Universitat Autònoma de Barcelona

2021/2022

Cytogenetics

Code: 100761
ECTS Credits: 6

Degree	Type	Year	Semester
2500250 Biology	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

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Use of Languages

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

Teachers

Asuncion Duran Puig
Sandra Andreu Cortés

Prerequisites

Knowledge required:

1. Understand the basics of the subjects: "Cell Biology" and "Genetics".

2. Understand specific aspects of these subjects: Mendelian principles, chromosome theory of inheritance, the flow of genetic information, cell cycle principles and mechanisms of cell division.

3. Read correctly in English.

4. Use at the user level, basic computer tools (Internet, PowerPoint and Word Processor)

Objectives and Contextualisation

Cytogenetics is a hybrid discipline that draws on concepts of Cell Biology and Genetics. The convergence of issues from these areas has contributed to the development of a modern and dynamic science that has as a main objective the study of the chromosome.

The progress of this discipline has been characterized by the combination of conventional and modern techniques, as well as a continuous exchange between the development of new methods and the formulation of new hypotheses. This has significantly improve the understanding of the chromosome, providing a dynamic conception of this cell structure and developing to the limits the structure-function binomial.

In recent years, the consolidation of Cytogenetics has resulted in an alive discipline, approaching the borders to other disciplines with significant repercussions and applications in human health, agriculture and evolution.

In this context the objectives of the subject are:

1. To offer a comprehensive view into the structure and behavior of chromosomes to guarantee the preservation of genetic information, its transmission from parents to children and gene expression.

2. To study chromosomes variations, from the mechanisms that originate them to the genetic consequences for the offspring.

3. To perform a comprehensive analysis about the cytogenetics applications in human health, agricultural genomics and speciation studies.

Competences

- Be able to analyse and synthesise
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Perform genetic analyses.
- 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.
- Understand the processes that determine the functioning of living beings in each of their levels of organisation.

Learning Outcomes

1. Analyse a situation and identify its points for improvement.
2. Be able to analyse and synthesise.
3. Describe the structure, morphology and dynamics of the eukaryotic chromosome.
4. Determine levels of gene, chromosome and genome damage, both spontaneous and induced.
5. Perform genetic diagnoses and advise on these.
6. Propose new methods or well-founded alternative solutions.
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.

Content

PART I: ORGANIZATION OF HEREDITARY MATERIAL IN HIGHER EUCARYOTES

Chapter 1. General introduction

Chapter 2. The eukaryotic chromosome

PART II: CHROMOSOMES AND CELL DIVISION

Chapter 3. Mitotic cell division

Chapter 4. Meiotic cell division

PART III: SPECIALIZED CHROMOSOMES

Chapter 5. Adaptational forms of normal chromosomes

Chapter 6. Permanently specialized chromosomes

PART IV: TECHNIQUES FOR CHROMOSOME IDENTIFICATION AND ANALYSIS

Chapter 7. Generalities of the cytogenetic analysis protocols

Chapter 8. Chromosome identification techniques

PART V: GENETIC AND EPIGENETIC ANOMALIES

Chapter 9. Alterations of the karyotype

Chapter 10. Chromosome structural anomalies

Chapter 11. Chromosome numerical anomalies

Chapter 12. Epigenetic anomalies

PART VI: CYTOGENETICS APPLICATIONS

Chapter 13. Applications in speciation studies

Chapter 14. Applications in human health

Chapter 15. Applications in plant breeding

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

Methodology

Theoretical classes: The content of the theoretical program will be explained by the teacher in the form of master classes, with the appropriate audio-visual support and encouraging the active participation of students through reciprocal questions. This teaching methodology will be applied in 35 sessions of 50 minutes.
The tables, figures and graphics used in class will be available in *pdf format on the Virtual Campus. Students may also consult on this platform the videos, animations and websites used in class.
The study of the theory program implies that students regularly consult the books and review articles selected by the teacher in order to consolidate the contents explained in class (see Bibliography section). The articles will be available on the Virtual Campus in *pdf format.

Problem-solving classes: This learning methodology has the following objectives:

- To inititiate the student in the resolution of representative experiments that clearly illustrate new advances in cytogenetics.
- To consolidate the concepts developed in theoretical classes, as well as evaluate the implications that arise from them.

- To initiate the students in the scientific method, working with the learning objectives especially related to reasoning, critical judgment and communicative skills.

There are 5 sessions of 50 minutes of duration programmed during the course. Within each group, students will be organized in groups of four people. The methodology applied to the classroom will consist on the following phases:

- Students will have a list of problems (available at the Virtual Campus) that will be resolved in a non-face-to face way by the established groups. For each of the scheduled sessions, students must work on 4 problems and prepare an answer dossier.
- At the beginning of each session, each group will deliver the teacher the answer dossier (one delivery per group). All problems will be discussed and corrected in the classroom requiring the active participation of the students. Specifically, the teacher will ask a member of the different workgroups to present the resolution of a problem to the rest of the students. The resolution of the problem will be evaluated by the teacher and the qualification obtained will be applicable to all the members of the workgroup to which the student belongs.
- The answer dossier given by each workgroup will be evaluated as follows: at the end of each session, the teacher will choose a problem, which will be the same for all the groups, and these will be corrected and evaluated by the teacher.

The qualification obtained in Problem-solving activities will be the same for all the members of the group and will contribute to the final qualification of the subject.

Laboratory practices: Practices will be carried out in groups of two people. The students will have a guideline document (Virtual Campus of the subject) to address practical sessions. To facilitate the understanding of the contents and a good development of the classes it is advisable that the student read the practice guideline before each session. During the elaboration of the practices students will have to solve face-to-face exercises facilitated by the teacher. These exercises must be delivered at the end of each session.

In order to carry out the practical classes, the student must justify having passed the biosafety and security tests (Virtual Campus) and be knowledgeable and accept the operating regulations of the Bioscience's laboratories.

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Classroom practical classes (solved problems exposition)	5	0.2	12, 1, 3, 4, 5, 6, 11, 10, 9, 7, 8, 2
Laboratory practices	12	0.48	1, 4, 5, 11, 10, 9, 7, 8, 2
Theoretical classes	35	1.4	12, 3, 4, 5, 11, 10, 9, 2
Type: Autonomous			
Individual study	60	2.4	3, 4, 5, 6, 11, 10, 9, 7, 2
Solve problems	33	1.32	12, 3, 4, 5, 6, 10, 9, 7, 8, 2

Assessment

To pass the subject it will be essential to obtain a final grade equal to or greater than 5 points out of 10 based on the contributions of the different evaluation activities. Students who preform less than 50% of the evaluation activities described above will be considered as not evaluated.

1. Written exam (individual evaluation):

During the semester, two written tests (see course program) will be carried out on the theoretical contents of the subject.The objective is to evaluate the mastery of the concepts and the knowledge exposed in class, verifying the hability of applying and relating them.

Each test will have a value of 35% on the final qualification of the subject. Students must obtain a minimum score of 4 points of the mean of the two written exams.

2. Problem solving (group evaluation)

The qualifitacion of this part will be obtained by the arithmetic mean of the sum of the qualification obtained by each group of students throughout the course (dossier and oral resolutions). The teacher will ensure that during the course each group has made at least one exhibition. A problem not delivered or not solved in class will be scored with a zero in the calculation of the average grade of the group.

The assessment of the problems will be performed taking into account the correction in the response, the approach and the interpretation of the results. The final grade will be shared by all the members of each group and will have a weight of 15% in the final mark of the subject.

3. Laboratory practices (group evaluation)

The laboratory practical mark will be obtained by the arithmetic mean of the marks achieved in the exercises performed during the laboratory sessions. The assessment of the exercises will be performed taking into account the correction in the response, the approach and the interpretation of the results. The practical mark will be shared by all the members of each group and will be equivalent to 15% of the final mark.

Taking into account that practical sessions attendance is mandatory, an unjustified absence implies a penalty in the mark applying the following criteria:

- To miss one day implies a reduction of 30% in the laboratory practices mark.

- To miss two or more days implies a zero in the practical note.

Students who can not attend to their group session due to a justified cause are exempt from this penalty. Justified cause is understood to be health problems (the corresponding medical certificate must be brought to the coordinator of the practices) or serious personal problems. In this case the practice will be recovered whenever possible.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Delivery and presentation of solved problems	15	0.5	0.02	12, 4, 5, 11, 10, 9, 7, 8, 2
Delivery of exercises of the laboratory practices	15	0.5	0.02	1, 4, 5, 6, 11, 10, 9, 8, 2
Written examination I (individual assessment)	35	2	0.08	12, 3, 4, 5, 11, 10, 9, 2
Written examination II (individual assessment)	35	2	0.08	12, 3, 4, 5, 11, 10, 9, 2

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Last version of the book in Spanish:

Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walter P. Biología Molecular de la Célula. 6ª Edición. Ediciones Omega S.A., 2016.

Free online book resource (4th edicion)

http://www.ncbi.nlm.nih.gov/books/bv.fcgi?call=bv.View..ShowTOC&rid=mboc4.TOC&depth=2

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Software

No specific software is used.