Universitat Autònoma de Barcelona

2021/2022

Molecular Biology and Genetics

Code: 100936
ECTS Credits: 6

Degree	Type	Year	Semester
2500253 Biotechnology	OB	2	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

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

Prerequisites

There are no specific official prerequisites. nnnnnn

Objectives and Contextualisation

This subject integrates the molecular mechanisms that occur in the processes of transmission of genetic information (replication, transcription and translation), based on the study of the three-dimensional structure of the macromolecules involved (nucleic acids, enzymes and regulatory proteins) and their interaction.

Specific objectives:

- knowing the different structures adopted by the nucleic acids, as well as the different degrees of packaging of the DNA according to the type of organism and the moment of the cell cycle.

- Understanding the function of the different RNA polymerases from their three-dimensional structure, and the mechanisms for controlling transcription depending on the type of organism.

- Knowing the structure and function of the ribosomes, the differencesbetween prokaryotes and eukaryotes, and the mechanisms for controlling translation.

- Knowing the mechanisms of replication, recombination, and DNA repair that maintain the integrity of the genetic information; As well as the epigenetic modifications that are transmitted through generations.

- Understanding the regulation of eukaryotic gene expression as a whole.

Competences

- Describe the molecular, cellular and physiological bases of the organisation, functioning and integration of living organisms in the framework of their application to biotechnological processes.
- Interpret experimental results and identify consistent and inconsistent elements.
- Think in an integrated manner and approach problems from different perspectives.

- Work individually and in teams

Learning Outcomes

1. Correctly describe the structural bases of the interaction between proteins and nucleic acids.
2. Describe the differential regulation of gene expression in prokaryotes and eukaryotes.
3. Describe the molecular mechanisms involved in the perpetuation, maintenance and generation of variability in genetic information.
4. Explain the molecular mechanisms of the transmission of genetic information from nucleic acids to proteins.
5. Interpret experimental results and identify consistent and inconsistent elements.
6. Think in an integrated manner and approach problems from different perspectives.
7. Work individually and in teams

Content

THEORY CLASSES

I. Structure and packaging of DNA

I.1 Chemical structure and composition: Chemical definition. Laws of Chargaff.

I.2 Double-helix structures: B-DNA. A-DNA. Z-DNA. RNA helices.

I.3 DNA supercoiling: DNA size. Kinetics of reassociation: Cot and Rot. Super-topology. Topoisomerases and quantification of supercoiling. *E. coli* chromosome .

I.4 Eukaryotic chromosome and chromatin: Histones. First level of organization: the nucleosome. Second level of organization: the solenoid. Third level of organization: radial loops.

II. Transcription

II.1 Structure and function of prokaryotic RNA polymerase: Structure and binding to the promoter. Termination of transcription. Transcription control in prokaryotes.

II.2 Nuclear RNA polymerases and transcription control: Structure of RNA polymerase II. Promoters type I and III. Type II promoters: transcription factors, response elements, enhancers, and mediator.

II.3 Post-transcriptional modifications: Pre-mRNA processing. Pre-rRNA processing. Pre-tRNA processing.

III. Translation

III.1 The nature of the genetic code.

III.2 RNA transfer and aminoacylation: Structure of tRNA. Aminoacyl tRNA synthetases. Codon-anticodon interactions. Intergenic suppressors.

III.3 Ribosomes: Structure. Peptide synthesis: initiation, elongation and termination.

III.4 Control in eukaryotes: Inhibition / enhancement of translation initiation. RNA interference and gene silencing.

IV. Replication, recombination and repair

IV.1 The replicon: Modes of replication. DNA polymerases I and III. Helicases, binding proteins, ligases and primases. Initiation and termination of the replication in *E. coli*.

IV.2 Replication in eukaryotes: eukaryotic DNA polymerases. Telomeres and telomerases. Reverse transcriptase and retrotransposition.

IV.3 Recombination in eukaryotes: Holliday Intermediate. Proteins involved in replication. DSB modelduring meiosis.

IV.4. Repair: Defects in eukaryotic repair systems and disease.

V. Regulation of gene expression in eukaryotes

V.1 Epigenetics: Epigenetic changes in chromatin. Genomic imprinting by deletion and by trinucleotide repetition.

V.2 Retrotransposons: Elements regulating gene expression.

PROBLEM BASED LEARNING

The content of this section consists of a certain amount of problem statements related to the topics developed in the Theory classes.

Methodology

The training activities consist of classes of theory and classroom practices. Each of them has its own specific methodology.

Theory classes
The teacher will explain the contents of the syllabus with the support of audiovisual material that will be available to students in the Virtual Campus of the subject, in advance. These lectures will be the most important part of the theory section. It is recommended that students have the material published on the CV in printed form in order to be able to follow the classes more comfortably.
Under the guidance of the teacher, the knowledge of some parts of the syllabus will have to be deepened by the students, by means of autonomous learning. In order to facilitate this task, information about locations will be provided in textbooks, web pages, etc.

Classroom practices
There will be 15 sessions of classroom practices per group, in the data announced in the calendar. For these sessions, the theory group will be divided into two subgroups of the same size, whose lists will be made public at the beginning of the course. Students will attend the sessions programmed for their group, exceptions will not be allowed.
In these sessions, the teacher will present the experimental and calculation principles necessary to work on specific problems, explaining the guidelines for their resolution and at the same time reinforcing the knowledge of different parts of the theory classes.

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			
PBL sessions	15	0.6	1, 3, 2, 4, 5, 6, 7
Theoretical sessions	30	1.2	1, 3, 2, 4, 6

Type: Autonomous			
Autonomous learning	25	1	1, 3, 2, 4, 5, 6, 7
Solving problems	25	1	1, 3, 2, 4, 5, 6, 7
Studying theory	50	2	1, 3, 2, 4, 5, 6, 7

Assessment

The evaluation of the subject will be carried out through a continuous assessment consisting of four assesments of two different types: two questionnaires with test questions and two probes with the resolution of two problems. Each partial test will correspond to approximately one half of the theoretical syllabus or classroom practices.

Each trial will be independent about its recovery. Those students who have not passed 40% of one or both of the test type questionnaires must complete a final recovery of the test / s not passed. With regard to problem-solving tests, the recovery is voluntary.

The recovery will also be open to any student who, despite having passed the continuous assessment, wishes to improve the grade obtained; In this case however, the corresponding proof is annulled. Honor matrils will be preferentially assigned to the best grades obtained for the continuous evaluation.

To participate in the recovery, the students must have previously been evaluated in a set of activities whose weight equals to a minimum of two thirds of the total grade of the subject or module. Therefore, students will obtain the "Non-Evaluable" qualification when the assessment activities carried out have a weighting of less than 67% in the final grade. In other words, THE STUDENT MUST BE SUBMITTED TO THE 2 PARTIALS TO RECOVER THE SUBJECT.

The final grade obtained will be calculated as follows: 3.75 * questionnaire-1 + 1.25 resolution problems-1 + 3.75 * questionnaire-2 + 1.25 resolution problems-2
(*) TO PASS THE SUBJECT, IT IS MANDATORY THAT THE NOTE OF THE QUESTIONNAIRES IS SUPERIOR TO 1.5 / 3.75, AND THE GLOBAL NOTE OF 5.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Part 1- Theory	3.75	1	0.04	1, 2, 4, 6, 7
Part 1-PBL	0.125	1.5	0.06	3, 2, 4, 5, 6, 7
Part 2-PBL	0.125	1.5	0.06	1, 2, 4, 5, 6, 7
Part 2-Theory	3.75	1	0.04	3, 2, 4, 6, 7

Bibliography

Main Textbooks

- Biochemistry (4erd Ed, 2011)

D. Voet & J.G. Voet Ed. John Wiley & Sons

Main Book

- Lewin's Genes XII (2017)

J.E. Krebs, E.S. Goldstein, S.T. Kilpatrick. Ed. Jones and Bartlett Learning.

Secondary book

- Biochemistry (3erd Ed, 2000)

C.K. Matthews, K.E., van Holde, and K.G. Ahern. Ed. Benjamin/Cummings

Only for DNA topology.

- Gene Control (2on Ed. 2015)

D.S. Latchman. E. Garland Science

For eukaryotic gene control.

Enllaços web

Els enllaços Web s'han d'actualitzar contínuament. Es trobaran indicats dins de les presentacions de material penjades en el CV.

Software

There is no specific software for this subject.