



| Teaching Guide           |                                                                                                                                                                                                                                                                                                         |        |                             |           |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------------------------|-----------|
| Identifying Data         |                                                                                                                                                                                                                                                                                                         |        | 2019/20                     |           |
| Subject (*)              | Genetic Toxicology                                                                                                                                                                                                                                                                                      |        | Code                        | 610441017 |
| Study programme          | Mestrado Universitario en Bioloxía Molecular , Celular e Xenética                                                                                                                                                                                                                                       |        |                             |           |
| Descriptors              |                                                                                                                                                                                                                                                                                                         |        |                             |           |
| Cycle                    | Period                                                                                                                                                                                                                                                                                                  | Year   | Type                        | Credits   |
| Official Master's Degree | 2nd four-month period                                                                                                                                                                                                                                                                                   | First  | Optional                    | 3         |
| Language                 | SpanishGalician                                                                                                                                                                                                                                                                                         |        |                             |           |
| Teaching method          | Face-to-face                                                                                                                                                                                                                                                                                            |        |                             |           |
| Prerequisites            |                                                                                                                                                                                                                                                                                                         |        |                             |           |
| Department               | BioloxíaDepartamento profesorado másterPsicoloxía                                                                                                                                                                                                                                                       |        |                             |           |
| Coordinador              | Valdiglesias García, Vanessa                                                                                                                                                                                                                                                                            | E-mail | vanessa.valdiglesias@udc.es |           |
| Lecturers                | Fernández García, Jose Luis<br>Valdiglesias García, Vanessa                                                                                                                                                                                                                                             | E-mail | vanessa.valdiglesias@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 mechanisms of toxic agents, and will learn the fundamentals and utility of the main methodologies used for genetic risk assessment. |        |                             |           |

| Study programme competences |                                                                                                                                                                                                                         |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code                        | Study programme competences                                                                                                                                                                                             |
| 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                          | Correct oral and written communication on scientific topics 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                          | Adequate oral and written expression in the official languages.                                                                                                                                                         |
| C2                          | Mastering oral and written expression in a foreign language.                                                                                                                                                            |
| C6                          | Acquiring skills for healthy lifestyles, and healthy habits and routines.                                                                                                                                               |

| Learning outcomes                                                                                                                                                                                         |  |                             |            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------------------------|------------|
| Learning outcomes                                                                                                                                                                                         |  | Study programme competences |            |
| Working in group in a collaborative manner.                                                                                                                                                               |  | BR6                         |            |
| Skills for speaking in public.                                                                                                                                                                            |  | BR9                         |            |
| Skills to express in scientific language and communicate in an effective manner.                                                                                                                          |  | BR5                         | CC1<br>CC2 |
| Skills to find and interpret any kind of toxicological information by using internet network and computer tools.                                                                                          |  | AR6                         | BR3<br>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<br>AR8<br>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<br>AR8                  |            |



|                                                                                                                                                 |             |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--|--|
| Learning the relationship between genotoxicity processes and cancer development.                                                                | AR6<br>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<br>AR12 |  |  |

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

| Planning                                                                                                                        |                          |                      |                               |             |
|---------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------------|-------------------------------|-------------|
| Methodologies / tests                                                                                                           | Competencies             | Ordinary class hours | Student's personal work hours | Total hours |
| Mixed objective/subjective test                                                                                                 | A12 A6 B5 B3 C1          | 2                    | 0                             | 2           |
| Guest lecture / keynote speech                                                                                                  | A6 A8 A12                | 12                   | 21                            | 33          |
| ICT practicals                                                                                                                  | B3 C2 C6                 | 2                    | 3                             | 5           |
| Supervised projects                                                                                                             | A12 B3 B5 B6 B9 C1<br>C2 | 0                    | 18.5                          | 18.5        |
| Seminar                                                                                                                         | B3 B5 B6 B9 C1           | 2                    | 3                             | 5           |
| Laboratory practice                                                                                                             | A8 A12 B3 B6 C6          | 5                    | 4.5                           | 9.5         |
| 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                                                                                                                                                                                                                                                                                                                                                                           |
| 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  | The professors will introduce the programme contents with the aid of multimedia stuff. They will answer the questions raised by the students.                                                                                                                                                                                                                                         |
| ICT practicals                  | Practical with computers about searching for toxicological information in internet.                                                                                                                                                                                                                                                                                                   |
| 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. |



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| Seminar             | Bibliographic seminars: students will present their projects. Then a debate on the topic of their presentation will be conducted.                    |
| Laboratory practice | Laboratory practices to be carried out in Hospital Oncolóxico laboratories. Students will learn several methodologies for genetic damage assessment. |

| Personalized attention |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Methodologies          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Supervised projects    | <p>Part-time students: materials used in lectures, and any other useful material, will be available in Moodle . Deadlines for supervised projects and questionnaires will be the same than for regular students, and will be specified in Moodle.</p> <p>Students not attending lab or computer practices must complete a questionnaire and submit it by Moodle before the established deadline.</p> <p>Upon students' request, personalized attention will be provided in order to give orientation on the contents to be included in each project, to answer questions, and to provide with help for developing specific and transversal study programme competencies.</p> |

| Assessment                      |                       |                                                                                                                                                                                                                                                                                                                              |               |
|---------------------------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Methodologies                   | Competencies          | Description                                                                                                                                                                                                                                                                                                                  | Qualification |
| Mixed objective/subjective test | A12 A6 B5 B3 C1       | Exam: short answer and/or test-type questionnaire. For the students not attending the lectures due to attendance exemption, this questionnaire will represent 60% of the final qualification. Passing this exam is mandatory to pass the whole subject. All mandatory tasks must be delivered in order to pass this subject. | 40            |
| ICT practicals                  | B3 C2 C6              | Mandatory attendance, excepting for blended students. These students must deliver a questionnaire on the activities conducted during the practical.                                                                                                                                                                          | 2.5           |
| Guest lecture / keynote speech  | A6 A8 A12             | Regular attendance and participation will be evaluated, only when the student pass the exam.                                                                                                                                                                                                                                 | 10            |
| Laboratory practice             | A8 A12 B3 B6 C6       | Mandatory attendance, excepting for blended students. These students must deliver a questionnaire on the activities conducted during the practical.                                                                                                                                                                          | 2.5           |
| Supervised projects             | A12 B3 B5 B6 B9 C1 C2 | It is mandatory to carry out a supervised project in group (if there are enough students). The qualification 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        | Regular attendance and participation will be evaluated, only when the student pass the exam.                                                                                                                                                                                                                                 | 5             |

| Assessment comments                                                                                                                                                                                                                                                                                |
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| Second opportunity evaluation: students must deliver and present a supervised project (in case they had not did it before) and do the exam. Moreover, if students did not attend the mandatory attendance practices, they must deliver a questionnaire on activities addressed in those practices. |

| Sources of information |
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|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Basic</b> | <p>LIBROS: Greim, H.; Snyder, R. (2007) Toxicology and risk assessment: a comprehensive introduction. Chichester: John Wiley &amp; 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 &amp; Francis. Stine, K.E.; Brown, T.M. (2006) Principles of toxicology. 2nd edition. Londres: CRC Press Taylor &amp; 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.; Györfy, 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.</p> |
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| Complementary | <p>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 Perspect.104 (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.</p> |
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## 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,&nbsp;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.