

Opis przedmiotów fakultatywnych na kierunku Biologia I stopnia specjalność Medical Biology oferowanych w roku akademickim 2024/2025

Medical Virology (lecture, B-BF.44)

a. prof. dr hab. Agnieszka Szuster-Ciesielska

b. summer, 15 godz., 1 ECTS

c. none

d. written test

e. Classification and origin of viruses. Basic definitions and concepts regarding the structure and replication of viruses. Genetic diversity of viruses and their variability. Viral infection of the body – pathogenesis. Mechanisms of body immunity in viral diseases; latent infections. Characteristics of the most influential families of DNA and RNA viruses pathogenic to humans and animals - epidemiology of viral infections, zoonoses, and teratogenic viruses. The problem of eradication of viruses – Poxviridae and Picornaviridae. Viruses and cancer. Prevention of viral infections – vaccines and antiviral drugs.

Honeybees as a source of medicinal active substances and bee products as functional food (lecture, B-BF.45)

a. dr hab. Aneta Ptaszyńska, prof. UMCS

b. summer, 30 godz., 2 ECTS

c. basic knowledge of zoology

d. project prepared individually

e. Honeybees (*Apis mellifera*) play a pivotal role in the production of a range of bee-derived products recognized not only for their nutritional value but also for their therapeutic properties. These products, including honey, propolis, royal jelly, bee pollen, and bee venom, have been harnessed in various traditional medicine systems across the globe and are increasingly studied for their functional food potential and pharmacological benefits. The diverse pharmacological activities of bee products make them valuable in both traditional and modern medicine, offering promising alternatives and supplements to synthetic pharmaceuticals. As research continues to uncover the mechanisms behind their benefits, bee-derived products are expected to play an increasingly significant role in health promotion and disease management strategies.

The aim of this course is to familiarize students with honeybee as a source medicinal active substances and bee products as functional food. Additionally, students will have practical training concerning classification of honeys, pollen and beebread analysis, and also bee venom sac preparation.

Insects in biomedical studies (lecture, B-BF.46)

a. mgr Michał Sułek

b. summer, 15 godz. 1 ECTS

c. none

d. Project prepared in groups – a PowerPoint presentation on a chosen issue in insect biotechnology that was not discussed during the lecture series. Emphasis on creativity and independent scientific description of selected topics of interest (e.g. use of transgenic insects in agriculture, insects in the food industry, innovative drugs for pollinators, etc.)

e. Introduction to insect immunobiology – issues related to the immunological system, biodiversity, evolutionary success of insects. *Drosophila melanogaster* as a model organism – features, history of the most important research that contributed to a better understanding of, among others, human immunology (Nobel prizes for work on *Drosophila* in 1933, 1946, 1995, 2004, 2011, 2017). *Galleria mellonella* as a model organism - features, applications, practical aspects of working with the greater wax moth. The use of *G. mellonella* larvae in

biomedical research. *Galleria mellonella* as a research model in the phenomenon of immune priming and a source of antimicrobial peptides (AMPs). The phenomenon of immune priming (immunological "memory" of invertebrates). Research history; scenarios for inducing immunological memory; the phenomenon of trans-generational immune priming. Immune priming as an analogue of trained memory in vertebrates. An introduction to the issue; discussion of potential mechanisms; new research trends. Insects as a source of AMPs. What are antimicrobial peptides; mechanism of action; AMPs as new generation antibiotics; advantages and disadvantages/limitations of using antimicrobial peptides as biomedical agents; drugs approved for use and currently ongoing clinical trials. Application of insect cell lines in the recombinant protein industry. Introduction to the issue of cell lines and working with cell cultures; specification of selected insect cell lines; the use of viral vectors in the production of recombinant proteins (*baculovirus expression vector system*); advantages and disadvantages/limitations in the use of insect cell lines.

Graphical image analysis in biology and Medicine (lecture, B-BF.47)

a. dr hab. Piotr Dobrowolski, prof. UMCS

b. summer, 15 godz., 1 ECTS

c. none

d. project prepared in groups

e. Biomedical image acquisition: microscopy, ultrasonography, computed tomography, magnetic resonance imaging; image recording formats; 2D and 3D images; analysis using dedicated software; image analysis using free open source software; Examples of ImageJ application and its development; image scale and calibration; planimetric measurements; image segmentation methods; textural analysis; automation of graphic analysis; construction of macro commands and scripts; basic programming languages in graphic analysis; plug-ins as additional analysis tools; and use and construction of basic neural networks in graphic image analysis.

Recommended literature: The image processing handbook. John C Russ, F. Brent Neal. CRC Press, 7th ed. 2016

<https://imagej.net/software/fiji/>

Electron and confocal microscopy (laboratory, B-BF.48)

a. dr Justyna Kapral-Piotrowska

b. summer, 30 godz., 2 ECTS

c. none

d. project prepared in groups

e. Construction, principle and working of the transmission and scanning electron microscope. Preparation of samples for transmission electron microscopy (TEM): fixation, dehydration, embedding, trimming of blocks, cutting ultra-thin sections, staining. Preparation of samples for scanning electron microscopy (SEM): fixation, dehydration, drying, sputter coating. Observation of specimens using transmission and scanning electron microscope. Construction, principle and working of confocal microscopy. Staining of apoptotic, necrotic and autophagic cells.

Recommended literature:

Electron Microscopy: A Brief History and Review of Current Clinical Application, 2014, Ronald E. Gordon

Transmission Electron Microscopy, 2009, David B. Williams , C. Barry Carter

Electron Microscopy: Principle, Components, Optics and Specimen Processing, 2018, Pranab Dey

Methods of Preparation for Electron Microscopy, 1987

Confocal Microscopy: Principles and Modern Practices, 2020, Amicia D. Elliott

Fluorescence methods in cell research (laboratory, B-BF.49)

a. dr Joanna Strubińska

b. summer, 15 godz., 1 ECTS

c. none

d. written test

e. Cell analyses based on fluorescence. Specific requirements for carrying out and documenting UV/VIS fluorescence observations and measurements (types of tracers, glass, photobleaching, etc.). Fluorescence analyses of cellular structures and processes using fluorophores, e.g. membrane tracers, pH-sensitive fluorophores, ion indicators etc. Principles of selection and application of fluorescent markers based on catalogues, databases and spectrum viewers (adaptation of markers to the labelling target, excitation and emission conditions, fluorescence properties of the sample and other fluorophores used simultaneously). Comparison of the effects of selected fluorescent tracers in microscopy and spectrofluorimetry (qualitative and quantitative results of the fluorophore experiment).

Spectroscopic methods in cell research (laboratory, B-BF.50)

a. dr hab. Ewa Janik-Zabrotowicz

b. summer, 15 godz., 1 ECTS

c. none

d. evaluation of lab reports

e. Overview of the possibilities of spectroscopic methods (UV/Vis absorption spectroscopy, spectrofluorimetry and infrared absorption spectroscopy) in quantitative and qualitative analysis of cells; Chemical mapping of tissues and cells; Investigation of changes in cell chemistry in control/test or normal/pathological systems based on spectral analysis; Determination of molecular organisation (monomer, dimer, aggregate) of bio-molecules; Analysis of purity of selected biologically active compounds used e.g. in medicine (anticancer, antifungal), cosmetology, food industry and agriculture.

Applications of plant *in vitro* cultures in biomedicine (laboratory, B-BF.51)

a. dr Kinga Lewtak

b. summer, 30 godz., 2 ECTS

c. none

d. final test

e. In vitro culture methodology: equipment, materials, sterilisation, media, growth regulators. Induction of *in vitro* plant organogenesis and embryogenesis as a method of preserving valuable genotypes. Micropropagation techniques of therapy/valuable plants that allows circumvention of physiological reproduction barriers e.g. isolation and culture of zygotic embryos, in vitro pollination. Extraction of biologically active secondary metabolites from callus cultures on solid media and in suspension. Methods of storing plant cultures including cryopreservation technology and artificial seed formation.