

PROGRAM OF THE COURSE

Objectives

This course provides the scientific ground of morphology, cytology, physiology, biochemistry, genetics and ecology of microorganisms. In particular the main aspects of metabolism and genetics correlated to the biotechnology are deepened, in order to adequately prepare the students to the following more specialising courses.

Introduction to the course

Historical development of the microbiology
Role of the microbiology in the biotechnology development

Cell morphology and cytology

Evolutionary relationships among prokaryotes (Bacteria and Archea) and with Eukarya.
Morphology, physiology, ecology and taxonomy of fungi. Bacterial morphology and cell structure: wall, capsules and slimes, cytoplasmic membrane, ribosome, reserve materials and other cellular inclusions, genome.
Endospore; spore formation and spore germination.

Microbial nutrition and growth

Nutritional requirements of microorganisms. Lab culture of microorganisms. Enrichment cultures.
Aerobic, facultative anaerobic, microaerophilic, obliged anaerobic bacteria. Relationships between microorganisms and oxygen.
Microbial growth: measurements, growth curve, continuous culture; environmental parameters effects on microbial growth (nutrients, pH, temperature, oxygen etc.).
Physical and chemical antimicrobial control.
Main microscopic techniques

Bacterial genetics

Bacterial genetic elements: chromosome, plasmids and transposons.
Mutations: screening and selection of mutants.
Virus. Bacteriophage: lytic and lysogenic pathways
Horizontal gene transfer among bacteria: transformation, conjugation, transduction.
Bacterial recombinants production
Examples of microbial biotechnologies application

Microbial metabolism

Energetic metabolism. Metabolic strategies and related bacterial groups.
Aerobic respiration of organic compounds; particular metabolic pathways: the oxygenases.
Chemolithotrophy. Anaerobic respiration. Main fermentations (alcoholic, lactic acid and heterofermentations, propionic, formic acid, butyric and butanol fermentations; aminoacid fermentation). Oxygenic and anoxygenic photosynthesis.

Nitrogen fixation and its application

Metabolism regulation

Gene expression regulation in the prokaryotes
Enzymatic activity regulation

Criteria and methods in bacterial taxonomy

Microbial ecology

Biogeochemical cycles and microorganisms involved
Associations among microorganisms, with plants (mycorrhizae, actinorhizae) and with animals (rumen, intestinal tract)

Laboratory course outline

Sterile techniques. Streak-plate, plating, isolation to obtain pure cultures. Enrichment culture. Aerobic and anaerobic cultures. Measurements of microbial growth. Optical observations of wet mount preparations. Staining. Identification of microorganisms by electronic programs .Search for specific microbial groups in environmental samples. Antibigrams

Methods

48 hours lectures, 16 hours laboratory.
One interim examination (see exam procedures).

Language

Italian, with some slides in English

Suggested textbooks:

Brock T.D., Madigan M.D., Martinko J.M., Parker J.: *Biologia dei Microrganismi* vol. 1 e 2. Casa Editrice Ambrosiana, Milano, 2003.

Perry J.J., Staley J. T., Lory S. (2004). *Microbiologia*. Zanichelli, Bologna

W. Sealey, P.Y. Vandermark, J.J. Lee (1995) *Laboratorio di Microbiologia*, Ed. Zanichelli, Bologna

L.M. Prescott, J.P. Harley, D.A. Klein: *Microbiologia*. Ed. Zanichelli, Bologna 1995

Baggi G. et al. (2004). course on line (see web site of the University)

Exam procedures

The exam is divided into three parts: an interim written exam on the first part of the course; a second oral exam at the end of the course on the second part of the course; a report about the lab activities. The final evaluation is based on the results of these three part. At the end of the course the examinations on the two part of the program will be carried out also together.

web pages of the course

<http://ariel.ctu.unimi.it/corsi/portal/user/login.asp>

G. Baggi (2003). **Microbiologia generale e agraria**. Online course on the UNIMI webpage.