

Subject card

Subject name and code	Biomolecules - structure, synthesis and properties (M02_B1), PG_00153663						
Field of study	Biotechnology						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2025/2026		
Education level	Bachelor's studies		Subject group		Obligatory subject group in the field of study Subject group related to scientific research in the field of study		
Mode of study	full-time studies		Mode of delivery		at the university		
Year of study	1		Language of instruction		Polish		
Semester of study	2		ECTS credits		5.0		
Learning profile	academic		Assessment form		exam		
Conducting unit							
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. Katarzyna Węgrzyn				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	78.0	0.0	0.0	0.0	0.0	78
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	78		0.0		47.0	125
Subject objectives	Program block 01 in Module 02 aims to provide detailed knowledge about the structure and properties of biomolecules (such as active low- and medium-molecular-weight compounds as well as proteins, nucleic acids, sugars and lipids) that create more complex biological systems, cellular compartments. By completing the program block, the student will gain detailed knowledge about the synthesis of biomolecules. The student will also gain knowledge related to the use of biomolecules' isolation methods and their biochemical, biophysical and bioinformatic analysis.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[BIOTECHL3_W07] The graduate knows and understands basic techniques and research tools used in biotechnology.		Student has knowledge about the synthesis of biomolecules. The student has also knowledge related to the use of biomolecules' isolation methods and their biochemical, biophysical and bioinformatic analysis.		[SW4] test/exam - oral or written		
	[BIOTECHL3_W01] The graduate knows and understands basic biological phenomena at the molecular level, he/she is familiar with their significance for biotechnology.		Student has knowledge about the structure and properties of biomolecules (such as active low- and medium-molecular-weight compounds as well as proteins, nucleic acids, sugars and lipids) that create more complex biological systems, cellular compartments.		[SW4] test/exam - oral or written		

Subject contents	F1. Introduction		
	• Compounds C, H, O, N, P, and S as the basis of life on Earth, primary synthesis • Core structures of simple biomolecules and their derivatives • Structures composed of simple repeating units • Main families of chemical compounds and connections between compounds from different families		
	F2. Carbohydrates		
	• Structure of simple and complex sugars (homo- and heteroglycans) • Transformations of simple sugars • Synthesis of complex sugars		
	F3. Nucleic Acids		
	• Structure of nitrogenous bases, nucleosides, and nucleotides, glycosidic and phosphoester bonds • Structure of oligonucleotides and nucleic acids, anhydride bonds of phosphoric acid, peptide analogs of nucleic acids, synthesis of oligonucleotide probes • Interconversions of nucleic acids, levels of genetic information transfer • Components of DNA, base pairing, tautomeric forms, B-helix shape, sequence recognition, DNA topology • Components of RNA, differences in spatial structure, spatial structures • DNA synthesis, replication models • Chromosome segregation • Replication forks, direction of DNA synthesis • <i>E. coli</i> polymerases • DNA helicase, topoisomerase, gyrase, SSB protein, polC holoenzyme, beta clamp • Coordination of leading and lagging strands, removal of Okazaki fragments, initiation at oriC, decatenation • Mutations, mutagens, DNA polymerase slippage • DNA repair systems • Emergency replication, homologous recombination, site-specific recombination • RNA synthesis • Linking transcription and translation via ppGpp • Synthesis and processing of rRNA and tRNA • Antibiotics inhibiting the replication process		
	F4. Proteins		
	• Structure of amino acids, peptide bond, oligopeptides • Protein structure (primary, secondary, tertiary, and quaternary structure); modular structures of proteins • Protein synthesis • Post-translational modifications of proteins • Proteins degradation in a cell		
	F5. Lipids		
	• Structure and biosynthesis of fatty acids • Modifications of fatty acids • Structure and biosynthesis of phospholipids, glycolipids, and triacylglycerols • Structure and biosynthesis of sphingolipids, ether lipids, suberin, cutin, and waxes • Structure and biosynthesis of cholesterol and plant isoprenoids		
	F6. Analysis of Biomolecules methods		
	• Chromatographic methods • Methods used in the analysis of nucleic acids and proteins • Methods used in the analysis of lipids • Databases and basic bioinformatics methods		
Prerequisites and co-requisites			
Assessment methods and criteria			
	Subject passing criteria	Passing threshold	Percentage of the final grade
	Integration exam	50.0%	40.0%
	F1-F6	51.0%	60.0%

Recommended reading	Basic literature	• Biochemistry, The Chemical Reactions of Living Cells. David E. Metzler, vol. 1 & 2. Second Edition, Elsevier, Academic Press, 2004 • Biochemistry, J.M. Berg, J.L. Tymoczko, L. Stryer, Scientific Publishing House PWN, Warsaw 2013 • LIPIDS - Chris Somerville, John Browse, Jan Jaworski, John Ohlrogge. In: Biochemistry & Molecular Biology of Plants. B. Buchanan, W. Gruissem, R. Jones, Eds. 2000, American Society of Plant Physiologist, Rockville, Maryland, USA (or 2nd edition, ISBN: 978-0-470-71421-8; Published 2015 by John Wiley & Sons, Ltd) • Plant Physiology. J. Kopcewicz and S. Lewak, Eds. 2002. Scientific Publishing House PWN Warsaw • Molecular Cell Biology, Lodish et al., edition IX (2021) • Molecular Biology of the cell, Alberts et al., edition VII (2022) • Genomes, A.T. Brown, edition IV (2018), PWN • Molecular Biology of the Gene, Watson et al., 7th edition (2014) • Genes XI, Lewin, 11th edition (2014)
	Supplementary literature	• Molecular Genetics, Węgleński et al., 6th edition (2012), PWN • Molecular Biology of Bacteria, Baj and Markiewicz, 1st edition (2012), PWN • Essential Cell Biology, Alberts et al., 2nd edition (2005), PWN • Principles of Biochemistry, Lehninger, 5th edition (2008) • Molecular Cloning, Sambrook and Russel, 4th edition (2012) • Molecular Cloning - A Laboratory Manual by Sambrook, Fritsch, and Maniatis • Molecular Cloning - A Laboratory Manual. 4th edition, (2012) Green, Sambrook • Materials prepared by the instructor • Materials independently searched and selected by students related to the classes using library resources and electronic sources
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	

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