UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Biochemistry

2627-1-H4602D005

Aims

1 Knowledge and understanding
Students will learn the structure and function of macromolecules, enzyme kinetics (including coenzymes and vitamins), detailed metabolic pathways, and their hormonal integration. They will deepen their knowledge of the metabolism of the main tissues, with particular attention to the composition and mineralization of hard tissues and salivary biochemistry. In the clinical field, they will acquire knowledge related to the diagnostic process, biomarkers, and the correct interpretation of laboratory tests for patient management.
2 Applying knowledge and understanding
Students will be able to connect biochemical concepts to organ physiology, clinical pathophysiology, and laboratory diagnostics. They will be capable of interpreting biochemical interactions between different organs and correlating systemic and organ-specific molecular mechanisms with pathologies of dental interest. From a clinical-diagnostic perspective, students will also know how to identify and apply the most appropriate laboratory tests in different pathophysiological contexts.
3 Making judgments
The course develops the ability to critically and independently evaluate scientific data, biological links, and laboratory reports. Students will be able to interpret analytical results, integrating them into the clinical dental context and formulating autonomous clinical judgments. Furthermore, they will be capable of critically assessing the appropriateness, diagnostic significance, and limitations of various biochemical-clinical investigations based on the specific needs of the patient.
4 Communication skills
Students will acquire the mastery of language necessary to interface effectively in both professional and clinical contexts. They will know how to use specialized terminology – in both molecular and biochemical-clinical fields – to correctly describe mechanisms of action and diagnostic profiles. Concurrently, they will develop the ability to translate complex scientific concepts into clear and accessible language for the patient.
5 Learning skills
The course provides the methodological tools for lifelong learning. Students will develop the autonomy required to consult advanced textbooks and scientific articles in the fields of medical, dental, and clinical biochemistry, as well as molecular diagnostics. Consequently, they will be able to independently assimilate future scientific discoveries, new laboratory diagnostic technologies, and biotechnological innovations applied to dentistry.

Contents

GENERAL BIOCHEMISTRY AND HUMAN SYSTEMATIC BIOCHEMISTRY
The course aims to educate students to reason in molecular terms about the main cellular metabolisms; to understand and explain at a molecular level the control systems of cellular and tissue functions, particularly of the connective tissue, bone, and tooth. Furthermore, the course aims to provide students with fundamental knowledge regarding biochemical-clinical investigations into the main alterations of organs/tissues relevant to the dental field.

CLINICAL BIOCHEMISTRY AND CLINICAL MOLECULAR BIOLOGY
The course aims to provide students with fundamental knowledge regarding biochemical-clinical investigations into the main alterations of organs/tissues relevant to the dental field.

Detailed program

GENERAL BIOCHEMISTRY
Enzymology: Catalysis and enzyme kinetics. Significance of Vmax and Km. Factors affecting enzyme activity. Inhibitors. Allosteric enzymes. Isoenzymes. Diagnostic use of enzymes and isoenzymes.Bioenergetics: Respiratory chain and oxidative phosphorylation. High-energy molecules. ATP production. Inhibitors and uncouplers of oxidative phosphorylation.Carbohydrate Metabolism: Digestion, absorption, and transport of carbohydrates. Aerobic and anaerobic glycolysis. Metabolic and hormonal regulation of glycolysis. Glycogen synthesis and glycogenolysis. Metabolic and hormonal regulation of glycogen metabolism. Interconversion of sugars. Galactose and fructose metabolism.Lipid Metabolism: Digestion and absorption of lipids. Lipid catabolism. Beta-oxidation of fatty acids. Role of carnitine. Citric acid cycle.Lipogenesis: Biosynthesis of fatty acids; biosynthesis of triglycerides. Regulation of lipolysis and lipogenesis. Metabolism of cholesterol and its derivatives. Conversion of cholesterol into steroid hormones and bile salts. Ketone body metabolism. Plasma lipoproteins. Lipoprotein metabolism. Lipoprotein receptors.Protein Metabolism: Protein digestion, absorption, and transport of amino acids. General metabolism of amino acids. Gluconeogenesis and its regulation. Metabolism of purine and pyrimidine nucleotides: Biosynthesis of purines and pyrimidines. Salvage pathways of purine nucleotides.

HUMAN SYSTEMATIC BIOCHEMISTRY
Metabolic Regulation of Blood Glucose: Hepatic and muscle glycogen. Hormonal regulation of blood glucose. Gastroenteropancreatic hormones: insulin, glucagon.Hormones: Hypothalamic and pituitary hormones. Releasing hormones. GH. Prolactin. ACTH. Vasopressin. Oxytocin. Thyroid hormones. Adrenal cortex hormones. Sex hormones. Hormones regulating hunger/satiety perception.Biochemistry of Nervous Tissue: Biosynthesis and catabolism of neurotransmitters. Neurotoxins. Biochemistry of blood and coagulation: Formed elements of blood and plasma proteins. Hemoglobin, myoglobin, and oxygen transport. The blood coagulation cascade. Anticoagulants and fibrinolysis.Liver Biochemistry: Role of the liver in gluconeogenesis. Urea cycle and extra-hepatic mechanisms of ammonia elimination. Urea cycle reactions. Extra-hepatic elimination of ammonia. Glutamate and glutamine. Hepatic detoxification mechanisms. Hemoglobin degradation. Ethanol metabolism. Oxidative stress and free radicals. (Nota: "Biochimica delegato" è stato corretto in "Liver Biochemistry", assumendo un refuso per "Biochimica del fegato").Biochemistry of Skeletal Muscle Tissue and Myocardium: Structure and muscle proteins. Mechanism of contraction. Muscle energy metabolism.Biochemistry of Connective Tissue: Proteoglycans, glycoproteins, collagen, elastin.Homeostasis and Regulatory Role of Calcium and Phosphorus: Calcitonin, Vitamin D, Parathyroid hormone.Biochemistry of Bone and Tooth: Macromolecules of the organic matrix. Mineralization of bone and tooth. Bone resorption. Growth factors and hormones acting on bone cells. Biochemistry of saliva.Biochemistry of Nutrition: Biochemical aspects of digestive processes and nutrient absorption. Basal metabolic rate. Principles of nutrition. Water-soluble and fat-soluble vitamins. Carbohydrate, lipid, and protein homeostasis. The fed-fasting cycle.

CLINICAL BIOCHEMISTRY AND CLINICAL MOLECULAR BIOLOGY
Clinical Biochemistry: Role, limitations, and aims. Biological variability, analytical and pre-analytical variability in clinical biochemistry. Analytical goals and quality control in clinical biochemistry.Terms of Comparison for Biochemical-Clinical Data: Reference intervals, desirable levels, decision thresholds. Sensitivity, specificity, and predictive value of biochemical-clinical investigations. Exploration of carbohydrate metabolism. Clinical biochemistry of plasma proteins and coagulopathies. Clinical biochemistry of lipids and plasma lipoproteins. Clinical biochemistry of hemoglobinopathies. Clinical biochemistry of bone and mineral metabolism. Enzymes and other macromolecular markers of function and injury. Biochemical tumor markers.

Prerequisites

Aims of Preparatory Sciences course.

Teaching form

All lectures are conducted in face-to-face delivery mode:

- 50 (2-hour) lectures conducted in the in-presence delivery mode.

Textbook and teaching resource

RECOMMENDED TEXTBOOK FOR GENERAL AND HUMAN SYSTEMATIC BIOCHEMISTRY:
Siliprandi/Tettamanti: Biochimica Medica. Piccin
Devlin T.M.: Biochimica (con aspetti clinici). Idelson-Gnocchi
Ferrier D.: Le basi della biochimica. Zanichelli
Nelson D.L. et al.: Introduzione alla biochimica di Lehninger. Zanichelli
Ferguson D.B.: Biologia del cavo orale. Zanichelli/CEA
Maccarrone M.: Fondamenti di Biochimica Umana ed Zanichelli

RECOMMENDED TEXTBOOK FOR CLINICAL BIOCHEMISTRY AND CLINICAL MOLECULAR BIOLOGY:
Federici G., Medicina di laboratorio, McGraw-Hill

Semester

First year of the course, second semester.

Assessment method

All students take a written exam followed by an oral interview.
The written exam consists of 27 closed-ended questions (20 single-choice questions and the remaining multiple-

choice). Twenty questions assess the student's preparation on the topics of GENERAL BIOCHEMISTRY and HUMAN SYSTEMATIC BIOCHEMISTRY, while the remaining 7 focus on topics of CLINICAL BIOCHEMISTRY.
Students are allocated one hour to complete the written exam.
The student is admitted to the oral exam if their score reaches a minimum of 18.
The oral exam takes place on the same day, after the marking of the written test, and lasts approximately 20-30 minutes for each candidate. The questions in the written exam are aimed at assessing the understanding of the topics covered during lectures, with particular reference to the acquisition of knowledge regarding cellular and organ metabolism, and the correct use of laboratory tests in various diagnostic fields. During the oral exam, building upon the questions from the written test, the student is asked to explain or elaborate on some of the answers provided (including both incorrect and correct ones) in order to verify the correct interpretation of the question and the reasoning that led to the answer. Furthermore, the evaluation will assess knowledge of the main metabolic pathways, the biochemical interactions between cells or within different organs/tissues, and the biochemical dysfunctions that cause alterations in the main blood chemistry parameters.

Office hours

Reception by appointment
Bulbarelli Tel. Ufficio 026448 8221
alessandra.bulbarelli@unimib.it

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING