Teaching Guide				
Identifying Data				2019/20
Subject (*)	Molecular Genetics		Code	610G02020
Study programme	Grao en Bioloxía			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Third	Obligatory	6
Language	Galician			
Teaching method	Face-to-face			
Prerequisites				
Department	Bioloxía			
Coordinador	Insua Pombo, Ana Maria	E-mail	ana.insua@udc.es	
Lecturers	Insua Pombo, Ana Maria Martinez Martinez, M. Luisa Vila Sanjurjo, Antón	E-mail	ana.insua@udc.es m.l.martinez@udc.es anton.vila@udc.es	
Web				
General description	This course focuses on the conceptual and methodological bases necessary to understand the organization, expression, variation and manipulation of genetic material. It provides a molecular perspective to the knowledge adquired in "Genetics" (second year) and knowledge necessary to address "Population Genetics and Evolution", "Cytogenetics" and related courses of third and fourth year.			

Study programme competences	
Code	Study programme competences
A5	Analizar e caracterizar mostras de orixe humana.
A11	Identificar e analizar material de orixe biolóxica e as súas anomalías.
A12	Manipular material xenético, realizar análises xenéticas e levar a cabo asesoramento xenético.
A15	Deseñar e aplicar procesos biotecnológicos.
A29	Impartir coñecementos de Bioloxía.
A30	Manexar adecuadamente instrumentación científica.
A31	Desenvolverse con seguridade nun laboratorio.
B1	Aprender a aprender.
B2	Resolver problemas de forma efectiva.
B3	Aplicar un pensamento crítico, lóxico e creativo.
B5	Traballar en colaboración.
B7	Comunicarse de maneira efectiva nunha contorna de traballo.

Learning outcomes			
Learning outcomes	Study programme competences		
General knowledge and understanding of the molecular basis of the organization, expression, variation and manipulation of genetic material.	A11 A12 A15 A29	B1 B2 B3 B5 B7	

Knowledge of the basic methodologies used in Molecular Genetics.	A5 A11 A12 A15 A29 A30 A31	B1 B2 B3 B5	
Ability to use sources of information of interest in Molecular Genetics.	A5 A11 A12 A15 A29	B1 B2 B3	
Ability to interpret and transmit Molecular Genetics information.	A29	B1 B2 B3 B5 B7	

Contents	
Topic	**Sub-topic**
1.- DNA REPLICATION	Semiconservative DNA replication: the Meselson and Stahl experiment. Modes of replication. Enzymology of the replication. DNA replication in Escherichia coli. DNA replication in eukaryotes. Telomere synthesis. Replication of mitochondrial and chloroplast DNA.
2.- SYNTHESIS AND PROCESSING OF RNA	Classes of RNA. RNA polymerases. Promoters and transcriptional apparatus. Transcription in prokaryotes and eukaryotes: initiation, elongation and termination. Interrupted genes: exons and introns. Processing of eukaryotic pre-mRNA. Synthesis and processing of pre-rRNA. Synthesis and processing of pre-tRNA. RNA edition. Revision of gene concept.
3.- TRANSLATION	Central dogma in molecular biology. Ribosomes and tRNAs. Translation cycle: initiation, elongation, and termination. Genetic code and genetic decoding. Peptydil transferase reaction. The ribosome: composition. Phylogenetic conservation of rRNA. Role of rRNA in initiation. Role of RNA in decoding. Role of RNA in peptydil transfer. The hypothesis of the RNA world.
4.- MUTATION AND DNA REPAIR	Molecular basis of spontaneous mutations: replication errors, unequal crossing over, spontaneous chemical changes. Molecular basis of induced mutations: chemical and physical agents. Repair mechanisms: direct reversal of damaged DNA, excision repair, mismatch repair, repair of double-strand breaks, translesion synthesis.
5.- MOLECULAR MECHANISM OF GENETIC RECOMBINATION	The role of genetic recombination. Gene conversion. Models of homologous recombination: Holliday model and double-strand break model. Enzymes required for recombination. Site-specific recombination. Immunoglobulin gene rearrangements.
6.- TRANSPOSABLE GENETIC ELEMENTS	Transposable elements in prokaryotes: insertion sequences, composite transposons and noncomposite transposons. Replicative and non replicative transposition. Transposable elements in eukaryotes: transposons and retrotransposon. Evolutionary significance of transposable elements.
7.- RECOMBINANT DNA TECHNOLOGY	Restriction enzymes. Cloning vectors. DNA libraries: construction and screening. Southern and northern blotting. PCR. Restriction maps. DNA sequencing. Site-directed mutagenesis.

8.- APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY	Expression of eukaryotic genes in E. coli. DNA transfer to eukaryotic cells. Transgenic animals. Transgenic plants. Gene therapy. Genetic diagnosis. Genome editing: CRISPR/Cas9 technology.
9.- GENOMICS	Structural genomics: molecular markers and genetic maps. DNA fingerprinting. Structural genomics: physical maps and genome annotation. Functional genomics: DNA microarrays, RNA-seq and reverse genetics. Comparative genomics. Metagenomics. Synthetic biology.
10.- REGULATION OF GENE EXPRESSION IN BACTERIA	Jacob and Monod?s operon model for the regulation of lac genes in E. coli. Positive control of the lac operon. The arabinose operon of E. coli: positive and negative control. The triptophan operon of E. coli: negative control and attenuation. RNA-mediated regulation.
11.- REGULATION OF GENE EXPRESSION IN EUKARYOTES	Changes in chromatin structure. DNA methylation. Transcriptional control. RNA processing control. Control of mRNA stability. Control at the level of translation. RNA interference. Epigenetics.
PRACTICE 1: DNA EXTRACTION	Genomic DNA extraction. Agarose gel electrophoresis for DNA. DNA quantification.
PRACTICE 2: PCR	PCR amplification of the CHD gene. Analysis of an intron polymorphism for bird sexing.
PRACTICE 3: DOT-BLOT	Nucleic acids hybridization: detection of microsatellite sequences by dot-blot
PRACTICE 4: BIOINFORMATICS.	Analyses and comparison of nucleic acid sequences. Primer design.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A5 A11 A12 A15 B2 B3 B7	28	42	70
Seminar	A5 A11 A12 A15 A29 B1 B2 B3 B5 B7	8	12	20
Laboratory practice	A5 A11 A12 A15 A30 A31 B1 B2 B3 B5 B7	15	7.5	22.5
Supervised projects	A5 A11 A12 A15 A29 B1 B2 B3 B5 B7	0	29.5	29.5
Mixed objective/subjective test	A5 A11 A12 A15 A29 B1 B2 B3 B7	6	0	6
Personalized attention		2	0	2
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	Description
Guest lecture / keynote speech	The teacher explains the main contents of each lesson.
Seminar	Resolution/discussion of questions and problems related to the subject.
Laboratory practice	The student conducts laboratory experiences following a protocol, under the supervision of the teacher.
Supervised projects	Solving of a practical case related to Bioinformatics, as well as, three questionnaires with exercises and questions related to some aspect of the subject. Both activities are done in groups. The practical case shall be delivered in writing.
Mixed objective/subjective test	Different types of questions (essay, multiple-choice, short answer, and multiple-matching) and problem solving.

Personalized attention	
Methodologies	Description

Supervised projects	Individually or in group, students can attend tutorial sessions to consult any doubts that might arise from the different activities.

Assessment			
Methodologies	Competencies	Description	Qualification
Supervised projects	A5 A11 A12 A15 A29 B1 B2 B3 B5 B7	Assessment will be based on the proportion of correct answers, the clarity of the explanations, the quality of the presentation, and the reasoning used in answers. The practical case represents 20% of the final grade and will be graded at the group level by means of the delivered written (10%) and at the individual level (10%). Questionnaires represent 10% of the final grade and will be graded at the individual level only. Individual evaluations will be carried out through a short answer test (phrase, word, number or symbol), which could be face to face or via Moodle.	30
Mixed objective/subjective test	A5 A11 A12 A15 A29 B1 B2 B3 B7	The degree of general knowledge and understanding of the subject will be assessed. It will consist of two parts. One is related to the theoretical content and represents 60% of the score. The other is related to the laboraroty practices and represents 10% of the score.	70

Assessment comments
To pass the course, the score must be 5 or higher, but at least a 4 is required in all tests corresponding to theory, laboratory practices, and practical case. If the sum of the score of all activities is higher than 5, but the score on one the tests is lower than 4, the final score is 4.9 (failing score). The grade of Non Attendance (NP) will be applied to the students that do no attend the official exam. Preferably, first class honors will be awarded in January among students with a score of 9 or higher. A mid-term exam will be held. A score of 4 or higher will be maintained until July. In July there will be a second opportunity to take the tests corresponding to theory, laboratory practices, and practical case. First opportunity's scores of questionnaires and group grades of practical case will be maintained. In the case of justified exceptional circumstances, additional measures may be taken, so that the student can pass the subject, such as flexibility in the delivery date of supervised projects, flexibility in practice schedules or a global assessment test of the learning results.

Sources of information	
Basic	- Klug, W.S., Cummings, M.R., Spencer, C.A (2013). Conceptos de Genética . Pearson/Prentice Hall, Madrid - Pierce, B.A. (2010). Genética: un enfoque conceptual. Médica Panamericana, Madrid

Complementary	- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. (2010). Biología molecular de la célula. Omega, Barcelona - Benito, C., Espino, F.C. (2013). Genética: conceptos esenciales. Médica Panamericana, Madrid - Brooker, R.J. (2018). Genetics: analysis and principles (6th ed.). McGraw-Hill, New York - Brown, T.A. (2008). Genomas (3ª ed.). Médica Panamericana, Buenos Aires - Cox, M.M., Doudna, J.A., O'Donnell (2012). Molecular biology: principles and practice. W.H. Freeman, New York - Craig, N.L., Cohen-Fix, O., Green, R., Greider, C., Storz, G., Wolberger, C. (2014). Molecular biology: principles of genome function. Oxford University Press, Oxford - Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2015). Introduction to genetic analysis (11th ed.). W.H. Freeman, New York - Hartwell, L.H., Goldberg, M.L., Fischer, J.A., Hood, L., Aquadro, C.F. (2015). Genetics: from genes to genomes (5th ed.) . McGraw-Hill, New York - Herráez, A. (2012). Biología molecular e ingeniería genética. Elsevier, Ámsterdam - Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. (2012). Lewin genes: fundamentos. Médica Panamericana, Madrid - Lewin, B. (2008). Genes IX. McGraw-Hill. México - Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., Scott, M.P. (2016). Biología celular y molecular (7ªed) . Médica Panamericana, Madrid - Perera, J., Tormo, A., García, J.L. (2002). Ingeniería genética. Vol. I: Preparación, análisis, manipulación y clonaje de DNA. Síntesis, Madrid - Perera, J., Tormo, A., García, J.L. (2002). Ingeniería genética. Vol. II. Expresión de DNA en sistemas heterólogos. Síntesis, Madrid - Russell, P.J. (2010). iGenetics: a molecular approach (3rd ed.) . Benjamin Cummings, San Francisco - Snustad, D.P., Simmons, M.J. (2012). Genetics (6th ed.). John Wiley and Sons, New York - Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2014). Molecular biology of the gene. Pearson, Boston Consultar a plataforma Moodle para fontes de información adicionais.

Recommendations
Subjects that it is recommended to have taken before
Biology: Basic Levels of Organisation of Life I (Cells)/610G02007 Biochemistry I/610G02011 Biochemistry II/610G02012 Microbiology/610G02015 Genetics/610G02019
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Population Genetics and Evolution/610G02021 Cytogenetics/610G02022
Other comments
Recommendations:Attend class and follow the development of the course regularly.Check Moodle and email regularly to obtain the materials and know the schedule of activities.Attend tutorials to resolve any questions or difficulties that may arise.Consult the recommended bibliography.Keep up-to-date with course work.