



Syllabus

Term: 2026/27/1 **Subject name:** Molecular Biology - lecture **Subject code:** ENBIOB3401

Unit (Unit code) (BIOLOGIA)

Lecturer responsible for the course: Dr. KEMENESI Gábor

Requirement: Exam

Classes per week : 3/0/0

Classes per term: 39/0/0

Purpose of education:

The subject deals mainly with the molecular biology of DNA, the genes and the gene function. It presents the structure and function of the genomes and the genes and the regulation of gene expression both in prokaryotes and in eukaryotes. The main research methods to study gene structure and function will be also presented.

Contents:

1. DNA structure and function, the replication. Plasmids. Recombinant DNA technology: restriction endonucleases and DNA cloning.
2. DNA purification, agarose gel electrophoresis, physical mapping. Cloning vectors, detection of the insert DNA. Genomic libraries, plasmid, bacteriophage and cosmid vectors. In vivo and in vitro packaging of the lambda DNA. Bacterial and yeast artificial chromosomes (BAC, YAC), gene isolation from genomic libraries.
3. Molecular hybridization, theory and practice, radioactive and fluorescent labelling, Southern, Northern (Western) techniques, colony and plaque hybridization, the DNA chip.
4. DNA sequence determination, the dideoxy chain termination method, automated sequencing. Direct cloning: polymerase chain reaction (PCR), theory and practice, oligonucleotide design, PCR applications
5. The prokaryotic and the eukaryotic genome. The C-value paradox, renaturation kinetics, complexity, gene families, pseudogenes, non-coding sequences. Repetitive sequences: microsatellite sequences and mobile elements.
6. Study of gene expression: RNA isolation, cDNA library preparation and applications. Investigation of gene expression by differential hybridization and by microarray techniques. Reporter genes, transcription and translation fusions for gene expression studies.
7. Transgenic animals: egg cell and stem cell manipulation, knock out techniques, from chimeras to the homozygous transgenic animals. Use of transgenic animals in the basic research and in biotechnology. Reproductive cloning.
8. Transgenic plants: molecular biology of the Agrobacterium transformation, the Ti-plasmid and its use as a vector. Transgenic plants in the basic research and in biotechnology. GMOs in agriculture and industry.



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9. Regulation of gene expression in prokaryotes: transcription initiation, sigma factors, promoters, operators and repressors. Transcription termination and antitermination. Regulation of gene expression in the lytic cycle of the lambda phage.

10. Regulation of gene expression in eukaryotes: promoters, enhancers, transcription factors. The yeast two hybrid system and its use to study protein-protein interactions. Transcription and mRNA processing. Alternative splicing and RNA editing.

11. Cell nucleus and chromosome structure. Nuclear import and export. The nucleolus and assembly of the ribosomes. The genetic code and protein synthesis.

12. Protein transport to the endoplasmic reticulum, cotranslational translocation and signal sequences. Protein modifications and transmembrane proteins. Protein transport to the mitochondrion, chloroplast and peroxisomes. Vesicular transport through the Golgi apparatus.

13. Signal transduction from the receptor to gene expression. Membrane receptors families. Trimeric G-protein and tyrosine kinase signal transduction

System of examining and valuation:

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Bibliography:

Alberts B, Johnson A, Lewis J, et al. Molecular Biology of the Cell. 4th edition. New York: Garland Science; 2002. <https://www.ncbi.nlm.nih.gov/books/NBK21054/?term=molecular%20biology%20of%20the%20cell>

Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter (2015) Molecular Biology of the Cell, 6th edition, Garland Science

Bibliography: