General information		
Academic subject	**Molecular Biology**	
Degree course	Biological Sciences (L-13)	
Academic Year	2022-2023	
European Credit Transfer and Accumulation System (ECTS)		10
Language	Italian	
Academic calendar (starting and ending date)	03.10.22 - 20.01.23	
Attendance	compulsory	

Professor/ Lecturer	
Name and Surname	Prof. **Francesco Bruni**
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Department and address	Dept. of Biosciences, Biotechnologies and Environment
Virtual headquarters	Microsoft Teams (francesco.bruni@uniba.it)
Tutoring (time and day)	Monday-Friday, 9.30 am-5 pm (prior contact by e-mail)

Syllabus	
Learning Objectives	To provide a solid basic knowledge of Molecular Biology and relative methodologies/technologies used for scientific investigation. To offer an adequate preparation aimed to assimilate scientific and technological advances and to know the molecular aspects of the organism biology.
Course prerequisites	Knowledge of Organic Chemistry and Biological Chemistry
Contents	1. STRUCTURE OF NUCLEIC ACIDS. The molecular nature of genes: role of DNA as a genetic material. Nucleotides. The components of DNA. RNA. The double helix structure of DNA. Major and minor grooves. Alternative forms of the double helix. Plasticity of the DNA structure. Unusual DNA structures. DNA supercoiling. Topoisomerase and gyrase. Genes and genomes: general features of prokaryotic and eukaryotic genomes. The human genome. Nucleosomes and chromatin. DNA packaging. 2. DNA REPLICATION, REPAIR and REARRANGEMENTS. Semi-conservative DNA replication. Meselson and Stahl experiment. Unidirectional and bidirectional replication. The replication fork. DNA synthesis and the replication fork: DNA polymerase III. Beginning of replication. Selection of origins and regulation of replication in prokaryotes and eukaryotes. Termination of replication in prokaryotes and eukaryotes. DNA damage induced by physical, chemical and biological agents. Repair systems in E. coli and eukaryotes: direct repair; mismatch repair; base excision repair; nucleotide excision repair; SOS response. Homologous recombination. Enzymes involved in recombination and their mechanism of action. Site-specific recombination. Effects of site-specific recombination. Transposition. Mechanism of transposition of DNA elements. RNA-mediated transposition. Reverse transcriptase function. 3. RNA SYNTHESIS and MATURATION. RNA: types and characteristics. RNA synthesis. RNA polymerase of E. coli. Initiation of the transcription. Elongation. Intrinsic transcription termination and rho-dependent termination. Post-transcriptional modifications in prokaryotes. RNA synthesis in eukaryotes: eukaryotic RNA polymerases. Eukaryotic promoters. Recognition of promoters and beginning of transcription. Enhancers sequences and transcription factors. Post-transcriptional modifications in eukaryotes: capping, polyadenylation. Interrupted genes: appearance and role of introns. Splicing mechanism of mRNAs: trans-esterification; spliceosomes. Auto-splicing and the discovery of catalytic RNA. Alternative splicing and shuffling of exons. RNA editing. 4. PROTEIN SYNTHESIS. The genetic code: definition, identification and features. tRNA structure. Codon-anticodon interaction. Wobble hypothesis. Activation of amino acids: role

	and mechanism of action of aminoacyl-tRNA synthetase. Ribosomes. Recognition of the signal to initiate translation in prokaryotes. Formation of the initiation complex. Elongation step of the translation. Peptide bond formation. Translocation. Termination and recycling of the translation apparatus. Comparison between protein synthesis in prokaryotes and eukaryotes. Protein synthesis inhibitors. 5. REGULATION OF GENE EXPRESSION IN PROKARIOTES. Lac operon. Regulation by the repressor and the CAP protein. Arabinose operon. Tryptophan operon: the attenuation mechanism. Regulation of the lambda phage life cycle. STANDARD MOLECULAR BIOLOGY TECHNIQUES
Books and bibliography	• WATSON J. et al. - Biologia molecolare del gene – Zanichelli (VIII edition) • AMALDI F., BENEDETTI P., PESOLE G., PLEVANI P. - Biologia Molecolare – CEA (III ed.) • AMALDI ., BENEDETTI P., PESOLE G., PLEVANI P. - Tecniche e Metodi per la Biologia Molecolare • T.A. BROWN - Biotecnologie Molecolari - Zanichelli
Additional materials	

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
250	72	12	166
ECTS			
10	9	1	

Teaching strategy	
	Both lectures and laboratory exercises are provided. The frontal lectures are carried out by using teaching aids, such as the video projection of slides. The practical exercises are carried out in groups of 20 students, taking care that the students personally perform the various experiments.
Expected learning outcomes	
Knowledge and understanding on:	To learn the gene structural features and mechanisms of replication, transcription, translation and regulation of gene expression.
Applying knowledge and understanding on:	○ biomolecular and biotechnological concepts; ○ methodologies for biological research.
Soft skills	• *Making informed judgments and choices* ○ Acquisition of conscious autonomy in evaluation-related areas; ○ interpretation of experimental data. • *Communicating knowledge and understanding* ○ Appropriate use of the Molecular Biology jargon • *Capacities to continue learning* ○ Capabilities of applying molecular concepts and techniques.

Assessment and feedback	
Methods of assessment	Oral exam with support of diagrams/graphics (when required).
Evaluation criteria	The student must demonstrate knowledge of the basic mechanisms related to the structure and function of nucleic acids. Furthermore, the student must demonstrate knowledge of the basic techniques of Molecular Biology covered during the course.

Criteria for assessment and attribution of the final mark	The partial exposition of the topics (e.g., a too simple description of a process with little depth of its molecular mechanism) will be evaluated as a medium or low level. The clear and thorough exposure of the basic mechanisms relating to the structure/function of nucleic acids and biomolecular techniques will be evaluated as a high level. The acquisition of the 'links' between the various contents of the program, traced and highlighted during the lectures, is considered particularly important.
Additional information	