UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Marine Environmental Microbiology

2425-1-F7502Q035

Aims

The course aims at providing in-depth knowledge on microbial communities in marine environments, on their ecology and their functions.

1. Knowledge and understanding. At the end of the course the student must know: the methods for characterization of microbial communities; the principles at the basis of prokaryotic taxonomy and related problems; the main prokaryotic taxa inhabiting the marine habitats; the impact of microbial metabolism on geochemistry of marine environments; the environmental issues in the ocean involving microbial activities.
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 evaluate the impact of perturbations (e.g., human impact, climate change) on marine microbial metabolisms and its possible consequences.
3. Making judgments. The student must be able to critically read scientific papers about marine microbiology.
4. Communication skills. At the end of the course the student will be able to appropriately describe 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 other sources related to marine sciences, with a multidisciplinary approach.

Contents

1. Basic concepts of microbiology and marine microbial ecology. 2. Methods for the characterization of prokaryotic communities in marine environments. 3. Taxonomic diversity of marine prokaryotes; basics on marine viruses. 4. Role of prokaryotes and viruses in marine biogeochemical cycles and climate change impact on microbial activities. 5. Microbial marine habitats. 6. Bioremediation of oil spills. 7. Bioinformatics practical

Detailed program

1. Basic concepts of microbiology and marine microbial ecology.
   Different meanings of 'microbial diversity'. Ecological diversity and ecological strategies of marine prokaryotes.
2. Methods for the characterization of prokaryotic communities in marine environments.
   Microscopy techniques. Cultivation methods, isolation and identification of microbial strains. Taxonomy of prokaryotes. Culturability issues. Molecular methods for community characterization. Methods for the assessment of in situ microbial activity. '-omics' technologies.
3. Taxonomic diversity of marine prokaryotes; basics on marine viruses.
   Main marine taxa of domains Bacteria and Archaea and their functions. The universal tree of life. The unknown diversity in the oceans. Marine viruses.
4. Role of prokaryotes and viruses in marine biogeochemical cycles and climate change impact on microbial activities.
   Metabolic diversity in marine biological carbon cycle: phototrophy/chemotrophy; autotrophy/heterotrophy; methane cycle. Carbon cycling in the ocean: microbial loop, biological carbon pump, microbial carbon pump, viral shunt. The biological cycles of nitrogen, sulfur, iron, phosphorus and minor elements in the oceans. The impact of climate change on microbial marine activities.
5. Microbial marine habitats
   Open ocean. Marine sediments. Hydrothermal vents. Cold seeps. Sea ice. Microbial mats. Coastal environments. Living macroorganisms as microbial habitats.
6. Bioremediation of oil spills.
   Aerobic and anaerobic biodegradation of aliphatic and aromatic hydrocarbons. Bioremediation techniques for oil spill remediation.
7. Bioinformatics practical.
   Bioinformatics analysis of metagenomic data for microbial community characterization.

Prerequisites

Basics of Microbiology and/or Cell Biology

Teaching form

- 16 two-hour lectures, in person, alternating Delivered Didactics and Interactive Teaching
- 2 two-hour lectures, in person, with Delivered Didactics in the first part aiming at involving students in a group discussion in the second part (Interactive Teaching)
- 3 four-hour lab activities, in person, Interactive Teaching
  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.

Textbook:
Marine microbiology: ecology and applications (Munn), CRC Press.

Reference books:

1. Brock - Biology of Microorganisms (Brock, Madigan and Martinko), Pearson (available at the Library both in English and in Italian).
2. Microbial ecology of the oceans (Gasol and Kirchman), Wiley Blackwell.

Scientific papers provided by the teacher (case studies, supplementary study).

Semester

First semester

Assessment method

SHORT REPORT ON BIOINFORMATICS PRACTICAL: to be handed in before oral examination. This report will allow testing the acquired bioinformatics competencies applied to marine environmental microbiology. It constitutes 20% of the final mark.

ORAL EXAMINATION ON TOPICS COVERED IN CLASS: 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. It constitutes 80% of the final mark.
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)

Sustainable Development Goals

CLIMATE ACTION | LIFE BELOW WATER