



## Teaching Guide

Teaching Guide				
Identifying Data				2023/24
Subject (*)	Nanotoxicology	Code		610G04032
Study programme	Grao en Nanociencia e Nanotecnoloxía			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Fourth	Obligatory	6
Language	SpanishGalician			
Teaching method	Face-to-face			
Prerequisites				
Department				
Coordinador	Valdiglesias García, Vanessa	E-mail	vanessa.valdiglesias@udc.es	
Lecturers	Valdiglesias García, Vanessa	E-mail	vanessa.valdiglesias@udc.es	
Web				
General description	In this subject, students will acquire fundamental knowledge about nanotoxicology, they will address the interaction between nanomaterials and biological systems and their implications. The student will also become familiar with the potential risks associated with exposure to nanomaterials and how to assess them, and will learn about the mechanisms of action of nanomaterials at the genetic, cellular, tissue, organism, and ecosystem levels. Finally, he/she will acquire knowledge regarding safety protocols in the design and use of nanomaterials in the workplace and the existing regulations on the use and production of nanomaterials.			

## Study programme competences

Code	Study programme competences
A8	CE8 - Aplicar las normas generales de seguridad y funcionamiento de un laboratorio y las normativas específicas para la manipulación de la instrumentación y de los productos y nanomateriales.
A9	CE9 - Evaluar correctamente los riesgos sanitarios y de impacto ambiental asociados a la Nanociencia y la Nanotecnología.
A10	CE10 - Comprender la legislación en el ámbito del conocimiento y la aplicación de la Nanociencia y Nanotecnología. Aplicar principios éticos en este marco.
B1	CB1 - Que los estudiantes hayan demostrado poseer y comprender conocimientos en un área de estudio que parte de la base de la educación secundaria general, y se suele encontrar a un nivel que, si bien se apoya en libros de texto avanzados, incluye también algunos aspectos que implican conocimientos procedentes de la vanguardia de su campo de estudio
B3	CB3 - Que los estudiantes tengan la capacidad de reunir e interpretar datos relevantes (normalmente dentro de su área de estudio) para emitir juicios que incluyan una reflexión sobre temas relevantes de índole social, científica o ética
B4	CB4 - Que los estudiantes puedan transmitir información, ideas, problemas y soluciones a un público tanto especializado como no especializado
B5	CB5 - Que los estudiantes hayan desarrollado aquellas habilidades de aprendizaje necesarias para emprender estudios posteriores con un alto grado de autonomía
B6	CG1 - Aprender a aprender
B7	CG2 - Resolver problemas de forma efectiva.
B8	CG3 - Aplicar un pensamiento crítico, lógico y creativo.
B11	CG6 - Comportarse con ética y responsabilidad social como ciudadano/a y como profesional.
C3	CT3 - Utilizar las herramientas básicas de las tecnologías de la información y las comunicaciones (TIC) necesarias para el ejercicio de su profesión y para el aprendizaje a lo largo de su vida
C6	CT6 - Adquirir habilidades para la vida y hábitos, rutinas y estilos de vida saludables
C7	CT7 - Desarrollar la capacidad de trabajar en equipos interdisciplinares o transdisciplinares, para ofrecer propuestas que contribuyan a un desarrollo sostenible ambiental, económico, político y social.
C8	CT8 - Valorar la importancia que tiene la investigación, la innovación y el desarrollo tecnológico en el avance socioeconómico y cultural de la sociedad

## Learning outcomes



Learning outcomes	Study programme competences		
To work collaboratively in groups		B6	
To know how to express yourself in public		B4	
To know the scientific language of the discipline and communicate effectively		B5	
Ability to search for and interpret toxicological information of any kind using computer tools and the Internet		B3	C3 C6
To know what are the fundamentals and basic principles of Nanotoxicology		B1 B4 B6	C8
To identify the main interactions between nanomaterials and biological systems, as well as their toxicity and response	A9	B5 B6	
To understand the mechanisms of action and adverse effects of nanomaterials and the influence of their physicochemical properties on them	A9	B1 B6	C8
To know the different methodologies for the evaluation of nanotoxicity and the risk of exposure to nanomaterials at different levels	A9	B5 B11	
To solve basic problems of nanotoxicology		B6 B7 B11	C7
To interpret and present experimental data		B3 B8	C3 C7
To recognize the prevention measures and risks associated with the production of nanomaterials, and the legislation in force for their manufacture and commercialization	A8 A10		C6

Contents	
Topic	Sub-topic
I. Introduction to nanotoxicology. Interaction between nanomaterials and biological systems.	1. Basic concepts in Toxicology and Nanotoxicology. 2. Introduction to Nanotoxicology. 3. Toxicokinetics of nanomaterials.
II. Toxicodynamics of nanomaterials. Nanotoxicology at genetic, cellular, tissue, systemic and organism level.	4. Toxicodynamics and mechanisms of action of nanomaterials. 5. In vitro and in silico nanotoxicity studies. 6. In vitro and epidemiological nanotoxicity studies.
III. Presence and behavior of nanomaterials in the environment.	7. Ecotoxicology of nanomaterials. 8. Evaluation and characterization of the environmental impact of nanomaterials.
IV. Nanosecurity and regulation.	9. Occupational exposure to nanomaterials. 10. Regulation and ethical aspects in the use and production of nanomaterials.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student's personal work hours	Total hours
Introductory activities	B6 B7 C8	1	0	1
Guest lecture / keynote speech	A8 A9 A10 B1 B5 B7 B8 B11 C6	30	60	90
Mixed objective/subjective test	A8 A9 A10 B1 B5 B7 B8 B11 C6	3	0	3
Laboratory practice	A8 A9 B3 B4 B6 B7 B8 C7 C8	10	25	35
ICT practicals	A9 B3 B7 C3	2	5	7
Student portfolio	A9 B1 B3 B4 B5 B7 B8 B11	0	12	12



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
Introductory activities	Presentation of the subject and introduction by the teacher of the contents of the program with the help of multimedia materials. Resolution of the issues raised by the students.
Guest lecture / keynote speech	Exposure through expository teaching in the classroom of the topics and subtopics contained in the subject. Participatory, collaborative, constructivist methodology, with teacher-guided learning.
Mixed objective/subjective test	At the end of the subject program, a test will be carried out that will consist of short answer questions and/or multiple choice.
Laboratory practice	Classes on solving cases and problems through interactive teaching that will be carried out in the classroom, in which practical aspects of the matter explained during the master sessions will be worked on and various methodologies will be learned for the evaluation and interpretation of the results obtained, of the damage induced by exposure to nanomaterials.
ICT practicals	Practice carried out using computer equipment on the search and management of toxicological and nanotoxicological information on the Internet.
Student portfolio	At the end of the interactive teaching, the student must prepare and present a portfolio as a written work, where the results of the practical cases seen during the classes are collected, as well as the answers to the questions and questionnaires raised in them. In addition, the analysis and graphic representation of the data will be done if requested. Portfolio must be delivered to the teacher of the subject in paper format before the end of the period set for its evaluation and qualification.

Personalized attention	
Methodologies	Description
Guest lecture / keynote speech Laboratory practice ICT practicals	At the request of the students, tutorials will be carried out to specify the issues to be dealt with in the portfolio, as well as to resolve doubts, offer guidance and help in the development of both the specific competences of the subject and the transversal and core competences of the degree.

Assessment			
Methodologies	Competencies	Description	Qualification
Guest lecture / keynote speech	A8 A9 A10 B1 B5 B7 B8 B11 C6	The content of the magisterial sessions will be evaluated through the mixed test.	0
Mixed objective/subjective test	A8 A9 A10 B1 B5 B7 B8 B11 C6	The evaluation of the skills acquired in the course will be carried out by taking an exam at the end of the course, it will be individual and cannot be done in a group. The exam will consist of short answer and/or multiple choice questions on basic concepts learned during classes and related practical questions. The student will have to obtain at least a five in the final exam to pass the course.	80
Laboratory practice	A8 A9 B3 B4 B6 B7 B8 C7 C8	The evaluation of the individual learning work carried out by the student will be carried out through continuous monitoring during the development of the practical classes of interactive teaching. The skill in solving the cases and exercises proposed that the students will deliver in the portfolio will be valued, as well as the ability to reason and provide solutions to the problems raised.	0
ICT practicals	A9 B3 B7 C3	As with the laboratory practices, the evaluation of the individual learning work carried out will be carried out through continuous monitoring during the development of the practical classes through ICT. The student must solve the cases and exercises proposed during the class and deliver them in the portfolio together with the practical laboratory cases. The students who do not attend the practices through ICT must also complete the proposed questionnaires and attach them to the portfolio for their delivery in a timely manner.	0



Student portfolio	A9 B1 B3 B4 B5 B7 B8 B11	The students will prepare a portfolio in which they will detail the objectives, procedures and results of the activities carried out. The degree of comprehension of the treated subject, the capacity for analysis and synthesis, the consulted bibliography and the clarity of the exposition, writing and spelling will be valued. The delivery of this portfolio will be mandatory. However, it will not be essential to pass this work to pass the whole subject. Students who do not attend practices must also make the portfolio and deliver it in the form and period indicated.	20
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## Assessment comments

All those students who take the official final exam of the subject and have delivered the corresponding portfolio of laboratory practices and practices through ICT will be considered PRESENTED in the course proceedings.

The final mark in the minutes of the students who do not reach the minimum mark to pass the subject in the objective test of the theoretical syllabus, but whose cumulative score is greater than 50, will be a 4.9 (SUSPENSE).

On the second opportunity, only students who have not taken the first one, or who have not passed the minimum mark to pass the subject in the objective theory test, must take the exam. The evaluation methodology will be the same as the first opportunity.

During the practical test, on either occasion, except as otherwise indicated, the use of any device with Internet access is prohibited. If, during the practical test, there is an indication of the unauthorized use of these devices, the student will be expelled from the classroom, and the procedure will be followed according to Law 3/2022, of February 24, on university coexistence and the disciplinary regulations for students of the UDC. The fraudulent performance of the tests and/or activities will directly imply the qualification of suspense ("0") in the subject in the corresponding call, invalidating any qualification obtained in all the activities for the next opportunity, if any, within the same academic course.

The fraudulent performance of the tests or evaluation activities will directly imply the qualification of SUSPENSE (0) in the subject at the corresponding opportunity.

In carrying out work, plagiarism and the use of non-original material, including that obtained through the Internet, without express indication of its origin, will be considered cause for qualification of suspense (numerical grade 0) in the activity. All of this without prejudice to any disciplinary responsibilities that may arise after the corresponding procedure.

In the case of duly justified exceptional situations, additional measures may be adopted so that the student can pass the subject, such as flexibility in the portfolio delivery date or modification of the date of the learning results assessment test.

The students with officially recognized part-time dedication, will be able to carry out the activities proposed in the seminars via on-line and, through the tutorials (face-to-face or on-line), solve the questions that may arise.

In the event of discrepancies between the teaching guides in different languages, the Spanish version will prevail.

## Sources of information

<b>Basic</b>	<p>LIBROS: Fadeel, B., Pietroiusti, A., Shvedova, A. (2012) Adverse Effects of Engineered Nanomaterials. USA. Elsevier.</p> <p>Greim, H.; Snyder, R. (2007) Toxicology and risk assessment: a comprehensive introduction. Chichester: John Wiley &amp; sons.</p> <p>Klaassen, C.D.; Watkins III, J.B. (2005) Fundamentos de Toxicología de Casarett y Doull. Madrid: MacGraw Hill.</p> <p>Kumar, V., Dasgupta, N., Ranjan, S. (2018) Nanotoxicology. Toxicity Evaluation, Risk Assessment and Management. CRC Press. Taylor and Francis Group.</p> <p>Nelson Duran, Silvia S Guterres, et al., (2016) Nanotoxicology, Springer.</p> <p>Ramachandran, G. (2011) Assessing Nanoparticle Risks to Human Health. USA. Elsevier.</p> <p>Reineke, J. (2012) Nanotoxicity. Methods and Protocols. USA. Springer.</p> <p>Repetto, M.; Repetto, G. (2009) Toxicología fundamental. Madrid: Díaz de Santos.</p> <p>Riviere, J.E. (2006) Biological concepts and Techniques in Toxicology. An integrated approach. New York: Taylor &amp; Francis.</p> <p>Saib, Q., Faisal, M., Al-Khedhairi, A.A., Alatar, A.A. (2018) Cellular and Molecular Toxicology of Nanoparticles. Saudi Arabia. Springer.</p>
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<b>Complementary</b>	LIBROS:Barile, F.A. (2008) Principles of Toxicology Testing. Florida: CRC Press.DeCaprio, A. (2006) Toxicologic biomarkers. New York: Taylor and Francis.De Seres F.J., Blown AD. (1996) Ecotoxicity and human health. A biological approach to environmental remediation. CRC Lewis Publisher, Boca Ratón.IPCS (1993) Biomarkers and risk assessment: concepts and principles. International Programme on chemical safety. Environmental Health Criteria 155. World Health Organization. Geneva.Landis WG., Yu MH. (1995) Introduction to environmental toxicology. Impacts of chemicals upon ecological system. CRC Lewis Publishers, Boca Ratón.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.Stine, K.E; Brown, T.M. (2006) Principles of toxicology. 2nd edition. Londres: CRC Press Taylor & Francis.
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## Recommendations

### Subjects that it is recommended to have taken before

Microbiology and Immunology/610G04024

Molecular and Metabolic Biochemistry/610G04023

Numerical and Statistical Methods/610G04013

Cell Biology/610G04003

### Subjects that are recommended to be taken simultaneously

Nanotechnology in Pharmacy/610G04043

Nanotechnology in Food Industry/610G04044

Nanotechnology in Medicine/610G04037

Nanotechnology in Environmental Science/610G04038

### Subjects that continue the syllabus

### Other comments

- It is recommended to have computer knowledge at the user level, for the use of the Moodle platform and the preparation of the portfolio and its presentation.- It is recommended to have knowledge of English, for the consultation of bibliographic materials.-&nbsp;As stated in the transversal competences of the degree (C4), the development of a critical, open and respectful citizenship with diversity in our society will be encouraged, highlighting the equal rights of students without discrimination based on gender or sexual condition. Inclusive language will be used in the material and in the development of the sessions. Work will be done to identify and modify prejudices and sexist attitudes and the environment will be influenced to modify them and promote values of respect and equality.- 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 of this subject that are delivered on paper:They will not use plastics.They will use double-sided printing.Will use recycled paper.It will avoid making drafts.

(\*)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.