COURSE DATA

DATA SUBJECT

Code: 43250
Name: Evolutionary paleobiology
Cycle: Master's Degree
ECTS Credits: 3
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period

SUBJECT-MATTER

Degree	Subject-matter	Character

COORDINATION

BOTELLA SEVILLA HÉCTOR

SUMMARY

Evolutionary theory and their history. The synthetic theory of evolution. The evolutionary reading of the registry fossil: evolutionary rates and patterns of evolution. Micro and macroevolution. Basic notions of the theory of systems and their application to the theory of evolution. Individuals and selection units in their different levels. Phyletic gradualism and punctuated equilibrium. Decoupling between micro and macroevolution. Stochastic aspects of the evolution contemplated through paleontological data. Mechanisms macroevolutionary. Diversity and disparity: macroevolution and morphological evolution. The consideration of embryonic development (evo-devo). Notions of biomorphodynamics: Morphology as evidence of the evolutionary change; the factors that determine the organic form; approaches to Morphologies evolutionary, theoretical and functional; isometry and allometry. Limitations (constraints) to the morphological evolution. Towards and Extended Theory of Evolution. Extinctions: their role in macroevolution. Types of extinctions: background, mass and episodic. Stochastic aspects of extinctions. The classic causes of mass extinction. Dynamics of biodiversity during the Phanerozoic: evolutionary fauna and flora.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

There are no enrollment restrictions with other subjects of the curriculum. However it is recommended a minimum knowledge of zoology, botany and ecology, as well as general Geology and Paleontology.

COMPETENCES / LEARNING OUTCOMES

2148 -

Be able to access to information tools in other areas of knowledge and use them properly.

Be able to communicate and disseminate scientific ideas.

Favour intellectual curiosity and encourage responsibility for one's own learning.

Stimulate the capacity for critical reasoning and for argumentation based on rational criteria.

Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.

Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.

Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.

Students should demonstrate self-directed learning skills for continued academic growth.

Students should possess and understand foundational knowledge that enables original thinking and research in the field.

To be able to assess the need to complete the scientific, historical, language, informatics, literature, ethics, social and human background in general, attending conferences, courses or doing complementary activities, self-assessing the contribution of these activities towards a comprehensive development.

DESCRIPTION OF CONTENTS

1. NATURE OF THE FOSSIL RECORD

T.1 The nature of the Fossil Record

- Nature and scope of Paleobiology (Inaugural Lecture I)
- Preservation of the fossil record
- Sampling the fossil record
- Completeness of the fossil record
- Rarefaction

T.2 Populations, species and fossil record

- The species in paleontology
- Actualistic aspects: speciation, pre- and postzygotic reproductive isolation, and biogeography
- Determination of species: determination criteria.How species are inferred through the fossil record: their possibility of determination. Species in the fossil and stratigraphic records: spatial and tempo

2. GLOBAL DIVERSIFICATION AND EXTINTION

T.3. Extinction (1). General aspects

- Definition and modalities. Background, mass and episodic extinction
- E. and cyclicity. Geometry of the e. en masse: gradual, staggered and catastrophic
- Stratigraphic limits of the e. mass
- Taphonomy and limits of e. en masse. Lazarus effect (ecological shelters)
- Signor-Lipps effect (poor sampling). Specific crises and threshold crises
- Chance and mass extinction: Galtonian extinction
- Episodic extinction
- Practical cases of extinction analysis

T.4. Extinction (2). Causes
- Background extinction: conditions that lead to a critical population size. Selective vulnerability
- The great crises: environmentalist and internalist explanations. Common Agents of Destruction vs. particular agents of each medium
- The continuous spectrum of extinction magnitude (from background to episodic)
- The responses of the species during the Phanerozoic
- Climate as the major causal factor
- Transgressions, regressions and generalized volcanism, and climate. Climate and cosmic phenomena: meteoritic impacts
- Problematic aspects
- The great Fini-Permian extinction. The great Fini-Cretacic extinction

Biospheric dynamics during the Phaneozoic.

T.5. Exponential diversification model: its limitation

- Density-dependent diversity: logistic growth. Possible explanations. Sepkoski's evolutionary fauna
- The two equilibrium model
- Factor analysis: R mode and Q mode
- Biota as a process of self-organization
- Internalist vision of the great extinctions. Internalist models that reproduce macroevolutionary behaviors

T.6. The picture of evolution: cladogenesis vs. Anagenesis)

- The diagonal model (anagenesis) and the rectangular model (interrupted equilibrium)
- Stanley's evidence in favor of m. rectangular: adaptive radiation, Pontian cockles, living fossils, and generation time
- Origination and extinction.Their rates: R, S, E. Exponential diversification. Estimation of R, S, and E under this regime

3. GLOBAL DIVERSIFICATION AND EXTINTION (2)

Biospheric dynamics during the Phaneozoic.

T.5. Exponential diversification model: its limitation

- Density-dependent diversity: logistic growth. Possible explanations. Sepkoski's evolutionary fauna
- The two equilibrium model
- Factor analysis: R mode and Q mode
- Biota as a process of self-organization
- Internalist vision of the great extinctions. Internalist models that reproduce macroevolutionary behaviors- Selection of species
- Taphonomic considerations when evaluating differential rates of evolution

Rates and evolutionary trends
Macroevolution; Macroevolutionary Mechanisms
Evolutionary interpretation of the fossil record

T.7. Macroevolution: definition

- Ecological time and t. evolutionary (or geological). Micro- and macroevolution
- Evolutionary trends: their possible causes according to the modern synthesis
- Evaluation of evolutionary rates
- Evolution patterns: diversification, disparity, adaptive radiation, convergence and parallelism, and ecological replacement
- The reductionism of the modern synthesis

T.8. Species or lineages

- Morphological stasis: contradiction with traditional schemes
- Morphological stasis and speciation: Interrupted equilibrium
- Explanatory potential: evolutionary trends, Cambrian explosion, etc.
- Interrupted equilibrium and natural selection
- Decoupling between micro- and macroevolution
- Conclusion: the various positions in the face of organic change: directionality vs. its absence, internalism vs. environmentalism and saltationism vs. gradualism

T. 10. Selection at various levels of the hierarchy

- The group: when is group selection possible? Selection at the genome level
- Consequences. Conflicts and synergisms between selection levels
- The interrumpted equilibrium provides the basis for the individuality of the species

T.9. Selection at various levels of the hierarchy

- The group: when is group selection possible? Selection at the genome level
- Consequences. Conflicts and synergisms between selection levels

4. EVOLUTIONARY INTERPRETATION OF THE FOSSIL RECORD (2)

Rates and evolutionary trends
Macroevolution; Macroevolutionary Mechanisms
Evolutionary interpretation of the fossil record

T.7. Macroevolution: definition

- Ecological time and t. evolutionary (or geological). Micro- and macroevolution
- Evolutionary trends: their possible causes according to the modern synthesis
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- Evolution patterns: diversification, disparity, adaptive radiation, convergence and parallelism, and ecological replacement
- The reductionism of the modern synthesis

T.8. Species or lineages

- Morphological stasis: contradiction with traditional schemes
- Morphological stasis and speciation: Interrupted equilibrium
- Explanatory potential: evolutionary trends, Cambrian explosion, etc.
- Interrupted equilibrium and natural selection- The disrupted equilibrium provides the basis for the individuality of the species

T.10. Macroevolutionary mechanisms (1)

- Ideas on macroevolutionary mechanisms
- Triad (sorting) is not synonymous with selection, although it does include it. Effect triad, hitchhiker triad (hick-hicker) and Mustapha Mond triad. Effect triad (functional or adaptive improvement): macroevolutionary examples
- Conflicts between levels in macroevolution: excess specialization

T.11. Macroevolutionary mechanisms (2)

- Selection and adaptation
- Adaptation and exaptation as cases of adaptation in general. Adaptation and exaptation of organisms in populations. Adaptation and exaptation at the species level
- Emergent properties at the species level. Its variability from one species to another as a basis for the selection of species
- Requirements for s. of species
- Species selection and interrupted equilibrium
- Selection of species and evolutionary trends

T.12. Macroevolutionary mechanisms (3)

- Vrba's hypothesis of effect
- Random news at a lower level (genome, organisms) and evolutionary trends
- Amplitude in the use of resources: specialists and generalists, pinhores and euricoros

5. EVOLUTIONARY INTERPRETATION OF THE FOSSIL RECORD (2)

T.10. Macroevolutionary mechanisms (1)

- Ideas on macroevolutionary mechanisms
- Triad (sorting) is not synonymous with selection, although it does include it. Effect triad, hitchhiker triad (hick-hicker) and Mustapha Mond triad. Effect triad (functional or adaptive improvement): macroevolutionary examples
- Conflicts between levels in macroevolution: excess specialization

T.11. Macroevolutionary mechanisms (2)

- Selection and adaptation
- Adaptation and exaptation as cases of adaptation in general. Adaptation and exaptation of organisms in populations. Adaptation and exaptation at the species level
- Emergent properties at the species level. Its variability from one species to another as a basis for the selection of species
- Requirements for s. of species- Contrasting against the selection of species

6. EVOLUTIONARY MORPHOLOGY

T.13. Theoretical Morphology

- Biomorphodynamics: the four factors
- Traditional explanation of the forms
- Plan unit vs. functionality. Forms in modern synthesis
- Variability and its restriction (constraints)
- Evo-devo; The importance of development in evolution. Limitations to natural selection: experiments of artificial selection. Limitations to phenotypic variability: malformations. The epigenetic landscape of Waddington. Channeling and creods. About orthogenesis: the teachings of development
- The evolutionary pathways allowed by development: heterochronies. Development sequences: von Baer vs. Haeckel. Embryonic similarities. Heterochrony: definition and modalities. The human case: neoteny or hypermorphosis? Malformation and heterochrony. The example of the extremities of vertebrates

T. 14. Functional Morphology

- Biomechanics
- Ecomorphology
- Other evidences in Functional Morphology

7. MULTIDISCIPLINARY CASE STUDIES IN PALEOBIOLOGY

T.15. Multidisciplinary study cases in paleobiology

- Paleontology as an integrative science
- Case studies

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Total hours	0,00

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	45,00
Preparation of lessons	0,00
Preparation for assessment activities	0,00
Resolution of case studies	0,00
Total hours	45,00

TEACHING METHODOLOGY

Lectures through computer presentations (30 contact hours):

• Methodology:

- Master classes through computer presentations.

- The appropriate audiovisual resources that will previously be accessible to students through the university's teaching support platform (virtual classroom).

- Exhibition and public defense of group work

- Controls

- Seminaries and exams:

- Attendance at conferences, field work and / or specialized theoretical-practical seminars that complement their training.

- Preparation of various materials and documents in theoretical and practical activities.

- Assessable individualized work:

o Preparation of reports on exposed content.

o Preparation of documents

EVALUATION

A final test, consisting of a **Theoretical exam**.

Memory of the seminar according to models provided to the student.

It will also take into account:

- **Attendance and use of classes**.

- **Practical exercises**.

- **Participation in seminars**.

Weighing:

- Final test: 75%

- Seminar report: 10%

- Practical work and participation: 15%

REFERENCES

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