DEGREE CURRICULUM

MOLECULAR BIOLOGY

Coordination: FERREZUELO MUÑOZ, FRANCISCO

Academic year 2022-23

MOLECULAR BIOLOGY 2022-23

Subject's general information

<table>
<tr><td>Subject name</td><td>MOLECULAR BIOLOGY</td></tr>
<tr><td>Code</td><td>101609</td></tr>
<tr><td>Semester</td><td>2nd Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Bachelor's Degree in Biotechnology</td><td>1</td><td>COMMON/CORE</td><td>Attendance-based</td></tr>
</table>
</td></tr>
<tr><td>Course number of credits (ECTS)</td><td>6</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
<table>
<tr><th>Activity type</th><th colspan="2">PRALAB</th><th>PRAULA</th><th>TEORIA</th></tr>
<tr><td>Number of credits</td><td>0.4</td><td>0.4</td><td>1.2</td><td>4</td></tr>
<tr><td>Number of groups</td><td>5</td><td>3</td><td>2</td><td>1</td></tr>
</table>
</td></tr>
<tr><td>Coordination</td><td>FERREZUELO MUÑOZ, FRANCISCO</td></tr>
<tr><td>Department</td><td>BASIC MEDICAL SCIENCES</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>60 hours in-class teaching and 90 hours homework</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>Mainly Spanish, although some information (videos and other materials) in English.</td></tr>
</table>

MOLECULAR BIOLOGY 2022-23

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
FERREZUELO MUÑOZ, FRANCISCO	francisco.ferrezuelo@udl.cat	9,6	

Subject's extra information

This course at 1st year (freshmen) provides basic knowledge regarding the function of genes; it is really a Molecular Genetics course. It requires concepts of Chemistry and Biochemistry and provides concepts that will be required in other courses of the major such as Genetics, Microbiology (microbial genetics), Genetic Engineering and Plant Biotechnology.

Learning objectives

The student must be able to:

Demonstrate knowledge about the concepts, terminology and basic mechanisms related to the structure and functioning of the genetic material.
Apply the acquired concepts to different situations and solve basic problems.

Competences

General competences

CG1 To be able to selectively search and use sources of information necessary to achieve the training objectives.
CG2 To interpret scientific-technical information with a critical sense, and be able to make presentations based on this information.
CG4 To know and properly use the scientific and technical vocabulary typical of the different areas of Biotechnology.
CG5 To work in the laboratory applying quality criteria and good practice.
CG6 To know how to use the software and the specific databases in the different areas of Biotechnology.
CG11 To acquire criteria for choosing the most appropriate analytical techniques for each specific practical case.

Transversal competences

CT1 To be able to make comprehensible written and oral reports on the work carried out, with a justification based on the theoretical-practical knowledge obtained.
CT4 To respect the fundamental rights of equality between men and women, the promotion of Human Rights and the values of a culture of peace and democratic values.

Specific competences

CE14 To know the biology of living beings at their molecular, cellular, organic and population levels, with an emphasis on organisms with biotechnological interest.
CE15 To know the essential biomolecules for life and the basic concepts of enzymology.
CE20 To understand the function of genes and their regulation in response to external changes in the cell.
CE21 To know the fundamentals and the methodology used in the genetic modification of organisms and know how to apply it.

Subject contents

Unit 1. The establishment of deoxyribonucleic acid (DNA) as the genetic material of living organisms

1. State of knowledge about the chemical composition of the genetic material by 1925. 2. The transforming principle of pneumococci. 3. The transforming principle of pneumococci is DNA. 4. The chemical composition of DNA and Chargaff's rules. 5. The genetic material of bacteriophages is DNA. 6. DNA X-ray diffraction pattern and the double helix model of Watson and Crick.

Unit 2. Nucleic acids: general characteristics and techniques

1. Chemical components of nucleic acids. 2. Structural characteristics of DNA double helix. 3. RNA. 4. Basic concepts on nucleases. 5. Denaturation and renaturation of nucleic acids. 6. Techniques: "dot blots" and "macroarrays" - electrophoresis - Southern and northern "blots".

Unit 3. DNA replication

1. DNA replication models: the Meselson and Stahl experiment. 2. Chemistry of DNA synthesis. 3. Mechanism of action of DNA polymerases. 4. Processivity of DNA polymerases. 5. Fidelity of DNA polymerases. 6. The replication fork. 7. The trombone model. 8. Regulation of replication. 9. The problem of replication of linear chromosome ends. 10. The problem of chain opening and DNA supercoiling.

11. Topoisomerases: types and mechanisms.

Unit 4. Mutagenesis and DNA repair

1. Origin of mutations: Luria-Delbrück experiment. 2. Mutagenesis: general considerations. 3. DNA mistmach repair. 4. Mechanisms of DNA damage repair: direct reversal, damage excision, and repair of double-strand breaks. 5. Damage tolerance.

Unit 5. Recombination of DNA

1. Homologous recombination: genetic consequences and role in meiosis. 2. Site specific recombination. 3. Transposition: concept and type of transposons.

Unit 6. Transcription and RNA processing

1. Gene expression: the central "dogma" of Molecular Biology. 2. General characteristics of transcription. 3. Binding of RNA polymerase to DNA: transcription initiation. 4. Transcription elongation. 5. Capping and polyadenylation of eukaryotic mRNAs. 6. Transcription termination. 7. Splicing: concept, mechanism and types.

Unit 7. The genetic code and the translation of the genetic message

1. Concept and general characteristics of the genetic code . 2. Effect of mutations on the genetic message. 3. Molecular components of translation: messenger RNA, transfer RNA and wobbling, aminoacyl-tRNA synthetases, the ribosome. 4. The translation process.

Unit 8. Structural organization of cellular DNA

1. Chromatin 2. Chromatin in prokaryotes. 3. Chromatin in eukaryotes: the nucleosome. 4. Higher order structures of eukaryotic chromatin. 5. Regulation of chromatin structure: histone modification and nucleosome remodeling. 6. Nucleosome assembly during DNA replication.

Unit 9. Regulation of gene expression

1. General concepts of the regulation of gene expression. 2. Transcriptional regulation in prokaryotes. 3. Transcriptional regulation in eukaryotes. 4. Epigenetics, gene silencing and heterochromatin: X-chromosome inactivation. 5. Post-transcriptional regulation: riboswitches and interference RNAs.

Unit 10. Genomes: sequencing and editing

1. The C value paradox and gene density. 2. DNA sequencing: Sanger's method and genome sequencing. 3. General characteristics of the genomes of different groups of organisms. 4. CRISPR as a bacterial antiviral defense system and its adaptation as a genome editing tool.

Practical activities

- Problem sessions: Application of acquired knowledge in case and problem solving.

- Computer sessions: Genome databases. Polymerase chain reaction (PCR).

- Laboratory: DNA analysis by PCR and electrophoresis.

Methodology

Type of activity	Description	Student in-class activity		Student home activity		Evaluation	Total time
			Horas	**Student work**	**Hours**	**Hours**	**Hours**
Lectures	The professor explains the subject in the classroom.	Students may attend the class if they wish. Attendance is neither controlled nor evaluated.	**40**	Study of class notes. Textbook reading.	**40**	**-**	**80**
Exercise sessions	Exercises must be worked out at home before in-class session. (Mid size group)	It is important that students actively participate in solving the problems at the classroom.	**11**	Working out the problems at home.	**22**	**-**	**33**
Laboratory	Laboratory practical session (Small size group)	Students carry out a protocol at the lab. They must understand phenomena, measure...	**4**	-	**-**	**-**	**4**
Computer sessions	Computer practical sessions (Mid size group)	Students must grasp a basic knowledge of a genome database, understand PCR and learn how to use some bioinformatic tools.	**5**	-	**-**	**20 minutes (included)**	**5**

Written tests	Two written tests with multiple choice and short-answer questions to demonstrate theoretical knowledge, problem solving skills and practical knowledge.	Test completion	**-**	Study the course material.	**28**	**4**	**28**
Total			**60**		**90**		**150**

Evaluation

Knowledge / Activity	Evaluative procedure		Weight in final score
Theoretical Knowledge	First written test Units 1-5		**29**
Theoretical Knowledge	Second written test Units 6-10		**29**
Problems	First written test		**10**
Problems	Second written test		**12**
Laboratory	Second written test		**10**
Computer sessions	Online test		**10**
Total			**100**

Observations

All the scores obtained throughout the course are added together. To pass the course, it is necessary to obtain a 50% score. This percentage is equivalent to a final grade of 5. Whoever does not reach this threshold has the possibility of taking another test on the COMPLETE course at the end of June. Completing this test involves renouncing to the grading obtained during the course. The final grading will be that obtained in the resit exam. This test will focus on the basic concepts of the course with more direct questions that will contain more explicit information, and therefore the level of difficulty will be lower than the tests carried out during the course. To pass this test it will be necessary to obtain 55% of the score. This percentage is equivalent to a final grade of 5 and 100% to a final grade of 8. This is the maximum grade obtainable on the June test.
To qualify for the 10% of the laboratory mark in the written test (second test), it is required to attend the corresponding laboratory session. Students that already attended the lab session in previous years are exempt from this requirement.

Bibliography

Most Molecular Biology or Molecular Genetics textbooks are appropriate.

A good deal of the course contents are based on:

Molecular Biology of the cell. 6th ed. Alberts et al. 2015 Garland Science.

MOLECULAR BIOLOGY 2022-23

Molecular Biology of the gene. 7th ed. Watson et al. 2014 Pearson Education Inc.

Molecular Biology of the cell: the problems book. 5th ed. wilson & Hunt. 2008 Garland Science.