UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Microbiologia Ambientale

2021-2-F7501Q087

Aims

The course aims to provide in-depth knowledge on the assessment of microbial communities in natural and anthropic environments, on the ecological processes that regulate them, and on their functions in the ecosystems.

1. Knowledge and understanding. At the end of the course the student must know: the characterization methods of microbial communities; principles at the basis of microbial taxonomy and related problems; the main bacterial taxa in different environmental compartments and their functions, also as ecosystem services provided; ecological processes that drive microbial communities; the main interactions of microorganisms with animals, plants and anthropic environment.

2. Applying knowledge and understanding. At the end of the course the student must be able to apply the knowledge acquired during the course demonstrating his/her ability to include microbiological aspects in the assessment of natural and anthropic ecosystems.

3. Making judgments. The student must be able to make hypotheses about ecological processes and ecosystem services due to microbial activities in a variety of natural and anthropic contexts.

4. Communication skills. At the end of the course the student will be able to describe appropriately the topics studied using the correct specific vocabulary.

5. Learning skills. At the end of the course the student will be able to consult the literature on the topics covered and autonomously integrate the knowledge acquired with others related to the sector of remediation and treatment of contaminated matrices, also with a multidisciplinary approach.

Contents

1. Characterization of bacterial communities. 2. Taxonomic diversity of microorganisms. 3. Role of bacteria in

biogeochemical cycles and climate change impact on microbial activities. 4. Bacteria of environmental compartments: soil, freshwater, cryosphere and atmosphere bacteria. 5. Ecological processes applied to microbial communities and species interactions. 6. Ecological roles of animal and plant-associated microbiomes. 7. Bacteria in cultural heritage. 8. Molecular microbiology practical 9. Bioinformatics practical

Detailed program

1. Characterization of bacterial communities.

Cultivation techniques, isolation and identification of microbial strains. Microbial taxonomy. Culturability issues. Molecular techniques for community characterization. Evaluation methods of in situ microbial activity. “Omics” methods.

2. Taxonomic diversity of microorganisms.

Main taxa of domains Bacteria and Archaea and their functions. The universal tree of life. Role of Horizontal Gene Transfer.

3. Role of bacteria in biogeochemical cycles and climate change impact on microbial activities.

The biological cycle of carbon: phototrophy / chemotrophy; autotrophy / heterotrophy; methane cycle. The biological cycles of nitrogen, sulfur, iron and minor elements. Climate change impact on microbiological activities.

4. Bacteria of environmental compartments and their functions.

Classification of bacteria according to ecological and physiological properties. Soil bacteria. Freshwater bacteria; focus on antibiotic resistance gene transfer. Cryosphere bacteria. Airborne bacteria and their dispersal.

5. Ecological processes applied to microbial communities and species interactions.

Selection, dispersal, drift. Mutualisms, commensalisms, predation and parasitism among microorganisms and among micro- and macroorganisms.

6. Ecological roles of animal and plant-associated microbiomes.

Phyllosphere and rhizosphere bacteria. Rumen bacteria. Gut microbiomes of humans and animals.

7. Bacteria in cultural heritage.

Biocorrosion, biodeterioration and biological remediation of artwork surfaces.

8. Molecular microbiology practical.

DNA extraction from soil samples, analysis and quantification of taxonomic and functional markers

9. Bioinformatics practical.

High-throughput sequencing data: formats and databases. Bioinformatics data processing.

Prerequisites

Basics of Microbiology

Teaching form

Lectures in synchronous mode (videoconference), supported by PowerPoint presentations (4.5 CFU; 36 h). Practical (1.5 CFU): molecular microbiology practical in presence (8 h) + bioinformatics practical in synchronous remote mode (7 h). Methods of delivery may vary following the evolution of the health situation. Teaching material will be made available to students through e-learning

Textbook and teaching resource

Slides are available at the e-learning page of the course. Since there is no textbook, attending the course or viewing recorded lessons is highly recommended.

Scientific papers are available for supplementary study.

Semester

First semester

Assessment method

Oral examination: 3 general questions on the topics covered during the lectures. The students must demonstrate to be able to clearly expose the acquired knowledge, demonstrating their complete understanding and language properties.

Optionally, it is possible to choose a topic of interest and study it in more detail through one of the available papers. In this case, one of the three questions will be replaced by the selected topic.

Office hours

By appointment (e-mail: isabella.gandolfi@unimib.it)