Teaching Guide				
Identifying Data				2021/22
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	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.			

Contingency plan	MODIFICATIONS THAT WILL BE CARRIED OUT IN THE EVENT OF A "NON-IN-PERSON" SCENARIO DUE TO THE PANDEMIC. 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 Virtual Campus. 5. Modifications to the bibliography or web content: Freely available electronic resources will be provided. ADAPTATIONS THAT WILL BE CARRIED OUT IN THE EVENT THAT THE CLASSROOM CAPACITY ALLOCATED FOR THE SUBJECT IS EXCEEDED: The Center will assign two or more classrooms to the subject and class will be taught through Teams for students who are not in the classroom with the teacher. Regarding the lab sessions, groups will be split to adapt to the lab maximun occupancy.

Study programme competences	
Code	Study programme competences
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		
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: RNA-seq. 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 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: BIOINFORMATICS.	Edition and analyses of nucleic acid sequences. BLAST. GenBank: record search and analysis. Primer design. Virtual PCR. Directed cloning.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	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	16	24
Supervised projects	A5 A8 A11 A12 A15 A29 B1 B2 B3 B5 B7	0	16	16
Laboratory practice	A5 A8 A11 A12 A15 A30 A31 B1 B2 B3 B5 B7	6	6	12
ICT practicals	A5 A8 A12 A15 B2 B3 B5 B7	9	9	18
Mixed objective/subjective test	A5 A11 A12 A15 A29 B1 B2 B3 B7	4	18	22
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 and raises questions.
Seminar	Question and problem solving and discussion of specific topics related to the subject.

Supervised projects	Resolution of two questionnaires with exercises and questions related to some aspect of the subject. Group activity.
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**	**Description**	**Qualification**
Guest lecture / keynote speech	A5 A8 A11 A12 A15 B2 B3 B7	In the master classes, quizzes will be posted using electronic devices. The evaluation of this activity requires participating in 80% of the quizzes that are carried out.	5
Laboratory practice	A5 A8 A11 A12 A15 A30 A31 B1 B2 B3 B5 B7	Knowledge acquisition and general understanding of the practices carried out will be assessed by means of a test with essay-type questions, multiple-choice, short-answer and / or association tests.	15
Supervised projects	A5 A8 A11 A12 A15 A29 B1 B2 B3 B5 B7	The ability to solve problems and connect the contents of the course subject will be assessed by means of two tests with multiple-choice, short-answer and / or association test questions.	10
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 understanding of the assays carried out as well as the knowledge on the use of bioinformatics tools will be assessed. The test requires the use of a computer connected to the internet and equipped with the bioinformatics programs to be used in the course.	20

Assessment comments

To be evaluated, it is essential to take tests on theory (mixed test), laboratory practices, and ICT practices.
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.
Honors will be preferably awarded among students with a score of 9 or higher in the January opportunity.
There will be a midterm exam and, in case of achieving a grade higher than 4, it will not have to be repeated in the January and July opportunities.
On the second opportunity (July), you may choose to: (A) adopt the evaluation criteria of the first opportunity (specified in the EVALUATION section); or (B) take the tests corresponding to theory (mixed test), laboratory practice sessions, and ICT, with the mixed test representing 65% of the total grade.In the case of students with part-time dedication and exemption from attendance, additional measures may be adopted so that the subject can be passed. These measures may include flexibility in the date of delivery of supervised work, flexibility in the hours of practices, or grading through a global assessment test of learning outcomes.

Students who request the early December call will be able to choose between the application of the current teaching guide or that of the previous year.

Fraudulent realization of tests or evaluation activities, once verified, will directly imply the qualification of "0" in the corresponding opportunity.

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 - Klug, W.S., Cummings, M.R., Spencer, C.A., Paladino, M.A., Killian, D.J. (2020). Concepts of Genetics. Pearson Education, Harlow - Pierce, B.A. (2020). Genetics: a conceptual approach. Freeman, New York

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 - Real García, M.D., Raussell Segarra, C., Latorre Castillo, A. (2017). Técnicas de ingeniería genética. Síntesis, Madris - 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.GREEN CAMPUS FACULTY OF SCIENCES PROGRAM

To help achieve a sustainable immediate environment and comply with point 6 of the "Environmental Declaration of the Faculty of Sciences (2020)", the documentary works carried out in this matter: a. They will be requested mainly in virtual format and computer support.
b. If done on paper:

- Plastics will not be used.
- Double-sided prints will be made.
- The preparation of drafts will be avoided.