COURSE DATA

DATA SUBJECT

Code: 33152
Name: Development genetics
Cycle: Undergraduate Studies
ECTS Credits: 4.5
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1109 - Degree in Biochemistry and Biomedical Sciences	Facultat de Ciències Biològiques	3	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1109 - Degree in Biochemistry and Biomedical Sciences	Biomedicina molecular	COMPULSORY

COORDINATION

PEREZ ALONSO MANUEL

ARTERO ALLEPUZ RUBEN DARIO

SUMMARY

The subject "Genetics of Development" is taught in second semester of the third year of the Degree in Biochemistry and Biomedical Sciences. This is a compulsory subject, with subjects Genomics, Developmental Genetics, Human Genetics, Genetics and Cytogenetics, Genetic Analysis Techniques and Genetic Engineering aims in order to provide students with the basic knowledge about biological inheritance and the conceptual and methodological tools which enable it to carry out, in their professional work, tasks related to genetic analysis and clinical genetics.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

COMPETENCES / LEARNING OUTCOMES

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Capacidad de aprendizaje autónomo.

Capacidad para la organización de la información (esquemas, diagramas, mapas conceptuales) y la preparación de exposiciones públicas.

Comprensión de las bases celulares y moleculares del establecimiento de patrones de destino celular y la morfogénesis.

Comprensión de los mecanismos moleculares básicos que controlan los procesos de división, proliferación celular, diferenciación celular, apoptosis y senescencia.

Comprensión de los mecanismos moleculares y celulares que controlan el desarrollo de los organismos.

Comprensión de los procesos de renovación y reparación tisular a nivel celular y molecular.

Comprensión y manejo de los sistemas experimentales y métodos utilizados en la investigación de las materias de estudio.

Conocimiento de la conservación de procesos esenciales en el control de la división celular, diferenciación celular y desarrollo.

Conocimiento de las bases moleculares del cáncer.

Conocimiento del método científico. Desarrollo de la capacidad de entender y razonar la base experimental del conocimiento.

Conocimiento de los organismos modelo fundamentales en el estudio del ciclo celular, diferenciación y desarrollo.

Conocimiento y manejo de diversas fuentes de información.

DESCRIPTION OF CONTENTS

1. The development of organisms as genetic program.
2. Study Models in Developmental Genetics.
3. Gene regulation in cell differentiation.
4. Genetic analysis of the development.
5. Genetic tools for studying cell lineage relationships.
6. Genetic analysis and molecular.
7. Molecular and cellular analysis of differential gene expression.
8. Maternal genome contribution to embryonic development.
9. Zygotic genome activation.

1. THEORY CLASSES

1. The development of organisms as genetic program.
2. Study Models in Developmental Genetics.
3. Gene regulation in cell differentiation.
4. Genetic analysis of the development.
5. Genetic tools for studying cell lineage relationships.10. Diversification of gene expression patterns.

1. The development of the organisms as a genetic program

Inheritance and development. Stability of genetic information. Differentiation and determination. Concept of positional information. Establishment of body patterns.

2. Model organisms in Developmental Genetics

Drosophila melanogaster, Xenopus, Caenorhabditis elegans and mouse. Other models in the study of the animal and plant development

3. Gene regulation in cell differentiation

Proteins determine the phenotypic characteristics of cells. Genes as responsable for the control of differentiation. Totipotency: studies in plants and amphibians. Differential gene expression.

4. Genetic analysis of the development

Fundamentals of the analysis of mutants. Mutant isolation protocols. Maternal and zygotic effect mutations. Transposon tagging. Mutational analysis of segmentation in Drosophila. Somatic genetics.

5. Genetic tools for studying cell lineage relationships

The paradigm of C. elegans. Experimental embryology. Genetic methods of labeling. Mosaic gynandromorphs and mitotic recombination. Autonomy versus cell interactions. The development of the Drosophila compound eye.

6. Molecular genetic analysis

Mutations and molecular mapping of transcripts. Methods for ectopic gene expression: production of dominant phenotypes. Molecular analysis of gene interactions: molecular epistasis studies. Functional significance of protein-DNA interactions and protein-protein

7. Molecular and cellular analysis of differential gene expression

In situ hybridization and immunohistochemistry. Northern blot and Western blot. Reporter gene and the enhancer trap. Utility of transgenic organisms in the analysis of regulatory elements: gene fusions.

8. Maternal genome contribution to embryonic development

Oogenesis. Determining the axial coordinate. The anteroposterior axis and dorsoventral axis. Protein gradients and positional information. Specification of the anteroposterior axis: the paradigm of gene bicoid.

9. Zygotic genome activation

Embryogenesis and larval development: the blastoderm fate maps of Drosophila. Segmentation genes: expression patterns and gene functions. Preparation of the anteroposterior axis: compartments and parasegmentos. Molecular analysis of the segmentation: molecular epistasis. Hierarchies of gene regulation. Interaction between the maternal genome and zygotic genome. Specification of tissues: elaboration of dorsoventral axis.

10. Diversification of gene expression patterns

Homeotic genes and the homeobox. Gene complexes that control the body plan of insects: the bithorax complex and Antennapedia Complex. Selector genes and effector genes. Evolutionary conservation of homeotic genes: Hox complexes in vertebrates. Homeotic genes in plants. Homeosis and evolution.

11. Developmental Genetics in the context of biomedical research

The use of animal models in the understanding of disease pathways. Biomedical research and biopharmaceutical reseach. The translation of knowledge in Biomedicine and collaboration with biotech industry. From the understanding of the biological basis of disease to the discovery of therapeutic targets, drug disvovery and biopharmaceutical development.

12. A practical case of the aplication of Developmental Genetics in translational biomedical

The discovery of genes relevant for the development of disease. From the implication of one gene in a pathophysiological pathway to the creation of a disease model. From mutant phenotypes to the understanding of disease. Developmental Genetics tools in drug discovery. Preclinical development of drugs.

13. LABORATORY PRACTICAL CLASSES

Practice 1: Study of mutations affecting the pattern of larval cuticle of Drosophila.

Practice 2: Detection of genes regulated during Drosophila development by the enhancer trap technique: description of embryonic expression patterns.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	3,00
Theory	32,00
Laboratory	10,00
Total hours	**45,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	67,50
Preparation of lessons	0,00
Preparation for assessment activities	0,00
Resolution of case studies	0,00
Total hours	**67,50**

TEACHING METHODOLOGY

The development of the subject, as to-face work, is divided into:

Theory classes: Three weekly sessions of theory classes one hour for 9 weeks. In these sessions is to present and analyze the basic concepts of the subject with a special interest in highlighting the practical aspects of the same. It is highly recommended prior reading of the issues. A total of 27 sessions required 1 hour of presentation of topics by the teacher.

Hands-on labs: 5 sessions of two hours each. Attendance at these sessions is mandatory.

Group mentoring: The student will be encouraged to utilize this resource for advice and discuss any topic with the teacher about the program, the subject, or career. A total of 3 hours have been allocated for these tutorials.

Seminars, conferences and other activities: 3 hours for participation in activities, which will serve to allow students to expand their knowledge on the subject and relate with other disciplines, and promote the

acquisition of competences other than those acquired in the theoretical and practical classes.

One of these activities (1.5 hours) will consist in critical analysis of scientific papers selected by the teachers of the subject. This activity aims at training the student in the reading of scientific papers (which necessarily involves reading technical English), bringing him/her closer to the original literature and to new insights that enable the development and advancement of biomedical sciences. This activity is mandatory, will be organized jointly with the other subjects in their third year, corresponding to the Genetics of Development a total of 3 articles. The preparation, presentation and discussion (30 minutes) of the topics are held in groups of 2 students and supervised by the teacher through the tutorials.

EVALUATION

Objective tests on the course content (total 80%): 80 points in the form of a final exam on the theoretical content of the syllabus.

Individualized tracking in practical activities (total 15%): 5 points for daily tasks and 10 points for solving practical questions.

Assessment of written reports and oral presentations (total 5%). 5 points in Journal Club activities.

It will be necessary to obtain 50% in the final grade to pass the course.

REFERENCES

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- WILKINS, A.S. (1992). Genetic Analysis of Animal Development, 2ª edición. John Wiley and Sons (New York), pp. 566.
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- Páginas web:
- Developmental Biology Online (8ª edición): http://8e.devbio.com/
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- Molecular Biology of The Cell Online: http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=mboc4 Scitable (Nature) http://www.nature.com/scitable/topics