GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | Molecular Biology, PG_00059424 | | |
| Field of study | Biotechnology | | |
| Date of commencement of studies | October 2026 | Academic year of realisation of subject | 2027/2028 |
| Education level | first-cycle studies | Subject group | Obligatory subject group in the field of study<br>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 | 5.0 |
| Learning profile | general academic profile | Assessment form | exam |
| Conducting unit | Department of Microbiology -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr hab. inż. Lucyna Holec-Gąsior | |
| | Teachers | | |

**Lesson types**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 30.0 | 0.0 | 30.0 | 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 | 8.0 | 57.0 | 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 the processes related to the replication and expression of genetic material. Knowledge of various techniques of molecular biology and the ability to use them in practice. Ability to work in a molecular biology laboratory with the use of appropriate research tools as well as the analysis and processing of results.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| K6_K04 | The student has the ability to work with biological materials such as nucleic acids and proteins. | [SK5] Assessment of ability to solve problems that arise in practice<br>[SK3] Assessment of ability to organize work |
| K6_U06 | The student is able to choose the appropriate technique to perform a specific task. The student is able to prepare a laboratory stand. The student uses the basic techniques and methods used in the molecular biology laboratory. | [SU4] Assessment of ability to use methods and tools<br>[SU3] Assessment of ability to use knowledge gained from the subject<br>[SU1] Assessment of task fulfilment |
| K6_W06 | The student defines the basic concepts of molecular biology. It explains the central dogma of biology. Understands the basic processes taking place in the cell: replication, transcription, and translation. The student has knowledge of the structure of nucleic acids (DNA and RNA). Understands the mechanism of action of the following cellular enzymes: DNA polymerases, RNA polymerases, topoisomerases, ligases, restriction enzymes, phosphatases, and kinases. The student has knowledge of the regulation of gene expression, DNA damage, and repair. | [SW1] Assessment of factual knowledge |

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| Subject contents | Course content – lecture<br>**LECTURE:** Introduction to molecular biology. The dogma of molecular biology. Basic concepts (gene, genotype, phenotype, nucleic acids, replication, transcription, translation). Characteristics of nucleic acids (DNA and RNA). Three-dimensional structure of DNA in a prokaryotic and eukaryotic cell. DNA replication (basic rules of the replication process: initiation, elongation, and termination; proteins participating in the replication process; characteristics of DNA polymerases). DNA damage and repair (types of mutations, the molecular basis of mutations; mutagens, DNA repair mechanism). DNA recombination (Holliday homologous recombination model; localized recombination; transposition; gene conversion). Transcription in Prokaryotes and Eukaryotes (basic rules of transcription, initiation, elongation, termination, characteristics of RNA polymerases). RNA maturation processes. Regulation of transcription in bacteria (lactose operon, tryptophan operon, catabolic repression mechanism, attenuation). Regulation of transcription in eukaryotes (chromatin modifications, protein activators and repressors of the transcription process, structural motifs responsible for interactions with nucleic acids). Differentiation of RNA structure and function (types of RNA acid; ribosome structure, transfer RNA, messenger RNA). RNA maturation processes. Translation and its regulation (molecular mechanism of translation: initiation, elongation, termination). Genetic code. Proteins - structure and properties. Post-translational protein modifications: protein folding, chaperones, signal sequences; chemical modifications of proteins (acetylation, glycosylation, phosphorylation, proteolytic cleavage, controlled protein degradation, the role of ubiquitin). Basic techniques for the study of nucleic acids and proteins.<br><br>**LABORATORY:** Basic techniques and methods used in the molecular biology laboratory. Isolation of plasmid and genomic DNA. Agarose electrophoresis of nucleic acids. Chemical transformation of *Escherichia coli* cells with plasmid DNA. Chromatographic methods in the purification of proteins. Metal Affinity Chromatography. Protein polyacrylamide electrophoresis under denaturing conditions (SDS-PAGE) and staining of gels using the Coomassie Brilliant Blue method. |
| Prerequisites and co-requisites | Knowledge of the basics of cell biology and microbiology. |

**Assessment methods and criteria**

| Subject passing criteria | Passing threshold | Percentage of the final grade |
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| lecture - written exam | 60.0% | 60.0% |
| laboratory - short written tests | 60.0% | 40.0% |

**Recommended reading**

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| Basic literature | 1. Baj J., Markiewicz Z. Molecular biology of bacteria. PWN, Warsaw, 2012.<br>2. Węgleński P. Molecular genetics. PWN, Warsaw, 2012.<br>3. Brown T.A. Genomes. PWN, Warsaw, 2018.<br>4. Turner P.C., McLennan A.G., Bates A.D., White M.R.H., Short Lectures. Molecular biology. PWN, Warsaw, 2011.<br>5. Matthews. H.R., Freedland R.A., Miesfeld R.L., Biochemistry and Molecular Biology in Outline. Prószyński i S-ka, Warsaw, 2000. |
| Supplementary literature | Scientific publications on the presented issues. |
| eResources addresses | |

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| Example issues/ example questions/ tasks being completed | 1. What is the dogma of molecular biology?<br>2. Characteristics of nucleic acids.<br>3. What is the three-dimensional structure of DNA in a prokaryotic and eukaryotic cell?<br>4. What is the molecular mechanism of DNA replication?<br>5. What are the types of DNA damage?<br>6. Models of recombination DNA.<br>7. What is the molecular mechanism of transcription?<br>8. What are the types of RNA polymerases?<br>9. How does RNA mature in a eukaryotic cell?<br>10. Diversity of RNA structure and function.<br>11. What is the molecular mechanism of the translation process?<br>12. What are the post-translational modifications of proteins.<br>13. Methods of testing nucleic acids.<br>14. Properties and application of restriction enzymes as tools in the study of nucleic acids. |
| Practical activites within the subject | Not applicable |