



Subject card

Subject name and code	MOLECULAR GENETICS, PG_00065568						
Field of study	Biotechnology						
Date of commencement of studies	October 2026	Academic year of realisation of subject			2027/2028		
Education level	second-cycle studies	Subject group			Optional subject group Specialty subject group 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	2	Language of instruction			Polish		
Semester of study	3	ECTS credits			3.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Faculty of Chemistry -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Beata Zalewska-Piątek					
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	0.0	15.0	45
	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	45	5.0		40.0	90	
Subject objectives	The aim of the course is to familiarize yourself with the basic mechanisms of genome functioning, the regulation of their activity and inheritance, and the methods used to analyze the structure and function of genes, their deactivation and the effects of mutational changes.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K7_K02] is aware of the potential risks and opportunities associated with the development of science and technology for the natural environment and society	The student identifies and evaluates the possible consequences of the development of molecular genetics and related technologies for the natural environment and the functioning of society, taking into account ethical and social aspects.			[SK5] Assessment of ability to solve problems that arise in practice		
	[K7_W01] defines the phenomena, processes and laws of living nature applied to the production of useful goods and the carrying out of services	The student defines the basic molecular phenomena and processes related to the functioning of the genome and analyzes methods of their use in biotechnology and services based on biological knowledge.			[SW3] Assessment of knowledge contained in written work and projects		
	[K7_U08] prepares documentation of experiments and technological processes using professional terminology in biotechnology and related fields	The student analyzes the functional annotation documentation of genes using available biotechnological methods, using appropriate specialized terminology.			[SU1] Assessment of task fulfilment [SU5] Assessment of ability to present the results of task [SU3] Assessment of ability to use knowledge gained from the subject		

Subject contents	<p>Course content – lecture Genes as carriers of genetic information, the concept of the genome. Eukaryotic genomes. The physical structure of nuclear and organellar genomes, packaging mechanisms, and functions. Prokaryotic genomes and mobile genetic elements. Anatomy and global nucleoid organization, condensation mechanisms. Repetitive DNA. Transposons. Functional annotation of genes. Assigning genes their role in the organism: bioinformatics methods and experimental methods (homologous recombination, transposons, RNAi, yeast two- and one-hybrid systems, site-directed mutagenesis). Group II RNA introns and bacterial gene knockout. Generation of chromosomal libraries with knockout genes. Cre-loxP-dependent recombination and Cre recombinase. Genome editing. Programmable nucleases. Modifications of genomes via meganucleases, ZFN and TALE nucleases, CRISPR system. The CRISPR-Cas9 II system and its alternative prime editing and potential applications. Development of animal and cellular models of human diseases, therapy of genetic, cancer, viral, and parasitic diseases. Characterization of the prime editing system based on the SpCas9n-RT. Regulation of genome activity through direct and indirect signaling. Mechanisms determining short-term and permanent changes in genome activity (genome rearrangements, changes in chromatin structure, and feedback). Regulation of genomic changes during developmental processes. Developmental studies of unicellular and multicellular organisms (<i>B. subtilis</i>, <i>C. elegans</i>, <i>D. melanogaster</i>). Analysis of the mechanisms of neurodegenerative diseases. Mutations, mutagens, and environmental mutagenesis. Methods used to study genotoxic effects. Ames test. Analysis of chromosomal aberrations. Sister chromatid exchange. Micronucleus method. Comet assay and Tunnel. Fluorescent hybridization and its modifications. Biological responses induced by mutagens. Biomarkers (acetylcholinesterase, coagulation proteins, monooxygenases, vitellogenin, porphyrins) and biotransformation.</p> <p>Course content – seminar 1. History written in genes. Which came first, DNA or RNA? The formation of new genes. 2. Constructing and using phylogenetic trees. 3. Forensic genetics. Identification of individuals and samples, determining paternity, examining material evidence. 4. Stem cells from umbilical cord blood. Applications and hopes. 5. Tissue transplants and organ transplants. Legal, ethical, and cultural conditions of brain death. 6. Tissue scaffolds as an alternative to organ and tissue transplants. Biomaterials mimicking native tissues. 7. Biotechnological nanomaterials and their application in medicine. 8. Recombinant proteins as useful therapeutic agents (insulin, growth hormone, blood clotting factors, cytokines). 9. Molecular mechanism of neurotransmission. Neurotransmitter molecules (excitatory and sensory). 10. Bacterial biofilm formation (detection methods) and alternative therapy to antibiotic therapy. 11. Ag43 adhesin in <i>E. coli</i> cells and its role in the pathogenesis of bacterial infections (structure and transport, biological properties, autoaggregation, and biofilm formation). 12. Gene therapy and cancer (suicide, immunomodulatory, antiangiogenic, and proapoptotic genes). 13. MDR systems as a mechanism of resistance of Gram-negative bacteria to chemotherapy. 14. Molecular diagnosis of genetic diseases (chromosomal aberrations, point mutations, deletions). 15. X-linked recessive diseases (hemophilia, Duchenne muscular dystrophy, mucopolysaccharidosis type II). 16. Neurodegenerative diseases (Alzheimer's, Parkinson's, and Huntington's). 17. Genetically determined recurrent fever syndromes in children and syndromes without a known genetic basis. 18. Genetic predisposition to breast and ovarian cancer in women (high-risk genes, mutation and cancer, genetic testing). 19. Pathomechanism of UTIs caused by uropathogenic <i>E. coli</i> strains and alternative forms of therapy (vaccines, innovative chemotherapeutics).</p>											
Prerequisites and co-requisites	Fundamentals of biochemistry and molecular biology.											
Assessment methods and criteria	<table border="1"> <thead> <tr> <th data-bbox="448 1151 794 1182">Subject passing criteria</th> <th data-bbox="794 1151 1141 1182">Passing threshold</th> <th data-bbox="1141 1151 1487 1182">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 1182 794 1263">Seminar evaluation includes evaluation for the presented paper and the classes activity.</td> <td data-bbox="794 1182 1141 1263">60.0%</td> <td data-bbox="1141 1182 1487 1263">40.0%</td> </tr> <tr> <td data-bbox="448 1263 794 1323">Lecture evaluation includes evaluation of the oral exam.</td> <td data-bbox="794 1263 1141 1323">60.0%</td> <td data-bbox="1141 1263 1487 1323">60.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Seminar evaluation includes evaluation for the presented paper and the classes activity.	60.0%	40.0%	Lecture evaluation includes evaluation of the oral exam.	60.0%	60.0%
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Recommended reading	<p>Basic literature</p> <p>Brown T. A. Genomes. PWN. 2019.</p> <p>Węgleński P. Molecular Genetics. PWN 2012.</p> <p>Żeromski J. Immunology. PZWL. 2000.</p> <p>Epstein R.J. Human Molecular Biology. CZELEJ. 2006.</p> <p>Raszeja S., Nasiłowski W., Makarewicz J. Forensic Medicine. Student Textbook. PZWL. 1990.</p> <p>Szcerkowska Z. Biological Tests in Forensic Paternity Establishment. Institute of Forensic Research Publishing House, IES. 1998.</p> <p>Szcerkowska Z., Pawłowski R. Fundamentals of Forensic Genetics. Medical University of Gdańsk Publishing House, AMG, Gdańsk, 2002.</p>											

	Supplementary literature	Ridley M. Genome. New York Times. Księgrania Bookcity. 2016. Branden C., Tooze J. Introduction to protein structure. Garland. 1999.
	eResources addresses	
Example issues/ example questions/ tasks being completed	<p>Mutagens and environmental mutagenesis.</p> <p>Functional gene annotation.</p> <p>Genome editing - CRISPR-Cas prime editing, programmable nucleases.</p> <p>Use of model organisms in gene expression analyses.</p>	
Practical activities within the subject	Not applicable	

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