VNIVERSITAT DE VALÈNCIA

Course Guide
33054 Evolutionary processes and mechanisms

COURSE DATA

Data Subject	
Code	33054
Name	Evolutionary processes and mechanisms
Cycle	Grade
ECTS Credits	4.5
Academic year	2020 - 2021

Study (s)

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

Subject-matter

Degree	Subject-matter	Character
1100 - Degree in Biology	20 - Evolution	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” and “Major Evolutionary Transitions” (3rd year both), 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

OUTCOMES

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.

LEARNING OUTCOMES

- 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.

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. The origin of species

Species concepts. Isolation mechanisms. Biogeographic patterns in speciation. Genetic differentiation during speciation. Speciation rates.

6. Sexual selection and life-history strategies

Evolution of sex. Sexual conflict. Males compete: intrasexual selection. Females choose: intersexual selection.

7. Levels of selection and evolution

Punctuated equilibrium and phyletic gradualism. Microevolution and macroevolution. The necessity and limitations of the adaptationist program.

8. Evolution of complex organisms

The origin of body patterns and complex organisms, homeotic mutations and Hox genes. Aging and senescence. Cancer from an evolutionary perspective.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	28,00	100
Classroom practices	8,00	100
Computer classroom practice	6,00	100
Tutorials	3,00	100
Attendance at events and external activities	1,50	0
Development of group work	5,00	0
Study and independent work	16,00	0
Readings supplementary material	10,00	0
Preparation of evaluation activities	20,00	0
Preparation of practical classes and problem	10,00	0
Resolution of online questionnaires	5,00	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. This is a common, transversal and interdisciplinary activity shared by all the subjects in the second course of the Degree in Biology (Cell and Tissue Biology, Developmental Biology, Biochemistry, Botany, Genetics, Molecular Methods in Biology, Evolutionary Processes and Mechanisms, and Zoology). The activity is mandatory for all the students enrolled in their second year except for those who have passed it before (and whose mark has been upheld). Each working group, formed by three students, will prepare a seminar (including a written essay and a talk) on a topic assigned on a public draw among those proposed by the faculty involved in the previously mentioned subjects. Each interdisciplinary work will be linked (with consequences for its evaluation) to the subject whose faculty proposed the corresponding topic. Each work will have a tutor, who will be responsible for its development and supervise its presentation. For this, each group will meet regularly with its tutor during the school-year. At the beginning of the first term the dates for these meetings, the presentation of the final work and the documents to be included. A cotutor, who will review the final version of the work, will also be assigned. Every work will be presented in a 30 minute talk by all the members of each group. It is mandatory for all the students enrolled this year to attend the talks, along with at least two professors, the tutor and a second professor (different from the cotutor and drawn from the faculty of the year).Students and professors will participate in the selection of the works that, because of their quality and originality, will be presented at the Congress of Biology, jointly held by students of the first and second years of the degree in Biology.

Alternatively to this activity, it can make other interdisciplinary activity of a project of educational innovation supported by the CAT.

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.

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. Alternatively, and always with previous agreement between the students and teacher, this part of the evaluation may be done through a continuous grading along the term, by means of individual tests or questionnaires. These tests will be weighted for the final mark (65% of the value of this item) always conditioned on passing the previously mentioned objective test.

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.

If a student does not complete the interdisciplinary work (which is mandatory), s/he will not pass the subject linked to the work (the topic of the work was proposed by the faculty of this subject and the tutor is one of them), regardless the marks received in the remaining items of the subject. If that is the case for this subject, and this has been passed in the other items (that is, receiving a grade equal or higher than 5 over 9 and fulfilling the other requirements to pass, as detailed above), the grade will be kept for the next year, and only for that period. The mark received in the interdisciplinary work will be added to the rest when passed. If this is not the subject linked to the interdisciplinary work and the student fails it, s/he will

be graded on a maximum score of 9, but it will still be necessary to get at least a grade 5 to pass 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.)

REFERENCES

Basic

- Freeman, S., and Herron, J.C. 2007. Evolutionary analysis. 4th 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.
- 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
- Smith, J.M. 1997. Evolutionary Genetics. 2ª edición. Oxford Univ. Press.
- Zimmer,C., and Emlen, D.J. 2013. Evolution. Making Sense of Life. Roberts & Co. Greenwood Village, Colorado, USA.

ADDENDUM COVID-19

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

The PME teaching guide already includes the appropriate considerations in case it is necessary to evaluate non-contact teaching