

Control of Gene Expression in Eukaryotes

Code: 101978
ECTS Credits: 6

| Degree | Type | Year | Semester |
|------------------|------|------|----------|
| 2500890 Genetics | OT | 4 | 0 |

Contact

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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

Teachers

Maria Plana Coll
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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, Cellular 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.

Skills

- Apply knowledge of theory to practice.
- Apply scientific method to problem solving.
- Be able to analyse and synthesise.
- Be able to communicate effectively, orally and in writing.
- Describe and identify the structural and functional characteristics of nucleic acids and proteins including their different organisational levels.
- Describe epigenetic mechanisms.
- Describe the genetic bases of the development and control of genic expression.
- Understand and describe the structure, morphology and dynamics of the eukaryotic chromosome during the cell cycle and meiosis.
- Use and manage bibliographic information or computer or Internet resources in the field of study, in ones own languages and in English.

Learning outcomes

1. Apply knowledge of theory to practice.
2. Apply scientific method to problem solving.
3. Be able to analyse and synthesise.
4. Be able to communicate effectively, orally and in writing.
5. Describe the mechanisms and genetic consequences of epigenetic modifications.
6. Describe the mechanisms for regulating genic expression in viruses, bacteria and eukaryotes.
7. Describe the organisation of genetic material throughout the cell cycle.
8. Describe the processes of replication, transcription, translation and regulation of genes in prokaryotes and eukaryotes.
9. Enumerate and describe the basic mechanisms of pattern-forming in animals.
10. Explain the role of tool genes in development.
11. Relate the structure of nucleic acids with their biological functions.
12. Use and manage bibliographic information or computer or Internet resources in the field of study, in ones own languages and in English.

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. Oncogenes 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

Methodology

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

Seminar classes will work entirely in English.

Activities

| Title | Hours | ECTS | Learning outcomes |
|--------------------------|-------|------|---------------------------------------|
| Type: Directed | | | |
| Seminar | 15 | 0.6 | 2, 1, 6, 5, 8, 7, 9, 10, 11, 4, 3, 12 |
| Theory classes | 30 | 1.2 | 2, 1, 6, 5, 8, 7, 9, 10, 11, 3 |
| Tutorials | 5 | 0.2 | 2, 1, 6, 5, 8, 7, 9, 10, 11, 3, 12 |
| Type: Supervised | | | |
| Preparation of a seminar | 15 | 0.6 | 2, 1, 6, 5, 8, 7, 9, 10, 11, 4, 3, 12 |
| Type: Autonomous | | | |
| Autonomous study | 74 | 2.96 | 2, 1, 6, 5, 8, 7, 9, 10, 11, 4, 3, 12 |

Evaluation

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 retake 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

Evaluation activities

| Title | Weighting | Hours | ECTS | Learning outcomes |
|--|------------------------|-------|------|---------------------------------------|
| Partial exams of theory (2) | 37.5% each (Total 75%) | 4 | 0.16 | 2, 1, 6, 5, 8, 7, 9, 10, 11, 4, 3, 12 |
| Seminar: written work and oral presentation in group | 10% | 5 | 0.2 | 2, 1, 6, 5, 8, 7, 9, 10, 11, 4, 3, 12 |
| Written test about the content of seminars | 15% | 2 | 0.08 | 1, 6, 5, 8, 7, 9, 10, 11, 4, 3, 12 |

Bibliography

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

Latchaman, D.S. "Gene Control" (2010) Garland 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.