Biology Msc from 2018

Name of the specialization:

Molecular, Immune- and Microbiology (MIMB)

OVERVIEW OF THE FIELD

This specialization covers three scientific areas, which are focusing on the structure and function of biomolecules in living organisms and on the molecular-level chemical processes within the cell (biochemistry/molecular biology), focusing on the defense mechanisms of an organism against antigens and on the mechanisms maintaining its integrity (immunology), and the studies of microscopic-sized organisms (microbiology). These fields have important applied aspects, like molecular medicines, biotechnology, drug research and the bioremediation of contaminated sites. Due to the rapid methodological improvements of the last few decades, more and more significant discoveries were made. These are reflected in the Nobel Prize-winning scientific innovations and findings in the field of chemistry and physiology or medicine (novel therapies against infections, discoveries of molecular regulatory mechanisms and new structural biology techniques, revealing the microbiological background of certain cancer types and other diseases).

TEACHING CONTENT

Within molecular biology, the diverse protein science and its theoretical and methodological background is explained, and additionally, emphasis is put on the practical application of the methodological arsenal of gene technology. The broad course collection of this specialization spans from the molecular mechanisms through the reactions of our body against infections and the pathological immune responses to the introduction of microorganisms adapted to extreme environmental conditions. Highlighted courses in this specialization:

Protein Science: During this course all information are presented that are required for the understanding the relationships among the structure, function and interactions of proteins. Various methods used for in the studies of proteins and the topic ‘proteins as drug targets’ are also presented in the lectures.

Gene Technology Practical: In this practical students will be familiar with the in vitro (cleavage, isolation, ligation) and in vivo steps (making competent cells, transfection, selection and clone identification) of molecular cloning. Students amplify DNA sequences using polymerase chain reaction and finally they produce recombinant fluorescent proteins in bacterial expression systems.

Immunopathology: During the course, those points of the immune system are emphasized where pathological reactions might emerge, which are followed by the topics: inherited and acquired immunodeficiency, different types of immune suppression and hypersensitivity reactions, autoimmune diseases and their systemic and organ-specific forms, immune responses against tumors, various forms of immune therapies and the immunological background of transplantations.

Advanced Practical Course in Immunology I.: The aim of this practical is to introduce the students to some methods based on immunologic reactions, which could be later applied during their studies or after graduation (these methods are also applied in different other

fields for diagnostic, research or therapeutic purposes). Reactions based on antigen-antibody interactions and the separation and characterization of cell populations from blood by flow cytometry are among the most important methods presented.

Trends in Classical and Molecular Bacteriology: In this course, among others the following topics are presented in detail: animal-microbe and plant-microbe interactions, the newest cultivation-based, molecular microbiological and microscopic techniques, microbiology of aquatic habitats and anaerobic environments.

Classical and Molecular Methods in Microbiology: Students will be familiar with the methods suitable for the determination the abundance of microorganisms, identification of taxa and revealing the function of microbes. Recognizing the advantages and disadvantages of different techniques are aided with the introduction both into the classical light microscopic techniques and the latest DNA-based methods.

RESEARCH PERSPECTIVES

Research groups from the three departments offer the highest variety of diploma work topics within the Biology MSc program.

Researchers at the Department of Biochemistry are focusing on the structure and function of motor proteins (myosins, helicases), amyloid protein aggregates, proteases of complement pathways, protein-protein interactions, and the so-called linear binding motifs of intrinsically disordered proteins. Besides basic research, several applied studies are going on, such as drug design.

Researchers of the Department of Immunology study the cellular elements of innate immune system, the complement system, the molecules regulating the complement system, the regulation and diversity of humoral immune response in healthy individuals and autoimmune patients (e.g. rheumatoid arthritis). Besides bioinformatic analyses, the most up-to-date immuno-biotechnological tools are applied, e.g. flow cytometry, confocal microscopy, surface plasmon resonance and next-generation sequencing. The diverse connection with the pharmaceutical industry provides opportunity to gain insight into the most recent immuno-biotechnological innovations.

Research areas of members of the Department of Microbiology cover the environmental microbiology in its broadest sense. They apply the classical (cultivation-based) and the most recent molecular methods to answer questions related to microbial ecology (what kind of microbes are living in a certain habitat, what is their activity and how they are organized into communities). Besides the ecological questions focusing on the surrounding environments, studies related to applied microbiology and species descriptions are also carried out.

TEACHERS AND RESEARCHERS

Department of Biochemistry

Zsuzsanna Dosztányi performs studies on intrinsically disordered proteins and protein structures using mainly bioinformatic tools. She draws special attention on the so-called linear binding motif-based protein-protein interactions.

József Kardos's research area is the structure of amyloid protein aggregates and the proteomics of the complement system in the brain.

Mihály Kovács works with molecular motors, studies the structure and function of myosins and DNA helicases, molecular mechanisms of DNA recombination and performs myosin-based drug design.

András Málnási Csizmadia studies motor proteins, the structure and function of myosins, performs the development of the microscopic cell biology method 'molecular tatooing' and myosin-based drug design.

László Nyitray studies mainly protein-protein interactions in signalizations using biochemical, biophysical, cell biology and structural biology methods.

Gábor Pál studies the proteases of complement pathways and their inhibition using biochemical, enzymology and directed evolution methods, he also performs protease-based drug design studies.

Department of Immunology

Zsuzsa Bajtay studies the effect of the most important humoral part of the innate immune system, the effects of complement proteins on the differentiation and function of phagocytes (phagocytosis, adherence, migration, podosome formation).

Anna Erdei studies the linkage between innate elements and adaptive immunity. The regulation of B lymphocyte activation by complement system proteins and *Toll-like* receptors is in the center of her studies. Besides the B cells of healthy persons, her studies also cover the B cells of patients with autoimmune diseases or lymphocytic leukemia.

Mihály Krisztián Józsi's research interest covers physiological and pathological roles of the complement system. He focuses on the regulation of the alternative complement activation pathway and on the structure and function of complement-regulating factor H molecule and related proteins.

Imre Kacskovics analyses the diversity of the humoral immune response in healthy individuals and autoimmune patients, furthermore he performs antibody-based drug design. He applies the most up-to-date tools of molecular and cell biology in his research, most recently next-generation sequencing supplemented with bioinformatic analyses.

Gabriella Sármay focuses on deciphering the role of B cells in immune response. Her major research area is revealing the molecular and cellular interactions of B lymphocytes. She studies the mechanisms regulating B cells, the mechanisms regulated by B cells and the role of B cells in autoimmune diseases.

Department of Microbiology

Andrea Borsodi's research area includes revealing the bacterial diversity of various aquatic habitats, she studies the microbiology of hypogenic karst systems, microbial communities of extreme environments and the composition of different biofilm and rhizosphere communities.

Tamás Felföldi's main research area is the microbial ecology of aquatic habitats: he studies the planktonic microbial communities of soda and saline lakes and prokaryotic microorganisms of wastewater treating bioreactors. Additionally, he describes new bacterium, alga and enchytraeid species.

Judit Makk studies bacteria which are adapted to radioactive environments and performs analyzes on biofilm samples using electron microscopy. These studies are supplemented with the description of new species.

Károly Márialigeti's research interest covers environmental microbiology and microbial ecology. Among others he develops environmental biotechnologies and deals with the application of inoculants used for increasing the yield of agricultural plants. He also focuses on the biological treatment of environmental pollutions and the biological treatment of different wastewaters.

Erika Tóth's main research area is bacterial taxonomy and revealing the diversity of oligotrophic environments (e.g. spas, springs). She describes new bacterial species with the aid of medium design, and additionally she studies the potential application of chemotaxonomic methods in environmental microbiology.

Balázs Vajna's research areas are the followings: microbiological background of mushroom production, studies on fungal-bacterial interactions, the role of fungi in the adaptation of climate change, multivariate and statistical analysis of microbiological data series.

CARRIER OPPORTUNITIES

Graduated students could continue their studies in PhD schools in the fields of protein science, immunology and environmental microbiology. However, there are possibilities to find positions in applied science, which includes pharmaceutical research (mainly biological drugs), research and development in biotechnology (practically all fields of biotechnology), and additionally diagnostic companies and governmental organizations (e.g. National Institute of Pharmacy and Nutrition) also search for new staff members.