GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Molecular Biology, PG_00048403		
Field of study	Green Technologies		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2024/2025
Education level	second-cycle 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	general academic profile	Assessment form	exam
Conducting unit	Department of Microbiology -> Faculty of Chemistry		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Lucyna Holec-Gąsior	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	15.0	15.0	0.0	0.0	60

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	60	15.0	50.0	125

Subject objectives

The aim of the course is to provide knowledge in the field of molecular genetic mechanisms and basic research techniques used in molecular biology. Knowledge and understanding of processes related to the reproduction and expression of genetic material. Knowledge of various molecular biology techniques and the ability to use them in practice. Ability to work in a molecular biology laboratory using appropriate research tools and analysis and development of results.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U05] can formulate and test hypotheses related to the problems of engineering and simple research problems relating to the protection of the environment, new environmental technologies and analytical procedures	The student is able to perform in silico analysis and to plan and perform experiments on the search for microorganisms that produce restriction enzymes.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task
[K7_W03] will have a detailed knowledge of the theoretical basis of methods and types of apparatus used in chemical analysis of environmental pollutants and the technology of cleaning and neutralization of industrial waste and wastewater management and the design and supervision of environmentally friendly technologies	The student knows and explains the principles of the basic techniques and research tools used in molecular biology.	[SW3] Assessment of knowledge contained in written work and projects
[K7_W01] a broader and deeper knowledge of certain branches of mathematics, including elements of applied mathematics and optimization methods including mathematical methods, useful to formulate and solve complex tasks in the field of environmental technologies and modern analytical methods	The student understands and is able to explain the meaning of the terms used in molecular biology and understands the molecular mechanisms occurring in a living cell.	[SW3] Assessment of knowledge contained in written work and projects

Subject contents	**Lecture** 1. Introduction to molecular biology. Basic information about the prokaryotic and eukaryotic cells. The dogma of molecular biology. Basic concepts (gene, genotype, phenotype, nucleic acids, replication, transcription, translation). 2. Structure and properties of DNA and RNA. Structure and characteristics of nucleic acids (structural features of DNA, RNA molecules). Biological role of nucleic acids. 3. DNA replication. Molecular mechanism of DNA replication (basic rules of the replication process, DNA initiation, elongation and termination). Characteristics of polymerases 4. DNA damage and repair. Mutations (their characteristics, causes and types, replication fidelity). DNA repair systems. 5. Molecular mechanism of DNA recombination. Homologous recombination (Holliday homologous recombination model). Localized recombination. Transposition (unauthorized recombination). Replicative and conservative transposition of DNA transposons. Transposition of retroelements. 6. Transcription in Prokaryotes and Eukaryotes. Basic rules of transcription (initiation, elongation, termination). Characteristics of RNA polymerases. 7. RNA structure and function diversity. Structure of the ribosome (ribosomal ribonucleic acids - rRNA, ribosomal proteins). Transfer RNA (tRNA). Messenger RNA (mRNA). RNA maturation processes. tRNA maturation, mRNA splicing in eukaryotes, introns and exons, catalytic ribonucleic acids (ribozymes), RNA editing. 8. Transcription regulation. The concept of an operon, lactose operon, tryptophan operon, catabolic repression mechanism, attenuation. Regulation of transcription in eukaryotes. 9. Translation and its regulation. Characteristics of the genetic code. Molecular mechanism of protein synthesis (initiation, elongation, termination). Comparison of translation in prokaryotes and eukaryotes. 10. Proteins - structure and properties. Structure of proteins. Four levels of polypeptide chain organization. Functions of proteins. 11. Post-translational modifications of proteins. Protein folding, chaperones, signal sequences. Chemical modifications of proteins: acetylation, glycosylation, phosphorylation, proteolytic cleavage, controlled protein degradation, the N-terminal base, the role of ubiquitin. 12. Basic techniques for the study of nucleic acids and proteins. 13. Application of molecular biology in environmental protection, medicine and industry. **Laboratories** During the classes, students work in groups, implementing a project entitled "Searching for microorganisms that produce restriction enzymes". Successful completion of the task gives the opportunity to present the results obtained during the scientific conference. During the classes, the students become acquainted with the following techniques used in molecular biology: • Basic methods for testing nucleic acids. • Isolation of plasmid and genomic DNA. • Electrophoresis methods: agarose gel electrophoresis. • Properties and use of restriction enzymes as tools in nucleic acid research. • Chain polymerization reaction. • Sequencing. **Computer classes** Students work individually using generally available, free specialized computer programs. • Literature databases. Searching and reading scientific publications. • Comparing DNA sequences. • Design of PCR primers. • In silico restriction analysis of DNA fragments. • Analysis of the amino acid sequence of proteins (determination of ORF; predicting the location of epitope domain of proteins, transmembrane fragments and hydrophobic regions). • In silico cloning project.
Prerequisites and co-requisites	The student should have basic knowledge of cell biology and basic biochemical processes in the cell. .

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<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>laboratory - short tests and final report</td><td>60.0%</td><td>25.0%</td></tr>
<tr><td>computer classes - bioinformatics tasks and final test</td><td>60.0%</td><td>25.0%</td></tr>
<tr><td>lectures - written exam</td><td>60.0%</td><td>50.0%</td></tr>
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<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. Baj J., Markiewicz Z. Molecular biology of bacteria, PWN, 2012.
2. Węgleński P. Molecular genetics, PWN, Warsaw, 2012.
3. Brown T.A. The genomes. PWN, Warsaw, 2018.
4. Turner P.C., McLennan A.G., Bates A.D., White M.R.H. Short lectures. Molecular biology, PWN, Warsaw, 2011.</td></tr>
<tr><td>Supplementary literature</td><td>There are no requirements</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">Lectures: explain the central dogma of molecular biology; describe the structure and biological function of nucleic acids; discuss the replication mechanism; explain the molecular mechanism of translation; describe the types of DNA recombination; explain the diversity of RNA structure and function; describe the post-translational modifications of proteins.

Laboratories: develop an experiment that identifies lipase producing microorganisms.

Exercises: design a method to detect Staphylococcus aureus (using molecular biology techniques).</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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