DEGREE CURRICULUM

MOLECULAR BIOLOGY

Coordination: FERREZUELO MUÑOZ, FRANCISCO

Academic year 2019-20

MOLECULAR BIOLOGY 2019-20

Subject's general information

Subject name	MOLECULAR BIOLOGY
Code	101609
Semester	2nd Q(SEMESTER) CONTINUED EVALUATION
Typology	Degree: Bachelor's Degree in Biotechnology; Course: 1; Character: COMMON; Modality: Attendance-based
Course number of credits (ECTS)	6
Type of activity, credits, and groups	

Activity type	PRALAB		PRAULA	TEORIA
Number of credits	0.4	0.4	1.2	4
Number of groups	4	2	2	1

Coordination	FERREZUELO MUÑOZ, FRANCISCO
Department	BASIC MEDICAL SCIENCES
Important information on data processing	Consult this link for more information.

MOLECULAR BIOLOGY 2019-20

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
FERREZUELO MUÑOZ, FRANCISCO	francisco.ferrezuelo@udl.cat	8,8	

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.
Being able to solve basic problems.

Competences

General competences

The degree candidate in Biotechnology must:

Be able to selectively search and use sources of information necessary to achieve training objectives.
Interpret scientific-technical information with a critical viewpoint, and be able to make presentations based on this information.
Be able to make understandable written and oral reports about the work done, with a justification based on the theoretical and practical knowledge gained (Strategic competence of the UdL).
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 (Strategic Competence of the UdL).
Know and properly use the scientific and technical vocabulary of the different areas of Biotechnology.
Work in the laboratory applying quality criteria and good practice.
Know and know how to use the specific software and databases in the different fields of Biotechnology.

Specific competences

The degree candidate in Biotechnology must:

Know the biology of living beings in their molecular, cellular, organic and population levels, with emphasis on organisms with biotechnological interest.
Know the essential biomolecules for life and the basic concepts of enzymology.
Understand the function of genes and their regulation in response to external cell changes.

Subject contents

Unit 1. The structure of DNA: first great success of Molecular Biology.

1. What does Molecular Biology study?. 2. State of knowledge about the chemical composition of genetic material by 1925. 3. The genetic material is DNA: five experiments and a model (the transforming principle of pneumococci; the transforming principle is DNA; Chargaff's rules; the genetic material of the phages is DNA; studies of X-ray diffraction of DNA; the double helix model of Watson and Crick).

Unit 2. Nucleic acids: generalities.

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

Topic 3. DNA topology.

1. Concept and types of supercoiling. 2. Visualization of DNA topoisomers. 3. DNA topoisomerases: types and mechanisms.

Topic 4. 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 in eukaryotes. 9. Replication of the ends of linear chromosomes in eukaryotes.

Unit 5. 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 6. Recombination of DNA.

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

Topic 7. Transcription and RNA processing.

1. General characteristics of transcription. 2. Binding of RNA polymerase to DNA: transcription initiation. 3. The elongation phase. 4. Capping and polyadenylation of eukaryotic mRNAs. 5. Termination of transcription. 6. Splicing: concept, mechanism and types.

Unit 8. The genetic code and RNA translation.

1. Concept of genetic code and general characteristics. 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. Translation.

Unit 9. Chromatin.

1. Chromatin concept 2. The nucleosome. 3. Higher order chromatin structures. 4. Regulation of chromatinic structure: histone modification and nucleosome remodeling. 5. Nucleosome assembly during DNA replication.

Unit 10. Regulation of gene expression: transcriptional regulation.

1. Regulation of gene expression: general concepts. 2. Transcriptional regulation in prokaryotes: the lactose operon. 3. Transcriptional regulation in eukaryotes. 4. Epigenetics, gene silencing and heterochromatin.

Unit 11. Regulation of gene expression by non-coding RNAs.

1. RNA interference. 2. CRISPR and gene therapy.

Unit 12. Genomes.

1. The paradox of the C value and gene density. 2. DNA sequencing: Sanger's method and genome sequencing. 3. General characteristics of genomes of different groups of organisms.

Practical activities

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

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

- Laboratory: DNA analysis by PCR and electrophoresis.

Methodology

Activity	Description	Student attendance activity		Non attendance act		Assessment	Total time
			Hours	Student work	Hours	Hours	Hours
Lectures	The teacher provides the detailed contents of each topic (except for topic 1) as an online course in the CV. In the classroom, the teacher will summarize the most important concepts and those that may present the greatest difficulty in understanding. The evaluation will be of all the contents, not only those presented in class. Students are encouraged to read the topics in the CV and ask questions in class.	The student may attend the lecture or not. Attendance per se is not considered in the evaluation process.	**40**	Home study with notes, books and the Internet.	**28**	**-**	**68**
Problem sessions	Problems are worked individually or in groups at home before the corresponding session. In classroom we all solve the problems working together: preferably the students with some help from the teacher if necessary.	The student must actively participate in solving the problems in class and understand the reasoning used.	**11**	Problem thinking at home.	**22**	**-**	**33**

Laboratory	Practical laboratory work (small group)	Execution of the lab protocol: undestanding phenomena, measuring...	**4**	-	**-**	**-**	**4**
Computer room	Practical work in the computer room (Medium size grup)	Execution of the practical work: basic knowledge of databases, understanding PCR technique, use of some bioinformatic tool...	**5**	-	**-**	**30 min (included)**	**5**
Written tests	Two written tests with questions (multiple choice, short) about theoretical and practical knowledge and problem resolution.	Answering the tests	**-**	Home study	**40**	**4**	**40**
Total			**60**		**90**		**150**

Evaluation

Knowledge / Activi	Evaluative procedure		Weight in final score
Theoretical	First written test Units 1-6		**35**
Theoretical	Second written test Units 7-12		**35**
Problems / Practical cases	First written test		**7**
Problems / Practical cases	Second written test		**8**
Laboratory	Second written test		**5**
Computer room	Second written test		**5**
Computer room	Practical case to solve in the last session with the use of bioinformatic tools		**5**
Total			**100**

Observations

All scores obtained throughout the course are added. To pass the course you need to obtain a 60% score. This score is equivalent to a final score of 6. Those who fail to reach this threshold have the possibility of taking a test for the WHOLE course in June. This test will be about basic concepts of the different topics in the course and therefore the level of difficulty will be lower than in the tests taken during the course. To pass, it will be necessary to obtain a score of 70%, which will be equivalent to a final grade of 5, and a score of 100% to a final grade of 6.

Only those attending the practical sessions can score for the corresponding questions in the written tests. This requirement does not apply

to students who attended these sessions in previous years.

Bibliography

Basic bibliography

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

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

Molecular Biology of the cell. 5th ed. Alberts et al. 2008 Garland Science.

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

Molecular Biology of the gene. 6th ed. Watson et al. 2008 Pearson Education Inc.

Genes IX. 9th ed. Lewin 2008 Jones and Batlett Publishers.

Lewin's essential genes. 2nd ed. Krebs et al. 2010 Jones and Batlett Publishers.

Genetics: analysis of genes and genomes. 7th ed. Hartl & Jones 2009 Jones and Batlett Publishers.

Genetics: a conceptual approach. 3rd ed. Pierce 2008 W.H. Freeman and Co.

Genetics: analysis & principles. 3rd ed. Brooker 2009 McGraw-Hill Higher Education.

Adaptations to the contents due to COVID-19

The laboratory session is replaced by a videoconference where we will use videos and simulators to recreate (to a certain extent) virtually what we would have done in the real laboratory.

Adaptations to the methodology due to COVID-19

We will change to a flipped-classroom methodology. The course content is provided as an online course through the virtual campus and the lectures are replaced by videoconferences for the resolution of doubts and reinforcement activities. The sessions of problems, computer tools and recreation of the laboratory practice will be done by videoconference. The virtual campus activities tool will also be used to deliver solved problems. The exams will be online* and will be carried out in writing using the test tool and questionnaires of the virtual campus or, exceptionally, they will be oral examinations using the videoconference tool.

*The recovery exam may be onsite instead of online.

Adaptations to the evaluation due to COVID-19

The theory of the first exam continues with a weight of 35%, the theory of the second exam goes from a weight of 35% to 32%, the problems of the first exam go from 7% to 2%, the problems of the second exam pass From 8% to 3%, work at home will be evaluated in solving problems up to 10% *, the monitoring of the online course is evaluated through test-type questions that students answer at home as they read the topics in the course (weight 5%). Computer-sessions contents continue to weigh 10% but in an eminently practical test on the same day as the second exam. The contents of the recreation of the laboratory practice go from 5% to 3%.

Passing the course goes from obtaining 60% of the score to 55%, and in the recovery exam it goes from 70% to 60%.

* However, and given that this evaluative evidence may involve a greater degree of subjectivity than others, students who so wish may renounce the score obtained and undergo a problem-solving test.