Module 19: Microbiology and Microbiology Laboratory Course
Module code: MIB and MBP
Module coordinator: Prof. Dr. Matthias Mack

Course 1: Microbiology (MIB)
Lecturer: Prof. Dr. Matthias Mack
Status in curriculum: Mandatory course in the 3rd semester BB, Level 2
Language: German
Teaching method: Lecture, 4 teaching units
Required work input: 60 hours course time and 60 hours personal learning
Credit points: 4
Prerequisites acc. to PO: Principles of biology, Molecular Cell Biology
Recommended prerequisites: Organic chemistry (OCG)

Duration and type of examination: Written examination, 120 min (K120)

Learning outcomes and qualification goals:
Microorganisms are the workhorses of biotechnology. Most classical and many modern biotechnological processes use microorganisms for the production of a wide range of industrially relevant molecules such as antibiotics or therapeutic proteins. This module aims to explain to students what microorganisms are, where microorganisms are found in Nature, how they are organized, how they grow and how their growth can be inhibited. The student will understand why microorganisms are so useful for the fermentation industry and which rules and techniques are required to successfully work with these “invisible organisms”. Their metabolic diversity and flexibility will be explained which allows them to survive in often extreme habitats. It will be shown that this makes them extremely interesting for the biotechnology industry, since they are an ideal source for new biocatalysts or “enzymes”. For example the well known Taq-DNA-polymerase, now an indispensable tool of modern biology and medicine, has been isolated from a microorganism living in a 95°C hot spring.

On successful completion of this module, students will be able to:
- Understand the differences between eukaryotic and prokaryotic cell types
- Describe several structural elements of the bacterial cell and explain their function
- Understand microbial cell division and growth
- Outline the major pathways of bacterial metabolism
- Explain the diversity of mechanisms for energy conservation in bacteria
- Understand why microbial degradation is indispensable for the recycling of the elements
- Describe the salient features of selected groups of bacteria
- Describe the action of DNA-polymerases, RNA-polymerase, ribosomes and reverse transcriptase
- Understand the need for regulation of gene expression
- Describe ways in which genetic techniques can be applied to the study of bacteria and applications of these techniques in biotechnology
- Describe uses of bacteria in industrial processes
- Describe basic themes in bacterial infectious disease

Course content:
- General introduction to microorganisms
- Composition and structure of prokaryotic and eukaryotic cells with an emphasis on bacterial cells
- Culture media
- Metabolic diversity: microbial growth and metabolism
- Antibiotics and growth control
- Host-parasite relationships
- Microorganisms in diverse habitats
- Environmental and economic impact of microorganisms
- Bacterial genetics and the molecular biology of bacteria
Learning resources and further reading:

- “Biology of microorganisms”, by Michael T. Madigan, John M. Martinko, and Jack Parker, Prentice Hall
- “Microbiology”, by Daniel Lim, McGraw Hill
- “Allgemeine Mikrobiologie”, by Georg Fuchs, Thieme Verlag.

Course 2: Microbiology Laboratory Course (MBP)

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<tr>
<th>Lecturer:</th>
<th>Prof. Dr. Matthias Mack</th>
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<td>Recommended prerequisites:</td>
<td>Organic Chemistry Laboratory (OCP)</td>
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<td>Duration and type of examination:</td>
<td>Technical performance in the laboratory; protocols to the experiments</td>
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Learning outcomes and qualification goals:
At the end of this course the students:

- Are aware of health and safety relevant aspects of a microbiological laboratory
- Are able to operate a light microscope (bright field and phase contrast microscopy)
- Are able to describe the morphology of different microorganisms
- Are able to work aseptically
- Are able to sterilize working material in a laboratory
- Are able to produce liquid and solid growth media
- Are able to grow aerobic and anaerobic bacteria
- Are able to determine and follow microbial growth
- Are able to enrich and isolate microorganisms from a natural sample
- Are able to characterize an unknown microorganism
- Understand and measure the effects of various antibiotics

Course content:
In this module the students are introduced to the basic techniques of a microbiological laboratory, which are indispensable for biotechnology and modern molecular biology. Although not visible with the unaided eye, microorganisms can be uncovered and characterized by a variety of methods. In addition, the students will learn how to work aseptically, enrich, isolate and grow bacteria from different natural sources and prepare bacterial stock cultures.

- Laboratory safety, disinfection and aseptic techniques
- Enrichment and isolation of endospore-forming aerobic and anaerobic bacteria
- Air-borne contaminants
- Light microscopy of microorganisms
- Colony morphology of bacteria, yeasts and moulds
- Differential staining techniques
- Measurement of growth
- Antibiotics sensitivity testing
- Detection of bacteria in drinking water
- Physiological characterization of microorganisms: the IMViC test

Learning resources and further reading:
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