UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Biochemistry and Microbiology

2021-2-E3201Q108

Aims

The course aims to provide knowledge on the relationship between structure and function of biomolecules in order to understand the fundamentals of biochemical processes that occur in living organisms (biochemistry module) and on the biology of microorganisms with particular attention to morphofunctional diversity, biogeochemical processes promoted by them, as well as evolutionary and ecological aspects (microbiology module. The specific objectives are detailed in the syllabi of the two modules and concern 1. Knowledge and comprehension skills; 2. Ability to apply knowledge and understanding; 3. Autonomy of judgment; 4. Communication skills 5. Learning skills.

Contents

The teaching deals with:

1. the structure and function of simple, polymeric and complex biomolecules;
2. the ways in which biochemical reactions take place in living organisms;
3. the role of the environment in which biochemical reactions take place;
4. of the ways in which biochemical reactions can be controlled both physiologically and artificially.
5. of the description of biochemical reactions and how they develop within paths called metabolic pathways.
6. of the main study techniques of biomecules.
7. of the structure, function and evolution of microbial cells,
8. traditional and innovative methodologies and specific microbial habitats
9. analysis of microbial communities, systematics and elements of microbial genetics.

Detailed program

1. Biomolecules: amino acids: structure and properties. The peptide bond and the primary structure of proteins. Secondary, tertiary and quaternary structure of proteins. Respiratory pigments and oxygen

transport. Monosaccharides and polysaccharides. Nucleotides and nucleic acids. Lipids: structure and functions. Biological membranes: structure and transport of solutes.

2. Enzymes: classification and catalysis. Coenzymes and vitamins. Enzymatic kinetics: Henri-Michaelis-Menten equation. The enzymatic dosage. Reciprocal double equation.
3. Water: hydrophilic and hydrophobic substances. pH and buffer systems.
4. Enzymatic inhibition: reversible and irreversible inhibition. Allosteric enzymes. Examples of herbicides and insecticides that act as enzyme inhibitors.
5. Principles of bioenergetics and metabolism. Role of ATP and electron carriers. Catabolism. Glycolysis: reactions, enzymes and intermediates. Via of the pentoso phosphates. Lactic and alcoholic fermentation. Krebs cycle and anaplerotic reactions. Glyoxylate cycle. Beta-oxidation of fatty acids. Degradation of amino acids and urea cycle. The electronic mitochondrial flow and the biosynthesis of ATP. Rotational catalysis. Inhibitors and decouplers of oxidative phosphorylation. Mixed function oxidases. Biotransformation of xenobiotics. Role of glutathione. Anabolism: gluconeogenesis, biosynthesis of fatty acids and biosynthesis of amino acids. Nitrogen cycle. Carbon organization: Calvine cycle and photosynthesis.
6. Basic biochemical techniques: sample preparation, centrifugation, electrophoresis, immunological and enzymatic techniques. Enzymes as environmental biomarkers.
7. historical excursus on the main discoveries and prominent personalities that have allowed the development of microbiology; microbial evolution. Origins of life on Earth. Microbial physiology. Microbial growth principles. Structures and functions (single-cell Bacteria, Archea, Eukarya). Microbial metabolism. Biogeochemical cycles. General principles and specific description of C, N, P and S cycles
8. Antibiotics and quorum sensing
9. Microbial systematics. Genetics of microorganisms. Horizontal gene transfer, two-component systems, examples of transcriptional and post-translational regulation. Symbiosis. Principles and examples of different forms of symbiosis involving different categories of microorganisms.

Prerequisites

Basic knowledge of cell biology, general chemistry, organic chemistry and thermodynamics

Teaching form

Frontal lessons for a total of 12 credits, equivalent to 96 hours. During the Covid-19 emergency period, lessons will take place in a mixed mode: partial attendance and all lessons will be videotaped asynchronously.

Textbook and teaching resource

The course will be carried out with the help of slides, videos and scientific articles. All the projected teaching material and the in-depth material is made available to students on the Ateno e-learning platform.

Recommended texts:

Biology of Microorganisms (Dehò-Galli - Ambrosiana Publishing House);

Brock - Biology of Microorganisms (Madigan, Martinko, Stahl, Clark - PEARSON Publishing House).

Nelson & Cox, Introduction to the biochemistry of Lehninger, Zanichelli ed., 2018.

The texts are available for personal loan in a reduced number of copies at the science library; paper copies are available at all university bookstores or as an e-book at the university library.

Semester

Second semester

Assessment method

The verification of the knowledge learned will be carried out in three distinct moments: 1. An oral biochemistry test consisting of the discussion of two topics chosen by the teacher among those treated during the course; 2. a written examination on microbiology topics followed by an oral microbiology test, during which the elements of weakness identified during the written test are deepened. The exam is considered passed if the student obtains a mark resulting from the mathematical average of the two results obtained from the test (1) and from the tests (2) between 18 and 30 out of thirty. Other details on the modalities are specified in the syllabi of the two modules.

Office hours

By appointment writing to andrea.franzetti@unimib.it (Microbiology) and to paolo.parenti@unimib.it (Biochemistry)