COURSE DATA

Data Subject	
Code	33054
Name	Evolutionary processes and mechanisms
Cycle	Grade
ECTS Credits	4.5
Academic year	2024 - 2025

Study (s)

Degree	Center	Acad. year	Period
1100 - Degree in Biology	Faculty of Biological Sciences	2	First term
1106 - Degree in Biology	Faculty of Biological Sciences	2	First term

Subject-matter

Degree	Subject-matter	Character
1100 - Degree in Biology	20 - Evolution	Obligatory
1106 - Degree in Biology	13 - Evolución	Obligatory

Coordination

Name	Department
GONZALEZ CANDELAS, FERNANDO	194 - Genetics

SUMMARY

“Evolutionary processes and mechanisms” is a compulsory subject in the Biology Degree at the Universitat de València. It belongs to the matter “Evolution”, along with “The Tree of Life” (first year) and “Paleontology” (second year) and “Major Evolutionary Transitions” (3rd year), and its main objective is to introduce the core of evolutionary theory. This subject, placed at the beginning of the students’ learning process, will acquaint them with the scientific theory which unifies and integrates knowledge from the other disciplines in Biology. In consequence, its main goal is teaching a complex theory. Additionally, it will be shown how scientific knowledge advances, both presently and through history. Lastly, it will enable students to integrate knowledge from diverse and more specialized subjects in specific topics of Biology.

FOR STUDENTS ENROLLED WITH THE 2010 STUDY PLAN (OLD STUDY PLAN, IN THE PROCESS OF EXTINCTION): DUE TO THE IMPLEMENTATION OF THE NEW PLAN OF STUDIES FOR THE DEGREE IN BIOLOGY, THIS SUBJECT IS IN THE PROCESS OF EXTINCTION AND, THEREFORE, IT IS OFFERED ONLY WITHOUT TEACHING (SD). THIS MEANS THAT THERE WILL NOT BE ANY ASSOCIATED TEACHING ACTIVITY AND THAT THE EVALUATION OF THE SUBJECT WILL BE CARRIED OUT ONLY THROUGH A THEORETICAL-PRACTICAL EXAM.

STUDENTS WHO DO NOT PASS IT IN ANY OF THE CALLS OF THE 2024-25 OR 2025-26 COURSES WILL BE OBLIGED TO ADAPT TO THE NEW PLAN TO CONTINUE THEIR DEGREE STUDIES IN BIOLOGY.

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)

1100 - Degree in Biology

- Capacidad de análisis, síntesis y razonamiento crítico.
- Capacidad de resolución de problemas.
- Capacidad de aprendizaje autónomo.
- Capacidad de comunicación oral y escrita.
- Capacidad de manejar el inglés como vehículo de comunicación científica.
- Capacidad de utilizar las nuevas tecnologías de información y comunicación.
- Comprender el método científico.
- Capacidad de trabajar en equipo y de liderazgo.
- Argumentar y razonar en base al conocimiento científico.
- Analizar las diferentes formas de abordar problemas científicos complejos.
- Integrar en una teoría común los desarrollos de distintas disciplinas y niveles de estudio de la Biología.
- Conocer la teoría de la evolución, sus postulados y sus ámbitos de aplicación, y su impacto en el desarrollo de la Biología.

- Conocer los principales modelos descriptivos del cambio en el tamaño y composición de las poblaciones de organismos actuales y fósiles.
- Entender los modos de acción, regímenes y limitaciones de la selección natural y sus consecuencias.
- Entender los procesos de selección sexual y su papel en la evolución.
- Conocer los fundamentos del estudio de la variabilidad genética de las poblaciones y de su mantenimiento.
- Conocer los principios básicos de la teoría neutral de la evolución molecular.
- Conocer los principales conceptos de especie.
- Entender los mecanismos de especiación.
- Conocer las implicaciones de los cambios genómicos en la evolución.
- Conocer el concepto de eficacia biológica, su dinámica y sus medidas.
- Conocer la relación entre procesos de desarrollo y dinámica evolutiva.
- Conocer los patrones y mecanismos micro y macro evolutivos.

1106 - Degree in Biology

- Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.
- Interpret, analyse, evaluate, process and synthesise biological data and information by applying mathematical and statistical methods.
- Organise, plan and manage information in a manner that allows the individual to analyse, synthesise and develop critical reasoning that can be applied to solve problems, make decisions and carry out work.
- Use scientific language, both oral and written, and be able to adapt the register to the target audience and/or readers. Use the most common foreign languages in each discipline as a vehicle for communication in a globalised system.
- Understand the historical nature of the evolutionary process in terms of unrepeatability, contingency and/or necessity and apply the principles and methods for the interpretation of the fossil record and its use in dating, palaeoenvironmental reconstruction and evolutionary inferences.
- Analyse the evolutionary mechanisms, processes and models at different levels of biological organisation, and understand their relationship with organic and environmental diversity.

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

- To discriminate between scientific and pseudoscientific explanations in evolution.
- To interpret social and cultural influences in the development of evolutionary theory.
- To apply statistical methods to evaluate scientific hypotheses.
- To recognize the adaptations of organisms to the environment, along with their costs and limitations.
- To gather and integrate field and laboratory data to solve problems in evolutionary biology.
- To calculate and interpret evolutionary rates from empirical data of different kinds.
- To analyze the evolutionary process in the different levels of biological organization.
- To differentiate between natural selection and evolution.
- To identify the main developmental mechanisms relevant for evolution.
- To recognize different levels of selection and evolutionary hierarchies.
- To analyze the ecological stage of evolutionary processes and its effect in the generation of the phenotype.
- To relate environmental and organic diversity and the evolutionary process.

DESCRIPTION OF CONTENTS

1. The ecological framework of evolution

Natural selection. Adaptation and environment. Fitness. Niche and competition. Models of population growth. Adaptive trade-offs

2. Genetic variability and selection

Origin, description and quantification of genetic variability. Hardy-Weinberg equilibrium. Simple one-locus selection models. The fundamental theorem of natural selection.

3. Other processes of evolutionary change

Mutation, genetic drift, migration, recombination. Inbreeding.

4. Evolution of genes and genomes

Evolution at the molecular level. Neutral theory. Adaptation at the molecular level. The genome as the unit of evolution. Comparative evolution of genomes

5. Levels of selection and evolution

Levels of selection: group selection, kin selection. Sexual selection. Conflict between levels of selection. Microevolution and macroevolution. The necessity and limitations of the adaptationist program.

6. Evolution in complex organisms

Origin and evolution of sex and sexual reproduction. Evolution of aging and senescence. Evolution and development

7. The origin of species

Isolation mechanisms. Genetic differentiation during speciation.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	29,00	100
Classroom practices	8,00	100
Computer classroom practice	6,00	100
Tutorials	2,00	100
Development of group work	10,00	0
Study and independent work	20,00	0
Preparation of evaluation activities	20,00	0
Preparing lectures	7,50	0
Preparation of practical classes and problem	10,00	0
TOTAL	**112,50**	

TEACHING METHODOLOGY

This subject is based upon different teaching/learning activities including:

Lectures, in which the teachers will explain the basic concepts of each lesson using the appropriate multimedia resources. Before each class, students will be able to access the material in the web platform. Students will be guided about the relevant references and resources to use for a deeper study of the concepts. These will be related with the topics covered in the other activities programmed in the subject.

Practical classes, including problems to be solved analytically and through simulation programs (Populus, Avida, Stella, or similar), insisting and deepening on the main concepts explained in the lectures. The analytical problems are intended to make students face the formulation and solving of simple questions related to the main concepts of the subject. These sessions are a key point so students get started on the basic methods and techniques of problem solving. Additionally, the simulation of evolutionary processes with computer programs allows showing and checking the consequences of

evolutionary models and methods. In this line, these practical classes allow the interpretation of graphic plots, the study of the effects of different conditions and assumptions on the evolutionary process, and the appreciation of the role of stochastic processes in evolution. As evolution is a slow process, computer simulations become a very useful teaching aid to show it in short time and to appreciate the quantitative and qualitative consequences of different assumptions.

Interdisciplinary work: preparation and presentation of a seminar. The activities of the subject are completed and complemented with the transversal activity "Interdisciplinary Seminars" directly focused on the work on competences. This is a cross-disciplinary activity common to all subjects in the second year of the degree in (Histology, Evolutionary Processes and Mechanisms, Zoology II, Botany II, Biochemistry, Genetics, Paleontology, Developmental Biology, and Biostatistics). It consists of the preparation and presentation, by a working group (3 students), of a seminar, which will consist of a written text and an oral presentation. The activity is compulsory for all students enrolled in the second year, except for those who have done it before. Each working group prepares a seminar on a topic proposed by the teachers of the participating subjects. The assignment of each group to the subjects will be randomly done. Each interdisciplinary work will thus be linked to the corresponding subject resulting from the draw.

A tutor will be assigned to each of the projects, who will supervise the completion of the project and supervise its presentation. To this end, a series of regular meetings will be held with the tutor throughout the course. A co-tutor will also be assigned, who will review the final version of the work submitted. Each paper will be presented orally by all members of the group for 30 minutes. The presentation will be attended by all students on the course, as attendance is compulsory, and by two lecturers: the tutor and a second lecturer. Both students and teachers will take part in the presentation.

Tutorials in reduced groups. These will be used for the follow-up and continuous evaluation of students. They must prepare questions and doubts arising during the study and in the lectures and practical sessions. They might be answered by other students or the professor, when appropriate. Students, and not the professor, are expected to lead these tutorial classes.

Other activities, non requiring attendance, will reveal the interest and involvement of the students on this subject, such as actively participating in the open forum for questions and discussions of hot topics in Aula Virtual or in volunteer activities for gaining a deeper knowledge of the subject (solving advanced problems, reading and commenting articles and texts, etc.).

On-line tutorials, to solve doubts and specific questions, asking about specific topics, debating about current scientific and social topics related to this subject, etc.

NOT APPLICABLE FOR STUDENTS ENROLLED WITH THE 2010 STUDY PLAN (OLD STUDY PLAN, 1100, IN THE PROCESS OF EXTINCTION) DUE TO THE IMPLEMENTATION OF THE NEW STUDY PLAN: SEE THE SUMMARY SECTION.

EVALUATION

The continuous evaluation of each student will be based on the different classroom and non-classroom based activities described in the Methodology section, taking into account the attendance to all classroom activities, the completion and delivery of home work and complementary activities, the participation and involvement in the teaching-learning process. Specific points to be evaluated are:

-Objective test of theoretical and practical questions about the topics covered in this subject. The mark of this test will represent 75% of the final grade (45% corresponding to theoretical contents and 30% to practical ones). In this test, special attention will be given to the understanding of basic concepts for the development of biological learning and to reaching the general goal of this subject. In order to pass the subject, it is necessary to obtain a mark of 5 on 10 in this test. Additionally, this part of the evaluation may be complemented through a continuous grading along the term, by means of individual tests or questionnaires. These tests will be weighted for the final mark increasing in up to 2 points the score of the previously mentioned objective test, always under the condition that the test is passed.

-Evaluation of the participation in face-to-face activities (lectures, practical classes, seminars and group tutorials) and other non-classroom based activities (participation in Aula Virtual forums, other activities for advanced study, etc.) Among others, the ability to pose doubts, to propose answers and to lead group discussions will be valued as another component of the continuous evaluation of each student. The mark in this section will represent 15% of the total grade.

-The mark received in the interdisciplinary work will represent a 10% of the final grade of the subject. The mark will be given by the tutor and cotutor of the work as well as by another faculty attending the oral presentation of the work (with weights of 60%, 20% and 20%, respectively). The evaluation of this activity will consider both the scientific content and the form they are presented, giving special value to communication skills and the transmission of ideas and concepts. Those works selected for presentation in the Biology Congress will receive extra points as much as 10% of the mark of this activity.

The grade obtained in the interdisciplinary work will account for 10% of the grade for the subject. The tutor and an assistant lecturer (cotutor) will participate in the grading and will take into account both the oral presentation of the work and the written text. In these assessments, the relative weight of the tutor's and co-tutor's marks will be 60% and 40%, respectively. The evaluation of this activity will take into account both the scientific content and the way in which it has been presented, especially the ability to communicate and transmit ideas and concepts. The works selected for presentation at the Biology Congress will receive an extra mark, corresponding to 10% of the mark for the activity.

In the event of failing the course, the grade for the interdisciplinary work will be saved for the following year.

In the event that the interdisciplinary work (of a compulsory nature) is not carried out, this subject will be failed if it is the subject linked to this interdisciplinary work, regardless of the grade obtained in the rest of the subject.

In the second call of examinations, the same method of evaluation will be applied, but the possibility of a continuous evaluation might be obviated, keeping the grades of seminars and participation received in the first call and taking a new objective test with the previously described conditions.

Finally, be aware that it is not possible to decline the grade of this subject once grades have been made public, both for the marks in participation in classroom-based activities (laboratory, problems, seminars, etc.) as well as for those of the different tests and documents used for them (essays, exams, etc.).

NOT APPLICABLE FOR STUDENTS ENROLLED WITH THE 2010 STUDY PLAN (OLD STUDY PLAN, IN THE PROCESS OF EXTINCTION) DUE TO THE IMPLEMENTATION OF THE NEW STUDY PLAN: SEE THE SUMMARY SECTION.

REFERENCES

Basic

- Herron, J.C., and Freeman, S. 2013. Evolutionary analysis. 5th edition. Prentice Hall. Versión en castellano: 2002. Análisis evolutivo. Prentice Hall, Madrid.

Additional

- Barton N.H., Briggs, D.E.G., Eisen, J.A., Goldstein, D. B., and Patel, N.H. 2007. Evolution. CSHL Press.

- Baum, D.A. et al. 2014. The Princeton Guide to Evolution. Princeton Univ. Press.

- Fontdevila, A., y Moya, A. 2004. Evolución. Editorial Síntesis, Madrid.

- Futuyma, D.J. 2009. Evolution. 2nd edition. Sinauer.

- Stearns, S.C., y Hoekstra, R.F. 2005. Evolution: An introduction. 2nd edition. Oxford University Press, Oxford

- Majerus, M., Amos, W. y Hurst, G. 1996. Evolution. The four billion year war. Longman

- Ridley, M. 2004. Evolution. 3rd edition. Blackwell

- Zimmer,C., and Emlen, D.J. 2013. Evolution. Making Sense of Life. Roberts & Co. Greenwood Village, Colorado, USA.