UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Human Systematic Biochemistry

2627-3-E0201Q065

Aims

The course aims to understand, at the biochemical and molecular level, the complex phenomena of communication between organs and tissues, the control systems of their functions and their interrelations in physiological conditions. The course is projected towards the understanding of the basic mechanisms responsible for alterations of homeostasis and the onset of diseases. The main mechanisms of biochemical regulation of blood, digestive, cardiovascular, hepatic, nervous system and bone tissue regulation will be illustrated. The hormonal and metabolic regulation of the metabolism and the conditions that can lead to their alteration will be described.

At the end of the course of Human Systematic Biochemistry students will be able to:

Knowledge and understanding - outline the general picture of metabolism in organs and tissues; to understand and explain, at the molecular level, the control systems of the functions of the main organs and tissues in normal conditions; to understand the systems for maintaining homeostasis of the main metabolites.

Applying knowledge and understanding - apply the knowledge acquired to the understanding of the main processes concerning growth and proliferation.

Making judgements – understand the different cell processes described in the course and evaluate the consequences of their malfunctioning.These skills will be developed through interactive lectures, guided discussion of case studies, practical exercises (such as exam-style questions), and analysis of scientific articles, all of which will stimulate the student’s critical thinking in interpreting the molecular mechanisms underlying cellular functions and related pathologies.

Communication skills – acquire an adequate scientific language and the ability to describe orally the topics discussed in the course.

Learning skills - understand and critically evaluate the experimental methods described in the scientific literature on the topic of cellular biochemistry.

Contents

Blood biochemistry

Homeostasis of carbohydrates, lipids and proteins

Hormonal regulation

Control of glycemia

Biochemistry of nervous system

Liver biochemistry

Biochemistry of bone tissue

Biochemistry of muscle tissue

Hypothalamus / pituitary axis

Nutrition feed/fasting cycle

Metabolism of ethanol

Detailed program

BLOOD BIOCHEMISTRY
Biochemistry of the erythrocyte. Plasma proteins. Biochemistry of blood coagulation. Anticoagulants and fibrinolysis. Plasma lipoproteins and lipid transport: VLDL, IDL, and LDL. HDL and reverse cholesterol transport. Lipoprotein receptors. Dyslipidemias.

REGULATION OF BLOOD GLUCOSE
Metabolic regulation of blood glucose. Glycogen storage diseases. Hormonal regulation of blood glucose and diabetes mellitus.

HOMEOSTASIS OF CARBOHYDRATES, LIPIDS, AND PROTEINS
Biochemistry of fasting. Ketoacidosis.

LIVER BIOCHEMISTRY
Hepatic metabolism. Hepatic detoxification mechanisms. Extrahepatic ammonia elimination. Xenobiotic metabolism.

BONE TISSUE BIOCHEMISTRY
Metabolism of collagen, laminin, and elastin. Metabolism of the mineral component of bone tissue. Collagen as a biomaterial. Diseases associated with alterations in collagen metabolism.

MUSCLE TISSUE BIOCHEMISTRY
Biochemistry of muscle tissue under physiological conditions and its adaptations during physical exercise of varying intensity.

NERVOUS TISSUE BIOCHEMISTRY
Metabolism of the nervous system. Neurotransmitters. Neurotoxins. Metabolism of recreational and illicit drugs. Biochemical alterations associated with disease (brain tumors and neurodegenerative disorders). Biochemistry of the blood–brain barrier.

HYPOTHALAMIC–PITUITARY AXIS
Direct influence and feedback interactions among the hypothalamus, pituitary gland, and peripheral endocrine glands. Hormonal control. Regulation and control of blood pressure.

HORMONAL REGULATION
Gastroenteropancreatic hormones: insulin, glucagon, somatostatin. Hypothalamic and pituitary hormones: growth hormone (GH), prolactin, adrenocorticotropic hormone (ACTH), vasopressin, oxytocin. Thyroid hormones. Adrenal hormones. Sex hormones.
Homeostasis and regulatory role of calcium and phosphorus.
Calcitonin. Vitamin D/calcitriol. Parathyroid hormone (PTH).

NUTRITION
Caloric and nutritional value of foods. Effects of different diets on metabolism. Body Mass Index (BMI).
Feeding–fasting cycle.
Changes in metabolic pathways (carbohydrate, lipid, and protein metabolism) in the fed state, during short-term fasting, and during prolonged fasting.
Alcohol metabolism.
Metabolism of alcohol consumed through alcoholic beverages. Alcoholism. Metabolic changes following alcohol and drug consumption.

Prerequisites

Background: none

Specific prerequisites: Biochemistry.

General prerequisites: Students can take the exams of the third year after having passed all the exams of the first year of the course.

Teaching form

32 hours (16 lessons of 2 hours each): Didattica Erogativa (DE), lectures, in-person activities
6 hours (3 lessons of 2 hours each): Didattica Erogativa (DE), lectures, synchronous remote activities
4 hours (2 sessions of 2 hours each): Didattica Interattiva (DI), practical exercises, in-person activities. Two 2-hour practical sessions conducted interactively in person, aimed at supporting students in their study and exam preparation.

Textbook and teaching resource

Learning material (slides of the lessons, videolessons, scientific papers) is available at the e-learning platform of the course.

Recommended textbooks:Mauro Maccarone, Fondamenti di Biochimica umana - Zanichelli

Semester

First semester

Assessment method

Individual written examination
13 multiple-choice questions (2 marks each) on frontal lesson
1 open question (4 marks) on all the programme of the course
to be completed in 30 minutes.

The exam is positively evaluate with a score of 18/30 or higher. The questions proposed in the written exam will be constructed in such a way as to induce the student to biochemical-bio/nanotechnological reasoning, to understand the units of measurement and to be able to evaluate the skills and competences acquired according to the objectives of the course.

There are no *itinere* tests planned.

Office hours

Contact: on demand, upon request by mail to lecturer.

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING