

Molecular Biology

Code: 100858
ECTS Credits: 6

Degree	Type	Year	Semester
2500252 Biochemistry	OB	2	2

Contact

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Use of Languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Other comments on languages

Materials in Catalan and English will also be used

Prerequisites

It is highly recommended have done previously the following subjects: Biochemistry, Chemistry and Engineering of Proteins, Basic and Advanced Instrumental Techniques, Cell Biology, Genetics, and Microbiology.

Objectives and Contextualisation

This course will focus on the structure and function of nucleic acids. The detail topics of the course are listed in the contents section. The main objective of this course is that students get knowledge on the fundamentals in chromatin structure, epigenetics, transcription and translation mechanisms in prokaryotic and eukaryotic organisms, and how the DNA is replicated and repaired. Moreover, the experimental foundations on which the different topics are based will be specifically addressed during this course.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Collaborate with other work colleagues.
- Define the structure and function of proteins and describe the biochemical and molecular bases of their folding, intracellular traffic, post-translational modification and replacement.
- Identify molecular structure and explain the reactivity of the different biomolecules: carbohydrates, lipids, proteins and nucleic acids.
- Interpret experimental results and identify consistent and inconsistent elements.
- Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
- Read specialised texts both in English and one's own language.
- Stay abreast of new knowledge of the structure, organisation, expression, regulation and evolution of genes in living beings.

- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
- Use ICT for communication, information searching, data processing and calculations.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Collaborate with other work colleagues.
3. Compare the molecular mechanisms involved in the perpetuation, maintenance and generation of variability in genetic information.
4. Correctly describe the structural bases of the interaction between proteins and nucleic acids.
5. Describe the differential regulation of gene expression in prokaryotes and eukaryotes.
6. Describe the molecular mechanisms of the transmission of genetic information from nucleic acids to proteins.
7. Explain the structural and dynamic polymorphism of nucleic acids.
8. Explain the structural models of DNA folding in chromosomes.
9. Indicate the capacity of the different structural analysis techniques and decide which to apply in specific experimental situations.
10. Interpret experimental results and identify consistent and inconsistent elements.
11. Interpret findings from structural studies of proteins and nucleic acids.
12. Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
13. Read specialised texts both in English and one's own language.
14. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
15. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
16. Use ICT for communication, information searching, data processing and calculations.

Content

Syllabus:

1. Genes and chromosomes.

DNA size. Supercoiling. Structure of the eukaryotic chromosome: chromatin, histones, nucleosomes. Organization at higher levels. Chromosome maintenance proteins (SMC).

2. The structure of chromatin as a mechanism for controlling gene expression.

Levels of regulation of gene expression. Methods of analysis of differential gene expression. Active chromatin and nuclease sensitivity assay. Modification of histones. Remodelling complexes. Subtypes of histones. DNA methylation

3. Prokaryotic and eukaryotic transcription.

Structure and function of prokaryotic RNA polymerase: Structure and binding to the promoter. Elongation and Termination of transcription. General principles of the regulation of gene expression: positive and negative regulation. Control of transcription in prokaryotes. Eukaryotic RNA polymerases and synthesis of the different RNAs. Other eukaryotic RNAs: miRNA, siRNA, piRNA and lncRNA. The promoter zone of RNA polymerase II and other regulatory elements. Assembly of the transcription machinery. The mediator complex. Characteristics of transcription factors.

4. Processing of eukaryotic mRNA.

Processing at the 5' end. Splicing Processing at the 3' end. Alternative splicing. Edition of the RNA. Mechanism of mRNA degradation. P-bodies and stress granules. Regulation of the transport and stability of eukaryotic mRNA.

5. Translation.

The genetic code. Transfer RNA and aminoacylation: Structure of tRNA. Aminoacyl tRNA synthetases. Codon-anticodon interactions. Ribosomes: Structure. Peptide synthesis: initiation, elongation and termination. Control of translation.

6. Replication, repair, recombination and transposition.

Molecular mechanism of DNA replication in prokaryotes. The replisome (helicase, RNA primase, DNA polymerases); ssDNA binding proteins; DNA ligase; topoisomerases. DNA polymerases I and III. Replication of DNA in eukaryotes: cell cycle, mechanism of replication. Reverse transcriptase and telomerase. Repair systems. Homologous DNA recombination. Transposition.

Methodology

The teaching activities are divided into two sections: lecturer sessions and seminar sessions, each of them with their specific methodology.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	35	1.4	3, 4, 6, 5, 7, 8, 11, 10
Seminar sessions	10	0.4	16, 2, 3, 4, 6, 5, 7, 8, 11, 10, 13
Type: Supervised			
Preparation and exposition of seminars (in group)	20	0.8	
Type: Autonomous			
Study, and research of information.	78	3.12	16, 3, 4, 6, 5, 7, 8, 11, 10, 13

Assessment

Assessment:

1) Midterm exams:

The total weight of the two midterm exams will be 80%. The minimum mark is 4.0 points out of 10. In case someone obtains a lower grade, they will need to retake the exam.

2) Seminars:

It will weight 20% of the total mark. Assignments will be in groups of 3 students. The use of English will be scored for non-native speakers (up to 10% of the total mark).

Seminars will not be retaken.

Additional points:

The subject will be passed when the sum of the different parts weighted by their specific weight in the subject equals or exceeds 5.0 out of 10 points. The mid-term exams must be overcome with a minimum value of 40% of the maximum grade in order to be eligible to add the seminar mark.

In order to be eligible for performing the final exam, according to UAB regulations, students must have done a set of activities, the weight of which equals a minimum of two-thirds of the total mark in the subject. Therefore, the students will get a "Not assessable" when the sum of activities carried out have a weight lower than 67% of the total.

Those students who must do the final exam will not be eligible for the maximum grade of honour. It will not be possible to take the remedial exam only to improve the grade when the mid-term examen was already passed (with a minimum grade of 5.0 points).

Those students who couldn't attend to a midterm exam for a justified reason (such as illness, the death of a first-degree relative, an accident ... etc), and provide the corresponding prove to the degree-coordinator, will have the opportunity to perform his/her assessment in a different date.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Assessment of assignments	20%	1	0.04	1, 15, 14, 16, 2, 3, 4, 6, 5, 7, 8, 9, 11, 10, 12, 13
First midterm exam	40%	3	0.12	3, 4, 6, 5, 7, 8, 9, 11, 10, 13
Second midterm exam	40%	3	0.12	3, 4, 6, 5, 7, 8, 9, 11, 10, 13

Bibliography

- Gene Control. Latchman DS, 2nd Ed. Garland Science, 2015 (ebook at the library).
- Epigenetics. Allis, C.D. et al., 2n Ed. CSH press, 2015.
- Lehninger. Principles of Biochemistry. Nelson, D. and Cox, M., 8th ed. W.H. Freeman (Macmillan Learning), 2021.
- Biochemistry. Voet D and Voet JG. 4th ed. John Wiley & Sons Ltd, 2011 -Fundamentos de Bioquímica: La vida a nivel molecular 4a ed. Editorial Medica Panamericana, 2016.

Other original papers will be indicated during the course in the slide presentations.

Software

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