UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Industrial Microbiology

2627-2-E0202Q069

Aims

Microbiology is one of the most versatile, cutting-edge, applicable fields of study in Biology. Microbiology is present in all aspects of everyday life. Think of the daily news stories on vaccines, diseases, remediation, biotechnology, food production and safety, etc.: all represent a field of microbiology. Microorganisms are everywhere. They are essential to our well-being as individuals, maintain the balance of chemicals and living organisms in the global environment, and they help to recycle chemical elements in the land and water. On the other hand, some can be nasty pathogens for humans as well as for other organisms. Microorganisms (in the context of this course) are minute living things that are individually too small to be seen with the naked eye. The term includes bacteria, archea, microscopic fungi (yeasts and molds), protozoans, microscopic algae. Despite not considered as living forms, also viruses are included as part of the microbial world. The course aims to provide students with the basic knowledge necessary to undertake fundamental and applied studies in microbiology.

Knowledge and understanding
The student will gain knowledge and the principles of microbiology, spanning from fundamental to diverse applied field of studies, learning how microbes have a fundamental role on our living planet.

Applying knowledge and understanding
The student will be able to apply the acquired knowledge to evaluate all the potential of the microbial world

Making judgements
The contents, delivered both with DE and DI, and the study of the matter will provide the basis for thinking critically about issues in microbiology.

Communication skills
Use of an appropriate scientific/chemical vocabulary and ability in oral reports

Learning skills
Subjects learned previously in Themes of Biology will be applied to the microbial world, as will those learned in General and Organic Chemistry and Biochemistry, when discussing the makeup and energy usage of

microorganisms. Likewise, the student will be able to apply the knowledge gained from what will be learned in teachings that have as prerequisites knowledge of the basics of microbiology, and its industrial and applied implications.

Contents

The course shed lights on the basic knowledge necessary to understand the basis of microbial biodiversity (with a specific attention to peculiar and unique cellular structures), as well as the diverse metabolisms that sustain our living planet. Moreover, attention will be given to the understanding of the abundance and diversity of microbial life on Earth, its role of microorganisms in our everyday lives. The theme of microbial communities and symbiosis will be also introduced, with a section dedicated to the mechanisms of microbial pathogenicity.
The following topics will be addressed:
1. The history of Microbiology.
2. The origin of Life and Microbial evolution.
3. Microbial physiology and principles of microbial growth.
4. Microbial metabolism and applications.
5. Structures and functions, with a focus on Bacteria, Archea and Fungi.
6. Symbiosis.
7. Antibiotics and quorum sensing.
8. Biogeochemical cycles.
9. Microbial pathogenicity.
10. Virology.

Detailed program

1. The history of Microbiology. Brief historical excursus on the main events and on the prestigious scientists that made Microbiology a recognized discipline in life science.
2. Microbial evolution. The origin of life on Earth: from ancient to modern theories and the most recent versions and descriptions of the tree of life.
3. Microbial physiology. Principles of growth and nutrition. Microbial structures and functions (Bacteria, Archaea, unicellular Eukarya).
4. Microbial metabolism. Catabolisms and unique pathways for the assimilation and organication of the essential elements for life will be presented.
5. Hints on microbial genetics. Mechanisms of horizontal gene transfer, CRISPR-Cas as natural defense against viruses.
6. Symbiosis. Principles and detailed examples of different forms of symbiosis.
7. Antibiotics and quorum sensing.
8. Biogeochemical cycles. General principles and specific description for the Carbon and Nitrogen cycle
9. Microbial pathogenicity. General principles, endo- and exotoxins
10. Virology. Basis of virology and general morpho- physiological descriptions, including the relation with the hosts

Prerequisites

Background: General Chemistry; Organic Chemistry; Biochemistry
Specific prerequisites: Biochemistry
General prerequisites: Students can take the exams of the second year after passing the examinations of

Introductory Biology, General and Inorganic Chemistry, Mathematics, and Foreign Language.

Teaching form

The course will consist of 64 hours of face-to-face lectures, in presence, delivered in 32 lessons of 2 hours consisting of:

- a part (approximately 7/8 of the lectures, corresponding to 56 hours) in delivered mode (delivered didactics, DE) focused on the presentation-illustration of contents, concepts, scientific principles, but within which there are never lacking moments of interactive didactics determined by extemporaneous questions addressed to the trainees/ students or by requests for clarifications.
  In particular, the lecturer tends to encourage questions that may allow the creation of interdisciplinary insights.
- a part in interactive mode (interactive didactics, DI, approximately 1/8 of the lessons, corresponding to 8 hours), which envisages integrative didactic exchanges with the students/ students, through the viewing of short videos and/or the use of tools such as Kahoot or Mentimeter to involve the entire audience in short exercises/quizzes/tests/wordcount creation aimed at familiarising them with the concepts delivered in the lessons, and at fixing specific terminology and fundamental concepts.
  The distribution in hours is given to better define the quantitative aspect, as DI classes will be interspersed with DE classes.

The teaching is delivered in Italian (and slides are in Italian too), the lessons are recorded and the recordings are available on the e-learning page dedicated to the course.

Textbook and teaching resource

Learning material (slides, suggested web sites, and scientific article, interviews and links to Scientific Community Reference Societies) is available at the e-learning platform of the course.

Recommended textbooks:
- Brock – Biologia dei Microrganismi (Madigan, Martinko, Stahl, Clark – Casa Editrice PEARSON);
- Biologia dei Microrganismi (Dehò-Galli – Casa Editrice Ambrosiana);
- Microbiologia (Prescott, Harley, Klein – Casa Editrice McGRAW-HILL);
- Microbiologia (Wessner, Dupont, Charles– Casa Editrice Ambrosiana)

Semester

Second semester

Assessment method

The examination aims to assess the achievement of the expected learning outcomes and consists of a compulsory written test and an optional oral exam. There are no mid-term partial tests.

Written Test (Compulsory, duration 90 minutes): It consists of one broad-spectrum question on microbial metabolism and two specific questions on other program topics. The test assesses knowledge and understanding (Dublin Descriptor 1) and the ability to apply concepts to biological and industrial contexts (Dublin Descriptor 2). Since the written exam includes open-ended questions with free-text answers, the oral exam is not mandatory to register the grade.

Oral Exam (Optional): Accessible upon passing the written test with a minimum score of 18 out of 30. It involves an in-depth discussion regarding the weak points of the written paper and an assessment of an additional topic from the program. It specifically evaluates the student's independent judgment (Dublin Descriptor 3) and communication skills (Dublin Descriptor 4).

Evaluation Criteria and Grade Graduation:
18-23/30: Elementary knowledge of basic concepts, basic but correct use of scientific vocabulary.
24-27/30: Good knowledge of the contents, ability to connect different metabolic pathways, appropriate microbiological terminology.
28-30/30: Excellent mastery of the subject, critical thinking skills, fluid exposition, and outstanding scientific vocabulary. Mentio cum laude (honors) is awarded for exceptional performance in both the written and oral exams (if taken).

Office hours

By appointment, upon e-mail request to the professor, or before/after lectures

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | CLEAN WATER AND SANITATION | AFFORDABLE AND CLEAN ENERGY | INDUSTRY, INNOVATION AND INFRASTRUCTURE | SUSTAINABLE CITIES AND COMMUNITIES | CLIMATE ACTION | LIFE BELOW WATER | LIFE ON LAND