Research topics for undergraduate students in the Biological Research Centre for the academic year of 2025-2026

Characterization of protein posttranslational modifications using mass spectrometry
Zsuzsanna Darula (Laboratory of Proteomics Research)

Protein-protein interaction analysis by mass spectrometry
Aladár Pettkó-Szandtner (Laboratory of Proteomics Research)

Pattern recognition in biological macromolecules
Zoltán Hegedűs (Bioinformatics Laboratory)

Bioinformatic evaluation of NGS sequencing data
Zoltán Hegedűs (Bioinformatics Laboratory)

Investigation of hierarchically ordered structures with differential-polarization laser scanning microscopy.
Gábor Steinbach (Cellular Imaging Laboratory)

Studying structure-function relationship of ion-pumping rotational membrane proteins using state-of-the-art molecular biophysical methods
Krisztina Sebők-Nagy and Tibor Páli (Institute of Biophysics)

Determining the structure of membrane proteins using combined machine learning (artificial intelligence) and molecular mechanics methods
Teruaki Koto and Páli Tibor (Institute of Biophysics)

Biophysics of biological and model membranes: a spectroscopic approach
Tibor Páli (Institute of Biophysics)

Examination of free radicals and free radical reactions in biological samples and food products
Tibor Páli (Institute of Biophysics)

Integrated optical devices in biology: biosensors, protein based optoelectronical devices
Sándor Valkai and András Dér (Institute of Biophysics)

Construction of microfluidic devices and their utilization in biophysical applications
Sándor Valkai and András Dér (Institute of Biophysics)

Development and fabrication of polymer microtools for biological applications
Lóránd Kelemen (Institute of Biophysics)

Application of optical tweezers in biology
Lóránd Kelemen (Institute of Biophysics)

Development of a new, induced pluripotent stem cell-based lab-on-a-chip system to model brain pathologies and drug delivery
Fruzsina Walter and Mária Deli (Institute of Biophysics)

Effect of ecdysteroids on the Blood Brain Barrier
Ana Martins and Mária Deli (Institute of Biophysics)

Laboratory evolution of antibiotic-producing bacteria in the presence of antibiotic-resistant pathogens
Ana Martins (Institute of Biophysics)

Molecular bases of neurovascular functions
István Krizbai (Institute of Biophysics)

Role of the blood-brain barrier in the formation of brain metastases
Imola Wilhelm and Csilla Fazakas (Institute of Biophysics)

Molecular characteristics of the brain metastatic microenvironment
Imola Wilhelm (Institute of Biophysics)

Role of pericytes in neurovascular functions
István Krizbai and Imola Wilhelm (Institute of Biophysics)

Studying the neurovascular unit with two-photon microscopy
Attila Elek Farkas (Institute of Biophysics)

Restoration of cerebrovascular functions during aging
István Krizbai and Attila Elek Farkas (Institute of Biophysics)

Studying bacterial communication by microfluidic techniques
Péter Galajda, Krisztina Nagy (Institute of Biophysics)

Assembly and development of microbial communities in microfluidic chips
Péter Galajda, Krisztina Nagy (Institute of Biophysics)

Studying bacterial cells by optical tweezers
Péter Galajda, Krisztina Nagy (Institute of Biophysics)

Studying bacteria on single-cell level in microfluidic devices
Krisztina Nagy, Ágnes Ábrahám (Institute of Biophysics)

Integration of photosynthetic reaction centres into bio-hybrid photovoltaic systems
Petar Lambrev and Melinda Magyar (BRC Institute of Plant Biology)

Evolutionary Diversity of Light-Harvesting Complexes as a Resource for Photosynthetic Optimization
Petar Lambrev (BRC Institute of Plant Biology)

Mechanisms and dynamics of the ultrafast processes in photosynthesis
Petar Lambrev (BRC Institute of Plant Biology)

Electric current production by green algae
Szilvia Z. Tóth and Nia Petrova (Institute of Plant Biology)

Photosynthetic hydrogen production by green algae
Szilvia Z. Tóth and Valéria Nagy (Institute of Plant Biology)

Investigation of phosphate and ascorbate transporters in plants
Szilvia Z. Tóth (Institute of Plant Biology)

Investigation of stress adaptation of microalgae
Bettina Ughy (Institute of Plant Biology)

Investigation of bacterial growth at the individual and population level
Bettina Ughy (Institute of Plant Biology)

Identification and functional analyis of plant genes involved in symbiotic nitrogen fixation.
Péter Kaló, János Barnabás Biró, Szilárd Kovács (Insitute of Plant Biology)

Functional study of symbiotic genes, proteins and peptides
Gabriella Endre (Institute of Plant Biology)

Investigation of the effect of isolated *Rhizobium* and soil bacteria on plants under abiotic stress
Gabriella Endre (Institute of Plant Biology)

Scenes from a (bad) marriage: How legume plants choose their symbiotic partners from the soil microbiome containing plenty of eligible rhizobia?
Attila Kereszt (Institute of Plant Biology)

Role of plant antimicrobial peptides in the selection and control of the bacterial partners in the course nitrogen-fixing symbiosis
Attila Kereszt (Institute of Plant Biology)

Development and adaptation of methods to modify the genome and expression pattern of nitrogen-fixing rhizobia
Attila Kereszt (Institute of Plant Biology)

Salt tolerance and adaptation studies on green algae. Molecular mechanisms of salt tolerance.
Gergely Maróti (Institute of Plant Biology)

Investigation of natural and synthetic algal-bacterial communities, interactions. Including utilization studies in bioenergy generation and wastewater treatment.
Gergely Maróti (Institute of Plant Biology)

Development of automated single-cell microdissection systems
Péter Horváth (Institute of Biochemistry)

Development of deep learning algorithms for single-cell segmentation and classification in microscopic images
Péter Horváth (Institute of Biochemistry)

Molecular analysis of human mitotic cells
Vivien Miczán, Péter Horváth (Institute of Biochemistry)

Antibiotic resistance in microbes
Csaba Pál (Institute of Biochemistry)

Evolution of human immune system in response to pathogens
Csaba Pál (Institute of Biochemistry)

Effect of food additives on the human gut microbiome
Csaba Pál (Institute of Biochemistry)

Self-similarity and immunogenicity
Máté Manczinger (Institute of Biochemistry

The role of HLA molecules in antitumor immunity

Máté Manczinger (Institute of Biochemistry

Microbial evolutionary experiments in the laboratory
Zoltán Farkas (Institute of Biochemistry)

High-throughput laboratory experiments and their bioinformatic analyses
Zoltán Farkas (Institute of Biochemistry)

Bioinformatic investigation of species-specificity / repeatability / global biogeography of antibiotic resistance mechanisms
Zoltán Farkas (Institute of Biochemistry)

Studying protein stability in mammalian cell cultures
Zoltán Lipinszki (Institute of Biochemistry)

Heterologous expression and purification of recombinant proteins for immunological assay
Zoltán Lipinszki (Institute of Biochemistry)

Exploring new strategies against genotoxin-producing gut pathogens
Viktória Lázár (MTA-SZBK Lendület "Momentum" Systems Biology of Antibiotic Action Research Group, Institute of Biochemistry)

Single cell based bacterial virulence analysis via *in vitro* human cell based infection models
Viktória *Lázár (MTA-SZBK Lendület "Momentum" Systems Biology of Antibiotic Action Research Group, Institute of Biochemistry)*

Structural analysis of antifungal proteins with experimental and theoretical methods
Attila Borics (Institute of Biochemistry)

Investigation of the signaling mechanism of transmembrane receptor proteins
Attila Borics (Institute of Biochemistry)

Development and characterization of novel functionally selective dualsteric cannabinoid receptor 1 (CB1R) compounds for the treatment of alcohol and cannabinoid use disorders
Szabolcs Dvorácskó (Institute of Biochemistry)

Development of cannabinoid receptor 1 (CB1R) peptidic allosteric modulators (pepcans) against illicit synthetic cannabinoids toxicity and metabolic disorders
Szabolcs Dvorácskó (Institute of Biochemistry)

Toxicological and pharmacological evaluation of designer thc derivatives: scientific investigation of the mechanisms underlying their adverse effects for forensic purposes
Szabolcs Dvorácskó (Institute of Biochemistry)

Investigating the antibacterial potential of cannabinoids
Viktória Lázár and Szabolcs Dvorácskó (Institute of Biochemistry)

Repurposing opportunities of sigma receptor ligands in drug development
Szabolcs Dvorácskó (Institute of Biochemistry)

The extracellular vesicles and protein corona in shaping innate immune responses: integrated omics analysis and functional assays
Gabriella Dobra (Institute of Biochemistry)

Mapping the dynamics of vesicular communication in 2D and 3D tumor models
Mária Harmati (Institute of Biochemistry)

High-throughput drug screening in multicellular 3D tumor models by AI-driven single-cell analysis
Mária Harmati (Institute of Biochemistry)

Development of an AI-assisted diagnostic framework for kidney pathology
Mária Harmati (Institute of Biochemistry)

The relationship between the microbiome and cancer development in human cell model
Szilvia Juhász, BRC Institute of Biochemistry and HCEMM Hungarian Center

In vivo and *in vitro* studies on formin function
József Mihály (Institute of Genetics)

Identification and characterization of myofibrillar actin regulatory proteins
Szilárd Szikora (Institute of Genetics)

Investigation of myofibril organisation with single molecule localization microscopy
Szilárd Szikora (Institute of Genetics)

Studies on the role of Cyclase-associated protein (CAP) during sarcomerogenesis
Szilárd Szikora (Institute of Genetics)

Investigation of intracellular mechanisms affecting somatic LINE1 retrotransposition
Lajos Mátés (Institute of Genetics)

The mechanism of LC3-associated phagocytosis in *Drosophila* glia
Áron Szabó (Institute of Genetics)

Molecular mechanisms of synapse pruning
Áron Szabó (Institute of Genetics)

Production of organoid cultures from human pluripotent stem cells
Melinda Pirity (Institute of Genetics)

Generation of fluorescently labelled mouse stem cell lines for cell fate tracking
Melinda Pirity (Institute of Genetics)

Analysis of cell death signalling pathways in mouse and human stem cells
Melinda Pirity (Institute of Genetics)

The role of ADP ribosylation in cell cycle regulation"
Roberta Fajka-Boja (Institute of Genetics)

Analysis of blood cell transdifferentiation in *Drosophila melanogaster*
Erika Gábor (Institute of Genetics)

Modeling blood cell originated tumors in *Drosophila melanogaster*
Viktor Honti (Institute of Genetics)

Analysis of the therapeutic possibilities of blood cell originated tumors
Zsanett Takács (Institute of Genetics)

Studying extracellular matrix degradation mechanisms in *Drosophila*
Gábor Csordás (Institute of Genetics)

Characterization of *Drosophila* extracellular matrix-immune cell interactions
Gábor Csordás (Institute of Genetics)

Regulation of mutagenesis in yeast
Ildikó Unk (Institute of Genetics)

Role of polyubiquitylation in DNA damage tolerance
Ildikó Unk (Institute of Genetics)

Investigation of yeast genome structure using CRISPR-Cas technique
Zsuzsanna Győrfy (Institute of Genetics)

Role of DNA polymerases in genome stability
Éva Bálint (Institute of Genetics)

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