Teaching Guide				
Identifying Data				2020/21
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	SpanishGalicianEnglish			
Teaching method	Hybrid			
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.			
Contingency plan	1. Content modification No modifications will occur 2. Methodologies * Teaching methodologies that are maintained All the planned methodologies will be kept * Teaching methodologies that are modified In-person teaching activities will be carried out by using synchronous means of communication (Teams). In the case of laboratory sessions, materials and practical exercises will be provided to be solved independently by students with the support of tutorials. 3. Mechanisms of personalized attention to students Synchronous means of communication (Teams) and asynchronous means (email and Moodle) will be used. 4. Grading modifications The same criteria and assessment methodologies will be maintained. * Assessment observations: Tests will take place through Moodle. 5. Modifications to the bibliography or webgraphy Freely available electronic resources will be provided.			

Study programme competences / results	
Code	Study programme competences / results
A5	Analizar e caracterizar mostras de orixe humana.
A8	Illar, analizar e identificar biomoléculas.
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 / results		
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 A8 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 / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A5 A8 A11 A12 A15 B2 B3 B7	28	28	56
Seminar	A5 A8 A11 A12 A15 A29 B1 B2 B3 B5 B7	8	12	20
Supervised projects	A5 A8 A11 A12 A15 A29 B1 B2 B3 B5 B7	0	20	20

Laboratory practice	A5 A8 A11 A12 A15 A30 A31 B1 B2 B3 B5 B7	10.5	5.25	15.75
ICT practicals	A5 A8 A12 A15 B2 B3 B5 B7	4.5	13.5	18
Mixed objective/subjective test	A5 A11 A12 A15 A29 B1 B2 B3 B7	4	14.25	18.25
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.
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.
Laboratory practice	The student conducts laboratory experiences following a protocol, under the supervision of the teacher.
ICT practicals	Question solving by database searching and the use of bioinformatic tools.
Mixed objective/subjective test	Written test on the theory contents of the subject.

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 / Results**	**Description**	**Qualification**
Laboratory practice	A5 A8 A11 A12 A15 A30 A31 B1 B2 B3 B5 B7	The degree of general knowledge and understanding of the contents of the lab sessions will be assessed by a test with different types of questions (essay, multiple-choice, short answer, and/or multiple-matching).	15
Supervised projects	A5 A8 A11 A12 A15 A29 B1 B2 B3 B5 B7	The use of the knowledge on the contents of the subject for problem solving will be assessed by several tests (one test per questionnaire) with multiple-choice, multiple-matching and/or short answer questons.	20
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 may include different types of questions (essay, multiple-choice, short answer, and/or multiple-matching) and problem solving.	50
ICT practicals	A5 A8 A12 A15 B2 B3 B5 B7	The degree of knowledge and understanding of the bioinformatic tools used and the analyses carried out to complete the activities will be assessed by a test with multiple-choice, multiple-matching and/or short answer questons. The test may require the use of a computer with Internet connection and the bionformatic software required.	15

Assessment comments

To pass the course, the score must be 5 or higher, provided that the mean score of the practice tests (laboratory and ICT) and the score of the mixed objective/subjective test is >4 . If the sum of the score of all activities is higher than 5, but the above requirements are not met, the final score will be 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. Scores of 4 or higher will be maintained until July.

In July there will be a second opportunity to take the practice tests (laboratory and ICT) and mixedobjective/subjective test. First opportunity scores in the questionnaires will be maintained.

In the case of justified exceptional circumstances, additional measures may be taken to allow the student to pass the subject, such as flexibility in the delivery date of supervised projects, flexibility in practice schedules or a global assessment test of 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. (2015). 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 Consult the Moodle platform for additional sources of information.Consult the Moodle platform for additional sources of information.

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.