

Block Course “Microbiology and Immunology” (12273-01, 6 weeks, 15 credit points)

5th semester of the curriculum Bachelor of Biology, requirement for Major in „Molecular Biology“ or „Integrative Biology“.

Lecturers for microbiology and molecular genetics:

Marek Basler, **Dirk Bumann**, Christoph Dehio, Médéric Diard, Knut Drescher, Urs Jenal

Lecturers for immunology:

Jean Pieters, Daniel Pinschewer, Carolyn King

Goals:

The course teaches basic laboratory practices and experimental techniques used in modern molecular microbiology, bacterial genetics, bacterial infection biology, and immunology. Accompanying lectures complement the biological and technical themes.

Biological topics in microbiology, molecular genetics and infection biology (4.5 weeks)

Basic molecular and cellular concepts of

- (i) bacterial cell cycle control,
- (ii) bacterial differentiation,
- (iii) signal transduction and gene regulation in bacteria,
- (iv) bacterial heterogeneity,
- (v) bacterial pathogenesis and subversion of host cellular functions, with emphasis on type-IV and type-VI secretion systems,
- (vi) bacterial swarming and biofilm formation,
- (vii) innate and adaptive immune responses to bacterial infection,
- (viii) industrial microbiology,
- (ix) evolutionary microbiology.

Technical topics in microbiology, molecular genetics and infection biology

Sterile technique, light microscopy, bacterial and bacteriophage growth and titration, specific enrichment of bacteria from the environment, genetic manipulations of bacteria (transposon mutagenesis, general recombination, generalized transduction, mapping of mutations, antibiotic selection, conditional mutations), isolation of DNA, agarose-gel electrophoresis, PCR amplification of a gene, cloning of the gene and expression of the product, protein purification and analysis (SDS PAGE), cell culture and infection of cell lines, monitoring of bacterial invasion, monitoring of apoptosis, resistance to the bactericidal activity of complement, construction of bacterial knock-out mutants, bacterial conjugation, genetic screens, image analysis and data analysis, DNA microarray analyses, RNA isolation and quantitative RT-PCR analysis, green fluorescent protein and immunofluorescence staining and fluorescence microscopy, bacterial cell cycle synchronization techniques, flow cytometry, metabolic radiolabeling, immune-precipitation and immune-blot analysis, bacterial population dynamics in co-cultures.

Biological topics in immunology (1.5 weeks)

- (i) The molecular and cellular concepts for the development of the innate and adaptive immune system.
- (ii) How does the immune system respond to foreign intruders by discriminating between self/non-self.
- (iii) How does the immune system protect against viral infection.
- (iv) How do pathogens interact with and reprogram immune cells.

Technical topics in immunology

Identification of major organs of the immune system of mice by immunohistochemistry. Fluorescence activated cell sorting (FACS) for detection of cell types and antigen-specific T lymphocytes. Quantification of antibodies by enzyme linked immune sorbent assay (ELISA) and neutralization assay. Analysis of pathogen-macrophage interaction; Detection of immune activation status by PCR.