COURSE GUIDE

Genetics 2: from Sequence to Function (2001129)

Approval date: 23/06/2023

Grado (Bachelor's Degree)	Grado en Biología	Branch	Sciences
Module	Genética	Subject	Genética

Year of study	2º	Semester	2º	ECTS Credits	6	Course type	Compulsory course

BRIEF DESCRIPTION OF COURSE CONTENT (According to the programme's verification report)

- Genetic engineering and genomics
- Gene expression and regulation
- Developmental genetics, cell cycle and cancer
- Mutation, repair and transposition

SKILLS

GENERAL SKILLS

- CG02 - Teamwork
- CG03 - Applying knowledge to problem solving
- CG04 - Capacity for analysis and synthesis
- CG06 - Critical reasoning
- CG07 - Informatic knowledge regarding the field scope
- CG08 - Self-directed learning for continuous professional development
- CG09 - Oral and written communication in the mother tongue
- CG13 - Skills in interpersonal relations
- CG16 - Creativity
- CG17 - Information management skills
- CG19 - Ethical commitment

SUBJECT-SPECIFIC SKILLS

- CE02 - Realizar análisis genético
- CE03 - Cálculos de riesgos enfocados al asesoramiento genético
- CE08 - Realizar análisis filogenéticos
- CE14 - Manipular el material genético
- CE15 - Identificar y analizar material de origen biológico y sus anomalías
- CE43 - Knowing the types and levels of organisation
- CE44 - Conocer los mecanismos de la herencia

- CE45 - Saber los mecanismos y modelos evolutivos
- CE47 - Saber las bases genéticas de la biodiversidad
- CE54 - Entender los procesos de la replicación, transcripción, traducción y modificación del material genético

LEARNING OUTCOMES

The student will know/understand:
- The basic concepts and procedures of Genetics.
- Genetic analysis techniques (both molecular and classical).
- The mechanisms of inheritance
- Evolutionary mechanisms and models
- The genetic basis of biodiversity

The student will be able to:
- Solve genetic problems
- Develop practical skills in the methodology of the discipline.
- Design genetic experiments
- Perform risk calculations focused on genetic counseling.
- Perform phylogenetic analysis
- Manipulate genetic material
- Identify and analyze biological source material and its anomalies
- Analyze, interpret, assess, discuss and communicate data from genetic experiments
- Correctly handle the usual instrumentation in a genetics laboratory
- Apply statistical methods in the analysis of genetic data.
- Handle computer programs for the analysis of nucleic acid and protein sequences.
- Manage sources of scientific information (bibliographic databases in science).
- Apply the acquired knowledge to the future development of professional activities in the field of Genetics.
- To value the social scope of some aspects of Genetics research.
- To acquire a critical spirit in line with the scientific method.
- To acquire the necessary skills for self-learning.
- To work in groups
- To develop communication and public discussion skills

PLANNED LEARNING ACTIVITIES

THEORY SYLLABUS

UNIT 1. GENETIC ENGINEERING. Basic molecular analysis techniques and their applications. Restriction maps. DNA cloning. PCR. Molecular polymorphisms. Transgenic organisms. Gene therapy.
UNIT 2. GENOMICS. Concept. Genome sequencing and annotation strategies. Bioinformatics. Structural, functional, and comparative genomics. Transcriptome. Proteome.
UNIT 3. GENE EXPRESSION. Relationship between genes and proteins. Transcription. Introns and exons. RNA maturation. Self-processing. RNA editing. Genetic coding. Translation.
UNIT 4. GENE EXPRESSION REGULATION . Epigenetics. Transcriptional, post-transcriptional, translational, and post-translational control of gene expression.
UNIT 5. DEVELOPMENTAL GENETICS, CELL CYCLE, AND CANCER. Development, determination, and differentiation. Spatio-temporal programming of developmental gene expression. Genes that control development: study models. Sexual determination and differentiation. Cell cycle

control and programmed cell death. Cancer genetics.
UNIT 6. MUTATION, REPAIR, AND TRANSPOSITION. Concept of mutation. Types of mutations. Causes and consequences of mutation. Mutation rate. Reversion. Deletion. Mutation and repair. Transposition and effects of transposition.
UNIT 7. CHROMOSOMAL ALTERATIONS. Deletion. Duplication. Inversion. Translocation. Aneuploidy. Polyploidy.

PRACTICAL SYLLABUS

Seminars/Workshops/Tutelated Projects
Essays in which the knowledge acquired in the theoretical and practical classes is put into practice through the resolution of practical cases.
Essays on recent research articles in Genetics and Evolution.
Search of bibliographic material on recent research in the field of Genetics and Evolution, revision on this topic, elaboration of bibliographic essay of revision and exposition of this essay.
Laboratory Practices, Simulation and Problems
PRACTICAL CLASS 1. Utility of the use of PCR in genetic diagnosis. Detection of parasites that infect mollusks by PCR technique. Samples from different clam populations will be analyzed in order to detect the presence of the parasite and identify affected individuals.
PRACTICAL CLASS 2. DNA cloning. Isolation of specific DNA sequences by PCR technique and cloning in TA type vector.
PRACTICAL CLASS 3. Bioinformatics analysis I. DNA and protein sequence databases. Search of homologous sequences. FASTA and BLAST algorithms.
PRACTICAL CLASS 4. Bioinformatics analysis II. Functional genomics. Search for ORFs in a sequence. Computational gene prediction. CpG island prediction. Promoter prediction.
PRACTICAL CLASS 5 to 6. Molecular Genetics problem solving. Seminars in which the knowledge acquired in the theoretical classes is put into practice by solving problems of restriction maps and microsatellites.
PRACTICAL CLASS 7. Bioinformatic analysis III. Multiple alignment of DNA sequences and phylogenetic analysis.
PRACTICAL CLASS 8. Study of genes involved in mammalian sex determination and differentiation. Detection of the mouse Sry gene: the differential presence of this gene in male versus female mice will be detected by PCR technique. Differential expression of the Sox9 gene in male and female mouse gonads: by observation of immunohistochemistry preparations for SOX9.
PRACTICAL CLASS 9. Gene expression study by RT-PCR. RNA purification for a differential gene expression study between tissues by applying the RT-PCR technique.
PRACTICAL CLASS 10. Tutored work sessions: presentation of the work performed.

RECOMMENDED READING

ESSENTIAL READING

• Pierce, B.A. 2020. Genetics: A Conceptual Approach. 7th. Edition. WH Freeman Publishers
• Pierce, B.A. 2015. Genética. Un enfoque conceptual. 5ª. Edición. Editorial Médica Panamericana

COMPLEMENTARY READING

GENERAL COMPLEMENTARY BIBLIOGRAPHY:

• Pierce, B.A. 2009. Genética. Un enfoque conceptual. 3ª. Edición. Editorial Médica Panamericana.
• Pierce, B.A. 2011. Fundamentos de Genética: Conceptos y relaciones. 1ª Edición. Editorial Médica Panamericana.
• Klug, W.S., M.R. Cummings, Spencer, CA & Palladino MA. 2013. Conceptos de Genética. 10ª Edición. Pearson Educación.
• Griffiths, A.J.F, S.R. Wessler, R.C. Lewontin & S.B. Carroll. 2008. Genética. 9ª Edición. McGraw-Hill/Interamericana.
• Lewin, B. 2008. Genes IX. McGraw-Hill/Interamericana.
• Brown, T.A. 2008. Genomas. Editorial Médica Panamericana.
• Benito Jiménez, C., Espino Nuño F.J. 2013. Genetica: conceptos esenciales. Ed. Panamericana.

COMPLEMENTARY BIBLIOGRAPHY FOR PROBLEM SOLVING:

• Benito Jiménez, C. 1997. 360 Problemas de Genética resueltos paso a paso. Editorial Síntesis.
• Jiménez Sánchez, A. 1997. Problemas de Genética para un curso general. Universidad de Extremadura. España.
• Ménsua, J.L. 2003. Genética, problemas y ejercicios resueltos. Pearson/Prentice Hall.
• Stanfield, W.D. 1992. Teoría y Problemas de Genética. 3ª Edición. McGraw-Hill. México.
• Viseras, E. 2008. Cuestiones y problemas resueltos de Genética general (3ª Ed.). Servicio de Publicaciones de la Universidad de Granada.

RECOMMENDED LEARNING RESOURCES/TOOLS

• Library of the University of Granada: http://www.ugr.es/~biblio/
• Sociedad Española de Genética (SEG): http://www.segenetica.es/
• Online Mendelian Inheritance in Man (OMIM): http://www.ncbi.nlm.nih.gov/sites/entrez?db=omim
• GeneCards: http://www.genecards.org/
• National Center for Biotechnology Information (NCBI): http://www.ncbi.nlm.nih.gov
• NCBI Database: https://www.ncbi.nlm.nih.gov/search/
• PubMed: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=PubMed
• Medline: https://medlineplus.gov/
• National Center for Biotechnology (CNB): https://www.cnb.csic.es/index.php/es/
• European Bioinformatics Institute (EBI): http://www.ebi.ac.uk
• The Institute for Genome Research: http://www.jcvi.org/
• Science On-Line: http://www.sciencemag.org
• Nature On-Line: http://www.nature.com
• DNA Learning Center: https://www.dnalc.org/
• Khan Academy: https://es.khanacademy.org/
• Journal of Visualized Experiments (JoVE): https://www.jove.com/es/

TEACHING METHODS

- MD01 - Lección magistral/expositiva
- MD02 - Sesiones de discusión y debate
- MD03 - Resolución de problemas y estudio de casos prácticos
- MD04 - Prácticas de laboratorio y/o clínicas y/o talleres de habilidades
- MD06 - Prácticas en sala de informática
- MD07 - Seminarios
- MD08 - Ejercicios de simulación
- MD09 - Análisis de fuentes y documentos
- MD10 - Realización de trabajos en grupo

- MD11 - Realización de trabajos individuales

ASSESSMENT METHODS (Instruments, criteria and percentages)

ORDINARY EXAMINATION DIET

Continuous evaluation. The assessment of the level of acquisition by the students of the general and specific competences will be carried out continuously throughout the academic period by means of the following procedures:
Theoretical knowledge exam where both the assimilation and the expression of the acquired knowledge will be evaluated. 50% of the final grade.
Examination of problem solving, laboratory practices and simulation practices. 30% of the final grade.
Performance of tutored work (Seminars). 10% of the final grade.
Performance of class activities where the tasks that the students will perform throughout the course, both individually and in groups, will be evaluated. 10% of the final grade.
Ordinary call in June. Students must obtain a minimum of 50 points out of 100, being mandatory to obtain a minimum of 25 points out of 50 in the theoretical exam and a minimum of 15 points out of 30 in the practical exam.

EXTRAORDINARY EXAMINATION DIET

Extraordinary exam in July. Those students who do not obtain the 50 points will have to take the extraordinary exam in July. The exam will be composed of theory questions (proposed syllabus; 60% of the grade) and practical sessions (syllabus corresponding to laboratory practical classes, bioinformatics and problems; 40% of the grade). As in the June exam, the course will be passed by obtaining a minimum of 50 points out of 100 in the final grade and it is mandatory to obtain a minimum of 30 points out of 60 in the theory exam and a minimum of 20 points out of 40 in the practical exam.

SINGLE FINAL ASSESSMENT (evaluación única final)

A single exam will be given to those students who, by means of a request to the Department Direction, duly justify the reasons why they cannot follow the continuous evaluation, and always, in compliance with the evaluation regulations of the UGR. The exam will be composed of theory questions (proposed syllabus; 60% of the grade) and practical questions (syllabus corresponding to laboratory practices, bioinformatics and problems; 40% of the grade). Students must obtain a minimum of 30 points out of 60 in the theory exam and a minimum of 20 points out of 40 in the practical exam both in June and July.

ADDITIONAL INFORMATION

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PRADO Platform: https://prado.ugr.es/