COURSE DATA

DATA SUBJECT

Code: 33054
Name: Evolutionary processes and mechanisms
Cycle: Undergraduate Studies
ECTS Credits: 4.5
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1106 - Degree in Biology	Facultat de Ciències Biològiques	2	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1106 - Degree in Biology	Evolución	COMPULSORY

COORDINATION

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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.

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 / LEARNING OUTCOMES

1106 - Degree in Biology

Analyse the evolutionary mechanisms, processes and models at different levels of biological organisation, and understand their relationship with organic and environmental diversity.

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.

Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.

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.

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.

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.

DESCRIPTION OF CONTENTS

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

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

Mutation, genetic drift, migration, recombination. Inbreeding.

Evolution at the molecular level. Neutral theory. Adaptation at the molecular level. The genome as the unit

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

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

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	2,00
Theory	29,00
Computer classroom practice	6,00
Classroom practices	8,00
Total hours	**45,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	10,00
Independent study and work	20,00
Preparation of lessons	17,50

Preparation for assessment activities	20,00
Resolution of case studies	0,00
Total hours	**67,50**

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. Th analytical problems are intended to make students face the formulation and solving of simple question 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 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 interdisciplinary work BIOGRAU consists in the preparation a presentation of a scientific and popularizing seminar. This is a transversal activity, compulsory for all students enrolled in the second year, except for Erasmus students, those who have adapted or transferred from other Degrees. Each working group will consist of three students and is assigned to a participating subject by a random draw. One of the teachers of the subject is designated as tutor, who will supervise and review the work. With the tutor, each group selects a topic, prepares a written report and makes a presentation of about 30 minutes.
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, not 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 Aula Virtual or in volunteer activities for gaining a deeper knowledge of the subject (solving advance problems, reading and commenting articles and texts, etc.).
Online tutorials, to address specific queries and problems, raise points of interest, and discuss current scientific and social issues related to the course, etc.

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 an 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 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 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 of 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 mar in this section will represent 15% of the total grade.
-The evaluation of BIOGRAU will take into account the written report, the oral presentation, the individual and the team work. The tutor, along with the cotutor, will participate in the evaluation of the students with weight of 60% and 40%, respectively. Once the subject is passed, the mark from BIOGRAU will contribute a 10% to the final mark of all the subjects in 2º year. The best seminars will be selected to be presented in the annual BIOGRAU Congress and will receive an additional 10%. This activity cannot be recovered in the second call. The mark of BIOGRAU will be valid for 5 academic years. Please, check more detailed specifications in the BIOGRAU instructions at Aula Virtual.
In the second call of examinations, the same method of evaluation will be applied, but the possibility of 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, seminar etc.) as well as for those of the different tests and documents used for them (essays, exams, etc.).

REFERENCES

Basic References
-Weinreich, Daniel M.2023. The Foundations of Population Genetics. The MIT Press.

Complementary References
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Fontdevila, A., y Moya, A. 2004. Evolución. Editorial Síntesis, Madrid.
-Futuyma, D.J. 2009. Evolution. 2nd edition.
-Sinauer. Herron, J.C., and Freeman, S. 2013. Evolutionary analysis. 5th edition. Prentice Hall. Versión en castellano: 2002. Análisis evolutivo. Prentice Hall, Madrid.
-Majerus, M., Amos, W. and Hurst, G. 1996. Evolution. The four billion year war.
-Longman. Ridley, M. 2004. Evolution. 3rd edition. Blackwell.
-Stearns, S.C., and Hoekstra, R.F. 2005. Evolution: An introduction. 2nd edition. Oxford University Press, Oxford.
-Zimmer,C., and Emlen, D.J. 2013. Evolution. Making Sense of Life. Roberts & Co. Greenwood Village, Colorado, USA.