COURSE DATA

DATA SUBJECT

Code: 33056
Name: Main evolutionary transitions
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1100 - Degree in Biology	Facultat de Ciències Biològiques	3	Second quarter
1106 - Degree in Biology	Facultat de Ciències Biològiques	3	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1100 - Degree in Biology	Evolution	COMPULSORY
1106 - Degree in Biology	Evolución	COMPULSORY

COORDINATION

PERETO MAGRANER JULI

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SUMMARY

Major Evolutionary Transitions (PTE) is a subject that forms part of the Evolution module of the Degree in Biology at the University of Valencia and which, in the first semester of the third year, provides students with an overview of evolution through the most important milestones in the origin and increase of biological complexity. The fundamental concept on which this subject is based is that proposed by John Maynard Smith and Eörs Szathmáry for the `major evolutionary transitions¿ in the way biological information is transmitted and managed at different scales of complexity, from molecules to animal societies. Some transitions have been unique (origin of the genetic code, eukaryotic complexity or meiotic sex) and others have occurred more than once and independently (multicellularity, animal societies). But in no way can it be assumed that the unique transitions have been inevitable. Students therefore have to confront fundamental questions such as inevitability in the evolutionary process, historical contingency and the idea of progress.

The main objective of the subject is to familiarise students with the problem of the origin of

biological complexity, within the more general context of evolutionary theory. The course covers the main thresholds of increasing complexity: from the origin of life to the origin of language, passing through milestones such as the origin of the eukaryotic cell, sex and multicellularity. The final part of the course focuses on the particular study of the origin and evolution of the human species. The advanced position of this subject, chronologically speaking, within the subject of Evolution may be the ideal time to also introduce the implications of evolutionary biology, beyond the boundaries of biology itself. The course combines theoretical and practical sessions with tutored discussions and attendance at lectures.

DUE TO THE IMPLEMENTATION OF THE NEW CURRICULUM FOR THE BACHELOR'S DEGREE IN BIOLOGY, THIS SUBJECT IS BEING DISCONTINUED FROM THE OLD CURRICULUM AND IS THEREFORE OFFERED EXCLUSIVELY AS A NON-TEACHING (ND) COURSE IN THAT CURRICULUM. THIS MEANS THAT IT WILL NOT HAVE ANY FACE-TO-FACE TEACHING ACTIVITIES ASSOCIATED WITH IT AND THAT THE SUBJECT WILL BE ASSESSED SOLELY THROUGH A THEORETICAL AND PRACTICAL EXAM.

STUDENTS WHO DO NOT PASS THIS COURSE IN ANY OF THE 2025-26 OR 2026-27 ACADEMIC YEARS WILL BE REQUIRED TO ADAPT TO THE NEW CURRICULUM TO CONTINUE THEIR BACHELOR'S DEGREE 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

It is highly recommended to take this course after successfully passing the other courses of the topic matter Evolution, as well as the ones of a more basic character.

COMPETENCES / LEARNING OUTCOMES

1100 - Degree in Biology

Analizar las diferentes formas de abordar problemas científicos complejos.

Argumentar y razonar en base al conocimiento científico.

Capacidad de análisis, síntesis y razonamiento crítico.

Capacidad de aprendizaje autónomo.

Capacidad de comunicación oral y escrita.

Capacidad de manejar el inglés como vehículo de comunicación científica.

Capacidad de resolución de problemas.

Capacidad de trabajar en equipo y de liderazgo.

Capacidad de utilizar las nuevas tecnologías de información y comunicación.

Comprender el método científico.

Comprender la dimensión temporal del origen y evolución de la vida y sus implicaciones.

Comprender la naturaleza histórica del proceso evolutivo en sus aspectos de irrepetibilidad, contingencia y/o necesidad.

Conocer el papel de la simbiosis en el origen de la complejidad celular.

Conocer el proceso de hominización y los métodos para su estudio.

Conocer la explicación evolutiva de la unidad y diversidad bioquímicas.

Conocer la historia y la cronología de la vida y ubicar los grandes eventos evolutivos en la escala de tiempo geológico.

Conocer las evidencias paleontológicas, morfológicas y genéticas que sustentan las ideas actuales sobre el origen y la historia evolutiva de la especie humana.

Conocer las implicaciones de los cambios genómicos en la evolución.

Conocer la teoría de la evolución, sus postulados y sus ámbitos de aplicación, y su impacto en el desarrollo de la Biología.

Conocer los diversos mecanismos de generación de la diversidad metabólica.

Conocer los fundamentos biológicos de la diversidad, conducta y cultura humanas y apreciar sus implicaciones.

Conocer los fundamentos del estudio de la variabilidad genética de las poblaciones y de su mantenimiento.

Conocer los principales modelos, teorías y evidencias sobre el origen y la evolución temprana de la vida.

Conocer los principales modelos descriptivos del cambio en el tamaño y composición de las poblaciones de organismos actuales y fósiles.

Conocer los principios y métodos para la interpretación del registro fósil y su uso en la datación, la reconstrucción paleoambiental y la inferencia de procesos evolutivos.

Entender los mecanismos de especiación.

Entender los modos de acción, regímenes y limitaciones de la selección natural y sus consecuencias.

Integrar en una teoría común los desarrollos de distintas disciplinas y niveles de estudio de la Biología.

1106 - Degree in Biology

Apply principles of physics, chemistry and geology to the field of biology.

Explain the major events in evolutionary history from the origin of cellular complexity including the role of symbiosis to present-day diversity including that of the human species by applying the main models, theories and experimental observations with palaeontological, morphological, archaeological and genetic data.

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.

Que los estudiantes hayan desarrollado aquellas habilidades de aprendizaje necesarias para emprender estudios posteriores con un alto grado de autonomía

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.

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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.

To explain the major events in evolutionary history from the origin of cellular complexity, including the role of symbiosis, to current diversity including human cultural diversity, applying the main models, theories and experimental observations with paleontological, morphological, archaeological and genetic data

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

1. Origin and early evolution of life

What is life? The problem of defining life. Self-organisation, self-reproduction, autonomy and open evolution. Recursivity. The problem of measuring complexity. Chemical evolution and the origin of life. Formation of the Earth and abiotic chemistry. Contribution of extra-terrestrial materials and endogenous organic synthesis. Simulation experiments in prebiotic chemistry. Emergence of metabolism, cellularity and molecular replicators. Protometabolic networks and energy channelling. Lipid vesicles as protocellular models. Theories of the origin of genetic information and experimental models of RNA evolution.

Origin of translation and of the genetic code. RNA world hypothesis. Precursors and descendants of RNA: origin of proteins and DNA. Origin and evolution of the genetic code.

Origin of prokaryotic life. Chemical and palaeontological evidence of the first life forms. Reconstruction of the universal common ancestor: phylogenetic and genomic methods. The origin of the main cellular domains. Co-evolution of life and the planet: effects of the oxygenation of the atmosphere on metabolic and cellular complexity.

Origin of eukaryotic life. Origin of the endomembrane system. Symbiotic models for the origin of energy organelles. The origin of the cell nucleus. The acquisition of genomes through symbiosis and evolution of complexity.

Origin of sex. Cellular mechanisms of the haploid-diploid cycles. Evolution of meiosis. Intracellular, intergenomic and intragenomic conflicts.

Origin of multicellularity. Temporal organisation of genetic expression: the cell cycle. Aggregation and multicellularity: cellular differentiation and development of spatial patterns.

Origin of animal societies. Evolution of cooperation. Genetic theory of social evolution. Sociogenomics of bees and ants. Division of labour and sociability.

2. From primates to hominids

From primates to hominids: anatomical and functional changes. Classification of living primates. Anthropoid primates: anatomical, ethological and ecological characteristics. Molecular and genetic bases of the transition to hominids. Evolution of social behaviour. Intelligence in primates. Australopithecines and their ancestors: morphology and evolutionary processes.

3. Human evolution

The process of hominization. Chronological and climatic framework. The first Homo. Methods of

analysing the behaviour of the first hominids. Ancient humans: definition and evolution of Homo erectus, H. ergaster and H. heidelbergensis. The Atapuerca data and the origin of Neanderthals. The most recent human species. Comparative anatomy of Neanderthals and anatomically modern humans (AMH). Models of recent human evolution: African migrations. Molecular evidence: ancient DNA and Neanderthal genomics.

Cultural evolution in Neanderthals and anatomically modern humans. Behaviour of ancient and modern humans: technology, economy and habitat of Neanderthals and their contemporaries. Evolution and cultural diversity in hunter-gatherer societies.

The origin and evolution of language. Language as adaptation. Anatomical and genetic bases of language. How and when language evolved. Language and symbolism

4. The extant mankind

Phylogenetic position of humans and phylogeography of uniparental genomes (Y chromosome and mitochondrial genome). Geographical distribution of primates and humans: from sub-Saharan Africa to the Americas and the Pacific. Morphological and genetic diversity of human populations: inter- and intragroup variation. The concept of race. Examples of recent adaptations. Human pigmentation as a paradigm. Sexual dimorphism in the human species and its implications. Comparative primate genomics: what makes us human? Applications of studies of genetic variability in current human populations.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	6,00
Theory	34,00
Laboratory	10,00
Computer classroom practice	10,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	50,00
Preparation of lessons	20,00
Preparation for assessment activities	20,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

The course is based in different learning activities including:

Lectures at the classroom. The teachers will expose the fundamental concepts of each subject, with available audio-visual resources for the students through the Aula Virtual. They will orient the students on the suitable bibliography and the resources to use for the study and understanding of the concepts and will correlate the topics with the seminars. Assistance is not required but is evaluated. However, for the practical sessions, assistance is compulsory.

Scheduled seminars and conferences. There will be seminars and conferences on topics related to the subject that will serve to connect concepts and knowledge or of general type that are programmed in the Faculty. A review of a lecture in the format and length that will be proposed will be required.

Group discussions. These discussions will be used to debate on the scientific reading; to debate on current topics related with the course or for the follow-up and continued evaluation. The students should ask doubts and questions that might be answered by other classmates or the teacher.

Individual tutorial. To resolve specific questions: these may be person-to-person, online or by e-mail.

Remarks on the linguistic uses: Although each group is ascribed to a main language (Spanish or Catalan) some activities organized jointly for all the groups (assistance to conferences and seminars, for example) and occasional activities by teachers not ascribed to the group, can have a different linguistic profile from that of the original group. Therefore, students, independently of their elected profile, have to be prepared to attend some activities in Catalan, Spanish or English.

Use of the virtual classroom (AV). For all the activities we will employ the e-learning platform AulaVirtual of the University of València.

E-mail. AV, from its post module, will allow a fluent communication between students and teachers. Teachers will use this means to inform students on any aspect related with the development of the course. **Important remark**: only messages from the mail system of the University of Valencia (alumni.uv.es) will be accepted. Other mail accounts will be deleted.

News. The news module will be the usual means of information. Students entering the AV immediately see any news related with the course.

Resources. The resources folder will be the location where all the materials of the course, tutorials, scripts of practical, calendars of the course, will be uploaded.

Activities. This module will be used for several tasks. The exchange of materials between teachers and students will be done through this module.

NOT APPLICABLE DUE TO THE IMPLEMENTATION OF THE NEW STUDY PLAN.

EVALUATION

There will be a continuing evaluation of each student, based in the different presential and non-presential activities described in Methodology, valuing attendance to all the presential activities, the realisation and presentation of all the written assays and complementary activities, and the participation and the degree of implication in the education-learning process. The specific aspects to be evaluated will be the following:

Multiple-choice test on the contents of the course. It will consist of an exam with theoretical and practical questions. The mark of this test will represent a 55% of the final grade. In this test, we pay special consideration to the understanding of basic concepts for the development of biological formation and for the achievement of the global goal of the course.

Practical contents. This will be performed through the presentation of a questionnaire about the computer classes. The mark in this item will represent up to a 10% of the final grade.

Evaluation of conference and seminar abstracts. Attendance at the conferences will be compulsory and, therefore, it will not be possible to submit an abstract if you have not attended the conference. At least four conferences must be attended, and all conferences will be given the same evaluation in terms of attendance. It will also be necessary to submit at least one abstract. The evaluation of this activity will allow judging the ability to correlate knowledge of the subject in the context of science in today's world. This section will represent 20% of the final grade.

Participation in on site activities. In this part, the capacity to pose doubts, to propose answers and to lead group discussion will be evaluated. The mark of this part will represent a 15% of the final grade.

Final considerations. To pass the course it is necessary to reach at least 50% of the maximum qualification, having attained a mark equal or higher than 5 on 10 in the written test. Since the number of test questions is proportional to the time spent on each subject, that minimum score will be calculated only if the overall grade of the questions relating to the Thematic Block 1 or the corresponding to Thematic Blocks 2, 3 and 4, is at least 4 out of 10 points. If a student fails and needs to go to the second round, s/he only will have to repeat the written examination. In successive courses, only the qualifications of those activities with at least a 50% of the maximum possible mark will be kept.

NOT APPLICABLE DUE TO THE IMPLEMENTATION OF THE NEW STUDY PLAN.

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Complementary

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