# Biology of Microorganisms

## Prof. Edoardo Puglisi

***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

The course aims to provide students with the basic notions of the structure, functions and ecology of microorganisms, with particular attention to those of agricultural, food and environmental interest.

At the end of the course, students will be able to:

* know the structure and function of the cellular components of bacteria, archaea, fungi and viruses;
* know the methods for cultivating microorganisms and for counting their numbers using direct and indirect methods, as well as the main microbial metabolisms;
* know the principles of prokaryotic genetics, transcription and translation replication mechanisms, as well as horizontal gene transfer mechanisms and mutations;
* evaluate methods for the control of microorganisms, both physical and chemical;
* know the main classes of antibiotics and the related resistance mechanisms;
* know the main methods of bacterial and fungal phylogenetic classification and will be able to describe the main microbial groups of agricultural, food and environmental interest;
* possess practical laboratory skills for the isolation, counting and microscopic observation of bacteria, as well as the basic skills for sterile work.

***COURSE CONTENT***

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|  | ECTS |
| The prokaryotic cell: morphology, size, chemical composition and structure.  Movement of the bacterial cell.  Bacterial endospores.  Pure culture, type strain and conservation of bacterial cells.  International collections. | 1.0 |
| Bacterial nutrition: the nutritional groups.  Culture media.  Transport systems.  Bacterial growth, duplication mathematics and counting methods.  Energy metabolism or catabolism.  Biosynthetic metabolism or anabolism. | 1.0 |
| Prokaryotic genetics and chromosome organisation.  Plasmids, insertion sequences and transposons.  Bacteriophages and phage-resistance.  Horizontal genetic transfer systems: transformation, conjugation, translation.  Organisation of the prokaryotic gene. Brief notes on gene regulation. Mutations, the Ames test and mutagenicity. | 1.0 |
| Classical or phenotypic taxonomy. Taxonomy and phylogenesis. Genotypic methods for classification. Bergey's Manual and bacterial systematics. Phylogenetic classification. Bacterial identification methods. Certain microbial groups of agricultural, food and environmental interest. | 1.0 |
| The antimicrobial struggle: principles and mathematics of cellular inactivation.  Physical, chemical and pharmacological agents.  Chemical and physical methods of microorganism control.  Antibiotic resistance. | 1.0 |
| Taxonomy of mycetes with particular attention to yeasts.  The genetics of yeasts.  Sexual reproduction and ecology of mycetes.  Mycetes of agro-food and environmental interest.  Antifungals. | 1.0 |
| Environmental microbiology and microbial ecology: generalities. Association of microorganisms and biofilms. Microbial ecology of food. Role of microorganisms in plant production. Microbial production of bioenergy and biopolymers. | 1.0 |
| Tutorials. Classical microbiology techniques applied to the study of food: sterility, isolation, counts, microscope observations, estimation of the most probable number, indole test, gram staining. | 1.0 |

***READING LIST***

M. Madigan-J.S Martinko, K.S. Bender, D.H. Buckley, D.A. Stahl, *Brock Biologia dei Microrganismi*, 16th edition, Pearson, 2022.

B. Biavati-C. Sorlini, *Microbiologia generale e agraria,* 2nd edition, Casa Editrice Ambrosiana, 2012.

***TEACHING METHOD***

Frontal lectures during which the course topics will be presented and discussed; lectures will be held with the support of PowerPoint presentations, which will be provided to students on Blackboard at the end of each ECTS.

Laboratory tutorials in which students will carry out microbiological analyses on food (milk and yogurt) aimed at counting and isolating microorganisms of interest. An activity is also planned at the Faculty's electron microscopy centre.

***ASSESSMENT METHOD AND CRITERIA***

A final oral exam. In the middle of the course there is also an optional written test covering the first three course ECTS. This test consists of 18 multiple choice questions with a cross, and 6 open-ended questions; the mark for the written test will be out of thirty, with one mark given for each multiple-choice question and two marks for each open-ended question. Should a student pass the written test covering the first 3 ECTS, their mark will remain valid for one year. At the final oral exam, those students who passed the written test will be able to decide whether to keep the mark they obtained for the test, or be questioned on the entire course programme. In the former case, the lecturer will take the average of the written and oral marks.

In assigning the score, the level of knowledge, understanding and connection skills acquired by the student will be assessed with reference to the topics covered. Students must demonstrate an ability to correctly use the language and scientific terminology of the discipline. The final mark will be based on the average of the marks obtained for each of the questions.

***NOTES AND PREREQUISITES***

There are no prerequisites for attending the course, however, students are strongly recommended to acquire some prior knowledge of metabolisms and genetics, as covered in the previous semester's Biochemistry course.

Should the health situation relating to the Covid-19 pandemic not allow face-to-face teaching, remote teaching in synchronous or asynchronous mode will be guaranteed; this will be communicated in good time to students.

Information on office hours available on the teacher's personal page at <http://docenti.unicatt.it/>.