UAB
Universitat Autònoma de Barcelona

Control of Gene Expression in Eukaryotes

Code: 101896
ECTS Credits: 6

2025/2026

Degree	Type	Year
Biomedical Sciences	OT	4

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 prerequisites to follow the course successfully.

Nonetheless, it would be desirable if students were familiar with basic knowledge of Biochemistry and Molecular Biology, Genetics, Celular Biology and Animal Physiology.

Objectives and Contextualisation

The training objectives are that the student, at the end of the subject, will be able to:

- Describe the structural aspects of chromatin, the factors that regulate it and its role in the regulation of gene expression.
- To know the strategies used in the identification of the mechanisms for the control of the gene expression in eukaryotes.
- Describe the most significant types of transcription factors in the control of gene expression and the mechanisms that regulate them in response to intracellular and extracellular signals.
- To know the mechanisms for controlling the translation and the stability and activation of mRNAs in response to cellular demands, embryonic development and their alterations in various pathologies.
- Explain the functional interrelationship in the various mechanisms of gene expression control during proliferation, cell differentiation and embryonic development, as well as to meet energy demands in various physiopathological situations.

- Learn how to apply the knowledge studied and the information in the databases to solve quantitative and quantitative problems related to their alterations in pathological situations, especially to genetic diseases with a higher prevalence in our population.
- Know how to design experiments, including the limitations of the experimental approach, interpret the experimental results, apply the computer resources for the search of specialized information, the treatment of the data and the communication of the results to the scientific community.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Display knowledge of the basic life processes on several levels of organisation: molecular, cellular, tissues, organs, individual and populations.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Read and critically analyse original and review papers on biomedical issues and assess and choose the appropriate methodological descriptions for biomedical laboratory research work.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Analyse the molecular mechanisms that regulate the size and differentiation stage of cells in tissues.
3. Describe the mechanisms of cell signalling and communication.
4. Explain the regulation of the cell cycle and its modulation.
5. Identify the mechanisms that regulate gene expression in cells, and their importance in the different cell functions.
6. Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
7. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
8. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
9. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
10. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.

11. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
12. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
13. Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.
14. Write a review paper in the area of molecular and cell biology.

Content

Topic 1: Levels of control of gene expression in eukaryotes.

Introduction. Description of the different levels of gene expression controls. Methods for their study.

Topic 2: Structure of chromatin

The nucleosome. Histone variants Post-translational modifications of histones. Fiber of 30 nm. Structural and functional chromatin domains. Methylation of DNA.

Topic 3: Rol of the chromatin structure in the control of eukaryotic gene expression.

Alterations in DNA methylation of active or potentially active genes. Modifications of histones in chromatin of active or potentially active genes (Histone Code). Chromatin structure changes in active and potentially active genes. Remodeling complexes.

Topic 4: Control of transcription.

Transcription: control mechanisms in the formation of the initiation and elongation complex Transcription factors and control mechanisms in response to biological signals. End of transcription.

Topic 5: Transcription factors.

Structural characteristics. General action mechanisms on transcription. Activation of transcription factors. Response models of transcription factors to intracellular and extracellular signals.

Topic 6: Post-transcriptional processing. Transport and stability of mRNA.

Maturation of mRNA (capping / polyadenylation / splicing). Core-cytosol export of mRNAs and mechanisms that control it. Cytoplasmic distribution of mRNA: localization of translation. Storing mRNA in the cytosol and mRNA activation. Controlling the stability and degradation of mRNAs: Importance of siRNA and miRNA.

Topic 7: Translation and mechanisms to control it.

Stages and levels of translation control. Control of translation in response to intracellular and extracellular signals: importance of the structural elements present in the mRNA. Alternative mechanism of initiation of translation in eukaryotes and factors that control them.

Topic 8: Post-translational control.

Control of protein stability and degradation. Factors that influence the proteome: post-translational modifications and their control.

Topic 9: Control of gene expression in cellular development and differentiation.

Control of gene expression in embryonic development. Cell specification and control of gene expression specific to the cell type.

Topic 10: Gene regulation in cancer and other human diseases.

Oncogenes and tumor suppressor genes: Cellular mechanisms that affect their expression. Alterations of gene expression in genetic diseases. Infectious diseases and gene expression.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Seminar	15	0.6	3, 14, 4, 2, 5, 13
Theory classes	30	1.2	3, 4, 2, 5
Type: Supervised			
Preparation of a seminar	15	0.6	3, 14, 4, 2, 5, 13
Tutorials	5	0.2	3, 14, 4, 2, 5, 13
Type: Autonomous			
Autonomous study	74	2.96	3, 4, 2, 5

The course consists of theory classes, seminars and tutorials. The following is a description of the organization and teaching methodology that will be followed in each of these types of training activities

Theory classes:

The content of the theory program will be taught mainly by the professor in the form of lectures with audiovisual support. The presentations used in class by the professor will be available to the students in the Virtual Campus of the course before the beginning of each of the topics of the course. These expository sessions will constitute most of the theory section. Students are advised to regularly consult the bibliographic material recommended in this teaching guide, as well as the review articles referenced in the graphic material of the classes, which are accessible online from the UAB, to consolidate and clarify, if necessary, the contents explained in class.

Seminars:

This formative activity will be worked entirely in English.

The programmed seminars are designed to consolidate the contents worked on in the theory classes and for the students to acquire critical reasoning, communication and discussion skills of scientific topics in English. Depending on the number of people enrolled, this activity will be individual or in groups of 2 people. In these sessions, students will work on a specific topic related to the course syllabus for its subsequent oral presentation and collective discussion using the means available in the classroom.

At the beginning of the course, the teacher will propose a list of topics that will be published in the Virtual Campus. The organization of the groups, the distribution of topics to be dealt with and the scheduling of the presentation dates will be done during the first week of classes of the course. Each group will write a brief summary (1 page) of the content of their presentation and will be sent by e-mail, in pdf format, to the professor responsible for the seminars, atleast one week before the presentation of the seminar. The professor will make this material public in the Virtual Campus of the subject before the seminar presentation. 48 H before the day

of the seminar, the students will deliver to the professor, by e-mail and in pdf format, the presentation that will be used for the oral presentation of the seminar. The professor will also make this material public in the Virtual Campus of the course for the knowledge of all enrolled students.

It is necessary that all students attend the seminars. In the case of not being able to attend a seminar for justified reasons (such as illness, death of a first-degree relative or accident), official documentation must be provided.

In this activity, the use of artificial intelligence (AI) technologies is permitted as an integral part of the development of the work, as long as the final result reflects a significant contribution of the student in the analysis and personal reflection. The student will have to clearly identify which parts have been generated by this technology, specify the aspects, and include a critical reflection on how these have influenced the process and the final result of the activity. Non-transparency in AI use is considered a lack of academic honesty and may lead to a penalty in the activity grade, or major sanctions in serious cases.

Tutorials

Individual or small group tutorials will be held at the student's request. The objective of these tutorials will be to solve doubts, to orientate on the sources of information consulted and the preparation of the seminars. In case the number of requests is extremely high, especially before exams, a classroom tutorial could be held before exams, to solve doubts or to review basic concepts, which will be announced in due time through the Virtual Campus. These sessions will not be expository nor will the official syllabus be advanced, but will be sessions of debate and discussion.

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
Partial exams of theory (3)	25% each (total 75%)	6	0.24	1, 12, 3, 14, 4, 2, 5, 6, 11, 10, 9, 7, 8, 13
Peer assessment (students evaluating seminars of other students)	10% of the final grade	2	0.08	1, 12, 3, 14, 4, 2, 5, 6, 11, 10, 9, 7, 8, 13
Seminar written work and oral presentation in group	15% of the final grade	3	0.12	1, 12, 3, 14, 4, 2, 5, 6, 11, 10, 9, 7, 8, 13

In the evaluation of this subject, it is foreseen:

Continuous Evaluation

Theory (75% of the overall grade)

Three partial tests with questions corresponding to the content of each of the parts of the subject, formulated as:

(a) on specific individual aspects,

(b) on the relationship between various sections of the program.

(c) use of knowledge to interpret experimental results or solve problems related to the control of gene expression in pathophysiological situations.

The weight of each test will be 25% of the overall grade of the course, so that the total weight of the evaluation of the theory will be 75% of the overall grade.

In order for the grade of each theory midterm to be compensated with the other one, it will be necessary that the grade obtained in each theory midterm is equal or higher than 3.5 (out of 10). In case of not reaching this grade in each of the midterm exams, the student will have to take a theory recovery test, which will also be by midterm exams. To participate in this recovery, the student must have been previously evaluated in a set of activities whose weight is equivalent to a minimum of two thirds of the total grade of the subject.

On the occasion of the recovery test of the theory midterm, it will be possible to retake the exam in order to improve the grade of the previous midterm. In this case, it is understood that the grade obtained previously is waived and the grade obtained in the second exam will be considered as the grade obtained in the second exam.

Seminars (25% of the overall grade)

This section evaluates the capacity of analysis and synthesis of the students of each group, as well as the skills of group workand oral presentation.

The evaluation will consist of two parts:

(a) The teaching staff evaluates the content (degree of depth and knowledge of the topic) of the seminar, the initial summary, the oral presentation and the response to questions. This evaluation will correspond to 10% of the overall grade of the course and does not require a minimum grade to be able to compensate with the other tests.

(b) Peer assessment, at the end of each of the seminar sessions, the attending students will make an assessment on the content, the oral presentation and the answer to the questions of each of the works presented in that session. For each work, the average mark of the assessment given by the other students will be calculated, and this average mark will correspond to 10% of the overall mark of the student who completed the work.

Students must participate in the peer evaluation (section b) in at least 80% of the seminars presented by the

The total weight of the seminar evaluation will be 25% of the overall grade.

Single Evaluation

Theory (75% of the overall grade)

On the day marked by the third partial in the calendar of the subject, students who have opted for the single evaluation system will take a single written test with questions from the whole subject syllabus, formulated as:

(a) on specific individual aspects,

(b) on the relationship between various sections of the program.

(c) use of knowledge to interpret experimental results or the resolution of problems related to the control of gene expression in pathophysiological situations.

The weight of this single evaluation test of theory will be 75% of the course.

The single evaluation test of theory is recoverable and will be held on the same day as the recovery of the continuous evaluation tests, in which case the recovery will also be a single written test with questions of the whole subject of the course, with the same format described for the previous test.

To participate in this recovery, the student must have been previously evaluated in a set of activities whose weight is equivalent to a minimum of two thirds of the total grade of the subject.

Seminars (25% of the overall grade)

For the evaluation of the activity of the seminars the same system described in the continuous evaluation will be applied, due to the fact that, as described in the methodology section, the attendance to the seminars is necessary for all the students. In the case of not being able to attend a seminar for justified reasons (such as illness, death of a first-degree relative or accident), official documentation must be provided.

The total weight of the seminar evaluation will be 25% of the overall grade

General Considerations

In all evaluation systems, in addition to knowledge, the acquisition of written and oral communication skills will be taken into account.

In seminar activities, the use of artificial intelligence (AI) technologies is permitted as an integral part of the development of the work, as long as thefinal result reflects a significant contribution of the student in the analysis and personal reflection. The student will have to clearly identify which parts have been generated by this technology, specify the aspects and include a critical reflection on how these have influenced the process and the final result of the activity. Non-transparency in AI use is considered a lack of academic honesty and may lead to a penalty in the activity grade, or major sanctions in serious cases.

The sections of Theory and Seminars are inseparable, so the student must participate, and be evaluated, in both, to pass the subject.

In order for the theory grade to be compensated with the seminar grade, the grade obtained in the theory written test(s) must be equal or higher than 3.5 (out of 10).

To pass the course, it is necessary to achieve a final overall grade of 5.0 or higher (out of 10).

Students will get the grade of "Not Valuable" when the evaluation activities performed have a weight of less than 67% in the final grade.

Students who cannot attend an individual evaluation test for justified reasons (such as illness, death of a first-degree relative or accident) and provide the corresponding official documentation to the Grade Coordinator, will have the right to take the test on another day. The Grade Coordinator will ensure that this is arranged with the professor of the affected subject.

Any aspect not covered in this guide will follow the evaluation regulations of the Faculty of Biosciences.

Bibliography

a) Books

Latchaman, D.S. "Gene Control" 3rd Edition (2025) Garlan Sciences.

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Carlberg, C. (2024). Gene Regulation and Epigenetics: How Science Works (1st ed.) Springer

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Latchaman, D.S. "Eukaryotic transcription factors" (2008) Academic press.

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Carey, M., Peterson, C. L., & Smale, S. T. (2009). *Transcriptional regulation in eukaryotes: concepts, strategies, and techniques* (2nd ed.). Cold Spring Harbor Laboratory Press.

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Lewin B, Krebs J.K., Kilpatrick S.T., Goldstein E.S. "Genes X" (2011) Ed. Jones and Bartlett, Sudbury, Mass USA.

Mathews M.B. (Editor) "Translational Control in Biology and Medicine" (Cold Spring Harbor Monograph Series 48) (2007) Cold Spring Harbor.

Allis CD, Jenuwein T, Reinberg D, "Epigenetics" (2015) Cold Spring Harbor Laboratory Press

b) Review articles published in scientific journals.

The bibliographic references of the various recommended review articles will be indicated in the graphic material of the classes. These review articles will correspond to journals that are accessible via the network from the UAB.

Software

Microsoft Word, PowerPoint, Excel.

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
(SEM) Seminars	641	English	first semester	morning-mixed
(TE) Theory	64	Spanish	first semester	morning-mixed