COURSE DATA

Data Subject	
Code	33053
Name	The tree of life
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1100 - Degree in Biology	Faculty of Biological Sciences	1	First term
1106 - Degree in Biology	Faculty of Biological Sciences	1	First term

Subject-matter

Degree	Subject-matter	Character
1100 - Degree in Biology	5 - Biology	Basic Training
1106 - Degree in Biology	5 - Biología	Basic Training

Coordination

Name	Department
ROS FRANCH, SONIA	356 - Botany and Geology

SUMMARY

FOR STUDENTS ENROLLED WITH THE 2010 STUDY PLAN (OLD STUDY PLAN, IN THE PROCESS OF EXTINCTION):

DUE TO THE IMPLEMENTATION OF THE NEW SYLLABUS OF THE DEGREE IN BIOLOGY, THIS SUBJECT IS IN THE PROCESS OF EXTINCTION AND, THEREFORE, IT IS ONLY OFFERED WITHOUT TEACHING (SD). THIS MEANS THAT IT WILL NOT BE ASSOCIATED WITH ANY FACE-TO-FACE TEACHING ACTIVITY AND THAT THE SUBJECT WILL ONLY BE ASSESSED BY MEANS OF A THEORETICAL-PRACTICAL EXAM.

STUDENTS WHO DO NOT PASS THE COURSE IN ANY OF THE 2023-24 OR 2024-25 ACADEMIC YEARS WILL BE OBLIGED TO ADAPT TO THE NEW PLAN IN ORDER TO CONTINUE THEIR DEGREE STUDIES IN BIOLOGY.

"The tree of life" (AV) is a basic course belonging to the matter of Biology included in the "Degree in Biology" of the University of Valencia. This course is taught during the first semester of the first year, at the very beginning of the students' formative process, and provides a phylogenetic perspective of Biology. The main objective is to familiarize students with the most basic concepts of the theory of evolution and phylogenetics, as well as with the implications of the evolutionary process in the classification of living beings. These basic concepts should enable them to understand biological phenomena as a result of the evolutionary process that determines the phylogenetic relationships among organisms. The student should be able, therefore, to recognize the role of descent from common ancestors and the evolution of change in establishing patterns of similarity and difference between groups of organisms, to know the hierarchical structure of Systematics and the different classification systems, as well as the methodologies and basic tools for the classification of living things. The fundamental rules governing the designation of different groups of organisms and their relationships are also studied. Finally, the student should be familiar with the timeline of life on earth, and the major events in the history of life.

The course combines both theoretical and practical aspects. This is reflected in the time devoted to active discussion on controversial aspects of evolution, as well as to solve different types of problems.

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

- Situar la Biología en el contexto de la ciencia a través del conocimiento de algunos de sus grandes temas y problemáticas en el mundo actual.
- Manejo de material para la experimentación en el laboratorio y en el campo.
- Conocer las normas de seguridad e higiene en el laboratorio.
- Manejo de recursos informáticos de utilidad en Biología.
- Capacidad de análisis, síntesis, trabajo metódico y riguroso.
- Capacidad de análisis crítico de textos científicos.
- Develop the capacity for organisation and planning.
- Capacidad de presentación escrita y oral de datos científicos.
- Habilidad para el trabajo en equipo.
- Conocimiento y respeto de la diversidad cultural humana.
- Capacidad de valoración de los riesgos medioambientales y de las crisis de biodiversidad.

- Compromiso con la conservación y con el desarrollo sostenible.
- Compromiso con la defensa y práctica de las políticas de igualdad.
- Compromiso ético en el manejo de animales para experimentación.
- Compromiso ético en el ejercicio de la profesión de biólogo/a.
- Identificar relaciones entre la ciencia y la sociedad.
- Analizar los valores culturales implícitos en los saberes y prácticas de la ciencia.
- Asimilar la dimensión histórica del conocimiento.
- Asimilar el proceso de construcción del conocimiento científico.
- Capacidad para divulgar la ciencia.

1106 - Degree in Biology

- Students must have acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.
- 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 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.
- Design and conduct experiments by using scientific techniques and instruments appropriately and complying with laboratory safety regulations.
- 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.
- Use ICTs, apps and other computer tools to manage and disseminate information in both educational and professional environments.
- Develop the skills needed to carry out a professional activity with a proactive attitude towards the world of work and with an innovative and entrepreneurial spirit. Be able to apply sustainability criteria and to work within the framework of professional ethics.

- Understand the diversity of living organisms and the various classification systems to interpret the historical nature of the evolutionary process and apply methods for reconstructing the evolutionary process so as to place major evolutionary events on the geological time scale.
- Understand the phylogenetic and geographical relationships of living organisms, as well as their taxonomy and systematics. Apply current scientific techniques to identify organisms and discern their phylogenetic relationships.
- Assimilate the process of constructing scientific knowledge: experimentation in the laboratory and field studies, gathering, handling and analysis of data and preparation of scientific documents. Use of information and communication technology (ICT) in biology.

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

- Preparing practice reports.
- Carrying out work on the use of computer resources.
- Follow safety and hygiene rules in the laboratory.
- Obtain scientific information and have criteria to assess its validity.
- Identify the evolutionary relationships between the main groups of organisms.
- Place organisms on the tree of life.
- Construct and interpret phylogenetic trees.

Recognize taxonomic categories and use the rules of biological nomenclature.

DESCRIPTION OF CONTENTS

1. THE DISCOVERY AND THE CONCEPT OF EVOLUTION

What do we mean by evolution? Evolutionary theories before Darwin. The theory of evolution by natural selection: Darwin and Wallace. The evolutionary hypothesis: questions and answers. Common origin and descent with modification. The new synthesis. The current evolutionary theory.

2. NATURAL SELECTION: ADAPTATION AND DIVERSIFICATION

Natural selection in action. The postulates of Darwin. Natural selection as explanations to evolution and adaptation. The nature of natural selection. Types of selection.

3. EVIDENCE OF EVOLUTION

Geological evidence: the fossil record. Biogeographic evidence. The concept of homology in biology. Homologies as evidence for evolution. Structural evidence and vestigial organs. Biochemical and genetic evidence. Ontogeny. Homoplasy, convergent evolution. Direct observations of evolution.

4. THE ORIGIN OF SPECIES

Species concepts. Isolation mechanisms. Modes of speciation. Geographical classification.

5. PHYLOGENETIC RECONSTRUCTION

The phylogenetic perspective of biology. What is a phylogenetic tree? Inference and interpretation of phylogenetic trees. Basic methods of phylogenetic reconstruction. Molecular phylogenies.

6. CLASSIFICATION IN BIOLOGY

Requirement, logics and objectives. Related concepts: classification, systematics and taxonomy. Hierarchy in biological classification. Taxonomic categories: their use and application. The species as a basic unit. The use of intermediate categories. Artificial and natural classifications. Phenetic, cladistic and evolutionary systematic schools: their principles and methodologies.

7. BIOLOGICAL NOMENCLATURE

Nomenclature codes. Purpose and principles of nomenclature. Forming scientific names. Names of hybrids. Operating principles of nomenclature: Priority, Synonymy, Homonymy, The types in Systematic Biology. Particularities of specific groups. The case of domestic animals and cultivated plants.

8. THE TREE OF LIFE: MAJOR GROUPS

Life domains: Archaea, Bacteria and Eukaryotes. The last universal common ancestor of all cellular organisms. An overview of the major kingdoms and phyla.

9. LIFE HISTORY

Timeline of life on earth, the geological scale. Reconstructing and dating of the tree of life: molecules and fossils. Origin and phylogenetic relationships among major groups of organisms. Key events in the history of life. Major historical changes in diversity: evolutionary explosions, mass extinctions and adaptive radiations.

10. PRACTICAL SESSIONS (I)

PRACTICAL SESSION 1 Evolution and diversity: the problem of biological classification. The use of simple characters: Constructing binary matrices. 2 hours (lab).
PRACTICAL SESSION 2 The use of complex characters. Extraction of complex traits useful for classification. Development of characters x individual matrices. 2 hours (lab).
PRACTICAL SESSION 3 Phenetic methods I. Algorithms for measuring similarities and distances among individuals. Quantitative data processing. Clustering algorithms. Construction of dendrograms of taxonomic hierarchy. Delimitation of groups. 3 hours (classroom).
PRACTICAL SESSION 4 Phenetic methods II. Software application to real data matrices of different

groups of organisms. Consensus trees and evaluation of results. 3 hours (computer room).
PRACTICAL SESSION 5 Cladistic methods I. Application of parsimony in phylogenetic hypothesis testing. Selection and polarization of characters. The use of fossil organisms in the cladistic analysis and phylogenetic reconstruction. 3 hours (classroom).
PRACTICAL SESSION 6 Cladistic methods II. Application of software for phylogenetic reconstruction by parsimony. 3 hours (computer room).

11. PRACTICAL SESSIONS (II)

PRACTICAL SESSION 7 Molecular phylogenetics I. Molecular markers and their treatment as characters. Transformation of molecular characters into distances. 3 hours. Excersices.
PRACTICAL SESSION 8 Molecular phylogenetics II. Phylogenetic reconstruction from molecular data. Use of software for phylogenetic analysis of sequences. Simple methods of contrasting phylogenetic reconstructions. 3 hours. Informatics.
PRACTICAL SESSION 9 Comparison of phylogenetic reconstructions. Comparison of methods. Congruence between data types. 2 hours. Exercices.
PRACTICAL SESSION 10 Biological nomenclature. A series of exercises to apply the principles of biological nomenclature. 2hours. Exercices.
PRACTICAL SESSION 11 The tree of life: evolution and biodiversity. Guided tour through the history of life using this scientific and educational resources of the Museum of Natural Sciences in Valencia. 3 hours. External activity.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	29,00	100
Classroom practices	12,00	100
Computer classroom practice	10,00	100
Laboratory practices	6,00	100
Tutorials	3,00	100
Development of individual work	30,00	0
Study and independent work	60,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

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

The course is based on the use of different learning methods including:

• **Lectures**. The teacher will present the fundamental concepts of each topic, using appropriate

audiovisual resources, that will be accessible to students through the platform to support the teaching of the university (virtual classroom). During these sessions, students will focus on appropriate literature and resources to study and understand the key concepts. These concepts will be reinforced by attending conferences and seminars as part of the course.

• **Practical classes**. Practical sessions of 2/3 hours. The students will follow a guide which must be read before each practice. These practical sessions will be scheduled as lab sessions (2), problem resolution sessions (7) and computer sessions (5). During the practical sessions the professor will introduce the main objective of the practice and the basic methods to solve the proposed exercises. During the rest of the session the students will practice or solve exercises under the supervision of the professor. And at the end, the professor will propose additional exercises to reinforce the basic concepts treated. One of the practical sessions is a external visit to the Museum of Natural Sciences of Valencia, after which students will answer a questionnaire to determine if the student has achieved an adequate understanding of key concepts developed.

• **Scientific communication.** Students will prepare a scientific communication as a poster. This is a

transversal activity for all courses of the 1st year of degree.

• **Small group tutorial sessions**. These tutorials will be used to discuss papers read by students, or

current issues related to the subject, as part of the continuous evaluation of students. Students should prepare and pose questions during the course, which may be answered by other students or the professor it appropriate.

• **Individual tutorials**. These personal interviews will be used to solve specific questions or personal

problems related to the course. E-mail maybe also used for this purpose.

EVALUATION

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An ongoing assessment of the achievements of each student will be performed on the basis of the different activities described in the Methodology section, such as attendance, the completion and submission of all homework and the active participation and the degree of involvement in the learning process. The specific aspects to be evaluated are:

- • **An objective test on the contents of the course**. It consists of an examination of both theoretical and practical issues (problems, laboratory and computer). The score of the theory concepts will represent 40% of the final score and the practical problems, 35%. This exam will focus on the understanding of basic concepts for the development of their knowledge and skills to achieve the main goals of the course. It is mandatory to pass the exam with a minimum score of 5 out of 10 and, in addition, you have to get at least a 4 in each of the parts (theory and practice) in order to obtain an average and thus pass the exam. If the exam is not passed under these conditions, the mark for any of the parts will NOT be saved for the following exams.

- • **Evaluation of the interdisciplinary scientific communication**. The evaluation of this activity will test the ability of the student to obtain scientific information and to provide criteria for assessing its validity, the capacity to disseminate scientific knowledge, the ability for deal with a teamwork and the ability to present their results. This activity will represent a 10% of the final score.
- • **Assessment of participation in classroom activities, group tutorials and other activities**. Among other things, this section will evaluate the ability to ask questions, propose answers and lead the group discussion, as part of the evaluation of the student. The score of this section will contribute to a 15% of the final score.

EVALUATION SYSTEMS	MINIMUM	MAXIMUM	MEAN
Tests consisting of written, oral and/or practical examinations.	60	90	75
Evaluation of seminars, problem sessions and group tutorials: attitude, skills, reports, memoirs and oral communication.	2	15	7
Continuous assessment of each student based on classroom activities, participation and degree of involvement in the teaching-learning process.	-	-	-
Evaluation of the practical sessions in laboratory and field: attitude, execution of activities, skills, laboratory notebook, results obtained, reports, memoirs and oral communication.	2	10	4
Evaluation of the practical sessions in the computer classroom: attitude, skills, reports, memories and oral communication.	2	10	4
Assessment of the skills acquired using the reports of the company and/or university tutors as indicators..	-	-	-
Evaluation of work, memory and/or oral presentation carried out.	5	15	10
Public exposition, defence and debate with a panel of examiners.			
TOTAL	71	140	100

REFERENCES

Basic

- Referencia b1: Barton N.H., Briggs, D.E.G., Eisen, J.A., Goldstein, D. B., y Patel, N.H. 2007. Evolution. CSHL Press.
  Referencia b2: Fontdevila, A., y Moya, A. 2004. Evolución. Editorial Síntesis, Madrid.
  Referencia b3: Freeman, S., y Herron, J.C. 2002. Análisis evolutivo. Prentice Hall, Madrid.
  Referencia b4: Freeman, S., y Herron, J.C. 2007. Evolutionary analysis. 4th edition. Prentice Hall.
  Referencia b5: Futuyma, D.J. 2009. Evolution. 2nd edition. Sinauer.
  Referencia b6: Ridley, M. 2004. Evolution. 3rd edition. Blackwell.
  Referencia b7: Stearns, S.C., y Hoekstra, R.F. 2005. Evolution: An introduction. 2nd edition. Oxford University Press, Oxford.

Additional

- Referencia c1: Avise J.C. 2000 Phylogeny: The history and formation of species. Harvard University Press, Cambridge, Massachusetts.
  Referencia c2: Ayala, F.J. 1999. La teoría de la evolución. De Darwin a los últimos avances de la Genética. Temas de Hoy.
  Referencia c3: Carrión, J.S. 2003. Evolución Vegetal. Diego Marín, Murcia.
  Referencia c5: Cowen, R. 2005. History of Life. 4th Edition. Oxford, Blackwell Publishing.
  Referencia c6: DeSalle, R., Giribet, G. & Wheeler W. 2001. Molecular Systematics and Evolution: Theory and Practice. Birkhauser.
  Referencia c7: DeSalle, R., Giribet, G. & Wheeler W. 2002. Techniques in Molecular Systematics and Evolution. Springer Verlag.
  Referencia c8: Felsenstein J. 2004. Inferring phylogenies. Sinauer Associates, Sunderland, Massachusetts.
  Referencia c9: Hall, B.G. 2000. Phylogenetics Trees Made Easy: A How-To Manual for Molecular Biologists. Sinauer Assoc. Inc.
  Referencia c10: Hillis D.M., Moritz C., and Mable B.K., eds. 1996. Molecular systematics, 2nd ed. Sinauer Associates, Sunderland, Massachusetts.
  Referencia c11: Majerus, M., Amos, W. y Hurst, G. 1996. Evolution. The four billion year war. Longman.
  Referencia c12: Mayr, E. & P. D. Ashlock 1991. Principles of Systematic Zoology. 2nd Edition. McGraw-Hill, Inc., Singapore. 475pp.
  Referencia c13: Nei, M. & S. Kumar. 2000. Molecular Evolution and Phylogenetics. Oxford University Press.
  Referencia c14: Niklas, K.J. 1997. The Evolutionary Biology of Plants. Univ. Chicago Press.
- Referencia c15: Page R.D.M. and Holmes E.C. 1998. Molecular evolution: A phylogenetic approach. Blackwell Science, Oxford.
  Referencia c16: Quicke, D. L. J. 1993. Principles and Techniques of Contemporary Taxonomy. Tertiary Level Biology. Blackie Acad. & Professional, Chapman & Hall,Glosgow. 311 pp.
  Referencia c17: Smith, J.M. 1997. Evolutionary Genetics. 2ª edición. Oxford Univ. Press.

Referencia c18: Stuessy, T. F. 1990. Plant Taxonomy. The Systematic Evaluation of Comparative Data. Columbia University Press, New York. 514 pp.
Referencia c19: Wheeler, Q. & Meier, R. 2000. Species Concepts and Phylogenetic Theory. Columbia University Press.
Referencia c20: Wiens, J.J. 2000. Phylogenic Analysis of Morphological Data. Smithsonian Institution Press.
Referencia c21: Wiley, E.O., Siegel-Causey, D., Brooks, D.R. and Funk, V.A. (1991). The complet cladist. A primer of phylogenetic procedures. The University of Kansas, Museum of Natural History, special publication, Lawrence.