University of Gdańsk

Subject card

Subject name and code	Biochemical basis of gene expression, PG_00090768		
Field of study	Genetics and Experimental Biology		
Date of commencement of studies	October 2023	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	3	Language of instruction	Polish
Semester of study	6	ECTS credits	1.0
Learning profile	academic	Assessment form	credit
Conducting unit	Laboratory of Intracellular Signalling -> Department of Medical Biology and Genetics -> Faculty of Biology -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Monika Słomińska-Wojewódzka	
	Teachers	dr hab. Monika Słomińska-Wojewódzka	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	0.0	0.0	15

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	15	0.0	0.0	15

Subject objectives

1. To become familiar with the structure of mRNA and tRNA molecules and the functions of aminoacyl-tRNA synthetases and ribosomes.
2. To understand in detail the mechanisms of protein synthesis in prokaryotic and eukaryotic cells and how this process is regulated at different stages.
3. To understand the general principles of protein folding and degradation.
4. To develop the ability to use available sources of biological information when preparing scientific presentations.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[GBEL3_K07] The graduate is prepared to: lifelong learning and updating of knowledge in molecular genetics and other fields	The graduate recognizes the importance of lifelong learning and the continuous updating of knowledge in molecular biology.	[SK1] oral statement/conversation/ discussion [SK2] presentation/project/paper/ report [SK3] text preparation/written work [SK4] test/exam - oral or written [SK5] implementation of a problem task [SK8] observation of student's independent or team work
[GBEL3_K02] The graduate is prepared to: critically evaluate their own knowledge and methods in molecular biology and related fields and commercialise their research.	The graduate is prepared to critically evaluate his knowledge and methodological approaches in the field of molecular biology.	[SK1] oral statement/conversation/ discussion [SK2] presentation/project/paper/ report [SK3] text preparation/written work [SK4] test/exam - oral or written [SK5] implementation of a problem task [SK8] observation of student's independent or team work
[GBEL3_U07] The graduate is able to: work as part of a team and organise work in accordance with the principles of occupational health and safety and ergonomics	The graduate is able to collaborate effectively in a team to analyze biological problems related to the topics covered in the course.	[SU1] oral statement/conversation/ discussion [SU5] implementation of a problem task [SU8] observation of student's independent or team work
[GBEL3_U04] The graduate is able to: read scientific texts in English and Polish with comprehension, synthesise the knowledge they contain, prepare well-documented papers on biological problems and on the commercialisation of research	The graduate is able to critically read scientific literature in English and Polish, synthesize the information it contains, and prepare well-documented analyses of biological problems related to protein translation, folding, and protein properties.	[SU1] oral statement/conversation/ discussion [SU2] presentation/project/paper/ report [SU3] text preparation/written work [SU4] test/exam - oral or written [SU5] implementation of a problem task [SU8] observation of student's independent or team work
[GBEL3_W06] A graduate has an advanced knowledge and understanding of: the development and current state of knowledge and the latest trends in molecular genetics and related fields; indicates their relationship to other disciplines in the life sciences or medical sciences and their potential for use in practice	The graduate is familiar with the current state of knowledge and recent trends in molecular biology and understands their relationships with other disciplines within the natural and medical sciences.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion [SW2] presentation/project/paper/ report [SW3] text preparation/written work [SW5] implementation of a problem task
[GBEL3_W05] A graduate has an advanced knowledge and understanding of: principles for planning research based on the achievements of biological sciences and related disciplines and the possibility of putting their results into practice, principles for the operation of equipment and apparatus used in molecular genetics research, and the principle of interpreting biological phenomena and processes based on empirical data in research work and practical action, taking into account the sustainable use of biodiversity	The graduate understands the principles of planning research based on advances in biological sciences related to protein translation and their practical applications.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion [SW2] presentation/project/paper/ report [SW3] text preparation/written work [SW5] implementation of a problem task
[GBEL3_W03] A graduate has an advanced knowledge and understanding of: molecular mechanisms of genetic information transfer and gene expression and the molecular and genetic basis of human physiology and disease, including infectious diseases	The graduate knows and understands the molecular mechanisms of gene expression	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion [SW2] presentation/project/paper/ report [SW3] text preparation/written work [SW5] implementation of a problem task

Course outcome	Subject outcome	Method of verification
[GBEL3_W01] A graduate has an advanced knowledge and understanding of: the structure and properties of the main types of biological macromolecules; the molecular mechanisms of basic metabolic pathways and genetic information flow; the sources of genetic variation in organisms and the mechanisms of evolution. They can explain the principles of inheritance, the differences in structure and function between prokaryotic and eukaryotic cells, as well as the structure and functional relationships at the cellular and tissue levels.	The graduate describes the structure and properties of the major types of RNA, explains the mechanisms of translation, and identifies differences between prokaryotic and eukaryotic cells.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion [SW2] presentation/project/paper/ report [SW3] text preparation/written work [SW5] implementation of a problem task

Subject contents

mRNA: differences in structure of prokaryotic and eukaryotic mRNA, structure of 5' and 3' ends of mRNA, stability and degradation of mRNA. tRNA: structure, modifications of bases in tRNA, maturation of tRNA, isoacceptor tRNA. Genetic code: historical outline, properties, principle of code vacillation, deviations from code universality. Aminoacyl-tRNA synthetases: structure, classification, mechanism of action. Ribosomes: structure of prokaryotic and eukaryotic ribosomes, arrangement of active sites, characteristics of rRNA. Regulation of gene expression at the level of the translational process. Translation initiation in prokaryotic and eukaryotic cells: stages of translation initiation process, role of initiation factors (IFs), structure and role of initiator tRNAs. Elongation of translation: role of elongation factors (EFs), stages of elongation process, effect of antibiotics that inhibit elongation, mechanism of peptide bond formation. Termination of translation: mechanism of termination, role of termination factors (RF). Mechanism of selenocysteine coding. Systems of mRNA quality control. Suppressor mutations: mechanism of suppression of missense nonsense and insertion mutations. Programmable shift of the mRNA reading frame. General principles of protein folding. Selected post-translational modifications of proteins. General issues of protein degradation.

Prerequisites and co-requisites

Basic knowledge of cell biology, molecular biology, biochemistry. Good knowledge of English.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
oral multimedia presentation – assessed based on the comprehensiveness of the topic, correctness of the content, and the clarity and appeal of the presentation.	51.0%	30.0%
spontaneous oral responses and oral tests with access to materials – students' answers to posed problem tasks are assessed, and points are awarded for comprehensive responses.	80.0%	2.0%
Group work – evaluated based on task accuracy as well as teamwork and communication skills.	80.0%	8.0%
Tests assess the degree of mastery of the material covered in the seminar classes and are conducted in written form.	51.0%	60.0%

Recommended reading

Basic literature

1. Molecular Cell Biology, Lodish H., Berk A., Zipursky S.L., Matsudaira P., Baltimore D., Darnell J.E.; W.H. Freeman and Company, 2016

2. Molecular Biology of the Cell, Alberts B., Johnson A., Lewis J., Raff M., Roberts K., Walter P.; 2022

3. Genes XI, Lewin B, 2014, Pearson Prentice Hall

	Supplementary literature	1. Biochemistry, Berg J.M., Stryer L., Tymoczko J.L., Polish edition, PWN, 2019 2. Cytobiochemistry, Kłyszejko-Stefanowicz L., PWN 2022 3. Richter JD. Breaking the code of polyadenylation-induced translation. Cell. 2008, 8;132, 335-337. 4. Cochella L, Green R. Wobble during decoding: more than third-position promiscuity Nat. Struc. Mol. Biol. 2004, 11, 1160-1162 5. Francklyn CS. Charging two for the price of one. Nat Struct Biol. 2001, 8, 189-191. 6. Sherlin LD, Uhlenbeck OC. Hasty decisions on the ribosome. Nat Struct Mol Biol. 2004, 11,206-208. 7. Słomińska-Wojewódzka M, Sandvig, K. The Role of Lectin-Carbohydrate Interactions in the Regulation of ER-Associated Protein Degradation. Molecules, 2015, 20: 9816-9846. 8. Nowakowska-Gołacka J, Sominka H, Sowa-Rogozińska N, Słomińska-Wojewódzka M. Toxins Utilize the Endoplasmic Reticulum-Associated Protein Degradation Pathway in Their Intoxication Process. 2019, Int J Mol Sci, 20 (6).
	eResources addresses	
Example issues/ example questions/ tasks being completed	Regulation of mRNA polyadenylation process. What is the degeneration and wobble of the genetic code.	
Work placement	Not applicable	

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