Molecular Biology of Eukaryotes

Code: 100986
ECTS Credits: 6

2025/2026

Degree	Type	Year
Microbiology	OB	2

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

There are no official prerequisites. However, it is assumed that the student has acquired the knowledge taught in the subjects of the first year, especially from: Biochemistry, Genetics and Microbiology.

Objectives and Contextualisation

The educational objectives are for the students to describe and understand, at the molecular level, aspects related to:

1) How the genetic material is structured and organized in the eukaryotic organisms.

2) How these organisms are able to transmit their genetic information from one generation to the next with a high fidelity.

3) How eukaryotic organisms are able to respond to environmental changes, altering gene expression.

4) Some of the basic molecular biology tools used in Research and in Biotechnological applications.

Learning Outcomes

1. CM11 (Competence) Propose strategies for molecular cloning, mutant generation and genetic improvement using omics analysis with ethical responsibility and gender perspective to provide innovative responses to the needs and demands of society.
2. CM12 (Competence) Integrate knowledge and skills of molecular biology and genomics to develop and present academic work in the field of microbiology, either in English or in one's own language or others and working individually and in groups.
3. KM17 (Knowledge) Describe the molecular mechanisms responsible for the replication, conservation and transfer of genetic material, gene expression and regulation.
4. SM15 (Skill) Use bibliography and databases related to molecular biology and genomics, both in English and in one's own language.
5. SM16 (Skill) Relate the factors that control the different levels of gene expression with adaptation to existing environmental conditions and their application in biotechnology.
6. SM18 (Skill) Relate the processes of transfer and conservation of genetic information with its diverse applications in genetic engineering.

Content

1- Introduction

Molecular genetics: firstperiod and model organisms. Genomics and Genome projects. History of yeast as an experimental organism. Characteristics of *S. cerevisiae* genome. Analysis of homologies in the yeast genome. Yeast as a model system in Molecular Biology and some of its experimental approaches.

I STRUCTURE AND FUNCTION OF NUCLEIC ACIDS, AND PROTEINS IMPLIED IN THESE PROCESSES.

2- Genome organization

General characteristics of the genomes of eukaryotes. The sizes of the genomes. Gene families. The extranuclear genome: mitochondria and chloroplast.

3- Chromosomes, chromatin and nucleosome.

Chromosome concept. Gene concept, ORF and genome. Introns and pseudogenes in yeast. Functional elements of eukaryotic chromosomes: centromeres, telomeres and subtelomeric regions. The eukaryotic chromosome: model in yeast. Repetitive DNA in yeast. Topology of DNA, topological and supercoil link number, eukaryotic chromatin: histones, nucleosomes, fiber of 10 and 30 nm, heterochromatin and euchromatin. Structuring the metaphase chromosome. Interphase and mitotic chromatin. The cell cycle: regulation

4-The replication of the eukaryotic chromosome

The replication machine. The multiplicity of replicons and activation order. The replication fork. The termination of replication: formation of telomeres.

II MUTABILITY, REPARATION, RECOMBINATION AND TRANSPOSITION OF DNA

5-The recombination

Models of homologous recombination in the eukaryotes and proteins involved. Conversion of the mating type. Genetic consequences of the mechanism of homologous recombination. The gene conversion. The site-specific recombination. Recombination in yeast.

6-The transposition

Main mechanisms of transposition: classification of transposable elements (TEs). The Ty1, Ty3 and Ty5 elements of *S. cerevisiae*. Sex change in yeast by gene replacement: the cassette theory. Transposable elements in other microorganisms: microalgae, filamentous fungi and protozoa. Effects of transposition in the

genome. Regulation of the transposition. Interactions between TEs and the genome. Role of TEs in the genome.

7- Mutation and repair of genetic material

Duplication errors and their repair: nature of mutations and repair of mating. Chemical mutagens. Mutations induced by UV light. Repair of DNA lesions: Repair by recombination. Repair by split of bases. Repair by nucleotides cleavage. Yeast specific mechanisms of repair.

8-The rRNA, tRNA and other specialized RNAs

The RNA chain. General types of regulatory RNAs RNAs. RNAs with catalytic activity. siRNA and guide RNA (CRISPR/Cas9)

III REGULATION OF GENE EXPRESSION

9-Chromatin remodeling.

Remodeling the chromatin. Modification complexes. Histone code. Chromatin remodeling complexes. Chromatin during replication, transcription and repair.

10-Transcription and control at the transcriptional level of gene expression.

Basal transcriptional machinery. The eukaryotic RNA polymerases. The Pol II basal transcription machinery. Conservation of the transcription machinery. Specific factors of gene, DNA binding proteins and promoters in Pol II dependent transcription. Transcription factors. Interaction of proteins with DNA.

11- Processing and regulation of the half-life of mRNA

Obtaining functional mRNA, processing and splicing. Control and regulation mechanisms mRNA half-life.

12-Translation and control of translation

The eukaryotic translation machinery. Translation and translation regulation mechanisms. Protein folding. Chaperones. Protein modification.

13-Control of the half-life of proteins

Ubiquitination and proteolysis programmed by the proteasome. Proteolysis in the vacuolar system. Molecules ubiquitin type, SUMO. Ubiquitin binding domains. The 26S proteasome. The 26S proteasome of yeast as a model system. Cellular distributionof proteasomes and regulation of proteasome activity.

14- Molecular biology techniques in eukaryotic cells/organisms

Study of gene expression and techniques for the analysis of the regulation of gene expression. Methods on the study of chromatin structure and epigenetic marks. Genome-wide techniques. Gene function studies by forward and reverse genetics. Molecular biology techniques in yeast.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Seminars	6	0.24	CM11, CM12, SM15, SM16, CM11
Theory classes	40	1.6	KM17, SM16, SM18, KM17

Type: Supervised			
Mentorship	2	0.08	CM11, CM12, KM17, SM16, SM18, CM11
Type: Autonomous			
Bibliography search	8	0.32	CM12, SM15, CM12
Preparation of Oral presentation	12	0.48	CM11, CM12, SM15, CM11
Study	64	2.56	CM11, CM12, SM15, SM16, CM11
Texts reading	12	0.48	CM11, CM12, KM17, SM15, SM16, SM18, CM11

The formative activities are divided in two sections: theory classes and seminar/case study.

Mentoring will be done in the teacher's office after contacting him/her and setting a specific date. If the teacher considers it convenient, he/she will be able to do mentoring in the classroom when the dates of the written exams/tests are close. In this case the teacher will agree with the group of students a specific date and time for such tutoring.

Theory classes

The teacher will explain the content of the subject with the support of audiovisual material that will be available to students in the Campus Virtual. These expository sessions will be the most important part of the theory section. The presentations may contain text in English, as well as in Catalan and Spanish.

Seminar/Case study

In the "Seminar/Case study" sessions, the group will be divided into two subgroups of approximately 30 students each; the lists will be made public at the beginning of the course. Students will attend the 6 sessions scheduled by their group. In the sessions intended for "Seminar/Case study", students will select the topics to work in group among those proposed by the teacher. Each group will work on gathering information on these topics, will analyse data and will prepare compilation works that will be presented in the classroom to the rest of the classmates. One week prior to the day scheduled by the teacher for their group presentation, the students will send to the teacher a detailed guide to the exhibitions they will perform as well as the slides they will show in the classroom. The exhibition will cover a period of time previously set by the teacher, after which they will answer the questions posed by the rest of the students and the teacher. As indicated in the evaluation section, the professor will evaluate the quality of the compilation of the information and data analysis made and the oral presentation in the classroom.

During these sessions, students' skills in the application of theoretical knowledge to solve practical problems as well as the discussion of them will be promoted. In addition, students will be responsible for solving different problems raised in class for later delivery and evaluation.

If necessary, a short evaluation may be done about the seminar sessions.

Materials available:

Material available in the Virtual Campus of the subject

Teaching guide

Presentations used by teachers in theory classes

Proposals for seminars to be carried out.

Proposals for practical case to be carried out.

Calendar of teaching activities.

Use of AI
For this course, the use of Artificial Intelligence (AI) technologies is permitted exclusively for support tasks, such as bibliographic or information searches, text correction, or translations. For seminar/case study submissions, students must clearly identify which parts were generated using AI technology, specify the tools used, and include a critical reflection on how these tools influenced both the process and the final outcome of the activity. Lack of transparency regarding AI use in this assessed activity will be considered academic dishonesty and may result in partial or full penalties to the grade, or more serious sanctions in severe cases.

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.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exams or tests	80%	5	0.2	CM11, CM12, KM17, SM16, SM18
Seminars	20%	1	0.04	CM11, CM12, SM15, SM16, SM18

Theory

The total weight of the evaluation of the theory part will be 80% of the total grade of the subject. The main evaluation of this part of the course will be with two partial exams/tests, where both tests have an equal weight in the grade, that is, each accounts for 40% of the final course grade. To overcome this part of the subject a grade equal to or greater than 5.0 out of 10 should be reached. The partial exams/tests grade will average only when exceeding the minimum of 4.5 over 10.

Students who do not have the minimum grade in both partial proves or those who want to improve their grade, can attend to the recovery examination of one or the two partial exams, programmed at the end of the course.

The exams are designed as short questions or test. This part corresponds to the 80% of the course grade.

Seminar/Case study

The evaluation of the seminars represents 20% of the final grade. The students will work in groups on the topics provided by the teacher and will defend them in an oral presentation in the classroom. The defense will be evaluated. One week before of the presentation, the students will send the slides and a detailed guide of the presentation to the professor in charge; this work presented will also be evaluated.

To motivate class participation, a short test about the Seminars can be considered, by Kahoot or similar.

Since it is an assessable activity, attendance at the seminars is mandatory. The evaluation of seminars cannot be recovered.

Global evaluation

The student will pass the subject when the sum of the different parts will equal or exceed 5.0 out of 10 points.

Revision of qualifications: after each exam it will be a review day and a time. The grades of the continued evaluation will appear in the Campus Virtual.

To participate in the recovery exam of theory, according to UAB regulations, the studenthas to be previously evaluated in at least two-thirds of the total qualification of the subject. Therefore, the student has to perform the two partial exams if he wants to opt to the recovery exam, otherwise the non-attendance to a partial will imply a "non-evaluable".

Students who cannot attend an individual evaluation for a justified reason (illness, death of a first-degree relative or accident) and provide the official documentation corresponding to the Coordinator of the course, will have the right of attend to a recovery exam, that can be oral if the teacher considers convenient.

Single assessment

The single assessment consists of a single written test in which the contents of the entire theory program of the subject will be assessed. The test will consist of multiple choice-type questions and topics to be developed. The grade obtained in this written test will account for 80% of the final grade of the subject.

The evaluation of the seminars/case studies will be done through writen reports. The grade obtained will account for 20% of the final grade of the subject. Students who take the single assessment can hand in all the reports together on the same day as the day set for the written test.

The single assessment test will coincide with the same date fixed in the calendar for the last continuous assessment test and the same recovery system will be applied as for the continuous assessment.

Students will receive a grade of "Not Assessable" when the completed assessment activities account for less than 67% of the final grade.

The review of the final grade follows the same procedure as for continuous assessment.

Bibliography

1) Pierce, B.A. 2016. Genética. Un enfoque conceptual. (5th Edition). Ed. Médica Panamericana.

2) Watson, J.D.; Baker, T.A.; Bell, S. P.; Gann, A.; Levine, M.; Losick, R. 2016. Biología Molecular del Gen. (7th Edition). Editorial Médica Panamericana.

3) Lewin's. 2017. Genes XII. Jones and Bartllet Publishers. ALSO AVAILABLE AS ELECTRONIC BOOK

4) Brown, T.A. 2008. Genomes. (3rd Edition). Ed. Médica Panamericana. ALSO AVAILABLE AS ELECTRONIC BOOK

5) Latchman, D.S. 2015. Gene Control. (2nd Edition). Taylor & Francis Inc Garland Publishing Inc.

6) Latchman, D.S. 2005. Gene Regulation - A Eukaryotic Perspective. (5th Edition). Taylor & Francis Ltd

7) Feldmann, H. 2012. Yeast: molecular and Cell biology. (2nd Edition). John Wiley and Sons Ltd Wiley-VCH Verlag GmbH

8) Stansfiels, I. and Stark, M.JR. 2007. Yeast Gene Analysis. (2nd Edition). Academic Press.

Enllaços web:

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Software

There is no specific software.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	721	Catalan	second semester	afternoon
(PAUL) Classroom practices	722	Catalan	second semester	afternoon
(TE) Theory	72	Catalan	second semester	afternoon