

**COURSE DATA****Data Subject**

Code	43060
Name	Reproductive and developmental toxicology
Cycle	Master's degree
ECTS Credits	3.0
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. Period	year
2139 - Master's Degree in Environmental Pollution, Toxicology and Health	Faculty of Biological Sciences	1	Second term

Subject-matter

Degree	Subject-matter	Character
2139 - Master's Degree in Environmental Pollution, Toxicology and Health	3 - Environmental toxicology	Optional

Coordination

Name	Department
TARIN FOLGADO, JUAN JOSE	23 - Functional Biology and Physical Anthropology

SUMMARY

La asignatura Toxicología Reproductiva y del Desarrollo se encarga de transmitir conocimientos básicos sobre los principios de teratogénesis, patogénesis del desarrollo, mecanismos básicos de toxicidad del desarrollo, así como sobre los efectos de estresantes, tóxicos o disruptores endocrinos sobre el desarrollo y reproducción masculina y femenina en vertebrados, con especial mención a la especie humana. La adquisición de estos conocimientos es fundamental para todos aquellos que deseen especializarse en el área de conocimiento de Contaminación y Toxicología Ambientales.

Es una materia optativa con 3 créditos teóricos ECTS, situada en el segundo cuatrimestre del Máster y dirigida a alumnos de diversas titulaciones: Biología, Ciencias Ambientales, Ciencias del Mar, Bioquímica y Ciencias Bioquímicas, Física, Farmacia, Química, Geología, Veterinaria e Ingenierías, etc.



PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

2139 - Master's Degree in Environmental Pollution, Toxicology and Health

- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.
- Capacidad de utilizar las nuevas tecnologías de la información y la comunicación.
- Capacidad de análisis, síntesis y razonamiento crítico en la aplicación del método científico.
- Capacidad para el aprendizaje autónomo y organizado y para la adaptación a nuevas situaciones.
- Comprensión del mundo natural como producto de la evolución y de su vulnerabilidad frente a la influencia humana.
- Desarrollo de un compromiso ético y capacidad de participación en el debate social.
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- Comprender los mecanismos de toxicidad de contaminantes.
- Valorar integralmente del estado de salud del medio ambiente.
- Saber catalogar y evaluar recursos biológicos.
- Realizar diagnóstico de problemas ambientales.
- Conocer los modelos animales para el estudio de enfermedades humanas.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

SKILLS TO BE ACQUIRED

- To handle correctly scientific terminology and become familiar with their sources of information.



- Get an integrated view of the defense mechanisms and adaptation to the environment of living things, understand the meaning of the knowledge acquired, interrelate and apply.
- Ability to analyze data, choosing the right method, evaluation and critical interpretation of experimental results in its various forms of expression (tables, graphs...).
- Acquire capacity of synthesis to collect information or data from various sources in an organized and coherent way.

SOCIAL SKILLS

- Develop capacity of critical thinking, fostering communication and discussion in order to stimulate individual creativity.
- Ability to work together when facing problematic situations collectively.
- Ability to build a comprehensive and organized written text.
- Ability to speaking to a public audience, such as the class itself, through exposure or intervention in a debate on a controversial topic or issue.
- Ability to interact with both the teacher and with peers.
- Interest in the social and economic application of science and in particular the Environmental Toxicology.
- Interest in disclosing scientific data and the impact of science on culture and consciousness of society

DESCRIPTION OF CONTENTS

1. Topic 1

1. INTRODUCTION. Teratology basic terminology. Incidence of major and minor congenital malformations. Inducing causes of major malformations.

Analysis and discussion of the articles:

Gilbert SF. When "personhood" begins in the embryo: avoiding a syllabus of errors. Birth Defects Res C Embryo Today. 2008 Jun;84(2):164-73. doi: 10.1002/bdrc.20123.

Miklavcic JJ, Flaman P. Personhood status of the human zygote, embryo, fetus. Linacre Q. 2017 May;84(2):130-144. doi: 10.1080/00243639.2017.1299896.



2. Topic 2

2. BASIC PRINCIPLES OF TERATOGENESIS. Principles of Teratology Wilson.

Analysis and discussion of the articles:

Friedman JM. The principles of teratology: are they still true? Birth Defects Res A Clin Mol Teratol. 2010 Oct;88(10):766-8. doi: 10.1002/bdra.20697.

Jelínek R. The contribution of new findings and ideas to the old principles of teratology. Reprod Toxicol. 2005 Sep-Oct;20(3):295-300.

3. Topic 3

3. MECHANISMS TOXICITY DEVELOPMENT I. Definitions. General mechanical considerations. Mechanisms of developmental toxicity. Guidelines for evaluating hypotheses about mechanisms of action: temporary association, dose-response relationship structure-activity, strength and consistency of the association and consistency of the hypothesis.

Analysis and discussion of the article:

Henley DV, Korach KS. Physiological effects and mechanisms of action of endocrine disrupting chemicals that alter estrogen signaling. Hormones (Athens). 2010 Jul-Sep;9(3):191-205.

4. Topic 4

4. MECHANISMS TOXICITY DEVELOPMENT II. Toxicokinetic and toxicodynamic factors as basic mechanisms of toxicity. Biological basis organotropic toxicity: molecular homology, selective expression of transcription factors, selective expression of factors receptors. Basic mechanisms of transmembrane transport of xenobiotics: diffusion, facilitated diffusion, active transport, endocytosis. Biotransformation and bioactivation / bioinactivation: functionalization and conjugation reactions involved in the biotransformation of xenobiotics. Protection mechanisms reagents or metabolites stress response.

Analysis and discussion of the article:

Derghal A, Djelloul M, Trouslard J, Mounien L. An Emerging Role of micro-RNA in the Effect of the Endocrine Disruptors. Front Neurosci. 2016 Jun 30;10:318. doi: 10.3389/fnins.2016.00318.

5. Topic 5

5. PATHOGENESIS OF ABNORMAL DEVELOPMENT. Definitions. Manifestations of developmental toxicity: structural abnormalities (malformations, deformations and disruptions); multiple defects (syndromes, sequences and associations). Factors influencing the pathogenesis of abnormal development: stage of development; tissue specificity; influence of dose. Manifestations of the effects at the cellular level: cell death; cell proliferation; cell signaling and interaction; cell migration and differentiation. Manifestations of the effects at the tissue level.

Analysis and discussion of the article:



Stel J, Legler J. The Role of Epigenetics in the Latent Effects of Early Life Exposure to Obesogenic Endocrine Disrupting Chemicals. *Endocrinology*. 2015 Oct;156(10):3466-72. doi: 10.1210/en.2015-1434.

6. Topic 6

6. EFFECTS OF MATERNAL STRESSORS ON DEVELOPMENT. Definitions. Maternal types of stressors. Developmental damage or stress associated with maternal toxicity. Potentiation of chemical teratogenesis by maternal stress. Developmental toxicity mechanisms mediated by the mother. Effects of maternal prenatal development toxicity: placental toxicity induced by toxic alterations maternal nutritional status, gas exchange, stress produced by non-drug regimens. Effects of maternal postnatal development toxicity: effects on lactation, maternal care. Maternal and embryonic development.

Analysis and discussion of the article:

Cummings JA, Clemens LG, Nunez AA. Mother counts: how effects of environmental contaminants on maternal care could affect the offspring and future generations. *Front Neuroendocrinol*. 2010 Oct;31(4):440-51. doi: 10.1016/j.yfrne.2010.05.004.

7. Topic 7

7. PARENTAL IMPACT ON DEVELOPMENT. Evidence drawn from epidemiological studies. Evidence extracted from animal experimentation. Potential mechanisms: (1) Medicines, drugs or toxic substances in the seminal fluid. (2) Medicines, drugs or poisons that affect male germ cells: effect of stage of spermatogenesis, reversibility and heritability.

Analysis and discussion of the article:

Soubry A, Hoyo C, Jirtle RL, Murphy SK. A paternal environmental legacy: evidence for epigenetic inheritance through the male germ line. *Bioessays*. 2014 Apr;36(4):359-71. doi: 10.1002/bies.201300113.

8. Topic 8

8. EFFECTS OF ENDOCRINE DISRUPTORS ON FEMALE REPRODUCTION OF VERTEBRATES. Chemicals that can disrupt the endocrine system. Phases of female reproductive cycle life. Possible consequences of endocrine disruptors in female reproduction.

Analysis and discussion of the article:

Bergman Å, Heindel JJ, Jobling S, Kidd KA, Zoeller RT (ed.), published by UNEP and WHO in 2013, entitled *State of the science of endocrine disrupting chemicals - 2012. An assessment of the state of the science of endocrine disruptors prepared by a group of experts for the United Nations Environment Programme (UNEP) and WHO*. P. 34-44 and 47-48.

**9. Topic 9**

9. EFFECTS OF ENDOCRINE DISRUPTORS ON MALE REPRODUCTIVE MALE OF VERTEBRATES. Development of sexual phenotype in humans. Definitions. Symptoms of testicular dysgenesis syndrome. Examples of testicular dysgenesis syndrome of wild animals. Impairment of male reproductive function in humans. Source syndrome Testicular dysgenesis. Clinical trials of fetal origin of testicular dysgenesis syndrome of.

Analysis and discussion of the article:

Bergman Å, Heindel JJ, Jobling S, Kidd KA, Zoeller RT (ed.), published by UNEP and WHO in 2013, entitled State of the science of endocrine disrupting chemicals - 2012. An assessment of the state of the science of endocrine disruptors prepared by a group of experts for the United Nations Environment Programme (UNEP) and WHO. P. 57-68 and 72-75.

10. Topic 10

10. EFFECTS OF OOCYTE AGING OOCYTE ON OFFSPRING. Factors inducing oocyte aging. Effects of oocyte aging on oocytes, embryos and offspring. Long-term effects of oocyte aging on postnatal development, learning ability, reproductive efficiency and longevity of offspring. Prevention strategies of oocyte aging.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	21,00	100
TOTAL	21,00	

TEACHING METHODOLOGY

The course is divided into:

- Lectures of theory to develop fundamental knowledge and methodology to be used.
- Analysis-discussion of scientific papers directly related to the topics of the lectures.
- Seminars, to be held individually by each student. The teacher will propose topics that students may choose. However, students may develop topics of interest directly related to the syllabus. Students will search the literature and develop a work that will be presented orally to the other students and the teacher, opening a debate during and at the end of the presentation



EVALUATION

A process of continuous assessment where the degree of student involvement in the preparation of the theory classes and analysis-discussion of scientific papers related topics will be performed for evaluation.

On the other hand, the bibliographic work presented in the seminars will be evaluated.

The written work is assessed taking into account:

- The difficulty of the subject developed.
- The final structure of the work.
- The development and content.
- The conclusions reached by the student.
- The bibliography, etc.

The oral presentation will be evaluated considering the following criteria:

- The student presents the information in a logical and interesting class sequence that can follow.
- The student demonstrates a thorough knowledge (more than required) by answering all kinds of questions with explanations and details.
- The student explains visual material and strengthens the text and presentation.
- The presentation has not mistakes or grammatical errors.

The final mark for the course will be estimated by calculating the weighted average of the mark obtained in the continuous assessment (50% weight) and achieved mark on the bibliographic work (weight 50%).

However, in order for the continuous assessment process to be carried out, it is absolutely essential attendance at classes. If two classroom absences were taken place (excused or unexcused), the student will leave the process of continuous evaluation and, instead, will have to pass a final exam of the theory syllabus (50% weight).

REFERENCES



Basic

- Boelsterli UA (2007). *Mechanistic Toxicology: The Molecular Basis of How Chemicals Disrupt Biological Targets*, 2nd Ed. CRC Press, Taylor & Francis Group, Boca Raton, London, New York.

Briggs GG, Freeman RK, Yaffe SJ (2011). *Drugs in Pregnancy and Lactation*. 9th Ed. Lippincott Williams & Wilkins, a Wolters Kluwer business, Philadelphia.

Gilbert, S.F. and Barresi, M.J.F. (2016). *Developmental Biology*. 11th ed. Sinauer Associated, Inc.

Gilbert SF (2016). *A Small Dose of Toxicology: the Health Effects of Common Chemicals*. 2nd Ed. Healthy World Press.

Hood RD (2012). *Developmental and Reproductive Toxicology. A practical approach*. 3rd Ed. CRC Press, Taylor & Francis Group, an Informa Business, Boca Raton.

Yu MHo, Tsunoda H, Tsunoda M (2011). *Environmental Toxicology: Biological and Health Effects of Pollutants*. 3rd Ed. CRC Press, Taylor & Francis Group, an Informa Business, Boca Raton, London, New York.

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

English version is not available