COURSE DATA

Data Subject	
Code	33056
Name	Main evolutionary transitions
Cycle	Grade
ECTS Credits	6.0
Academic year	2018 - 2019

Study (s)

Degree	Center	Acad. year	Period
1100 - Degree in Biology	Faculty of Biological Sciences	3	Second term

Subject-matter

Degree	Subject-matter	Character
1100 - Degree in Biology	20 - Evolution	Obligatory

Coordination

Name	Department
BARRIO ESPARDUCER, ELADIO	194 - Genetics
GARCIA FERRIS, CARLOS	30 - Biochemistry and Molecular Biology
PERETO MAGRANER, JULI	30 - Biochemistry and Molecular Biology

SUMMARY

The Major Transitions in Evolution (PTE) is a subject included in the matter **Evolution** of the Degree in Biology of the University of Valencia and that, taught during the second term of the third year, poses to the students a general panorama of the evolutionary process through the most important milestones during the origin and increase of the biological complexity. The subject is based on the fundamental concept proposed by John Maynard Smith and Eörs Szathmáry for the “major evolutionary transitions” in the way genetic information flows from generation to generation. This question has also been addressed specifically by Christian de Duve. Some transitions have been unique (origin of the genetic code, of eukaryotic complexity or of meiotic sex) and others have occurred more than once independently (multicellularity, animal societies). But by no means it can be supposed that those unique transitions have been unavoidable. Therefore, students have to confront, fundamental questions like the inevitability of the evolutionary process, the historical contingency or the idea of progress.

The main objective is to familiarise students with the problem of the origin of biological complexity, in the more general context of evolutionary theory. The course will develop through the main thresholds of increase of complexity: since the origin of life to the origin of language passing through milestones such as the origins of eukaryotic cell, sex and multicellularity. The final part of the course centres in the particular study of the origin and evolution of the human species. Since this is the last course, chronologically speaking, within the matter **Evolution,** it can be the ideal moment to introduce also the implications of evolutionary biology, beyond the borders Biology. The course combines theoretical and practical sessions with group discussions and conferences.

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.

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.
- 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 la historia y la cronología de la vida y ubicar los grandes eventos evolutivos en la escala de tiempo geológico.
- 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.
- Conocer los fundamentos del estudio de la variabilidad genética de las poblaciones y de su mantenimiento.
- Entender los mecanismos de especiación.
- Conocer las implicaciones de los cambios genómicos en la evolución.
- Conocer los principales modelos, teorías y evidencias sobre el origen y la evolución temprana de la vida.
- Conocer la explicación evolutiva de la unidad y diversidad bioquímicas.
- Conocer los diversos mecanismos de generación de la diversidad metabólica.
- Conocer el papel de la simbiosis en el origen de la complejidad celular.
- 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.
- Conocer las evidencias paleontológicas, morfológicas y genéticas que sustentan las ideas actuales sobre el origen y la historia evolutiva de la especie humana.
- Conocer los fundamentos biológicos de la diversidad, conducta y cultura humanas y apreciar sus implicaciones.
- Conocer el proceso de hominización y los métodos para su estudio.

LEARNING OUTCOMES

SKILLS
To know the theory of the evolution, its postulates and fields of application, and the impact in the development of the Biology.
To understand the time dimension for the origin and evolution of life and their implications.
To understand the historical nature of the evolutionary process and aspects such as uniqueness, contingency and/or necessity.
To know the history and chronology of life and locate the major evolutionary milestones in the scale of geological time.
To analyse the process of evolution at the different levels of biological organisation.
To critically evaluate the definitions of life and the hypotheses on its origin.
To recognise distinct levels of selection and evolutionary hierarchies.
To relate the environmental and organic diversity with the evolutionary process.
To discriminate between scientific and pseudoscientific explanations in evolution.
To interpret the social and cultural influences in the development of the theory of the evolution.
To know the arguments for the common origin of all living beings.

To identify the evolutionary relationships between the main groups of organisms.
To apply evolutionary theory to the knowledge of the human species.
To apply the scientific method, in general, and the comparative method, as a specific one of Biology, for the establishment of theories and the interpretation of data and experimental and observational evidences.

SOCIAL ABILITIES

Capacity of autonomous learning.
Capacity to handle English as a vehicle for scientific communication.
Capacity to use information and communication technologies.
To analyse the different ways to address complex scientific problems.
To integrate in a common theory the developments of different disciplines and levels of study of the Biology.
Capacity to work in team when facing problematic situations.
Capacity of analysis, synthesis and critical reasoning.
Skills to argue on rational criteria, differentiating clearly what is opinionable from what are facts or accepted scientific evidences.
Capacity of interaction with the teacher and the classmates.
Capacity for oral expression in front of a public auditorium by means of brief talks or the intervention in a debate on a subject or controversial question.
Capacity of written communication.
Acquisition of social and professional consciousness on the importance of biodiversity and the environment and its conservation.

DESCRIPTION OF CONTENTS

1. Origin and early evolution of life

What is the life? The problem of the definition of life. Self-organization, autopoiesis, autonomy and open evolution. Recursivity. The problem of measuring complexity.
Chemical evolution and origin of life. Formation of the planet and abiotic chemistry. Contribution of extraterrestrial materials and the endogenous organic syntheses. Simulation experiments in prebiotic chemistry. Emergence of metabolism, cellularity and molecular replicators. Protometabolic networks and canalisation of energy. Lipid vesicles as protocellular models. Theories on the origin of genetic information and experimental models of RNA evolution.
Origin of translation and the genetic code. The 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 paleontological evidences of the first living beings. The reconstruction of the universal common ancestor: phylogenetic and genomic methods. The origin of the main cellular lineages. Coevolution of life and the planet: effects of the oxygenation of the atmosphere on the metabolic and cellular complexity.
Origin of eukaryotic life. Origin of the endomembrane system. Symbiotic models for the origin of the energetic organelles. The origin of the nucleus. The symbiotic acquisition of genomes and evolution of complexity.
Origin of the sex. Cellular mechanisms of the haploid-diploid cycles. Evolution of meiosis. Intracellular,

intergenomics and intragenomics conflicts.
Origin of the multicellularity. Temporal organisation of genetic expression: the cell cycle. Aggregation and multicellularity: cellular differentiation and the development of spatial patterns.
Origin of animal societies. The evolution of cooperation. The 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 changes. Classification of extant primates. Anthropoid primates: anatomical, behavioural and ecological characteristics. Evolution of social behaviour. Intelligence in primates. Australopithecines and their ancestors: morphology and evolutionary processes

3. Human evolution

The hominization process. Chronological and climatic frameworks. The first Homo. Methods of analysis of the behaviour of the first hominids. The ancient human: definition and evolution of Homo erectus, H. ergaster and H. heidelbergensis. The data from Atapuerca and the origin of the Neanderthals.
The more recent human species. Comparative anatomy of Neanderthals and anatomically modern humans (AMH). Models of recent human evolution: the African emigrations. The molecular evidence: ancient DNA and Neanderthal genomics.
Cultural evolution in Neanderthals and anatomically modern humans. Behaviours of the ancients' and the moderns': technology, economy and habitat of Neanderthals and their contemporaries. Evolution and cultural diversity in hunter-gatherer societies.
The origin and evolution of the language. Language as an adaptation. Anatomical and genetic bases of language. How and when language evolved. Language and symbolism.

4. The extant mankind

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

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	34,00	100
Computer classroom practice	10,00	100
Laboratory practices	10,00	100
Tutorials	6,00	100
Study and independent work	30,00	0
Readings supplementary material	20,00	0
Preparation of evaluation activities	20,00	0
Preparing lectures	10,00	0
Preparation of practical classes and problem	10,00	0
TOTAL	**150,00**	

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 subjects related to the course that will serve to connect concepts or will have a general character programmed by the School of Biology. It will be necessary to elaborate an essay on each conference in the indicated format and extension or it will be necessary to answer a questionnaire related with the conference.

Scientific reading. Students must read, at least, one scientific outreach book in the field of Evolution as recommended by the faculty. A session for group discussion with the students having read and worked the same text will be organised, and they will present a written review. Any student may present additional book reviews for evaluation if s/he wishes to do so.

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. "Hotmails" or 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

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 45% 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.
Readings. It will be necessary to present an assay of each reading and to take part in the discussion of a book. Additional book reviews will also be evaluated. The mark of this part will represent a 15% of the final grade. The evaluation of this activity pretends to value the capacity of analysis, of critical reading and of synthesis of scientific texts.

Conferences and seminars. Attendance to the conferences will be compulsory and, therefore, students cannot provide a summary unless they have attended the conference. It will be necessary to attend at least four conferences/seminars. All will be equally valued. The evaluation of this activity will allow judging the capacity of correlation between knowledge on the subject and the scientific context in the current world. This mark will represent a 15% 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.

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