UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Biological Chemistry

2627-2-E1302Q073

Aims

The course imparts basic knowledge and concepts of biochemistry, which represent the prerequisite to address any further biological subject at the molecular and cellular level. In particular, it deals with protein chemistry, enzymology and metabolism. In the framework of these topics, only fundamental contents are presented, without a systematic treatment of biochemistry. In fact, the course is mainly aimed at clarifying the rationale underlying the described phenomena, thus providing a key to the understanding of molecular and metabolic processes as a whole.
A significant part of the teaching will be devoted to theoretical exercises, whereby students will be familiarized with basic chemical-physical laws that govern biological phenomena.

1. Knowledge and understanding. Knowledge imparted provides the basic tools for the understanding of biological phenomena at the molecular and cellular level.
2. Applying knowledge and understanding. Knowledge imparted represents the basic background to address experimental issues in biology.
3. Making judgments. The course provides a knowledge basis for the understanding of scientific literature and for the critical assessment of issue related to biological experimentation.
4. Communication skills. The course imparts basic elements of scientific language currently adopted in the context of biological research.
5. Learning skills. Knowledge provided by the course represents a prerequisite for effective learning of contents subsequently imparted in several areas of biology.

Contents

FIRST MODULE:

- Non-covalent interactions in aqueous solution
- Structural levels and properties of proteins

- Enzymology
- Allosteric proteins

SECOND MODULE:

- Metabolism

Detailed program

FIRST MODULE:

1 - GENERAL PRINCIPLES
Structure and general properties of water. Intra- and intermolecular non-covalent interactions: their role in determining the properties of biological molecules. Acid-base dissociation in aqueous solutions. Buffer solutions.
2 – LEVELS OF STRUCTURAL ORGANIZATION IN PROTEINS
Structures of amino acids found in proteins. Physical and acid-base properties of amino acids. Properties of the peptide bond. Filamentous proteins. The different structural levels in proteins. Physical properties of proteins. Criteria of classification of proteins. Basic principles of protein folding. Methods of protein 3D structure prediction.
3 - ENZYMES
Mechanisms of enzyme catalysis. Examples of mechanisms of enzyme-catalyzed reactions. Steady-state enzyme kinetics. Physical factors affecting enzyme activity. Regulation of the enzyme activity: the role of inhibitors and activators.
4 – ALLOSTERIC PROTEINS
Definition and adaptive roles of allosteric behavior. Molecular mechanisms of allostericity. Interpretation of allosteric behavior at the molecular level. Some examples of allosteric proteins and enzymes. The globins.

SECOND MODULE:

5 – METABOLISM
Basic principles. Glycolysis and fermentations. The Krebs cycle. The oxidative phosphorylation. The pentose-phosphate pathway. Biosynthesis and degradation of lipids. Biosynthesis and degradation of amino acids. Glycogen metabolism. Gluconeogenesis. The nitrogen cycle in the biosphere. Integration of metabolic pathways. Basic concepts on the role and the action mechanisms of hormones.

Prerequisites

Knowledge of general and organic chemistry; principles of chemical equilibrium and chemical kinetics; principles of classical thermodynamics; basic concepts of cell biology.

Teaching form

64 h lessons, 2 h each: a section of delivered didactics (Didattica erogativa, DE) focused on the presentation-illustration of contents by the lecturer; a section of interactive teaching (Didattica Interattiva, DI) including teaching interventions supplementary to delivered didactic activities and discussion of case studies.

Didactic activities are conveyed by means of face-to-face lectures

Teaching language: Italian

Textbook and teaching resource

For the first module of the course, students are provided with the textbook edited by P. Tortora, D. Prosperi, and M. Colombo, entitled Principi di Biochimica (Edizioni Scientifiche Falco, ISBN: 9791280774613). This textbook contains all the material required for the examination concerning the general aspects of proteins and enzymology.

In addition, the following reference textbooks are recommended for consultation:

- Campbell and Farrell, Biochemistry, EdiSES.
- Nelson and Cox, Lehninger Principles of Biochemistry, Zanichelli.
- Mathews, Van Holde, and Ahern, Biochemistry, Casa Editrice Ambrosiana.

Additional supporting materials are also freely available online through the course e-learning platform. In particular, a collection of PowerPoint presentations is provided, covering all topics and content related to metabolism discussed during the lectures.

Semester

1st semester.

Assessment method

Students are required to take two written examinations, one for each module, consisting of multiple-choice questions and one or more open-ended questions. Each examination covers all the topics included in the corresponding module. The grading of the written examinations will be based on the criteria outlined at the beginning of the course in a dedicated scoring table, which will be made available on the e-learning platform to students enrolled in the course.
Students who have not taken the written assessments may opt to sit for a comprehensive oral examination, covering the content of both modules.
An oral examination is also required for students who have not completed all or part of the written assessments, as well as for those who obtain an insufficient grade in one or both written examinations.

Office hours

The teachers receive by appointment.

Sustainable Development Goals

QUALITY EDUCATION