UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Applied Micropaleontology and Biomonitoring

2627-1-F7504Q008

Aims

Provide the concepts and methods for the use of microfossils to reconstruct recent environmental changes in coastal marine and oceanic areas, based on the interaction between natural variability and the history of anthropogenic impacts. Provide the taxonomic background for microfossil identification and for their application in monitoring the status of the marine environment.

D1 – Knowledge and understanding:
During lectures, students will learn how to describe and identify marine microorganisms, understand their distribution patterns, and recognize their relationship with environmental parameters.

D2 – Applying knowledge and understanding:
During interactive lectures and laboratory activities, students will apply the acquired knowledge to case studies in order to analyse the distribution and abundance of several key marine microorganism taxa and to assess the conditions of present-day and past environments.

D3 – Making judgements:
During interactive lectures, students will learn how to critically evaluate the approaches described in the analysed scientific papers and compare different interpretations. During laboratory activities, students will be able to compare the obtained data with those available in the scientific literature and interpret them independently. Through the preparation of the laboratory report, students will improve their critical thinking skills and provide an evaluation of the evolution of marine environments and possible remediation strategies.

D4 – Communication skills:
During interactive lectures, students will be able to collaborate within working groups, contributing to the discussion of the analysed scientific papers and to the exchange of ideas with other students and the lecturer, using appropriate scientific terminology. At the end of the laboratory activities, students will be able to present the results of the activities carried out in small groups and discuss them clearly and effectively. They will also be able to summarise the most significant results obtained in an individual written report. During the oral examination, students will be able to explain the concepts in a clear and articulated way.

D5 – Learning skills:
Students will develop their learning skills throughout all phases of the course and will be able to independently expand their knowledge through the research and critical reading of scientific papers related to the topics covered.

Contents

How to sample, treat and identify planktic and benthic microfossils from different oceanographic contexts and how to apply them for understanding the recent past and for monitoring present-day conditions.

Detailed program

Plankton Module
Lectures
Bases of taxonomy. The main morphological traits to describe and identify planktonic microfossils.
Bases of biogeography. Ecological factors driving the distribution of planktonic organisms in the present and in the recent past. Examples of their application for the reconstruction of the recent environmental evolution of different marine contexts.
Microfossils as monitoring tools: case studies from oceanic (settings calcareous nannoplankton, diatoms silicoflagellates, planktonic foraminifera and pteropods to trace temperature and productivity changes; planktonic carbonate shells as proxy for ocean acidification) and analysis of time-series.
Practical Classes
Practical work under the microscope (reflected and transmitted light microscope; scanning electron microscope), with the aim of identifying microfossils from: sediment sequences from the recent past, present-day bottom sediments, sediment traps, water samples.

Benthos Module
Lectures
Bases of taxonomy. The main morphological traits to describe and identify benthic microfossils.
Biogeography and distribution of benthic foraminifera in the present and in the past. Ecological factors driving the distribution of marine shelled benthic organisms and examples of their application for the reconstruction of the recent environmental evolution of different marine contexts. Benthic microfossils as monitoring tools in coastal settings (e.g.: benthic foraminifera to assess water quality and environmental status; invasive benthic foraminifera species to trace recent climate change).
Practical Classes
Practical work under the microscope (reflected light microscope), with the aim of identifying microfossils from sediment sequences from the recent past and present-day bottom sediments.

Prerequisites

Paleontology and Geobiology are recommended

Teaching form

All classes will be in English

Plankton Module

- 7 two-hour lectures, in person (1 CFU), of which: 4 two-hours lectures performed as Delivered didactics (8 hours); 3 two-hour classes initially as Delivered Didactics (15 min), then actively involving students through Interactive Teaching (6 hours)
- 4 three-hours practical classes, in person, Interactive Teaching (12 hours, 1 cfu).

Benthos Module

- 7 two-hour lectures, in person (1 CFU), of which: 4 two-hours lectures performed as Delivered didactics (8 hours); 3 two-hour classes initially as Delivered Didactics (15 min), then actively involving students through Interactive Teaching (6 hours)
  4 three-hour practical classes, in person, Interactive Teaching (12 hours, 1 cfu).

Textbook and teaching resource

Slides and scientific papers provided by the Lecturers on the e-learning page

Semester

Second semester

Assessment method

The assessment of students' achievement will be **based on**:

- Two written reports (Plankton module and Benthos module) on the laboratory activities. The reports must include a summary of the laboratory notes, observations, and exercises carried out during the activities, as well as an interpretation of the obtained results.
  The assessment will focus on: the completeness of the report with respect to the proposed activities, the ability to summarise and discuss the analysed data, and the ability to use appropriate scientific terminology.
- Group presentation. The results of the data collected during laboratory activities will be presented by students working in groups.
  The assessment will focus on: the understanding of micropalaeontological methods, the students' ability to work in a team, the use of appropriate scientific terminology, and communication skills.
- Oral examination. Two open questions on the topics covered in the two modules.
  The assessment will focus on: the knowledge acquired and the students' ability to use appropriate scientific language and demonstrate mastery of the course topics.

The two written reports will contribute overall to one third of the final grade, while the oral examination will contribute to two thirds of the final grade. The group project will be assessed during the oral presentation scheduled for the last lecture and will contribute up to 3 points to the final grade.

The final grade is expressed on a 30-point scale and will be based on **the following criteria**:

D1 – Knowledge and understanding
D2 – Applying knowledge and understanding
D3 – Making judgements
D4 – Communication skills
D5 – Learning skills

Assessment below 18/30
D1: The student demonstrates fragmented theoretical knowledge.
D2: The student is unable to integrate knowledge into a complete analysis of case studies.
D3: The student processes information inaccurately and incompletely and is unable to critically elaborate on the concepts.
D4: During the presentation and/or oral examination, the student does not use appropriate scientific terminology and communicates in an unclear and ineffective way.
D5: The student does not demonstrate awareness of their learning process and is unable to identify the essential connections among the topics addressed.

Assessment 18–22/30
D1: The student demonstrates fairly complete theoretical knowledge, although with some inaccuracies.
D2: The student integrates knowledge into the analysis of case studies, but in an incomplete way.
D3: The student is able to discuss concepts critically at a basic level, with some inaccuracies.
D4: During the presentation and/or oral examination, the student uses appropriate scientific terminology, although with some inaccuracies, and communicates in a reasonably clear way.
D5: The student demonstrates a basic awareness of their learning process and is able to identify some essential connections among the topics addressed.

Assessment 23–27/30
D1: The student demonstrates complete and in-depth theoretical knowledge.
D2: The student satisfactorily integrates knowledge into the analysis of case studies.
D3: The student is able to critically and coherently discuss concepts, showing good ability to elaborate information.
D4: During the presentation and/or oral examination, the student demonstrates good command of scientific terminology and communicates clearly and effectively.
D5: The student demonstrates good awareness of their learning process and is able to highlight the connections among the different components analysed.

Assessment 28–30/30
D1: The student demonstrates complete, in-depth, and rigorous theoretical knowledge.
D2: The student demonstrates an advanced ability to integrate knowledge for the analysis of case studies and the interpretation of the analysed data.
D3: The student is able to critically and coherently discuss concepts, elaborating information in a solid and articulated way, with a well-structured logical approach.
D4: During the presentation and/or oral examination, the student demonstrates excellent command of scientific terminology and communicates clearly and effectively.
D5: The student demonstrates advanced awareness of their learning process and is able to connect the different components analysed in an effective, coherent, and rigorous way.

Office hours

Upon appointment by e-mail to the professors

Sustainable Development Goals

QUALITY EDUCATION | LIFE BELOW WATER