Universitat Autònoma de Barcelona

2020/2021

Control of Gene Expression in Eukaryotes

Code: 101896
ECTS Credits: 6

Degree	Type	Year	Semester
2501230 Biomedical Sciences	OT	4	0

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

Name: Inmaculada Ponte Marull
Email: Inma.Ponte@uab.cat

Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Other comments on languages

L'activitat formativa dels seminaris es treballarà íntegrament en anglès

Teachers

Maria Plana Coll

Alicia Roque Cordova

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 expression and cancer.

Oncogens and tumor suppression genes: Cell mechanisms that affect their expression.

Topic 11: Gene regulation and human diseases.

Transcription, post-transcriptional processing and human diseases. Structure of chromatin human diseases. Infectious diseases and gene expression.

Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.

Methodology

Teaching methodology consists of theory classes (30 H), seminars (15) and tutorials (5) (group and individual)

Seminar classes will work entirely in English.

The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities

Activities

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

Assessment

Theory Classes Evaluation

75% of the overall grade corresponds to the evaluation of theory classes. There will be two written examinations of a weight of 37.5% each.

So that the qualification of each theory part can be compensated with the one of the other it will be necessary that the note obtained in each partial theory is equal to or greater than 3.5 (out of 10). In the case of not achieving this qualification in each one of the partial ones, the student will have to present himself to a ratake process. To be eligible for the retake process, the student should have been previously evaluated in a set of activities equaling at least two thirds of the final score of the course or module.

Seminar Classes Evaluation

25% of the overall grade corresponds to the evaluation of the seminar activity: 10% work and presentation with the group and 15% individual written test.

General consideration

The student will be graded as "No Avaluable" if the weighthin of all conducted evaluation activities is less than 67% of the final score

Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Partial exams of theory (2)	37,5% each (total 75%)	4	0.16	1, 12, 3, 14, 4, 2, 5, 6, 11, 10, 9, 7, 8, 13
Seminar written work and oral presentation in group	10%	5	0.2	1, 12, 3, 14, 4, 2, 5, 6, 11, 10, 9, 7, 8, 13
Written test abount the contents of seminars	15%	2	0.08	1, 12, 3, 14, 4, 2, 5, 6, 11, 10, 9, 7, 8, 13

Bibliography

Carey, M., Smale, S.T. "Transcriptional Regulation in Eukaryotes" (2001) Cold Spring Harbor.

Latchaman, D.S. "Gene Control" (2010) Garlan Sciences.

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

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 (Editors) "Epigenetics" (2007) Cold Spring Harbor Laboratory Press.

Review articles published in scientific journals.