Teaching Guide				
Identifying Data				2021/22
Subject (*)	Genetic Toxicology		Code	610441018s
Study programme	Máster Universitario en Bioloxía Molecular, Celular e Xenética (semipresencial)			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	2nd four-month period	First	Optional	3
Language	SpanishGalician			
Teaching method	Hybrid			
Prerequisites				
Department	BioloxíaDepartamento profesorado másterPsicoloxía			
Coordinador	Laffon Lage, Blanca	E-mail	blanca.laffon@udc.es	
Lecturers	Fernández García, Jose Luis Laffon Lage, Blanca	E-mail	 blanca.laffon@udc.es	
Web				
General description	In this subject the student will learn fundamental concepts on toxicology, will get familiar with the toxicokinetic and toxicodynamic aspects underlying the action of toxic agents, and will learn the fundamentals and utility of the main methodologies used for genetic risk assessment.			
Contingency plan	Contingency plan is not required for the activities planned			

Study programme competences / results	
Code	Study programme competences / results
A6	Skills of understanding the functioning of cells through the structural organization, biochemistry, gene expression and genetic variability.
A8	Skills of having an integrated view of the previously acquired knowledge about Molecular and Cellular Biology and Genetics, with an interdisciplinary approach and experimental work.
A12	Skills to understand, detect and analyze the genetic variation, knowing genotoxicity processes and methodologies for its evaluation, as well as carrying out diagnosis and genetic risk studies.
B3	Skills of management of the information: that are able to gather and to understand relevant information and results, obtaining conclusions and to prepare reasoned reports on scientific and biotechnological questions
B5	Ability to draft, represent, analyze, interpret and present technical documentation and relevant data in the field of the branch of knowledge of the master's degree in the native language and at least in another International diffusion language.
B6	Skills of team work: that are able to keep efficient interpersonal relationships in an interdisciplinary and international work context, with respect for the cultural diversity.
B9	Skills of preparation, show and defense of a work.
C1	Ability to express oneself correctly, both orally and in writing, in the official languages of the autonomous community
C2	Ability to know and use appropriately the technical terminology of the field of knowledge of the master, in the native language and in English, as a language of international diffusion in this field
C6	Acquiring skills for healthy lifestyles, and healthy habits and routines.

Learning outcomes			
Learning outcomes	Study programme competences / results		
Working in group in a collaborative manner.		BR6	
Skills for speaking in public.		BR9	
Skills to express in scientific language and comunicate in an effective manner.		BR5	CC1 CC2
Skills to find and interpret any kind of toxicological information by using internet network and computer tools.	AR6	BR3	CC6

Learning the physical-chemical processes that a toxic agent experiences when enters the body and the factors influencing absorption, distribution, metabolizing and excreting phases.	AR6 AR8 AR12		
Learning the different relationships between the concentration of a toxic agent in the target location and the effects induced in the biological systems, and the factors influencing chemicals toxicity.	AR6 AR8		
Learning the relationship between genotoxicity processes and cancer development.	AR6 AR12		
Learning how assessment of exposure to genotoxic agents is carried out, and the advantages of biomonitoring vs. environmental assessment.	AR12		
Learning the different methodologies for genotoxicity assessment and the role of genetic polymorphisms as individual susceptibility biomarkers.	AR6 AR12		

Contents	
Topic	**Sub-topic**
I. General principles in Toxicology	1. Basic concepts in Toxicology 2. Toxicokinetics (ADME processes). 3. Toxicodynamics (dose-response curves, toxicity indexes, factors influencing toxicity).
II. Genetic Toxicology	4. Genotoxicity and its relationship with cancer. 5. Genetic risk evaluation I: Analysis of exposure to genotoxic agents. 6. Genetic risk evaluation II: Methodologies for genotoxicity assessment. 7. Genetic risk evaluation III: Individual susceptibility.
III. Reproductive toxicogenetics	8. Methodologies to evaluate chromosome and DNA damage in sperm.

Planning				
Methodologies / tests	**Competencies / Results**	**Teaching hours (in-person & virtual)**	**Student?s personal work hours**	**Total hours**
Mixed objective/subjective test	A12 A6 B3 B5 C1	1	0	1
Guest lecture / keynote speech	A6 A8 A12	0	37	37
ICT practicals	B3 C6 C2	2	2	4
Supervised projects	A12 B3 B5 B6 B9 C2 C1	0	20	20
Seminar	B3 B5 B6 B9 C1	2	3	5
Problem solving	A12 A8 B3 C6	2	2	4
Personalized attention		4	0	4
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	**Description**
Mixed objective/subjective test	At the end of the programme, an exam consisting of short answer and/or test-type questionnaire will be conducted.
Guest lecture / keynote speech	Videos in which the professors will introduce the program contents with multimedia stuff.

ICT practicals	Practical with computers about searching for and managing toxicological information in internet. The students will have to complete a questionnaire on that topic and deliver it within the established deadline
Supervised projects	Supervised projects in groups of students about an issue proposed by the professor. Personalized attention will be given in order to provide orientation on the contents to be included in each project. The files corresponding to each project and its presentation will be delivered through Moodle before the deadline fixed. Later on, all projects will be available in Moodle.
Seminar	Bibliographic seminar: students will present their projects using Teams.
Problem solving	The students will be provided with material on assessment of spermatic DNA fragmentation. The students will have to complete a questionnaire on that topic and deliver it within the established deadline.

Personalized attention	
Methodologies	**Description**
Guest lecture / keynote speech Supervised projects	Upon students' request, personalized attention will be provided in order to answer questions, to give support and orientation on the contents to be included in each project, and to provide with help for developing specific and transversal study programme competencies. The professors will be available in an established schedule on the weeks when the subject is developed, the week later, and the week before the first opportunity exam, to assist the students by Teams or email.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Mixed objective/subjective test	A12 A6 B3 B5 C1	Exam: short answer and/or test-type questionnaire. Passing this exam is mandatory to pass the whole subject.	52
ICT practicals	B3 C6 C2	Mandatory attendance. Attendance and participation will be considered, only when the student pass the exam. Those students who, due to justified causes, do not attend the practicals, will have to complete a questionnaire on the activities conducted during the practice (the same as for blended students), and deliver it by Moodle within the established deadline.	4
Guest lecture / keynote speech	A6 A8 A12	The content of the lectures will be evaluated in the exam	0
Problem solving	A12 A8 B3 C6	Mandatory attendance. Attendance and participation will be considered, only when the student pass the exam. Those students who, due to justified causes, do not attend the practice, will have to complete a questionnaire on the activities conducted during the practice (the same as for blended students), and deliver it by Moodle within the established deadline.	4
Supervised projects	A12 B3 B5 B6 B9 C2 C1	It is mandatory to carry out a supervised project in group (if there are enough students). Marks obtained will be the same for all group members. It will be evaluated only when the student pass the exam.	40
Seminar	B3 B5 B6 B9 C1	Mandatory presentation of the supervised project by Teams.	0

Assessment comments

The fraudulent performance of the tests or evaluation activities will imply a failure grade '0' in the subject in the corresponding oportunity, thus invalidating any grade obtained in all the evaluation activities for the extraordinary oportunity.
Requirements to pass the subject: to deliver and present the
supervised project, to deliver the ICT practices and problem solving questionnaires, to obtain a minimum of 50% marks in the exam, and to obtain a minimum of 50% marks in the total subject.

Second oportunity evaluation: students must deliver and present a supervised project (in case they did not do it before) and conduct the exam. Moreover, if students did not attend the ICT and laboratory practices, they must deliver a questionnaire on activities addressed in those practices.

Sources of information	
Basic	LIBROS: Greim, H.; Snyder, R. (2007) Toxicology and risk assessment: a comprehensive introduction. Chichester: John Wiley & sons. Klaassen, C.D.; Watkins III, J.B. (2005) Fundamentos de Toxicología de Casarett y Doull. Madrid: MacGraw Hill. Marquardt, H. ; Schäfer, S.G.; McClellan, R.O.; Welsch, F. (1999) Toxicology. San Diego: Academic Press. Repetto, M.; Repetto, G. (2009) Toxicología fundamental. Madrid: Díaz de Santos. Riviere, J.E. (2006) Biological concepts and Techniques in Toxicology. An integrated approach. New York: Taylor & Francis. Stine, K.E; Brown, T.M. (2006) Principles of toxicology. 2nd edition. Londres: CRC Press Taylor & Francis. ARTIGOS: Albertini, R.J.; Anderson, D.; Douglas, G.R.; Hagmar, L.; Hemminki, K.; Merlo, F.; Natarajan, A.T.; Norppa, H.; Shuker, D.E.G.; Tice, R.; Waters, M.D.; Aitio, A. (2000) IPCS guidelines for the monitoring of genotoxic effects of carcinogens in humans. Mutat. Res.463: 111-172. Cimino, M. C. 2006. Comparative overview of current international strategies and guidelines for genetic toxicology testing for regulatory purposes. Environmental and Molecular Mutagenesis 47:362-390. Gallo, V.; Khan, A.; Gonzales, C.; Phillips, D.H.; Schoket, B.; Györffy, E.; Anna, L.; Kovács, K.; Moller, P.; Loft, S.; Kyrtopoulos, S.; Matullo, G.; Vineis, P. (2008) Validation of biomarkers for the study of environmental carcinogens: A review. Biomarkers 13: 505 - 534. Imyanitov, E.N.; Togo, A.V.; Hanson, K.P. (2004) Searching for cancer-associated gene polymorphisms: promises and obstacles. Cancer Lett.204: 3-14. Srám, R.J. y Binková, B. (2000) Molecular epidemiology studies on occupational and environmental exposure to mutagens and carcinogens, 1997-1999. Environ. Health Perspect.108: 57-70. Young, R. 2002. Genetic toxicology: Web resources. Toxicology 173:103-121.

Complementary	LIBROS: Barile, F.A. (2008) Principles of Toxicology Testing. Florida: CRC Press. Córdoba, D. (2001) Toxicología. Bogotá: Manual Moderno. DeCaprio, A. (2006) Toxicologic biomarkers. New York: Taylor and Francis. Hamadeh, H.K.; Afshari, C.A. (2004) Toxicogenomics. Principles and Applications. New Jersey: Wiley-Liss. Hodgson, E.; Levi, P.E. (1997) A textbook of modern toxicology. Connecticut: Appleton and Lange. IPCS (1993) Biomarkers and risk assessment: concepts and principles. International Programme on chemical safety. Environmental Health Criteria 155. World Health Organization. Geneva. Mendelsohn, M.L.; Mohr, L.C.; Peeters, J.P. (1998) Biomarkers. Medical and workplace applications. Washington D.C.: Joseph Henry Press. Mendelsohn, M.L.; Peeters, J.P.; Normandy, M.J. (1995) Biomarkers and occupational health: progress and perspectives. Washington D.C.: Joseph Henry Press. National Research Council of the National Academies (2006) Human biomonitoring for environmental chemicals. Washington D.C.: The National Academies Press. Niesink, R.J.M. (1996) Toxicology: principles and applications. Boca Raton-Florida: CRC Press. Repetto, M. (1995) Toxicología avanzada. Madrid: Díaz de Santos. ARTIGOS: Albertini, R.J.; Nicklas, J.A.; O'Neill, J.P. (1996) Future research directions for evaluating human genetic and cancer risk from environmental exposures. Environ. Health Perspect104 (Suppl 3): 503-510. Au, W.W.; Oh, H.Y.; Grady, J.; Salama, S.A. y Heo, M.Y. (2001) Usefulness of genetic susceptibility and biomarkers for evaluation of environmental health risk. Environ. Mol. Mutagen.37: 215-225. Autrup, H. (2000) Genetic polymorphisms in human xenobiotica metabolizing enzymes as susceptibility factors in toxic response. Mutat. Res.464: 65-76. Bonassi, S. (1999) Combining environmental exposure and genetic effect measurements in health outcome assessment. Mutat. Res.428: 177-185. Butterworth, B.E.; Bogdanffy, M.S. (1999) A comprehensive approach for integration of toxicity and cancer risk assessments. Regul. Toxicol. Pharmacol.29: 23-36. Garte, S. (2001) Metabolic susceptibility genes as cancer risk factors: time for a reassessment? Cancer Epidemiol. Biomarkers Prev.10: 1233-1237. Gyorffy, E., Anna, L., Kovacs, K., Rudnai, P., and Schoket, B. (2008) Correlation between biomarkers of human exposure to genotoxins with focus on carcinogen-DNA adducts. Mutagenesis 23:1-18. Ingelman-Sundberg, M. (2001) Genetic variability in susceptibility and response to toxicants. Toxicol. Lett.120: 259-268. Lang, M. y Pelkonen, O. (1999) Metabolism of xenobiotic and chemical carcinogenesis. Metabolic polymorphisms and susceptibility to cancer. IARC Scientific Publications No. 148. International Agency for Research on Cancer. Lyon. pp: 13-22. Norppa, H. (2001) Genetic polymorphisms and chromosome damage. Int. J. Hyg. Environ. Health204: 31-38. Pavanello, S. (2003) Metabolic and DNA repair variations in susceptibility to genotoxins. Polycyclic Aromatic Compounds23: 49-107. Pavanello, S. y Clonfero, E. (2000) Biological indicators of genotoxic risk and metabolic polymorphisms. Mutat. Res.463: 285-308. Seidegard, J. y Ekström, G. (1997) The role of human glutathione transferases and epoxide hydrolases in the metabolism of xenobiotics. Environ. Health Perspect.105: 791-799. Talaska, G.; Maier, A.; Henn, S.; Booth-Jones, A.; Tsuneoka, Y.; Vermeulen, R.; Schumann, B.L. (2002) Carcinogen biomonitoring in human exposures and laboratory research: validation and application to human occupational exposures. Toxicol. Lett.134: 39-49. Thier, R.; Brüning, T.; Roos, P.H.; Golka, K.; Ko, Y. y Bolt, H.M. (2003) Markers of genetic susceptibility in human environmental hygiene and toxicology: the roles of selected CYP, NAT and GST genes. Int. J. Hyg. Environ. Health206: 149-171. Thybaud, V., Le Fevre, A.-C., and Boitier, E. 2007. Application of toxicogenomics to genetic toxicology risk assessment. Environmental and Molecular Mutagenesis 48:369-379.

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Other comments
-Computer skills (user level) are recommended in order to use the Moodle platform and prepare the supervised project and its presentation.-English language is recommended, in order to read the bibliographic stuff.-In order to contribute to a sustainable environment and to comply with point 6 of the "Faculty of Sciences Environmental Declaration (2020)", documents prepared for this subject must be delivered in digital format. In case of using paper:Plastics must not be used.Printing must be both sides.Recycled paper must be used.Draft printing must be avoided.

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.