# Study Plan

**School:** School of Sciences and Technology
**Degree:** Bachelor
**Course:** Biology (cód. 641)

**1st Year - 1st Semester**

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|
| MAT11377L | Mathematics | Mathematics | 6 | Semester | 156 |
| QUI01090L | General Chemistry | Chemistry | 6 | Semester | 156 |
| FIS12340L | Physics | Physics | 6 | Semester | 156 |
| BIO10917L | Cell Biology | Biological Sciences | 6 | Semester | 156 |
| BIO12341L | Biology and Society | Biological Sciences | 3 | Semester | 78 |
| PAO12342L | Basic Ecology | Environment and Ecology Sciences | 3 | Semester | 78 |

**1st Year - 2nd Semester**

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|
| QUI12343L | General Biochemistry | Chemistry | 6 | Semester | 156 |
| BIO00408L | Microbiology | Biological Sciences | 6 | Semester | 156 |
| BIO12345L | Animal Histology and Embryology | Biological Sciences | 3 | Semester | 78 |
| BIO12346L | Anatomy and Plant Histology | Biological Sciences | 3 | Semester | 78 |
| MAT11462L | Statistics | Mathematics | 6 | Semester | 156 |
| GEO12348L | Geology | Geosciences | 6 | Semester | 156 |

**2nd Year - 3rd Semester**

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|
| BIO12349L | Invertebrate Biology | Biological Sciences | 6 | Semester | 156 |
| BIO12350L | Community Biology and Ecosystems | Biological Sciences | 3 | Semester | 78 |
| BIO12408L | Genetics | Biological Sciences | 6 | Semester | 156 |
| BIO12409L | No-Seed Plants Biology | Biological Sciences | 6 | Semester | 156 |
| BIO12410L | Populations Biology | Biological Sciences | 3 | Semester | 78 |
| BIO12411L | Animal Physiology | Biological Sciences | 6 | Semester | 156 |

**2nd Year - 4th Semester**

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|
| BIO12351L | Vertebrates Biology | Biological Sciences | 6 | Semester | 156 |
| BIO12352L | Plant Physiology | Biological Sciences | 6 | Semester | 156 |
| BIO12412L | Molecular Biology | Biological Sciences | 6 | Semester | 156 |
| BIO12413L | Biology of Seed Plants | Biological Sciences | 6 | Semester | 156 |
| BIO12414L | Human Biology | Biological Sciences | 6 | Semester | 156 |

**3rd Year - 5th Semester**

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|
| BIO12353L | Marine Biology | Biological Sciences | 6 | Semester | 156 |
| BIO12354L | Evolutionary Biology | Biological Sciences | 6 | Semester | 156 |
| BIO12355L | Project in Biological Sciences I | Biological Sciences | 3 | Semester | 78 |
| BIO12356L | Biotechnology | Biological Sciences | 6 | Semester | 156 |
| GEO12357L | Paleonthology | Geosciences | 3 | Semester | 78 |
| BIO12415L | Conservation Biology | Biological Sciences | 6 | Semester | 156 |
| BIO12416L | * Project in Biological Sciences II | Biological Sciences | 6 | Semester | 156 |

**3rd Year - 6th Semester**

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|
| **Options** | | | | | |

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|
| BIO12358L | Biological Anthropology | Biological Sciences | 6 | Semester | 156 |
| BIO12359L | Biocomputing | Biological Sciences | 6 | Semester | 156 |
| BIO12360L | Water Biology | Biological Sciences | 6 | Semester | 156 |
| BIO12361L | Soil Biology | Biological Sciences | 6 | Semester | 156 |
| BIO12362L | Applied Botany | Biological Sciences | 6 | Semester | 156 |
| BIO12363L | Entomology | Biological Sciences | 6 | Semester | 156 |
| BIO12364L | Iberian Fauna | Biological Sciences | 6 | Semester | 156 |
| BIO12365L | Mediterranean Flora and Vegetation | Biological Sciences | 6 | Semester | 156 |
| BIO12366L | Environmental Microbiology | Biological Sciences | 6 | Semester | 156 |
| BIO12367L | Ornithology | Biological Sciences | 6 | Semester | 156 |
| BIO12368L | Marine Pollution and Conservation | Biological Sciences | 6 | Semester | 156 |
| BIO12417L | Immunology | Biological Sciences | 6 | Semester | 156 |
| BIO12418L | Virology | Biological Sciences | 6 | Semester | 156 |

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|---|---|---|---|---|---|
| BIO12416L | Project in Biological Sciences II | Biological Sciences | 6 | Semester | 156 |

## Conditions for obtaining the Degree:

*** TRANSLATE ME: Para obtenção do grau de licenciado em Biologia é necessário obter aprovação a 156 ECTS em unidades curriculares obrigatórias e 24 ECTS em unidades curriculares optativas, distribuídas da seguinte forma:

1º Ano

1º Semestre:

6 UC Obrigatórias num total de 30 ECTS

2º Semestre

6 UC Obrigatórias num total de 30 ECTS

2º Ano

3º Semestre

6 UC Obrigatórias num total de 30 ECTS

4º Semestre

5 UC Obrigatórias num total de 30 ECTS

3º Ano

5º Semestre

6 UC Obrigatórias num total de 30 ECTS

6º Semestre

1 UC Obrigatórias num total de 6 ECTS

4 UC Optativas do Quadro nº 5 num total de 24 ECTS ***

## Program Contents

Back

**Mathematics (MAT11377L)**

Linear systems. Eliminations of Gauss. Matrices and vectors. Operations with matrices. Determinants. Inverse matrix. Cramer's Rule.

Functions, Limits, and Continuity. Inverse and composite functions. Limits of numerical successions. Continuous functions and their properties.

Differential Calculus and Applications. Derivatives of composite, implicit, and inverse functions. Logarithmic differentiation. Theorems of Fermat, Rolle, Lagrange and Cauchy. Rule of L'Hôpital. Taylor's formula. Numerical differentiation. Applications of derivatives.

Integral Calculus and Applications. Primitives. Methods of primitivation: by substitution and by parts. Primitives of rational functions. Integral. The fundamental theorem of integral calculus. Numerical integration. Applications of integrals. Improper integrals. Power series.

Ordinary Differential Equations. Euler's method. First order separable and linear differential equations. Applications in the natural sciences.

Back

**General Chemistry (QUI01090L)**

1. Constitution of matter
2. Periodic table
3. Chemical bonding
4. States of aggregation of matter
5. Solutions
6. Chemical thermodynamics
7. Chemical equilibrium
8. Equilibrium in heterogeneous systems
9. Ionic equilibria in homogeneous systems: acid-base
10. Electrochemistry
11. (Optional Chapter)

Chemistry of life
Chemical corrosion
Chemical kinetics

Back

**Physics (FIS12340L)**

1. Mechanics
1.1 Newton's laws of motion. Applications.
1.2. Energy and conservation of energy.
1.3. Linear momentum and collisions.
1.4 Angular momentum.
1.5 Static equilibrium and elasticity.
1.6 Fluid mechanics
2. Oscillations and mechanical waves
2.1 Oscillatory and wave motion.
2.2 Sound waves.
3. Thermodynamics.
3.1 Laws of thermodynamics
3.2 Kinetic theory of gases.
33. Heat transfer
4. Electricity and magnetism
4.1 Electric field. Current and resistance.
4.2 Magnetic field. Electromagnetic waves.
5. Light and optics
5.1 The nature of light and propagation.
5.2 Laws of geometric optics
5.3 Mirrors and lenses
Laboratory:
1 - Measurement and uncertainty, graphical representation
2 – Free fall
3 - The simple gravity pendulum
4 – Verification of Hagen-Poiseuille equation.
5 - Geometric Optics.

Back

**Cell Biology (BIO10917L)**

Back

**Biology and Society (BIO12341L)**

1. History of Biology, main landmarks
2. Theories on the origin and diversity of life
3. Science and Religion
4. Biology of cancer
5. Biology of ageing
6. Stem cells and their potential therapeutic use
7. Tissue engineering
8. Bioethics: cloning
9. Impacts and use of genetically modified organisms
10. Medically assisted reproduction and genetic counselling; ethical implications.

Back

**Basic Ecology (PAO12342L)**

Structure and function of ecosystems: circulation of matter and energy; energy to control entropy.
Biogeochemical cycles: global and local, impacts of human activities.
Environmental factors: Leibig's and Shelford's Laws. Factors of production and decomposition.
Implications: distribution of organisms, success of introductions Production and trophic structure: Energy fluxes between trophic levels and ecological efficiencies. Predominant paths.
Population: characteristics and vital rates. Models of growth. Selection strategies r and K. Predator-prey interactions, population cycles. Competitive interactions, competitive exclusion. Population regulation.
Community: Structure, stability, environmental quality. Resistance and resilience.
Succession: Primary and Secondary. Natural and Cultural. Climax theories.

Back

**General Biochemistry (QUI12343L)**

Introduction to Biochemistry and its correlation with the other sciences. The importance of water and inorganic ions in biosystems. Biological buffer systems. Methods and techniques used in biochemistry.
Nomenclature, structure and properties of biomolecules: carbohydrates, lipids, amino acids, peptides, proteins and nucleic acids. Lipoproteins. Biomembranes. Enzymes and enzyme kinetics. Bioenergetics and bioelectrochemistry. The importance of ATP in metabolism. Anabolism and catabolism. The main metabolic pathways. Introduction to the metabolism of carbohydrate, fat and protein. Integration and metabolic regulation.

Back

**Microbiology (BIO00408L)**

Theoretical:
1. Historical context and Ubiquity
2. Diversity of the Microbial World
3. Microbial Growth and Death
4. Metabolism
5. Basics of Molecular Microbiology: Microbial genetics, Virology, Immunology
6. Microbes and disease; Normal flora, Pathology, infection and disease, Mechanisms of pathogenicity, Principles of epidemiology
7. Food microbiology: Hygiene and concept of indicator. Processing and storage of food. Foodborne diseases
8. Ecology and environmental microbiology: Soil and water, Biogeochemical cycles, Agricultural applications, Wastewater treatment, Biotechnology applications

Lab Practice:
Aseptic practice
Observation of bacteria, fungi and protists.
Demonstration of Ubiquity
Preparation and sterilization of culture media.
Isolation of pure culture.
Colonial and cellular morphology. Staining methods
Microbial counts
Environmental conditions for growth (pH, temp., O2)
Anaerobic Culture
Antibiograms
Microbial spreading simulation
Water and milk analises
Plant symbiosis.

Back

**Animal Histology and Embryology (BIO12345L)**

THEORICAL :

1. Introduction to the study of animal embriology and histology.
2. Morphological features related to the main stages in the embryology of amphibians, fishes, reptiles, birds and mammals.
3. Histology: the five basic tissues (epithelial; connective; muscular; blood and nervous). Histogenesis of the different tissues and functional characteristics. Integration of tissues in the structure of organs.

PRACTICAL :

A-EMBRIOLOGY

1. Embryological and histological methods and techniques.
2. Observation of models and slides representing the main stages of the embryological development (amphibians, birds and mammals).

B-HISTOLOGY

1. Basic histological techniques. Processing of tissue samples.
2. Observation of histological slides to identify the morpho-functional features of the epithelium, connective tissue (dense, loose, reticular, adipose, cartilage, bone and blood), muscular and nervous tissue. Integration of the cellular tissues in several structures and organs.

Back

**Anatomy and Plant Histology (BIO12346L)**

– Concept of development, growth, differentiation, dedifferentiation, specialization, totipotency, polarity and asymmetric division. Embryonic development in Magnoliophyta.
2 - Systems meristematic tissues, dermal, and Vascular Fundamental or Basic. Types of meristems. Fabric Coating: Epidermis and periderm. Fundamental tissues: parenchyma, collenchyma and sclerenchyma. Vascular system: xylem and phloem. Secretory structures.
3 - Radical System: Primary and secondary growth. Formation of lateral roots. Specialized roots.
4 - Origin, Function, Structure and Growth of the Stem. Primary and secondary growth of the stem. Specialized stems.
5 – Origin and leaf development. Morphology and histo-anatomical structure of leaves. Specialized leaves. Leaf abscission.
6 - Origin, Function and development of reproductive organs. Histo-anatomical structure of the flowers (sepals, petals, stamens and gynoecium), fruits and seeds.

Back

**Statistics (MAT11462L)**

1. Descriptive Statistics
2. Basic Probability Notions
3. Conditional Probability and Independence
4. Discrete and Continuous Random Variables
5. The Most Important Families of Discrete and Continuous Probabilities Distributions
6. Point and Interval Estimation
7. Hypothesis testing
8. Analysis of Variance (one-way)
9. Non-parametric Tests
10. Simple Linear Regression

Use of statistical software.

Back

**Geology (GEO12348L)**

Rocks and main mineral constituents.; Soil physical, chemical and biological properties.Magmatism, metamorphism and sedimentogenesis. The lithospheric plates, their boundaries and the asthenosphere. Cycles of formation, fragmentation and dispersal of supercontinents. Current distribution of sedimentary environments and their relation to climate and life forms. The Geological Time: relative dating and isotopic dating (absolute). The principles of stratigraphy and stratigraphic succession. Environments in Archaic, Paleoproterozoic, "Snowball Earth"in the Neoproterozoic and Cambrian Explosion of Life; Extinction and dispersal of organisms, colonization of the continents in Paleozoic: plants and animals;
Mass extinctions in the lower Paleozoic, Paleozoic-Mesozoic transition;
Nuna/Columbia, Gondwana and Pangaea supercontinents;
The Paleogeography of Paleozoic, Mesozoic and Cenozoic.
The significance of the stratigraphy of Portugal: the formation of supercontinents Gondwana and Pangaea.

Back

**Invertebrate Biology (BIO12349L)**

The first six lectures aim to achieve the following objectives:
(1) Set some basic terminology,
(2) introduce some new concepts,
(3) Present some of the subjects to be developed over the course. During these six first classes, the three topics mentioned above, and in which the program is based, are used as a link between phyla as a whole. In other classes, these issues continue to be present, but now in a comparative inter-and intra taxa.
General ecology of several groups of invertebrates will also be addressed, particularly when discussing their Bauplan.
As mentioned above, the practical lessons run for 15 sessions (2 hours each).
The laboratory practical classes and their sequence follow the thematic development of the program of lectures, reinforcing and complementing the learning process on the morphology and functional anatomy of the major invertebrate taxa.

Back

**Community Biology and Ecosystems (BIO12350L)**

Biological communities : general features, definitions and concepts; properties of communities, richness, diversity and evenness; resilience and stability; models of distribution of abundances; key species in communities; temporal patterns at different scales (daily, seasonal, annual, historical and geological); allogenic, autogenic, primary and secondary successions; the climax concept; habitat selection.
Ecosystems: concepts, structure and processes; types of ecosystems and biomes; flows of energy and matter; primary production; species as modifiers of ecosystems.
Structure and functioning of freshwater and brackish ecosystems. Coastal and marine ecosystems. Ocean ecosystems.

**Genetics (BIO12408L)**

Part I. Basic concepts
Chapter 1 Genetical material
Gene, chomosome, mutation
Chapter 2 Meiosis
Mendel's work with pea
Chromosome linkage
Tetrad analysis
Heterosomes
Cytoplasmic inheritance
Chapter 3 Phenotype
Dominance types
Interactions between nonalleles
Maternal effect
Developmental genetics
Chapter 4 Populations
Gene frequencies
Concept of equiibrium
Evolutive forces
Part II. Chromosomes
Chapter 5 Cariotypes
Ploidies
Variations in number
Variations in structure
Infertilities
Chapter 6 Maps
Diploids, haploids, prokaryotes
Genomics
Part III. Genetic analysis
Chapter 7 Mendelian analysis
Study of proportions
Pedigrees
Chi-square test
Chapter 8 Quantitative traits
Polygenes
Components of phenotypic variation
Heritability, artificial selection
QTLs
Part IV: Genetics and Evolution
Chapter 9 Evolution
Polymorphisms
Geographic variation
Speciation
Phylogenies

Back

**No-Seed Plants Biology (BIO12409L)**

1. The evolution in the plant kingdom - Diversity and characteristics morfo-functional of major groups. Life cycles and ecological and economic importance.
2. Monera: Cyanophyta - blue-green algae
3. Protists: Chlorophyta, Euglenophyta, Rhodophyta, Dinophyta, Bacillariophyta, Phaeophyta, Chrysophyta, Xanthopyta, Myxomycota, Acrasiomycota and Oomycota.
4. Fungi: Ascomycota, Basidiomycota, Zygomycota, Deuteromycota and lichenes.
5. Colonization of Earth. Comparison between aquatic and terrestrial enviroments.
6. Antocerophyta, Hepatophyta and Bryophyta; General characteristics. Morpho-anatomical aspects. Diversity and occurrence. Assexual and sexual reproduction. Importance in ecosystems.
7. Evolution of Tracheophyta. Fossil records.
8. Psilotophyta, Lycophyte, Sphenophyta and Pteridophyta: Characterization of the sporophyte and gametophyte. Lifecycle. Filogenetic relationships. Ecology, distribution and economic and ecological importance.

Back

**Populations Biology (BIO12410L)**

1. Population Ecology/Dynamic ecology
1.1. Isolate population Exponential growth model
1.2. Isolate population Logistic growth model
1.3. Fragmentation habitats and Metapopulations
1.4. Population growth models applied to habitat conservation.
1.5. Two populations growth under biotic relation of Competition and Predation (Lotka-Volterra models)

2. Genetic population and Evolution
2.1. Hardy-Weinberg equilibrium model
2.2. Frequency genetic variation models based on evolution forces: Mutation, Migration, Natural selection, Genética drift and Inbreading.

Back

**Animal Physiology (BIO12411L)**

1. Definitions and concepts in animal physiology.
2. Neuron physiology.
3. Information flow between neurons (synapses and neural networks).
4. Sensory physiology.
5. Nervous system.
6. Physiology of muscle contraction.
7. Glands and endocrinology.
8. Circulatory system.
9. Gas exchange and acid-base balance.
10. Ionic and osmotic balances.
11. Feeding, digestion, and energy metabolism.

Simulated virtual experiments on the computer to consolidate knowledge on the following topics: neuron physiology (action potential); synaptic transmission at the neuromuscular junction; regulation of the skeletal muscle contraction; neuroendocrine regulation of the mammalian cardiovascular system.

Back

**Vertebrates Biology (BIO12351L)**

1. General characteristics and classification of the vertebrates
2. Agnatha. Systematics; Biology of hagfish and lampreys.
3. Chondrichthyes: Systematics; Morphology of the Elasmobranchii and of the Holocephali.
4. Osteichthyes: Systematics and diversity; Morphology; Urogenital system and reproduction; Osmotic regulation; Biology of the Coelacanthimorpha and Dipnotetrapodomorpha.
5. Amphibia: Sistematics and phylogeny. Skeleton. Integument. Ear and audition. Respiratory, digestive, circulatory and urogenital systems. Reproduction.
6. Reptilia: Sistematics; Integument; Skeleton; Circulatory and respiratory systems; Sense organs; Urogenital system and reproduction.
7. Aves Systematics; Morphology; Integument; Skeleton; Circulatory, respiratory, digestive and urogenital systems; Reproduction;
8. Mammalia: Sistematics and phylogeny; Dentition; Horns and antlers;. Digestive and nervous systems. Biology of the Monotremata;. Urogenital system and reproduction (Methateria and Eutheria).

Back

**Plant Physiology (BIO12352L)**

WATER RELATIONS: Functions and water movement. Responses to water stress.
TRANSPORT IN PHLOEM: Input and output of metabolites in phloem and transport. Distribution of assimilates.
MINERAL NUTRITION: Essential elements. Criteria of essentiality. Absorption of minerals. Ion movement in roots. Ion transport in membranes.
PHOTOSYNTHESIS: Reactions directly dependent on light. CO2 reduction. Metabolism C3, C4 and CAM. Photorespiration. Abiotic factors that affect photosynthesis.
RESPIRATION: Pentose phosphate pathway. Abiotic factors that affect respiration.
DEVELOPMENT AND PHYTOHORMONES: Growth and differentiation. Auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, salicylic acid and estrigolactonas.
PIGMENTS and Photo-Morphological Characteristics: The pigments of blue light receptors. The family of Phytocrome.
PHOTOMORPHOGENESIS AND FLOWERING

Back

**Molecular Biology (BIO12412L)**

Theoretical

Part I. DNA, GENES and GENOMES.

1. Genes and Chromosomes;
2. DNA replication;
3. Recombination and transposition;
4. Mutation and repair;
5. Transcription;
6. Translation;
7. Regulation of gene expression;

Part II. TECHNIQUES AND APPLICATIONS.

8. Analytical methods, preparations and techniques in molecular biology;
9. Applications in genetic engineering;
10. Advances in Molecular Biology.

Practical and Laboratory.

1. Comparative Genomics;
3. Main methods of DNA extraction;
4. DNA amplification by PCR;
5. Electrophoresis and Hybridization;
6. Purification of PCR products;
7. Restriction enzyme digestion;
8. DNA cloning;
9. DNA sequencing;
10. Gene Deletion: Applications.

Back

**Biology of Seed Plants (BIO12413L)**

LECTURES:

1. The seed plant body – structural and architectural patterns;
2. Adaptations to different environments;
3. Taxonomy and evolution of seed plants;
4. Diversity and evolution of seed plants;
5. Distribution of the seed plants.

LAB:

1. Review of plant morphology; Comparative study of seed plant adaptations;
2. Collecting, pressing, drying and mounting plant specimens.

Back

**Human Biology (BIO12414L)**

Primatology: Man as a primate. Biogeography of primates: comparative anatomy of locomotion and dentition. Social and behavioral structures.
Human Evolution: hominoids, hominids and hominins. The bipedalism. The genus Homo. Our species. Current populations and polymorphisms.
Cellular homeostasis, cell cycle, signaling and cellular interactions, cell adhesion and communication, extracellular matrix; cell death, stress and cellular adaptation; carcinogenesis and cancer.
Stem cells: the concept, embryonic and adult stem cells, stem cell types. Cloning: types of cloning.
Blood: Elements in the mammalian blood.
Pathology and Environment: The evolution of human demography; Environmental exposure; Chemicals in the natural and built environment. Evolution of diseases of environmental etiology.
The policy of the 3Rs and Alternative Models:
1.Humane science and responsible use of animals;2.Principle of the 3Rs;3.Implementation and Regulatory Agencies;4.Alternative species:Zebra fish, water flea.

Back

**Marine Biology (BIO12353L)**

Marine biodiversity: concepts, spatial and temporal patterns; comparison between marine and terrestrial biodiversity.
Spatial and temporal patterns and processes (biological and non-biological) at different scales of distribution and abundance of planctonic, nectonic and benthonic organisms. Structure and functioning of marine systems: estuaries and sandy and rocky shores (intertidal and subtidal).

Back

**Evolutionary Biology (BIO12354L)**

1. Microevolutionary concepts (adaptive evolution; neutral evolution; the genetic impact of selection on populations; the origin and maintenance of genetic variations; the expression of evolution)
2. Design by selection for reproductive success (the evolution of sex; genomic conflict)
3. Principles of macroevolution (speciation; phylogeny and systematic; comparative methods)
4. The history of life
5. Integrating micro and macroevolution (coevolution, human evolution)
6. Nucleotide diversity and phylogenetic analysis of sequences, Neutral theory of molecular variation.
7. Intraspecific analysis with genetic markers.
8. Classification and Phylogeny.

Back

**Project in Biological Sciences I (BIO12355L)**

1 Scientific method and logical design in research in Biology: from observations and problems to interpretation of results.
2 Biological hypotheses: finding them in scientific work and suggestions to biological problems. From biological to statistical hypotheses and why we need statistics.
3 Fundamentals of sampling and experimental design.
4 Solving simple biological questions using statistic tools obtained in Statistics courses.
5 Planning scientific projects in Biology. Communication of scientific results: paper writing, oral and poster presentations (assembling information, presenting results as figures and tables, scientific writing).

Back

**Biotechnology (BIO12356L)**

1 Theoretical programme
a. Introduction
b. Fundaments of Molecular Cloning and DNA analysis
c. Microbial Systems in Genetic Engineering
d. Eukaryotic Systems in Genetic Engineering
e. Applications of Genetic Engineering for the development of new products and services
f. Official Regulation
2. Laboratorial programme
a. Training on pipeting. Solutions and dilutions.
b. Plasmidic DNA extraction (MiniPrep)
c. Restriction digestion of plasmidic DNA
d. Agarose gel electrophoresis
e. Preparation of competent bacteria
f. Transformation of competent bacteria
g. Screening of recombinants
h. Autonomous laboratorial work: Identification of unknown DNA sample

Back

**Paleonthology (GEO12357L)**

History: Definition and applications of paleontology; Fossils (definition and types); Development of paleontological studies and its influence on human thinking; Paleontology in Portugal.
TAPHONOMY: biological and geological factors; Formation and types of sites. Reference to some types of bearing layers celebrated deposits Exceptional sites (lagerstätten).
FOSSILIZATION: main types of fossilization; Ichnology. Techniques used in Paleontology: prospecting, sampling and preparation; Molding and reconstruction; Study of fossils.
PALEONTOLOGICAL taxonomy and Systematics: SYSTEMATICS; Taxonomic hierarchy; Main naming rules.
PALEOBOTANY: plant Fossils; Fragments and or plant organs; Main groups of plants, General characteristics and stratigraphic importance.
PALEOZOOLOGY: Major phyla of invertebrates with palaeontological interest; General characteristics; Systematic study and stratigraphic distribution; Phylogenetic relations scheme; Vertebrates, stratigraphic and evolutionary importance.

Back

**Conservation Biology (BIO12415L)**

1.Introduction to Conservation Biology: Origin and objectives; interdisciplinarity; basic concepts;
2.Biodiversity: what is biodiversity, levels of biodiversity, importance;
3.Ecosystem services and functions. Valuation of ecosystem services;
4.Main threats to biodiversity: habitat degradation, habitat fragmentation, introduction of exotic species, overexploitation, global changes;
5.Genes, species and populations: rare, endemic and isolated populations; inbreeding and bottleneck effect; extinction; metapopulations, minimum viable populations; key-species, flagship-species and umbrella species;
6.Statutes and Strategies for Conservation: IUCN Conservation Criteria and Statutes; European Biodiversity Strategy; Natura 2000 Network;
7.Management and Conservation of Biodiversity: Assessment of priorities and planning in conservation; restoration and rehabilitation of ecosystems; conservation outside protected areas; in situ and ex-situ conservation.

Back

**Project in Biological Sciences II (BIO12416L)**

Each work is individual and unique, and supervised by a doctor (PhD) in Biological Sciences, so the programmatic content is specifically related to the chosen work and model.

Back

**Biological Anthropology (BIO12358L)**

1. Human osteology.
1.1. Bone morphology and identification of anatomical structures of the skeleton.
1.2. Sex diagnosis in adult skeletons.
1.3. Choosing useful parameters to assess age at death estimation. Criteria for age at death estimation in non-adults skeletons. Dental and skeletal indicators in the process of development, growth and maturation.
2. Paleodemography, age and sexual distributions, life expectancy, mortality and birth rates and population size.
3. Growth: endochondral and intramembranous ossifications. Growth disruption.
4. Paleopathology: assessment of health profiles through bone and tooth injuries. Degenerative diseases, traumatic, infectious, oral, metabolic, congenital and neoplastic. Differential diagnosis. Epidemiology.
5. Muscle skeletal markers and reconstitution of physical activity.

Back

**Biocomputing (BIO12359L)**

1. Sequences databases
Editing and depositing sequences
Searching databases
2. Analysis of DNA and RNA sequences
Genetic codes and codon frequency
Identification of ORFs, promoters, terminators
Analysis of secondary structure of RNAs
3. Alignment of sequences
Programs Clustal and BLAST
Identification of functional domains
4. Analysis of genomes
Annotation of sequences
Analysis of Clusters of Orthologous Genes
Identification of genes and operons
Identification of introns and regulatory regions
5. Molecular phylogenetic analysis
Types of phylogenetic trees
Tree-building methods
6. Analysis of transcriptomic data
Analysis of microarrays data
7. Bioinformatics of Proteins
Identification of functional domains
Prediction of secondary structure and cellular localization
8. Introduction to the Linux command line
The operating system, file system and command line interface
Handling and processing text files
Tools for processing Next Generation Sequencing data

Back

**Water Biology (BIO12360L)**

1. The Integration of freshwater ecosystems in the context of the Biosphere
2. Lotic ccosystems
3. lentic ecosystem
4. Primary producers (algae and macrophytes)
5. Consumers (zooplankton and macroinvertebrates)
6. Consumers (ictofauna)
7. Riparian corridors and morphology of inland waters
8. Subterranean aquatic ecosystems
9. Cycles of matter and energy (decomposition of organic matter and trophic structure of macroinvertebrate communities)
10. Drift and colonization as vectors on the formation of aquatic communities (macroinvertebrates)
11. Consequence of natural disturbances and human disturbances on inland waters
12. Water Framework Directive and ecological quality assessment of inland waters
13. Comparison, on a planetary scale, of different types of inland waterss (environmental gradients across a global scale)

Back

**Soil Biology (BIO12361L)**

T0 Soil as a support and environment for biological activities. Diversity of living organisms in soil, adaptations to restrictions impinged by three-dimensional and multi-scale environments (namely available volume, light availability and light quality) and role of biological entities in creation, change and structure of soil.
Theoretical
T1 Introduction to soil science.
T2 Soil biodiversity and major taxonomic groups (e.g., bacteria, fungi, protozoa, arthropod, nematodes and plants).
T3 Relationships among morphology, size, biological activity and soil porosity.
T4 The biological interactions that develop in the soil, with emphasis on the various types of symbiosis that can be established and their effect on plant growth.
T5 Roots and soil seed banks.
T6 The consequences of soil disturbance and conservation strategies.
Experimental
P1 Methods in Soil Science studies.
P2 Planningand execution of experiments supervised by teachers

Back

**Applied Botany (BIO12362L)**

1. Plant interactions with their environment: plant evolution and functional adaptations.
2. Plant-animal interactions: pollination and diaspore dispersal; mechanical and chemical defenses.
3. Economic botany: history and evolution of useful plants; plant resources (eg edible, aromatic, medicinal and ornamental plants, wood, resins and paper products, fiber plants and oils; weeds.
4. Plants and society: allergy plants; drugs; plants and landscape; plants in art and religion; forensic botany.
5. Global environmental problems: plants and pollution (e.g. phytoremediation), carbon sequestration and climate change; invasive plants.

Back

**Entomology (BIO12363L)**

1. Arthropods and insects within bybiodiversity.
Population dynamics and ecological parameters. Methods of observation of insects.
2. Insects manipulation, preservation and preparation for taxonomic purposes.
3. Morphology, anatomy and biology of insects. Behavior and communication.
5 Techniques for creating insects in the laboratory.
6. Pre-social and social insects.
7. Ecology of insects in the trophic web.
8. Applied Entomology: Agricultural.
9. Forest Entomology.
10. Pests in stored food.
11. Aspects of Entomology, Veterinary, Human Medicine, Forensic Medicine.
12. Insects as objects of study in genetics, molecular biology.
13. Entomology and employability. Areas in society in which entomology matters.
Tours
14. Exercising, after an introduction, study skills of subjects taught in the form of review of the subjects taught, and clarification of doubts.

Back

**Iberian Fauna (BIO12364L)**

THEORETICAL
1. Specificity of the Iberian fauna
• Biogeography and determinants of faunal diversity
• Geological History
• Climate and Topography
• Human Presence
• Endemism Iberian
2. Conservation of Iberian Fauna.
• Arguments for the Conservation
• Characteristics and population processes that enhance the rarity and threat
• Red Book of Vertebrates of Portugal and Spain
• The Birds and Habitats Directives
• Hunting and Fishing in inland waters
3. Species of terrestrial vertebrates, including freshwater species occurring in the Iberian Peninsula
• Diagnosis
• Fundamentals of Ecology
• Phenology and Distribution
• Conservation
• Native and introduced species
THEORETICAL-PRACTICAL
4. Methods and techniques for wildlife census
• Direct. Direct observation, trapping, bird banding and electric fishing;
• Indirect. Presence signs, analysis of diet of predators, scent stations; automatic cameras, acoustic detection, molecular analysis;
5. Observation and handling of specimens in the field

Back

**Mediterranean Flora and Vegetation (BIO12365L)**

1. Biophysical Characterization of Portugal
2. Mediterranean Flora
• Taxonomic and ecological characterization of the main genera and families of the Mediterranean Region
• Native, non-native and invasive species
3. Phytosociology
• Notions of Bioclimatology and Biogeography
• Phytosociological methodology
• Biogeographic Classification of Iberian Peninsula
4. Conservation Biology
• Flora assessments - Environmental impact assessment
• Conservation of Habitats and Species of Flora
• Legislation

Back

**Environmental Microbiology (BIO12366L)**

Microbial diversity and physiological diversity. Biogeochemical cycles and anthropogenic action.
The soil as a matrix for microbial growth. The microbial diversity and interactions in the soil.
Water as a growth medium and vehicle for transport and microbial spread. Treatments of drinking water and waste water.
Aerosolization of biological particles and agents and their dispersion. Sampling methods and equipments for the study of microbes in the air. The microbes and organic pollutants and metals: Bioremediation and key factors involved in the efficiency of microbial removal processes of pollutants.
Presentation of case studies.
Practice:
Practical experiments: Effect of herbicides on soil microbial population. Water analyze before and after discharge of waste water treatment plant. The Winogradsky column. Sampling and assessment of indoor environments.
Review the oral presentation of scientific papers in the area of environmental microbiology.

Back

**Ornithology (BIO12367L)**

0. The value of birds.
1. Ancestral forms; the evolution of flight. Flightless forms.
2. Biogeographic issues. Historical and ecological biogeography. Perispecífic systematic (population structure of species); cycles of expansion and shrinkage of glaciers (differentiation, speciation an d extinction); history of avifaunas in the Mediterranean Region. Relations between the Palearctic and Afrotropical avifaunas.
3. Physiology, ecology, behavior and adaptive strategies. Physiological aspects. Space use and intraspecific relationships. Reproductive strategies. Breeding seasons. Clutch size and broods.
4. Migration. Migration and selection. Inducing stimuli. Navigation.
5 Populations, bird communities and conservation. Demography. Patterns of communities. Conservation of endangered species. Bird census methods and monitoring programs.

Back

**Marine Pollution and Conservation (BIO12368L)**

1. Marine pollution: main chemical, organic and biological disturbances (loads, distribution, biological and ecological impact, prevention and control); physical disturbances. Marine pollution in Portugal. Introduction of exotic species in marine environments.
2. Marine conservation: objectives, strategies and threats. Marine protected areas: selection, designation and management. Marine conservation in Portugal. Restoration of marine ecosystems.
3. Human impact assessment in marine environments. Distinction between natural variability and human disturbances. Differences between human impacts in marine and land environments.

Back

**Immunology (BIO12417L)**

1. Theoretical programme
a. Introduction to the immune system. General aspects.
b. Components of the immune system
c. Antigens and antibodies
d. Gene organisation and expression of immunoglobulin's
e. Immune responses
f. Effector mechanisms of the immune response
g. The immune system in the health and disease
h. Monoclonal antibodies
i. Experimental immunology
2. Laboratory programme
a. Introduction. Programming of the course
b. Experimental immunisation
c. Purification of immunoglobulin's
d. Test to the students natural immunity
e. Immunoprecipitation techniques
f. Observation of blood cells
g. ELISA
h. Autonomous laboratory work: goat immunisation and its characterisation

Back

**Virology (BIO12418L)**

Theoretical Programme

1. Introduction and functioning of the course
2. General and Molecular Virology
3. Taxonomy and Sistematics
4. Infection and infectious agents
5. Immunology of viral infections
6. Epidemiology of viral diseases
7. Treatment and prevention of viral diseases
8. Diagnostic of viruses
9. Biotechnological applications of virus

Laboratory Programme

1. Theoretical introduction. Biosafety in the laboratory.
2. Experimental study of virus
3. Plant viral Infection (tobacco)
4. Bacterial growth curve
5. Preparation of an elevated titre virus
6. Dosing of virus – Plaque forming assay
7. Dosing of virus – Limiting dilutions
8. Autonomous laboratory work: isolation and characterisation of an wild bacteriophage.