UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Integrated Physiology:from Cells To Systems

2425-1-F0901D044

Aims

The course aims to provide a solid understanding of basic cellular functions, including membrane transport processes and cellular signaling. Furthermore, it seeks to explore how cells interact with each other and their surrounding environment to form functional tissues, with particular attention to cellular communication and physiological regulation. The main systems of the human body (cardiovascular, respiratory, digestive, endocrine, and musculoskeletal) will be examined, understanding their functions and interactions. The course will also analyze how different physiological systems work in an integrated manner to maintain homeostasis and respond to environmental and physiological stresses. An additional objective is to delve into the molecular bases underlying physiological functions, including the study of genes, proteins, and biochemical mechanisms.

Contents

The course provides the student with the in-depth knowledge concerning the processes of integration between cell, tissue and organ, related to the human vital functions. It analyzes the mechanisms inherent to cardiovascular, respiratory, renal and endocrine system activity. During the course, the effects of the aging process on physiology and the effects due to gender differences will be emphasized.

Detailed program

The course explores the issues related to the functioning of transporters and ion channels present on the plasma membrane in physiological and pathophysiological conditions

Cardiovascular system. Myocardium. Electrical activity of the heart: the cardiac action potential; automatism in the heart. Frequency adjustment in the heart. The heart as a pump. Control of cardiac output. Hemodynamics. The

arterial system: arterial pressure and its control. Microcirculation and the lymphatic system.

Physiology of respiration. Lung as a gas exchanger. Spirometry: volumes and lung capacity. Ventilation. Dead space. Pulmonary mechanics. Mechanical thorax-lung coupling; origin of negative pleural pressure; pneumothorax. Pulmonary compliance. Surface tension and surfactant. Ventilation and perfusion. Pulmonary circulation. Factors that determine the non-uniformity of blood perfusion in the lung. Ventilation-perfusion ratio. Dissemination and transport of respiratory gases in the blood. Gaseous alveolus-capillary exchanges. Lung diffusion capacity. Blood capacity for O2. Hemoglobin. Curve of dissociation of hemoglobin for O2. Influences of PCO2, pH and temperature on said curve. CO2 transport in the blood. Blood capacity for CO2. Ventilation adjustment. Localization of respiratory centers. Respiratory response to CO2, pH, O2. Peripheral and central chemoreceptors. Respiratory regulation of acid-base balance. Blood buffers: bicarbonates, phosphates, proteins. Diagram of Davenport.

Renal function. Physiology of fluids and body osmolarity. Function structure of the kidneys. Glomerular filtration and renal blood flow. Renal transport mechanisms: reabsorption and secretion. Adjustment of the NaCl balance. Regulation of the balance of potassium. Renal regulation of the acid-base balance. Regulation of calcium and phosphate homeostasis.

The gastro-intestinal function. The perception of chemical senses: taste and smell. Gastrointestinal peptides: Gastrin, Cholecystokinin, Somatostatin, and Ghrelin. Enteric nervous system and the autonomic nervous system. Cellular physiology of the smooth muscle of the gastrointestinal tract. Organization and electrophysiology of interstitial cells of Cajal. Motility and secretion in the esophagus, stomach and intestine. Salivary secretion and its regulation. Gastric secretion and its regulation. Physiology of pancreatic secretion and its regulation. Bile formation and enterohepatic circulation. Digestion and absorption of sugars Digestion and absorption of proteins. Digestion and absorption of fatty acids and formation of chylomicrons. Absorption of iron and calcium.

The in-depth section held by Dr. Melgari will focus on

- Ion channels and cell electrophysiology techniques
- Cardiac action potential and hERG channels (function and pharmacology)
- Molecular membrane trafficking
- Advanced imaging techniques
- Techniques for the study of cellular bioelectric 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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Sustainable Development Goals

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