UNIVERSITY OF WARMIA AND MAZURY IN OLSZTYN

Faculty of Biology and Biotechnology

Course title: APPLIED MULTIOMIC

ECTS credit allocation (and other scores): 6

Semester: autumn

Level of study: ISCED-7 - second-cycle programmes (EQF-7)

Branch of science: Natural sciences

Language: English

Number of hours per semester: 120 h.

Course coordinator/ Department and e-mail: prof. dr hab. Nina Smolinska, Department of Animal Anatomy and Physiology, nina.smolinska@uwm.edu.pl; dr hab. Elżbieta Łopieńska-Biernat, prof. UWM, Department of Biochemistry, ela.lopinska@uwm.edu.pl; prof. dr hab. Lesław Lahuta, Department of Plant Physiology, Genetics and Biotechnology, lahuta@uwm.edu.pl; prof. dr hab. Jakub Sawicki, Department of Botany and Evolutionary Ecology, Jakub.sawicki@uwm.edu.pl

Type of classes: classes and lectures

Substantive content

CLASSES: Principles of omics research planning and selection of optimal research methods. Practical application of omics analysis in planning a scientific project and conducting a research experiment on selected biological material. Review the literature and select omics research methods, including modern techniques and analytical platforms and databases. Verification of data based on pattern analysis. The student will conduct the project independently and present their findings. Collects, develops, analyzes, interprets (in relation to literature data), and presents the results of experimental studies. Learns examples of large-scale omics analyzes of prokaryotic and eukaryotic organisms at different levels - whole organisms, selected organs, tissues, body fluids.

LECTURES: Genomics, transcriptomics, proteomics and metabolomics - concepts and definitions. History and strategies of omics research. Analytical techniques and platforms. Databases. Genomic libraries. Mass spectral libraries. Standardization in omics research. Data processing, analysis, visualization and storage. Validation of omics data. Examples of multiomics studies of microorganisms, plants and animal tissues and body fluids. Multiomics in biological research and medical diagnostics.

LEARNING PURPOSE: The student acquires knowledge of genomics, transcriptomics, proteomics and metabolomics. The student acquires the ability to practically apply omics analyzes in the planning of a scientific project and the execution of a research experiment on selected biological material. The student will review the literature and select an omics research methodology, including modern analytical techniques and platforms and databases. The student will learn examples of large-scale omics analysis of prokaryotic and eukaryotic organisms at different levels - whole organisms, selected organs, tissues, body fluids. Verifies data based on pattern analysis. The student carries out the project independently and presents his/her results. Collects, develops, analyzes, interprets (in relation to literature data) and presents the results of experimental studies.

On completion of the study programme the graduate will gain:

KNOWLEDGE: the student knows the concepts and definitions of genomics, transcriptomics, proteomics and metabolomics, strategies for omics research and their advantages/limitations; databases and examples of multi-omics analyzes of microorganisms and animals in relation to phenotypic traits and physiological responses to environmental factors; the complexity of interactions between the genome, transcriptome, proteome and metabolome of an organism and the importance of large-scale omics analyzes for systems biology.

SKILLS: the student can prepare biological material, perform a multi-omics experiment, check the accuracy of the identification of genes, proteins and metabolites, perform quantitative calculations, interpret the results in relation to literature data; present the course and results of the experiment in the form of a presentation and a poster report.

SOCIAL COMPETENCIES: the student is prepared to verify information from literature sources; to follow the rules of working with biological material; constantly update his/her knowledge, to disseminate the principle of rigorous interpretation of biological phenomena and processes based on empirical data.

Basic literature: 1. Simó C., Fundamentals of advanced omics technologies: from genes to metabolites, Oxford: Elsevier, 2. Principles of Genome Analysis and Genomics" by Sandy B. Primrose and Richard Twyman, Wiley-Blackwell, 2006 3. RNA-Seq Data Analysis: A Practical Approach" by Eija Korpelainen, Jarno Tuimala, Panu Somervuo, Mikael Huss, and Garry Wong, CRC Press, 2014 4. Computational Methods for RNA Sequencing Data Analysis" edited by Mingxiang Teng, Springer, 2017 5. Mass Spectrometry-Based Proteomics" by Jonas A. Nilsson, Springer, 2015 6. Introduction to Metabolomics: From Metabolite Profiling to Metabolic Networks" by Robert D. Hall, Springer, 2011. 7. Any authors, Selected scientific publications on the subject 2014-2024

Supplementary literature: 1. Multi-Omics for the Understanding of Human Diseases" by José Luis García-Giménez, Academic Press, 2018.

The allocated number of ECTS points consists of:

Contact hours with an academic teacher: 122 h.

Student's independent work: 28 h.