell death mechanisms. INSIGHT: Cellular biology in medicine: stem cells and regenerative medicine.

< CELLULAR BIOLOGY PRACTICALS>

This module is entirely based on laboratory practice exercises to implement selected topics:
1) Cell cycle and its regulation: analysis of microscope slides on mitosis and meiosis;
2) Basic cell culture techniques;
3) in-vitro differentiation assay of mesenchymal stromal cells culture and morphological staining of differentiated cells;

< HISTOLOGY AND GENERAL EMBRYOLOGY>

Histology: *From Cells to Tissues, Organs and Systems. Overview of methods applied for studying differentiated cells and tissues. Introduction to light microscopy and other optical systems; electronic microscopy; atomic force microscopy. Histochemistry and cytochemistry. Immunocytochemistry and hybridization techniques. Organ and tissue cultures. Mechanisms of cell differentiation and histogenesis. Tissue organization and maintenance. Stem cells and their niche. General characteristics of the tissues, their classification and identification. Epithelial tissues: simple and stratified lining epithelia; apical, lateral and basal domain specializations, glandular epithelia. Connective tissues: connective tissue proper; extracellular matrix, fibers and cells. Adipose tissue. Blood: plasma, red blood cells, leucocytes, platelets. Bone marrow and hematopoiesis. General organization of nerve tissue. Clinical correlations with defects in tissue differentiation and homeostasis.*

General Embryology. *Gametes: features and requirements for fertilization, sperm capacitation, acrosome reaction. Fertilization, molecular events in fertilization. The zygote. Events of the first, second and third week of development and early embryonic differentiation. Blastomeres, morula, compaction, trophoblast and inner cell mass, blastocyst. Embryo implantation in uterus, syncytiotrophoblast differentiation, chorionic villi development. Hypoblast and epiblast, amniotic cavity and yolk sac formation and maturation, extraembryonic mesoderm, blood islands. Gastrulation and formation of the three germ layers (ectoderm, mesoderm, endoderm) and their derivatives: notochord, neural tube and neural crest, somites. Morphogens. Embryo folding, coelomic cavity, primitive gut formation.*

<HISTOLOGY PRACTICALS>

Practical training in the use of light microscope, aimed at providing insights for a better understanding of histological aspects illustrated during lessons, as well as the acquisition of a professional competence for the analysis of tissue and cell samples of medical relevance. In particular, it will be given an overview of main histological methods applied in research and clinical fields, with focus on specimen preparation and stainings used to study different tissues, cells, and subcellular elements. By the examination of diverse specimens (such as: skin, trachea, lung, small intestine, blood smear, etc.), the students will be guided to understand the typical features and organization of epithelial and connective tissues in the context of different organs, identify blood components, and correlate structure with function, at cellular and tissue level.

<GENERAL MICROBIOLOGY *>*

Introduction to the microbial world through an historical perspective. Bacterial cell structure and functions. Specialized structures (peptidoglycan, flagella, pili, endospores). Bacterial growth, replication and survival; general concepts on bacterial metabolism; Fungi: general features on structure and function; classification; Viruses: general features on structure and function; replication and cultivation; classification; Phages: biology and applications. Bacterial genetics; Recombination, horizontal gene transfer and sources of genetic variability. The plasticity of bacterial genomes; Microbes, evolution and the tree of life.

<GENERAL MICROBIOLOGY PRACTICALS>

Culturing, counting and detecting bacteria; Gram staining; the skin microbiota: assessing activity of hand disinfectants; Gram staining and microscopical analysis of bacteria; Microscopical analysis of biological samples; Microscopical analysis of fungi.

<PHYSIOLOGY OF EXCITABLE CELLS>

Ionic channels and transporters. Resting membrane potential. Local electrical signal: passive electrical proprieties of excitable cells. Voltage-dependent membrane permeability. Propagated electrical signals: the action potential. Synaptic transmission: overview, neurotransmitters, neurotransmitter release, receptors and neurotransmitter transporters, postsynaptic potentials, synaptic integration Molecular signaling within the neurons. Neuromuscular junction.