UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Integrated Physiology:from Cells To Systems

2526-1-F0902D005

Aims

Knowledge and Understanding At the end of the course, the student will be able to:

1. Describe in depth the cellular and systemic physiological mechanisms, understanding how different organs cooperate to maintain the body's homeostasis.
2. Analyze the functional interactions between systems (cardiovascular, respiratory, renal, endocrine, nervous, etc.) under physiological conditions and in response to internal or external stimuli.
3. Understand the molecular and biochemical bases of physiological functions, with particular reference to regulatory signals, intercellular communication, and adaptation processes.
4. Interpret early signs of dysfunction and describe the continuum between normal physiology and the initial pathophysiological changes.

Applying Knowledge and Understanding The student will be able to:

1. Apply integrated models to interpret system functions in complex, dynamic, and real-life conditions.
2. Recognize and analyze compensatory mechanisms and early functional alterations that indicate a transition toward pathophysiology.
3. Use a translational biomedical approach, integrating concepts of experimental physiology with clinical and preclinical scenarios.

Judgment Autonomy The student will develop the ability to:

1. Formulate physiological and pathophysiological hypotheses based on evidence, interpreting both quantitative and qualitative data.
2. Critically assess the integration and consistency of information from various sources (biological, clinical, environmental).
3. Formulate independent evaluations of adaptive mechanisms and functional deviations that precede pathology.

Communication Skills The student will be able to:

1. Effectively communicate physiological knowledge and its pathophysiological implications using appropriate technical language, both in written and oral form.
2. Use digital tools, graphics, and experimental data to illustrate integrated functional models.
3. Actively participate in interdisciplinary discussions, clearly and concisely presenting complex concepts.

Learning Skills The student will be able to:

1. Plan autonomous learning strategies to update and deepen physiological knowledge in line with advances in biomedical research.
2. Connect the course content with related disciplines (pathology, pharmacology).
3. Recognize their own learning needs and identify the most appropriate and up-to-date information sources.ement for self-directed learning; make effective use of available resources to search for, identify, and select health-related information, and critically evaluate content and sources.

Contents

The student will be guided through a biomedical and systemic analysis of the main cellular functions and the interaction between various body systems (e.g., cardiovascular, respiratory, endocrine, digestive, musculoskeletal, and nervous), with an in-depth focus on key functional aspects selected for their clinical and pathophysiological relevance. Regulatory mechanisms (e.g., hormonal feedback, autonomic control, inflammatory responses, etc.) and their integration across systems will be explored in detail, including responses to physiological stress or changing environmental conditions.
Through case studies, analysis of physiological data, and discussion of borderline situations between health and disease, the course will encourage a critical and integrated perspective on biological function, promoting the development of physiological thinking oriented toward translational medicine and clinical practice.
Furthermore, the course will emphasize the impact of aging on physiology and the effects related to gender differences.

Detailed program

The course explores in depth the functioning of transporters and ion channels located on the plasma membrane under both physiological and pathophysiological conditions.

In the neuromuscular context, the course will cover in detail the neuromuscular junction and its mechanism.
In the muscular context, it will address the differences in contraction and relaxation mechanisms between skeletal and smooth muscle.
In the cardiovascular system, the course will focus on excitation-contraction coupling, including its differences compared to skeletal muscle.
In the respiratory system, the course will discuss the pathophysiological evolution of interstitial and pulmonary edema.
In the renal system, the course will cover the endocrine functions of the kidneys, their role in maintaining blood pH and blood volume, and their connection to blood pressure regulation.
In the gastrointestinal system, topics will include chemical senses and salivary secretion.

The teaching section led by Dr. Melgari will focus on:

- Ion channels and cellular electrophysiology techniques

- Cardiac action potential and hERG channels (function and pharmacology)
- Ion channels in sensory organs (vision)
- Advanced imaging techniques in cellular physiology
- Techniques for studying cellular bioelectrical activity

Prerequisites

Knowledge of the introductory courses indicated in the guidance of the degree course

Teaching form

Lectures will be held in presence. Specifically, 44 hours will be lecture-based and 8 hours will be interactive

Textbook and teaching resource

Some text book are suggested, stated that the student can use the text book that best allow him to form a solid knowledge of the subject, and that cannot be blocked by any of the texts listed below.

L. SHERWOOD, Fondamenti di Fisiologia Umana, Piccin

R. KLINKE, H.C. PAPE, A: KURTZ, S. SILBERNAGL, Fisiologia, EdiSES

A.C. GUYTON & J.E. HALL, Trattato di Fisiologia medica, Piccin

D.U. SILVERTHORN, Fisiologia, Un approccio integrato, Casa Editrice Ambrosiana

W.J. GERMAN & C.L. STANFIELD, Fisiologia Umana, EdiSES

Reviews or scientific papers recommended by the Professor During Lectures

Semester

First Semester

Assessment method

The exam consists in an written test. Open questions will be posed to the student in order to evaluate the general knowledge of the topics. Moreover, the student will be asked to answer to questions that require the analysis of a complex phenomenon, its rationalization and the application of specific physiology principles and to solve simple exercises. Finally, a clinical case may be presented which will require the analysis of the interconnections between

different physiological variables in the light of the theoretical paradigms.

Office hours

The professors receive the students by appoinment agreed upon e-mail
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dario.melgari@unimib.it

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION | GENDER EQUALITY