Program of Lectures

**Microbial evolution and systematics.** Early Earth and the origin of life; formation and early history of Earth; origin of cellular life; microbial diversification; endosymbiotic origin of eukaryotes. Microbial evolution; the evolutionary process; evolutionary analysis; theoretical aspects and analytical methods; microbial phylogeny; applications of SSU rRNA phylogenetic methods. Microbial systematics; phenotypic analysis; genotypic analysis; phylogenetic analysis; the species concept in microbiology; classification and nomenclature.

**Prokaryotic diversity: the Bacteria.** Bacterial phylogenesis. Phylum 1: Proteobacteria; Phylum 2 and 3: Gram-positive bacteria and Actinobacteria. Phylum 4: Cyanobacteria and Prochlorophytes; Phylum 5: Chlamydia; Phylum 6: Planctomyces/Pirellula; Phylum 7: Verrucomicrobia; Phylum 8: Flavobacteria; Phylum 9: the Cytophaga group; Phylum 10: Green-sulphur bacteria; Phylum 11: Spirochetes; Phylum 12: Deinococci; Phylum 13: Green non-sulphur bacteria; Phylum 14-16: deeply branching hyperthermophilic bacteria; Phylum 17 and 18: Nitrospira and Deferribacter.

**Prokaryotic diversity: the Archaea.** Phylogeny and general metabolism. Phylum euryarchaeota; Phylum Crenarchaeota; Phylum Nanoarchaeota; Evolution and life at high temperature.

**Metabolic diversity.** The phototrophic way of life; chemolithotrophy; energy from the oxidation of inorganic electron donors; the anaerobic way of life: anaerobic respirations; the anaerobic way of life: fermentations and syntrophy; hydrocarbon oxidation and the role of O2 in the catabolism of organic compounds; nitrogen fixation.

**Methods in microbial ecology.** Culture-dependent analyses of microbial communities; molecular (culture-independent) analyses of microbial communities; measuring microbial activities in Nature.

**Microbial ecology.** Microbial ecosystems; soil and freshwater microbial habitats; marine microbiology; the carbon and oxygen cycles; other key nutrient cycles; microbial bioremediation;
Course outline and aims
This course aims at providing students with an in-depth knowledge of the current view of microbial evolution and systematic, and the continuing roles played by microbes in the environment. Major methodological approaches to environmental microbiology including their powers and limitations will be also discussed.

Learning outcomes
Knowledge to be attained:
- Current views on the origin of life and the evolution of the major microbial taxa
- Current views on metabolic diversity in microbial world
- Special bacteriology: major Bacteria and Archaea taxa
- Microbial ecology: Key roles played by microbes in the aquatic and terrestrial environment including soil structure, element cycles, genesis and breakdown of fossil fuels and contribution to geological processes
- Microbial ecology: Detrimental roles played by microbes in pollution and the beneficial roles played by microbes in wastewater treatment and bioremediation
- Microbial ecology: interactions of microorganisms with other organisms.
- Methods in microbial ecology

Abilities to be attained:
- Culture-based and culture-independent methods in microbial systematic and ecology
- Methods to study microbial phylogeny
- Construction of phylogenetic trees

OBIETTIVI FORMATIVI

METODI DIDATTICI
Learning methods consist of formal lectures and integrative lectures making use of slides and hypertext links to specific Web sites. Outside these activities, the students are expected to read assigned papers from the scientific literature.

MODALITA’ D’ESAME
Oral examination. It is aimed at ascertaining, in proportion:
- The level of theoretical knowledge through the presentation of the program topics (50%)
- The level of practical abilities through description of methods and methodologies (25%)
- The ability to apply theoretical knowledge and practical skills to solve simple problems (25%)

TESTI DI RIFERIMENTO