UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Istituzioni di Biologia

2526-1-E0202Q047

Aims

The course aims to provide the student with the basic knowledge of the eukaryotic cell from a morpho-functional and ultrastructural point of view, the structural and functional properties of differentiated animal cells and their association modalities in tissue formation. The teaching also includes hints on the mechanisms of biological evolution as a unifying theory of biology.
The lectures are complemented by laboratory activity in which the use of the optical microscope will allow to observe histological preparations in order to acquire skills in the recognition of different tissues and their associations in relation to the functions of the tissues themselves.
The goals to be achieved are:
1-Knowledge and understanding.
At the end of the course the student will have to know the relationships between the molecular, cellular, tissue and organological levels in animal biology; must know the structure and function of the components of the eukaryotic cell and animal tissues and the basic use of the optical microscope; he will have to know the biological basis and the main mechanisms of evolution; must be able to understand the biological terminology related to these disciplines.

2-Applying knowledge and comprehension
At the end of the course the student will gain the ability to apply the knowledge acquired in point 1 to recognize cellular organelles in electron microscopy images; will be able to use an optical microscope and recognize the main tissues; will be able to understand the information obtained from two-dimensional images to reconstruct three-dimensional structures.

3-Making judgments
At the end of the course the student will have to prove autonomous in the choice of the criteria and the appropriate method for the analysis of specific structural aspects of the cell and of the tissues; he will have to identify the incontrovertible aspects of evolution; must be able to identify key concepts in cell byology, synthesize and exemplify them; will be able to consciously use the textbook and virtual resources to develop insights independently. The development of these skills will involve teacher-guided exercises and self-assessment tests.

4-Communication skills
At the end of the course, the student will have developed the ability to describe and represent the morpho-functional aspects of cells and tissues in a clear and rigorous way by appropriately using biological terminology.

5-Learning skills
At the end of the course the student will be able to consult the literature on the topics covered; will be able to analyze, apply, integrate and connect the knowledge acquired with what will be learned in the subsequent courses of the study plan.

Contents

Cytology:
1. Introduction to the study of cytology
2. The chemical basis of living matter
3. The plasma membrane
4. The cytoplasm
5. The nucleus
Elements of Biological Evolution
Tutorial Activities: Principles of Histology
1. Epithelial tissues
2. Proper and specialized connective tissues
3. Muscle tissues
4. Nervous tissue

Detailed program

Cytology
1-*Introduction to the study of cytology*
Hierarchy and complexity of biological organization. The cell as a fundamental unit of living organisms. Morphology and general organization of the prokaryotic cell and of the animal and plant eukaryotic cell. Orders of magnitude, units of measurement and resolution limits. Microscopic techniques for the study of cells and tissues.
2-The chemical basis of living matter
Structure and function of biological macromolecules (sugars, lipids, proteins, nucleic acids).
3-The plasma membrane
Properties and functions. Molecular composition and architecture: the fluid mosaic and lipid raft model; permeability and membrane transport mechanisms: simple diffusion, osmosis, passive and active transport, carrier proteins and membrane pumps, ion channels, membrane potential. Receptors, cell-to-cell communication and signal transduction. Specialization of the plasma membrane: microvilli, cilia and flagella, glycocalyx, cellular junctions (tight, adherent, desmosomes and communicating), extracellular matrix and cell-matrix interactions (focal contacts and hemidesmosomes).
4-The cytoplasm
Composition of the cytosol, ribosomes and polyribosomes. Endomembrane system and compartmentalization in eukaryotic cells: rough and smooth endoplasmic reticulum, Golgi apparatus, vesicular trafficking and protein coatings, lysosomes, endocytosis and exocytosis. Peroxisomes, mitochondria and chloroplasts. The cytoskeleton: structure and function of microtubules, centrosome and MTOC, model of dynamic instability, microtubular motors, ultrastructure of the axonema in cilia and flagella; structure and function of microfilaments, assembly and disassembly, interactions of actin filaments with myosin and actin-binding proteins in muscle and non-muscle cells; structure and function of intermediate filaments. Relationship between cytoskeleton and other cellular structures.
5-The nucleus

Structure of the interphase nucleus. Nuclear envelope and nuclear pores. Exchanges between nucleus and cytoplasm. Nucleolus. Chromatin structure. Constitutive and facultative heterochromatin. Metaphasic chromosomes and karyotype. Notes on the structure and function of the main RNAs. Genetic code. Introduction to DNA duplication, transcription and translation of genetic information. The cell cycle phases. Phase M: mitosis and cytokinesis. Sexual reproduction: somatic cells and germ cells. Meiosis, gametogenesis and gamete structure.

Principles of Biological Evolution

Panorama of living forms. Systematic categories. Genotype, phenotype, fitness, natural and artificial selection. Analogy and homology. Coevolution, mimetism. Hardy-Weinberg's principle. Mutations, genetic drift. Evolutionary meaning of sexual reproduction. Speciation. Molecular evolution. The historical evidence of evolution. Lamarckism, Darwinism, neo-Darwinism. Gradualism and punctuated equilibrium.

Tutorial activities: Principles of Histology

1-*Epithelial tissues*

Structural and functional classification of epithelia, morpho-functional polarity of epithelial cells; basement membrane. Coating epithelia. Glandular epithelia.

2-*Proper and specialized connective tissues *

Connective tissues proper: Own and migrating cells; extracellular matrix: biosynthesis and organization of extracellular components. Functions. Loose and dense fibrous connective tissue, reticular, elastic and adipose tissues. Supportive connective tissues: cartilage; spongy and compact bone tissue: mechanical functions and metabolic homeostasis, ossification. bone growth and rehash. Blood: Plasma and figurative elements.

3-Muscle tissues

Skeletal striated muscle tissue: histological organization, ultrastructural bases of muscle contraction. Cardiac striated muscle tissue: structural and ultrastructural organization, intercalary discs. Smooth muscle tissue: histological organization, distribution and functions.

4-Nervous tissue

Elements of general organization of the nervous system. Neuron structure and glia cells.

Prerequisites

Background: basic knowledge of biology acquired in secondary school.
Prerequisites: none

Teaching form

28 lessons of 2 hours each delivered in-person in an instructional mode (Didattica erogativa, DE), focused on the presentation and illustration of content, concepts, and scientific principles. These lessons also include interactive teaching moments (DI) based on brief interventions by the participants upon the instructor's requests, clarifications for questions, and short in-progress assessments not subject to evaluation, aimed at personally verifying learning.
5 practice activities of 2 hours each, conducted in an instructional mode (DE)(1 hour), (total DE 5 hours) during the first part, aimed at establishing the theoretical foundations of the activity and engaging students interactively (Didattica interattiva, DI) in the subsequent part(1 hour), (total DI 5 hours), in which participants will be guided to learn how to use the optical microscope and to acquire skills in observing and recognizing histological preparations.. **All activities are conducted in person**.

Language of instruction: Italian

Textbook and teaching resource

Learning material (slides of the lessons and scientific videos) wil be available on the course Moodle page.
The video recordings of the lectures will be provided for synchronous useas a study support .
Self-assessment test provided by the textbook publishers will also be made available on the course' Moodle page.
Websites will be suggested as a guide to tissue recognition in histological sections.

Recommended textbooks equipped with digital resources supplied by the editors.
Students can choose among the following options:

- Citologia e Istologia. I. Dalle Donne, S. Beninati, P. Bonfanti et al. EdiSES 2019
- Biologia cellulare e molecolare. Concetti ed esperimenti. G. Karp. EdiSes and Istologia ed elementi di anatomia microscopica - Dalle Donne et al., EdiSES. II edizione
- L'essenziale di biologia molecolare della cellula. Alberts B., et al. Zanichelli and Istologia ed elementi di anatomia microscopica - Dalle Donne et al., EdiSES. II edizione
  Beker: Il mondo della cellula - 10Ed. - Hardin, Lodolce- Pearson and Istologia ed elementi di anatomia microscopica - Dalle Donne et al., EdiSES. II edizione
  For Evolution topics: Biologia Evoluzionistica e biodiversità. S.L. Wolfe et al. Ed. EdiSEs

Semester

First semester

Assessment method

Written test with mandatory oral examination.

The **written test** aims to extensively assess your preparation on the exam program, verify the knowledge of the specific terminology, the basic concepts of the topics covered in the course, and the ability to recognize tissues in images of histological preparations. It is conducted in person via the Moodle platform "online exams" in a University computer lab and consists of a multiple-choice test (Types: True/False, Matching, Multiple Choice, Multiple Answers, Completion). The exam evaluation will be immediately visible to the student upon completion of the test. Access to the oral exam is only granted after passing the written test with a grade of at least 18 out of 30.

The **oral exam** consists of an interview on the topics covered in class, aimed at assessing the ability to re-elaborate, connect different topics, communicate clearly, and demonstrate linguistic propriety. The oral exam will be held in the days following the written exam according to a schedule published on the course's e-learning page, along with the written test results.

The **final grade for the exam**, expressed out of 30, will not be based on the arithmetic mean of the written and oral assessments; instead, 70% of the final grade will be weighted according to the grade achieved in the oral exam.

No in-progress exams are scheduled.

Office hours

Contact: on demand, upon request by mail to lecturer (patrizia.bonfanti@unimib.it)

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION | LIFE ON LAND