



## 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
QUI1090L	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
BIO0408L	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	Paleontology	Geosciences	3	Semester	78
BIO12415L	Conservation Biology	Biological Sciences	6	Semester	156



### 3rd Year - 6th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
<b>Options</b>					
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
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

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### **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.



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## General Chemistry (QUI1090L)

Course contents

1. Introduction

1.1 Models of atoms

The principal quantum number

Atomic orbitals

Hydrogen atom

Orbital Energies

Electronic structure of polielectronic atoms

The building-up Principle. The Aufbau rule. Exclusion Principle of Pauli. Hund's rule

1.2 The Periodic Table

Periodic classification of the elements.

Electronic structure and the Periodic Table

Periodic variation in physical properties

Effective nuclear charge

Atomic and ionic Radius

Ionization Energy, Electronegativity and electron Affinity

2. Chemical Bonding

2.1 Lewis structures. Octet Rule.

2.2 Bond types: ionic, covalent and metallic

2.3 The Ionic Bond

Ionic bond formation.

Ions interaction

Lattice energy of ionic compounds

Ionic solids

Polarizability and the ionic character of ionic bonds

2.4 The Covalent Bond

2.4.1 Lewis structure for polyatomic species

The concept of Resonance

Formal charge

Electronegativity and Polar bonds

2.4.2 Covalent bond strength.

The variation of bond strength. Dissociation energy. Bond length.

2.4.3 Exceptions to the Octet Rule: radicals and biradicals; expanded valence shell, incomplete octet

2.4.4 Coordinative covalent bond. Complexes and coordination compounds.

Ligands. Coordination number.

Chelate; bi- and polidentate ligands.

2.4.5 Molecular shape and structure

The VSEPR model

Molecules with lone pairs on the central atom

Valence Bond Theory

Hybridization of orbitals

Hybridization in a more complex molecules

Characteristics of double bonds

Benzene ring and Kekule structures

Polyatomic molecules

Polar molecules

2.5 Metallic bond

Band theory. Conductor and semiconductors.

Metals properties

3. Properties of gases, Liquids and Solids

3.1.1 Properties of gases

Pressure

Boyle's Law. Charles and Gay-Lussac's Law

Avogadro Principle.

3.1.2 The Ideal Gas model. Equation of Ideal Gases.

Gas density

3.1.3 Mixture of gases. Partial Pressure and Dalton's Law

3.1.4 Real Gases. Deviation from linearity.



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### **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.

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### **Cell Biology (BIO10917L)**

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### **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.



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### **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.

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### **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.

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### **Microbiology (BIO0408L)**

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### **Animal Histology and Embryology (BIO12345L)**

THEORICAL :

1. Introduction to the study of animal embryology 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.



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### **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.

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### **Statistics (MAT11462L)**

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### **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.

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### **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.





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### **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.



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## **Genetics (BIO12408L)**

Part I. Basic concepts

Chapter 1 Genetical material

Gene, chromosome, 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 equilibrium

Evolutionary forces

Part II. Chromosomes

Chapter 5 Karyotypes

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



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### **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, Xanthophyta, Myxomycota, Acrasiomycota and Oomycota.
4. Fungi: Ascomycota, Basidiomycota, Zygomycota, Deuteromycota and lichenes.
5. Colonization of Earth. Comparison between aquatic and terrestrial environments.
6. Antoceroophyta, Hepatophyta and Bryophyta; General characteristics. Morpho-anatomical aspects. Diversity and occurrence. Asexual 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.

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### **Populations Biology (BIO12410L)**

1. Population Ecology
  - 1.1. Isolate population Exponential growth model
  - 1.2. Isolate population Logistic growth model
  - 1.3. Allee effects in population growth
  - 1.4. Connectivity and population growth
  - 1.5. Logistic growth applied to fisheries or applied to stock regulation of populations in natural parks
  - 1.6. Two populations growth under biotic relation of Competition and Predation (Lotka-Volterra models)
  - 1.7. Biogeographic islands Model
  - 1.8. Metapopulations
2. Genetic population
  - 2.1. Hardy-Weinberg equilibrium model
  - 2.2. Frequency genetic variation models based on evolution forces: Mutation, Migration, Natural selection, Genética drift and Inbreeding.



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### **Animal Physiology (BIO12411L)**

Syllabus (main topics) of Seminar Lectures

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

Syllabus (main topics) of Tutorial-based Group Work

Experiment simulations using dedicated software simulators as tools for problem-solving based acquisition of knowledge and competences.

1. Electrochemical potential and balance, relative ionic permeability and membrane potential.
2. Action potential and underlying membrane mechanisms.
3. Ionic currents across membrane channels; intracellular recording simulation ("current-clamp" and "voltage clamp") and "patch-clamp".
4. Axon electric-circuit equivalent.
5. Synaptic transmission (chemical synapse).
6. Neuron networks and lateral inhibition in sensory systems.
7. Regulation of striated muscle contraction.
8. Neural and endocrine regulation of the cardiovascular system in a virtual rat.

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### **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: Systematics and phylogeny. Skeleton. Integument. Ear and audition. Respiratory, digestive, circulatory and urogenital systems. Reproduction.
6. Reptilia: Systematics; 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: Systematics and phylogeny; Dentition; Horns and antlers;. Digestive and nervous systems. Biology of the Monotremata;. Urogenital system and reproduction (Methateria and Eutheria).



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### **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. CO<sub>2</sub> reduction. Metabolism C<sub>3</sub>, C<sub>4</sub> 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 Phytochrome.

PHOTOMORPHOGENESIS AND FLOWERING

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### **Molecular Biology (BIO12412L)**

Part I. DNA REPLICATION

1. Genes and chromosomes
2. Replication of DNA
3. Recombination and transposition
4. Mutation and repair mechanisms

Part II. GENE EXPRESSION

5. Transcription
6. Translation
7. Regulation of gene expression

Part III. TECHNIQUES AND APPLICATIONS

8. Analytical and preparative methods in Molecular Biology
9. Techniques in molecular biology. Recombinant DNA techniques. Bioinformatics.
10. Applications in genetic engineering.

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### **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.



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### **Human Biology (BIO12414L)**

Introduction to the Study of Human Biology: Concept, importance and relationship with other disciplines.

Primatology: Man as a primate. Biogeography of primates: comparative anatomy of locomotion and dentition. Social and behavioral structures.

Human Evolution: hominoids, hominids and hominins; characterization and geographic distribution. The bipedalism: ecological framework and anatomy. The genus Homo and the output of Africa. Our species. Current populations and some polymorphisms.

Structure and Function of cell: 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: components (plasma, serum). Elements in the mammalian blood. Hematopoiesis.

Muscle-skeletal apparatus: bones, cartilage, joints, tendons and ligaments, muscles.

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### **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, nektonic and benthonic organisms. Structure and functioning of marine systems: estuaries and sandy and rocky shores (intertidal and subtidal).

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### **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.

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

#### **PART 1**

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).

#### **PART 2**

1 Introduction to Entrepreneurship and Innovation.

2 Innovation dynamics.

3. From Ideas to Business: explaining the process of business creation



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### **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

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### **Paleontology (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.



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### **Conservation Biology (BIO12415L)**

#### **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
4. Methods and techniques for wildlife census
  - Direct. Direct observation, trapping 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

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### **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.





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## **Biocomputing (BIO12359L)**

Introduction. The central paradigm of bioinformatics.

### 1. Sequences Databases

Editing and depositing sequences

Databases (NCBI Database, Ensembl, PDB)

Search databases

### 2. Analysis of DNA and RNA sequences

Analysis of genetic codes; codon frequency .

Identification of ORFs

Identification of promoters, terminators, etc.

Analysis of secondary structure of RNAs

### 3. Alignment of Sequences

Programs BLAST and Clustal

Identification of functional domains

### 4. Analysis of complete genomes

Annotation of sequences. RAST programs, Blast2GO

Analysis of categories of Clusters of Orthologous Genes (COG)

Analysis of interactive genes

### 5. Analysis of prokaryotic Genomes

Identification of genes and operons

### 6. Analysis of eukaryotic Genomes

Identification of introns, regulatory regions

### 7. Molecular phylogenetic analysis

Types of phylogenetic trees

Construction methods of trees (UPGMA, Neighbor-joining, Maximum likelihood, Maximum parsimony)

### 8 Analysis of transcriptomic data

Data Analysis of Microarrays, EST.

### 9. Bioinformatics of Proteins

Identification of functional domains

Prediction of secondary structure and cellular localization



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### **Water Biology (BIO12360L)**

1. The Integration of freshwater ecosystems in the context of the Biosphere
2. Lotic ecosystems
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 waters (environmental gradients across a global scale)

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### **Soil Biology (BIO12361L)**

T Soil as 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 Major taxonomic groups (e.g. microbes, protozoa, nematodes and arthropods), their relationships and roles in symbiosis, parasitism and natural soil tillage.

T3 Roots and soil seed banks.

T4 Relationships among morphology, size, biological activity and soil porosity.

T5 Chemical signalling in biological relationships in soil.

Experimental

P1 Methods in Soil Science studies.

P2 Planning, design and execution of experiments supervised by teachers belonging or not to this curricular unit.

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### **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.



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### **Entomology (BIO12363L)**

1. Arthropods and insects within biodiversity.  
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.

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### **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



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### **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

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### **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.

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### **Ornithology (BIO12367L)**

0. The value of birds.
1. Ancestral forms; the evolution of flight. Flightless forms.
2. Biogeographic issues. Historical and ecological biogeography. Perispecific systematic (population structure of species); cycles of expansion and shrinkage of glaciers (differentiation, speciation and 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.



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### **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.

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### **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



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### **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.

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

According to students choice given the Objectives (6.2.1.4).