BIOLOGY DEGREE SYLLABUS (Yearly updates of all courses at www.biologia.us.es):

The Biology Degree at the University of Sevilla is a 4-year study programme with 240 ECTS* distributed in 186 ECTS of compulsory courses and 54 ECTS of optional courses to be chosen out of 90 ECTS. Practicals are an essential part of our syllabus with a total of 33 ECTS dedicated to compulsory work in the laboratory and another 32 ECTS of laboratory and field work within the optional courses. All courses are taught in Spanish (a minimum language level of B1 is recommended for our Erasmus students).

<table>
<tr><td colspan="10">FIRST YEAR:
60 ECTS of compulsory courses</td></tr>
<tr><td rowspan="2" colspan="3">Applied Statistics for Biologists
Applied Informatics for Biologists
Applied Mathematics for Biologists</td><td rowspan="2">Physical Principles of Biology</td><td rowspan="2">Chemical Principles of Biology</td><td colspan="5">Principles, Implementation and Methodologies in:</td></tr>
<tr><td>Zoology and Animal Physiology</td><td>Cell Biology and Microbiology</td><td>Botany and Plant Physiology</td><td>Ecology and Edaphology</td><td>Genetics and Biochemistry</td></tr>
<tr><td colspan="10">SECOND YEAR:
60 ECTS of compulsory courses</td></tr>
<tr><td colspan="2">Biochemistry I</td><td>Biochemistry II</td><td>Cell Biology and Histology I</td><td>Cell Biology and Histology II</td><td>Botany I</td><td>Botany II</td><td>Zoology I</td><td>Zoology II</td><td>Genetics I</td><td>Genetics II</td></tr>
<tr><td colspan="6">THIRD YEAR:
48 ECTS of compulsory courses</td><td colspan="4">THIRD YEAR:
12 ECTS of optional courses</td></tr>
<tr><td colspan="2" rowspan="2">Animal Physiology I
Animal Physiology II</td><td rowspan="2">Ecology I</td><td rowspan="2">Ecology II</td><td rowspan="2">Microbiology I</td><td rowspan="2">Microbiology II</td><td rowspan="2">Plant Physiology</td><td>Immunology</td><td>Advanced Botany</td><td>Molecular Genetics</td></tr>
<tr><td colspan="3">Applied Microbiology and Biotechnology</td></tr>
<tr><td colspan="3">FOURTH YEAR:
18 ECTS of compulsory courses</td><td colspan="7">FOURTH YEAR:
42 ECTS of optional courses</td></tr>
<tr><td colspan="2" rowspan="4">Project Writing and Implementation</td><td rowspan="4">Final Degree Project</td><td colspan="3">Biodiversity and Animal Species Conservation</td><td>Developmental Cell Biology</td><td>Ecology of the Global Change</td><td>Applied Zoology</td><td>Cell Microbiology</td><td rowspan="2">Ecology and Management of Freshwater systems</td></tr>
<tr><td>Neurophysiology</td><td colspan="3">Structure and Biosynthesis of Macromolecules</td><td>Human Genetics</td><td rowspan="3">Molecular Biology and Plant Biotechnology</td></tr>
<tr><td colspan="2">Environmental Plant Physiology</td><td colspan="2">Mediterranean Flora and Vegetation</td><td>Cell Biology</td><td>Ethology</td></tr>
<tr><td colspan="5">Secondary Metabolism in Plants and Defenses against Pathogens and Herbivores</td></tr>
</table>

*1 ECTS=10 attending hours

43 Research Groups are currently based in the Faculty of Biology and some of them work in partnership with other faculties and prestigious Research Centres located in Sevilla such as CABIMER, IBIS, IBVF. Internships for Erasmus students are common in our Research Groups.
More information at http://biologia.us.es/en/movilidad/pagina/estudiantes/exchange-students/

Module	**Applied Statistics for Biologists**
Certification	Degree in Biology
Code	1530001
Stage	1
Type	Core Module
Duration	Four months (First term)
Total Credits	6
Theory Credits	5.2
Practicals Credits	0.8
Department	DEPARTMENT OF STATISTICS AND OPERATIONS RESEARCH (FACULTY OF MATHEMATICS)

Lecturers

- BARRANCO CHAMORRO, INMACULADA
- CUBILES DE LA VEGA; MARIA DOLORES
- ENGUIX GONZALEZ, ALICIA
- NOGALES GOMEZ, AMAYA
- OSUNA GOMEZ, RAFAELA
- PONCE LOPEZ, DIEGO
- SALAMANCA MIÑO, BEGOÑA

Module program

Specific teaching objectives

- Learn to plan and interpret the results of experimental analyses from the perspective of statistical significance.
- Learn how to use database and software that can be employed in the field of Biosciences.

Specific skills

- Develop knowledge-based critical attitudes.
- Acquire organization, planning and teamwork capabilities.
- Use information sources within the field of Biosciences.
- Learn to plan and interpret the results of experimental analyses from the perspective of statistical significance.
- Learn how to use database and software that can be employed in the field of Biosciences.
- Apply the basic principles of scientific thinking and methodology.
- Know how to obtain information from the observation of living beings, the functional processes they develop and the interactions that are established between them.
- Be able to design experiments, analyze and represent the data with adequate graphs, interpret their results and present them in the format of a scientific paper.
- Know the basic notions of probability and some classical models of distribution.

Contents of the module

- Descriptive analysis of a data set.

- Notions of probability. Population theoretical models.
- Introduction to statistical inference.

Learning activities

THEORY LECTURES, PRACTICALS, TUTOR SESSIONS AND EVALUATIONS

Total attending hours: 60

Non-attending hours: 90

Evaluation systems and criteria

Traditional Evaluation

A written theory-practical test will be performed in each one of the official examination sessions of the subject. In this test, the student must answer questions related to the subject matter taught in the theory lectures and solve problems similar to those performed in the lectures.

Alternative Evaluation

A non-compulsory theory-practical test will be performed in the last week of the term which will be similar in structure and content to the one performed in the traditional evaluation system. Passing this test will allow the student to pass the subject without the need for taking any further test. If the test is not passed, the student will have to use the traditional system in order to pass the subject. Regardless of the evaluation type by which the student is assessed, carrying out diverse practical tests will be proposed to the students throughout the course. The correct completion of these will improve the marks of those students who pass the subject in any of the first two examination sessions.

Module	**Applied Informatics for Biologists**
Certification	Degree in Biology
Code	1530002
Stage	1
Type	Core module
Duration	Four months (First term)
Total Credits	6
Theory Credits	6
Practicals Credits	0
Department	DIFFERENTIAL EQUATIONS AND NUMERICAL ANALYSIS (FACULTY OF MATHEMATICS)

Lecturers

- CLIMENT EZQUERRA, MARIA BLANCA
- FRANCO CORONIL, DANIEL
- GARRIDO ATIENZA, MARIA JOSE
- LUNA LAYNEZ, MANUEL
- MAESTRE CABALLERO, FAUSTINO
- RODRIGUEZ BELLIDO, MARIA ANGELES
- SUAREZ GRAU, FRANCISCO JAVIER

Module program

Specific teaching objectives

Basic knowledge and techniques in informatics with the aim of solving problem using a computer and be able to organize and manipulate data bases. Basic use of EXCEL spreadsheet (or similar) and MATLAB software package (or similar).

Generic transversal skills

- Organization and planning ability (Intense training)
- Basic general knowledge (Moderate training)
- Elemental skills in informatics (Intense training)
- Problem solving (Intense training)
- Decision making (Intense training)
- Teamwork (Moderate training)
- Skills to work in an interdisciplinary team (Moderate training)
- Ability to work autonomously (Intense training)
- Ability to apply theory to practice (Intense training)
- Teamwork skills (Moderate training)
- Analysis and synthesis ability (Intense training)
- Ability to gather and analyze information from different sources (Moderate training)

Specific skills
- Basic knowledge and techniques in informatics.
- Practical skills for operating useful software in the field of science.
- Problem solving ability using a computer.
- Ability to organize and manipulate data bases.
- Ability to interpret results obtained by computer.
- Skills to present information and results in an ordered manner.
- Self-learning ability.
- Teamwork ability.
- Ability to model and simulate experimental problems.

Contents of the module

- 1. Basic management of a spreadsheet (EXCEL or similar).
- 2. - Introduction to data bases.
- 3. - Introduction to some informatic tools for mathematical calculation and simulation, useful in Biology (MATLAB or similar).
- 4. - Informatic tools for Elemental Numerical Calculus.
- 5. - Solve differential equations using a computer.
- 6. - Introduction to symbolic computation.

Learning activities

THEORY LECTURES
Attending hours: 26
Non-attending hours: 40
Teaching-learning methodology:
The subject will be focused on the use of a computer. The student will work through the theoretical contents in the computer of the classroom.
Students will be provided with master classes, extended explanations, problem solving, questions, tutoring sessions, seminars and discussion of teamwork conclusions.
Students will perform the search, consultation and processing of information, team works development, experimentation and observation.
Skills developed:
Be able to operate computers to solve problems and simulate biological systems expressed in mathematical terms, as well as to interpret the results.
Learn to operate data bases and software that may be employed within the field of Biosciences.
INFORMATIC PRACTICALS
Attending hours: 30
Non-attending hours: 40
Teaching-learning methodology:
The student will work in the computer through the theoretical and practical contents taught throughout the course.
Extended explanations, problem solving, questions, tutoring sessions, seminars and discussion of teamwork conclusions will be provided.
Students will perform the search, consultation and processing of information, team works development, experimentation and observation.
Skills developed:
Be able to operate computers to solve problems and simulate biological systems expressed in mathematical terms, as well as to interpret the results.
Learn to operate data bases and software that may be employed within the field of Biosciences.

ACADEMIC ACTIVITIES PERFORMED IN THE PRESENCE OF THE LECTURER
Attending hours: 4
Non-attending hours: 0
Teaching-learning methodology:
It will be possible to propose detailed questions related to the subject matter to be developed by the students individually or as a team.
Skills developed:
The students´ ability to question, search for and synthesize information.
The ability to didacticly present their work and research.
ACADEMIC ACTIVITIES PERFORMED IN THE ABSENCE OF THE LECTURER
Attending hours: 0
Non-attending hours: 11
Teaching-learning methodology:
Research, compilation and concretion of information from the bibliographic sources available.
Skills developed:
The students' ability to search and synthesize information and to present their work and research in a didactic manner.

Evaluation systems and criteria

- Intermediate exams
- Assessment of the skills and knowledge acquired
- Exercise performance
- Proposals for both attending sessions and individual work
- Final exam of the whole program
- Final exam of the whole module program for those students who did not pass the course and for resit students
- Attendance will be valued.

Module	**Applied Mathematics for Biologists**
Certification	Degree in Biology
Code	1530003
Stage	1
Type	Core module
Duration	Four months (First term)
Total Credits	6
Theory Credits	6
Practicals Credits	0
Department	DIFFERENTIAL EQUATIONS AND NUMERICAL ANALYSIS (FACULTY OF MATHEMATICS)

Lecturers

- ECHEVARRIA LIBANO, ROSA
- GARCIA LUENGO, JULIA Mª
- GAYTE DELGADO, MARIA INMACULADA
- GONZALEZ BURGOS, MAUEL
- GUILLEN GONZALEZ, FRANCISCO MANUEL
- MAESTRE CABALLERO, FAUSTINO
- MARIN RUBIO, PEDRO
- SUAREZ FERNANDEZ, ANTONIO

Module program

Specific teaching objectives

- Provide the students with the mathematical tools they will need throughout their professional career.
- Accustom the students to the modeling and mathematical study of nature´s phenomena (especially in Biology).

Generic transversal skills

- Analysis and synthesis ability (Intense training)
- Organization and planning ability (Moderate training)
- Basic general knowledge (Intense training)
- Oral communication in the native language (Moderate training)
- Written communication in the native language (Moderate training)
- Elemental skills in informatics (Smooth training)
- Skills for gathering and analyzing information from different sources (Moderate training)
- Problem solving (Intense training)
- Decision making (Moderate training)
- Judgment and self-judgment abilities (Moderate training)
- Teamwork (Intense training)

- Abilities in interpersonal relationships (Moderate training)
- Teamwork abilities (Intense training)
- Ability to communicate with experts of other fields (Intense training)
- Ability to work in an international context (Moderate training)
- Ability to apply theory to practice (Intense training)
- Commitment with environmental quality (Smooth training)
- Research skills (Intense training)
- Learning skills (Intense training)
- Ability to adapt to new situations (Moderate training)
- Ability to come up with new ideas (Moderate training)
- Ability to work autonomously (Intense training)
- Plan and manage (Moderate training)
- Initiative and enterprising spirit (Moderate training)
- Concern about quality (Moderate training)
- Concern about success (Moderate training)

Specific skills

- Operate elemental mathematical formulas and solve problems through their correct mathematical formulation.
- Analyze and represent data with adequate graphs, interpret results and present them as a scientific paper.
- Apply the basic principles of scientific thinking and methodology.
- Operate some elemental models of Biomathematics.

Contents of the module

- 1. Elemental mathematical tools.
- 2. Solving systems of linear equations.
- 3. Limits, Continuity and Differentiability of functions. Representing functions.
- 4. Integral Calculus. Applications.
- 5. Introduction to Differential Equations. Application to the modeling of some problems in Biology.
- 6. Basic Methods of Numerical Calculus: solving non-linear equations, polynomial interpolation, and approximate integration.

Learning activities

THEORY LECTURES

Attending hours: 36

Non-attending hours: 36

Learning-teaching methodology:

Attendance will be voluntary. The lectures will be carried out mostly with a blackboard or projector. The theoretical concepts and results of the subject will be given throughout these lectures, showing their application using examples. In these lectures, the students will be able to ask questions. Likewise, the lecturer will encourage the students to participate.

Skills developed

Problem solving through adequate mathematical formulation.

Evolutionary mechanisms and models.

Population structure and dynamics.
Operating mathematical models of Natural Sciences.
Ability to model experimental problems.
Critical analysis of the results obtained.
Operating mathematical formulas.
Quantification and numerical calculation of results.
Graph interpretation.
Operating abstract concepts.

PROBLEM SOLVING IN PRACTICAL SESSIONS

Attending hours: 24
Non-attending hours: 60

Teaching-learning methodology:

These practicals will consist of solving problems related to the contents of the subject. Usually, they will be carried out in small groups and will be supervised by the lecturer.

Skills developed

Problem solving through adequate mathematical formulation.
Evolutionary mechanisms and models.
Population structure and dynamics.
Operating mathematical models of Natural Sciences.
Ability to model experimental problems.
Critical analysis of the results obtained.
Operating mathematical formulas.
Quantification and numerical calculation of results.
Graph interpretation.
Operating abstract concepts.

Evaluation systems and criteria

Continuous assessment of student´s participation.
Evaluation of the student´s attendance, active participation and interest on the different learning activities.
Exercises and assignments proposed.
Evaluation of the completion of exercises and/or assignments proposed, as well as of the accomplishment of their deadlines. Exams by topic blocks.
Exams of one or several blocks, thematic, possibly preliminary, to be performed within the official subject schedule.
Global exams of official examination sessions.
Exams corresponding to the examination sessions officially considered by the University, to be performed on the dates approved every year by the centre.

Module	**Physical Principles of Biology**
Certification	Degree in Biology
Code	1530004
Stage	1
Type	Core module
Duration	Four months (First term)
Total Credits	6
Theory Credits	5
Practicals Credits	1
Department	CONDENSED MATTER PHYSICS (FACULTY OF PHYSICS)

Lecturers

- BORREGO MORO, JOSEFA MARIA
- CONDE AMIANO, CLARA FRANCISCA
- CORDOBA ZURITA, ANTONIO
- FRANCO GARCIA, VICTORINO
- GALLARDO CRUZ, MARIA DEL CARMEN
- GUTIERREZ PARDO, ANTONIO ANSELMO
- HUAMAN MAMANI, FREDY ALBERTO
- IPUS BADOS, JOHN JAIRO
- LEMOS FERNANDEZ, MARIA DEL CARMEN
- VERA GARCIA, M. CARMEN

Module program

Specific teaching objectives

Show the student the contribution of Physics in understanding the biological world.
- Provide physical concepts that allow the later assimilation of more specific concepts.
- Apply theory concepts to practical cases.
- Learn how to use basic measuring tools.
- Initiate the student in adequately collecting data and elaborating the results.
- Use the computer to simulate physical processes explained in the lectures.

Generic transversal skills

- Analysis and synthesis ability (Intense training)
- Organization and planning ability (Intense training)
- Problem solving (Moderate training)
- Judgment and self-judgment abilities (Intense training)
- Teamwork (Moderate training)

- Ability to apply theory to practice (Intense training)
- Learning skills (Intense training)
- Ability to work autonomously (Intense training)
- Concern about quality (Moderate training)

Specific skills

Acquire adequate knowledge on the laws of physics that govern the biological processes.

Contents of the module

Contents to obtain the knowledge on the principles and laws of physics that govern the biological processes:

- Introduction
- Biomechanics
- Fluids
- Thermodynamics
- Electricity
- Magnetism
- Optics
- Radioactivity

Learning activities

THEORY LECTURES

Attending hours: 40

Non-attending hours: 60

Teaching-learning methodology:

This module will include theory lectures and problem solving sessions.

Skills developed:

Solid basic knowledge.

Analysis and synthesis abilities.

Skills for gathering and analyzing information from different sources.

Judgment and self-judgment abilities.

Fostering teamwork.

Ability to apply theory to practice.

Use of fundamental mathematics to show physical phenomena.

Knowledge integration.

Stimulation of new ideas.

Adequate interpretation of data.

LABORATORY PRACTICALS

Attending hours: 10

Non-attending hours: 15

Teaching-learning methodology:

Prepare the laboratory practicals proposed, use basic measurement tools, obtain data and analyze the results.

Use the computer to simulate physical processes explained in the lectures.

Skills developed:

Judgment and self-judgment abilities.
Fostering teamwork.
Ability to apply theory to practice.
Use of fundamental mathematics to show physical phenomena.
Adequate interpretation of data.
Fundamental skills in informatics as a working tool.

GROUP TUTORSHIP SESSIONS OF SCHEDULED CONTENTS

Attending hours: 10
Non-attending hours: 15

Teaching-learning methodology:

Tutorship sessions for clarifications and discussions about questions and problems separated by topic blocks. These will be carried out in small groups in order to go deeper into the contents explained in the theory lectures.

Skills developed:

Solid basic knowledge.
Analysis and synthesis abilities.
Judgment and self-judgment abilities.
Fostering teamwork.
Ability to apply theory to practice.
Use of fundamental mathematics to show physical phenomena.
Knowledge integration.
Stimulation of new ideas.
Adequate interpretation of data.

Evaluation systems and criteria

Students may choose one of the following evaluation ways
First way:
The final mark will be obtained from the score of the final written exam and from the practical assessment.
Second way:
This way will give the student the possibility to pass the module through a continuous evaluation. In order to take this way, the student will be required to attend the group tutorship sessions.
The mark will be obtained from the score achieved in two written tests and in the practicals, and from the attendance to the group tutorship sessions. This second way will be valid only in the first examination session of the course.
The student will also have the possibility to take the final written exam.
In both ways:
The final written exam will include diverse questions about conceptual aspects, specific applications and problems similar to those carried out in the lectures.
In order to pass the module the student will be required to carry out the practicals and hand in the corresponding results.

Module	**Chemical Principles of Biology**
Certification	Degree in Biology
Code	1530010
Stage	1
Type	Core module
Duration	Four months (First term)
Total Credits	6
Theory Credits	6
Practicals Credits	0
Department	PLANT BIOCHEMISTRY AND MOLECULAR BIOLOGY (FACULTY OF BIOLOGY)

Lecturers

- GARCIA HEREDIA, JOSE MANUEL
- DIAZ QUINTANA, ANTONIO JESÚS
- ORTEGA RODRIGUEZ, JOSE MARIA

Module program

Specific teaching objectives

GENERAL OBJECTIVES

- Understand that life may and must be described in chemical terms.
- Understand the current models about atomic structure and the nature of chemical bonds.
- Understand the structure and the chemical and physical properties of the main organic functional groups.
- Understand the mechanism of some of the most important chemical reactions from a biological perspective.
- Know the structure and the chemical-physical properties of organic molecules of biological and environmental interest.
- Know the structure and the chemical-physical properties of carbohydrates, lipids, aminoacids and nucleotides.

METHODOLOGICAL OBJECTIVES

- Introduce students to the methodology of experimental work.
- Improve the skills in the use of traditional information sources (text books, monographs, review articles or even original review works).
- Encourage students in the use of new technologies for accessing scientific information.
- Foster individual and team work.

Generic transversal skills

- Analysis and synthesis ability (Intense training)
- Organization and planning ability (Intense training)
- Basic general knowledge (Intense training)
- Solid basic knowledge of the profession (Moderate training)
- Oral communication in the native language (Moderate training)
- Written communication in the native language (Moderate training)
- Elemental skills in informatics (Moderate training)

- Skills for gathering and analyzing information from different sources (Intense training)
- Problem solving (Intense training)
- Decision making (Moderate training)
- Judgment and self-judgment abilities (Intense training)
- Teamwork (Intense training)
- Abilities in interpersonal relationships (Moderate training)
- Teamwork abilities (Intense training)
- Recognition of diversity and multiculturalism (Smooth training)
- Ethical commitment (Smooth training)
- Ability to apply theory to practice (Moderate training)
- Commitment with environmental quality (Moderate training)
- Research skills (Moderate training)
- Learning skills (Intense training)
- Ability to adapt to new situations (Moderate training)
- Ability to come up with new ideas (Moderate training)
- Leadership (Moderate training)
- Understanding of cultures and customs of other countries (Moderate training)
- Ability to work autonomously (Moderate training)
- Planning and management (Moderate training)
- Initiative and entrepreneurship (Moderate training)
- Concern about quality (Moderate training)
- Concern about success (Moderate training)

Specific skills

Cognitive (know):

Main aspects of chemical terminology
Properties of organic compounds
Nature and behavior of organic functional groups

Procedural/Instrumental (know how to):

Ability to prove knowledge and understanding of concepts and principles of organic chemistry
Skills for searching and selecting information, and preparation of a paper
Skills for operating basic software

Attitudinal:

Judgment and self-judgment abilities
Ability to come up with new ideas
Interpretation of data from experimental observations in terms of their significance and the basis that support them

Contents of the module

- Atomic and molecular structure of matter
- Non-covalent interactions
- Introduction to Organic Chemistry

- Isomerism
- Hydrocarbons: Aliphatic and Aromatic
- UV-Visible spectroscopy
- Hydroxyl group
- Amino group
- Carbonyl group
- Carbohydrates
- Carboxyl group
- Lipids

Learning activities

THEORY LECTURES

Attending hours: 30

Non-attending hours: 60

Teaching-learning methodology:

Each theory lecture will consist of a master lecture in which the contents of the topic will be presented, questions will be proposed for discussion and different learning activities will be proposed. These will last 55 min and will be taught in a lecture theater of the red building of the Biology Faculty, according to the schedule approved by the Board of the Center.

Skills developed:

Main aspects of chemical terminology
Properties of organic compounds
Nature and behavior of organic functional groups
Ability to prove knowledge and understanding of concepts and principles of organic chemistry
Basic general knowledge
Judgment and self-judgment abilities
Learning skills
Ability to come up with new ideas
Ability to work autonomously
Plan and manage
Concern about quality
Concern about success

GROUP TUTORSHIP SESSIONS OF SCHEDULED CONTENTS

Attending hours: 5

Non-attending hours: 0

Teaching-learning methodology:

A first group tutorship session will be held at the beginning of the course to discuss the objectives, methods, evaluation and possibilities of success in the module.
The second group tutorship session, one hour long, will be aimed to explain the standards of how to perform and present the coursework. It will be held at the date and place announced at the beginning of the course by the legally established means.

Skills developed:

Individual tutorship sessions of scheduled contents

Attending hours: 1
Non-attending hours: 0
Teaching-learning methodology:
Since Teamwork will be carried out in groups of several students, there will be a one-hour tutorship session for each group with the aim of monitoring the Teamwork performance. Likewise, the students may ask their questions by attending tutorship sessions or via e-mail through the e-mail addresses shown in the website of the module and/or the Department.
TEAMWORK AND SEMINARS
Attending hours: 5
Non-attending hours: 12
Teaching-learning methodology:
Groups of several students will be formed. Each group will perform and present in the classroom a paper about a topic proposed by the lecturer. The deadline for handing in and the presentation of the paper will be announced at the beginning of the course.
Skills developed:
Abilities to search and select information, and preparation of a paper.
Ability to operate basic software
Ability to obtain and analyze information from different sources
Teamwork skills
Public presentation ability
Analysis and synthesis ability
Organization and planning ability
Teamwork
Judgment and self-judgment abilities
APPLIED THEORY-LECTURES
Attending hours: 15
Non-attending hours: 15
Teaching-learning methodology:
The following activities will be performed:
-Discussion on topics of interest taught in the theory lectures.
-Exercises about formulation and nomenclature of organic compounds.
-Exercises about chemical reactions of organic compounds.
Each lecture will last 55 minutes and will be taught in the same lecture theater as the theory lectures, according to the schedule approved by the Board of the Center.
Skills developed:
Analysis and synthesis ability
Basic general knowledge
Judgment and self-judgment abilities
Ability to apply theory to practice
Learning skills
Ability to work autonomously
Main aspects of chemical terminology
Properties of organic compounds

Nature and behavior of organic functional groups
Ability to prove knowledge and understanding of concepts and principles of organic chemistry

PRACTICALS IN THE LECTURE THEATER

Attending hours: 5
Non-attending hours: 0

Teaching-learning methodology:

Several practical exercises will be carried out to complete the theory education (practicals with molecular models about organic compounds, practicals to assign D/L and R/S nomenclature to a compound, etc.).
These will last 55 minutes and will be taught in the same lecture theater as the theory lectures.

Skills developed:

Analysis and synthesis ability
Ability to apply theory to practice
Learning skills
Ability to adapt to new situations
Ability to come up with new ideas
Ability to work autonomously
Properties of organic compounds
Nature and behavior of organic functional groups
Ability to prove knowledge and understanding of concepts and principles of organic chemistry

Evaluation systems and criteria

Evaluation of the theory lectures

The evaluation of the theory lectures will be carried out through several tests about partial contents of this activity and through a final exam of its complete content. The final exam will take place according to the schedule approved by the Board of the Center.
The mark of the exam will be completed with the mark obtained in the voluntary activities suggested in the theory lectures.

Evaluation of the Applied Theory-Lectures

The evaluation of the theory lectures will be carried out through several tests about partial contents of this activity and through a final exam of its complete content. The final exam will take place according to the schedule approved by the Board of the Center.
The mark of the exam will be completed with the mark obtained in the voluntary activities suggested in the theory lectures.

Teamwork Evaluation

Two aspects of this activity will be valued:
1. The quality of the contents and the editing of the written work.
2. Clarity, concretion and organization of oral presentation.

Module	**Principles, Implementation and Methodologies in Cell Biology and Microbiology**
Certification	Degree in Biology
Code	1530005
Stage	1
Type	Core module
Duration	Four months (Second term)
Total Credits	6
Theory Credits	3
Practicals Credits	3
Departments	CELL BIOLOGY (FACULTY OF BIOLOGY), MICROBIOLOGY (FACULTY OF BIOLOGY).

Lecturers

- ALIAS VILLEGAS, CYNTHIA
- BUENDIA CLAVERIA, ANA MARIA
- CALVO RUIZ, PURIFICACION
- DOMINGUEZ GARCIA, INMACULADA
- HIDALGO JIMENEZ, JOSEFA
- LIMON MORTES, MARIA CRISTINA
- MARTIN RUBIO, MARIA ESTHER
- MUÑIZ GUINEA, MANUEL ANTONIO
- OLLERO MARQUEZ, FRANCISCO JAVIER
- ORTA VAZQUEZ, MANUEL LUIS
- PEREZ LINERO, ANA M.
- RUIZ SAINZ, JOSE ENRIQUE

Module program

Specific teaching objectives

- Acquire, develop and exercise the skills required to work in a laboratory of Cell Biology or Microbiology.
- Know, acquire and develop the main techniques of biological sample preparation.
- Know and acquire the skills to operate an observation instrument.
- Identify and describe different biological preparations.

Specific skills

1. Use of optical microscope.
2. Analysis and diagnosis of images of biological samples obtained with optical and electron microscopes.
3. Assimilation of the resolution levels achieved by different types of microscopes.
4. Production of mammalian cell culture.
5. Extraction of cellular subfractions.

6. Training in the study of prokaryote and eukaryote microorganisms in natural samples.
7. Methods of microorganism cultivation.
8. Problem solving in Microbiology.
9. Use of basic equipment in a Microbiology laboratory.
10. Microscope use and observation.

Contents of the module

THEORY LECTURES PROGRAM

Block 1: Cell Biology

- Topic 1: Origin of life and cell. General organization of eukaryote cells. Cell theory. Concept and targets of Cell Biology. Basic notions of safe laboratory operation. Diversity of experimental techniques used. Experimentation systems in Cell biology.
- Topic 2: Optical microscopy. Fundamentals. Processing biological samples. Methodology variables. Advanced techniques.
- Topic 3: Electron microscopy. Transmission electron microscope: Fundamentals. Processing biological samples. Applications. Scanning electron microscope: Fundamentals. Applications.
- Topic 4: Cell and tissue cultures. Concept. Animal cell cultures: purpose, requirements, primary cultures, cell lines, applications. Plant cell culture.
- Topic 5: Cell subfractioning. Concept. Methods of cell homogenization. Organelle purification. Applications.

Block 2: Microbiology

- Topic 1: The microbial world. The universal phylogenetic tree: Bacteria, Archaea and Eukarya domains. History of Microbiology.
- Topic 2: Structural diversity of microorganisms. Eukaryotic microorganisms. Prokaryotic microorganisms. Viruses.
- Topic 3: Metabolic diversity of microorganisms. Mechanisms of energy production. Nutrition and cultivation of microorganisms.
- Topic 4: Microorganism growth. Factors that affect growth. Microorganism growth control. Sterilization methods.
- Topic 5: Introduction to industrial microbiology. Production of substances of industrial and pharmaceutical interest. Introduction to the biogeochemical cycles. Bioremediation.

PRACTICALS PROGRAM

Block 1: Cell Biology

- Practical 1: Optical microscope: basic notions of use. “Fresh” preparation and observation of animal cells through Optical Microscope.
- Practical 2: Observation of plant cells by Optical Microscopy. Extraction and preparation of plant samples to identify some of their components at a cellular and tissue level. Basic notions of how a paraffin microtome works.
- Practical 3: Processing biological samples for their observation through electron microscope. Observation and analysis of electron micrographs. Comparison of optical and electron microscopy images. Cell homogenization. Differential centrifugation of cell organelles.
- Practical 4: Basic notions of safe cell cultivation. Cultivation of mammalian cell lines: Observation of cell cultures through inverted optical microscope. Subcultures: dilution calculations. Preparation of cells cultured in coverslips for their observation through optical microscope.
- Practical 5: Tests of optical microscope use. Valuation of the practical contents.

Block 2: Microbiology

- Practical 1: Diversity of the microbial world. “In vivo” observation of prokaryote (cyanobacteria) and eukaryote (unicellular algae, protozoa and yeast) microorganisms. Identification of live and dead cells of the yeast Saccharomyces cerevisae.
- Practical 2: Methods of prokaryote cultivation in solid and liquid culture media. Cultivation in tubes and plates. Observation of prokaryote microorganisms: 1) “in vivo” bacterial mobility and 2) simple staining with methylene blue.
- Practical 3: Observation of prokaryotes and eukaryotes. Differential staining. Gram staining for prokaryote observation. Staining of ciliated protozoa nuclei.

- Practical 4: Staining of endospore and cytoplasmic inclusions (poly-β-hydroxybutyrate granules).
- Practical 5: Assessment of the practical contents.

Learning activities

THEORY LECTURES

Attending hours: 30

Non-attending hours: 50

LABORATORY PRACTICALS

Attending hours: 30

Non-attending hours: 40

Teaching-learning methodology:

The laboratory practicals are compulsory for all students and they will be carried out in the laboratories of the Biology Faculty. The practicals will be performed in 12 sessions, in which the students will become familiar with the basic techniques in Cell Biology and Microbiology.

Evaluation systems and criteria

Theory exam

A written exam about the subject matter given will be performed by area. The maximum score for this exam will be 4 points, 2 points per area. In order to pass the module, it will be required to achieve 2 points in total and no less than 1 in each one of the two areas (Cell Biology and Microbiology)

Practicals

Each one of the areas involved will perform an exam about the contents taught, with the possibility of considering, in addition, a practical report and/or attendance.

The practicals will be valued with a total of 6 points, 3 per area. In order to pass the module it will be required to achieve 3 points in this section and no less than 1.5 in each one of the two areas (Cell Biology and Microbiology).

Module	**Principles, Implementation and Methodologies in Botany and Plant Physiology**
Certification	Degree in Biology
Code	1530006
Stage	1
Type	Core Module
Duration	Four months (Second term)
Total Credits	6
Theory Credits	2.5
Practicals Credits	3.5
Department	PLANT BIOLOGY AND ECOLOGY (FACULTY OF BIOLOGY)

Lecturers

- AVILA ROMAN, JAVIER
- CIRES SEGURA, ALFONSO
- ECEHEVARRIA RUIZ DE VARGAS, CRISTINA
- FERIA BOURRELLIER, ANA BELEN
- FERNANDEZ GONZALEZ, INMACULADA
- LUQUE PALOMO, MARIA TERESA
- PASTOR DIAZ, JULIO ENRIQUE
- ROMERO ZARCO, CARLOS MANUEL
- RUBIO CASAL, ALFREDO E.

Module program

Specific teaching objectives

Train the students to acquire basic attitudes and knowledge in the areas of Botany and Plant Physiology.

Specific skills

- Ability to recognize the organization levels of plants.
- Knowledge of the different study levels employed in vascular plants.
- Acquisition of practical skills in the study methodology of Plant Physiology.
- Practical skill in the obtainment and treatment of plant samples, processing and measuring of scientific parameters.
- Knowledge of a Plant Physiology laboratory. Similarities and differences with other Biology laboratories.
- Practical knowledge of the basic bibliographical sources and information formats in Plant Biology.
- Ability to obtain information from the critical observation of plants.
- Implementation of the basic principles of the scientific thinking and methodology to the study of plants.
- Familiarization with the physical environment and the teaching means of the Plant Biology studies in the University of Seville and knowledge of the main operation and safety rules in the Campus and the Biology Faculty.

Contents of the module

- 1st Part. Principles, Implementation and Methodologies in the area of Botany.
- 2nd Part. Principles, Implementation and Methodologies in the area of Plant Physiology.

Learning activities

THEORY LECTURES

Attending hours: 25

Non-attending hours: 38

Teaching-learning methodology:

Explanation about the basic contents of the subject aided by graphic presentations and documents available in the Internet.

Organization and planning of the activities to be carried out by the groups of practicals. Explanation of the rules and organization of the module

Skills developed:

All the specific skills of the module

LABORATORY PRACTICALS

Attending hours: 22

Non-attending hours: 33

Teaching-learning methodology:

Botany Practicals

Plant Physiology Practicals

Skills developed:

Most practical aspects of the specific skills of the module

COMPUTER PRACTICALS

Attending hours: 10

Non-attending hours: 20

Teaching-learning methodology:

Use of Botany-specific documentation.

Use of virtual bibliography of Botany.

Use of Botany databases.

Skills developed:

Practical knowledge of the basic bibliographic sources and information formats in Plant Biology.

FIELD PRACTICALS

Attending hours: 3

Non-attending hours: 5

Teaching-learning methodology:

Observation and study of plants in their environment

Skills developed:

- Ability to recognize the organization levels of plants.
- Practical skill in the obtainment and treatment of plant samples, processing and measuring of scientific parameters.
- Ability to obtain information from the critical observation of plants.
- Familiarization with the physical environment and the teaching means of the Plant Biology studies in the University of Seville and knowledge of the main operation and safety

rules in the Campus and the Biology Faculty

Evaluation systems and criteria

Written final exam

Both cognitive and practical abilities will be evaluated in the final exam.

The final exam will consist of two sections:

1st section: Botany

2nd section: Plant Physiology

Both sections will be required to be passed, independently from one another, in order to pass the module.

Participation in the activities

a) Attendance at practical lectures is compulsory. In each one of the two sections of the module (Botany and Plant Physiology), minimum attendance in order to pass the module will be 75% of the credits taught, with the condition that absences are justified with the corresponding document.

b) The results of the activities, laboratory notebooks, problems proposed and related assignments, both individual and group, will be evaluated in the practical activities.

c) The score for the practicals will be independent for each one of the two sections of the module (Botany and Plant Physiology).

d) The score of the practicals will influence the score of each section of the module according to the ratio of theory and practicals credits taught and to the degree in which the practical contents are involved in the corresponding written exam.

Module	**Principles, Implementatio and Methodologies in Ecology and Edaphology**
Certification	Degree in Biology
Code	1530007
Stage	1
Type	Core module
Duration	Four months (Second term)
Total Credits	6
Theory Credits	3.3
Practicals Credits	2.7
Departments	PLANT BIOLOGY AND ECOLOGY (FACULTY OF BIOLOGY), CRYSTALLOGRAPHY, MINERALOGY AND AGRICULTURAL CHEMISTRY (FACULTY OF CHEMISTRY)

Lecturers

- JAUREGUI ARANA, JUAN
- JORDAN LOPEZ, ANTONIO
- MARTINEZ ZAVALA, LORENA MARIA
- MATEOS NARANJO, ENRIQUE
- REDONDO GOMEZ, SUSANA
- RODRIGUEZ RUIZ, AMADORA
- SERRANO MARTIN, LAURA

Module program

Specific teaching objectives

ECOLOGY BLOCK

Ecology studies numerous processes that require a wide range of instruments and applying multiple methodologies. Teaching a large number of methodologies throughout the course may lead to think that, although this field of science is wide and diverse, it lacks a common ground. The aim of this module is to show the fundamentals that lie behind the main methodologies used in Ecology no matter how different they seem.

From the common principle of all experimental sciences, that is, the scientific method, the purpose of this subject is to explain the particularities applied by science to study ecosystems.

Among these particularities we must highlight the statistical context, since statistics is a specific methodology for the study of complex systems and ecosystems are complex systems. The statistical context must be applied throughout the whole research process, from the observation of reality (through sampling as statistical measurement), hypothesis development (through formulation and modeling) to the contrasting of these (through statistical analysis). Furthermore, error measurement throughout the research process in this context is especially important, since selecting the most adequate methodology depends, mainly, on identifying and balancing such errors.

EDAPHOLOGY BLOCK

Edaphology is a science of synthesis that embraces the study of components of diverse nature and very different processes that occur in soils. Therefore, the study and determination of chemical and physical parameters through field and laboratory methodologies is included in this module.

Furthermore, it includes the use of evaluation models of different aspects like chemical and physical degradation of soils. This way, the student is expected to obtain skills at both determining basic parameters of soil characterization in the laboratory and analyzing and diagnosing practical problems and proposing control or correction actions.

Last, and considering that edaphic parameters are essential for territory evaluation, the study of the basic techniques in soil mapping are included in this module, like photointerpretation, analysis of satellite images or the use of geographic information systems.

Specific skills

- Apply the basic principles of the scientific method in quantification and experimentation.
- Use the basic instruments for measuring ecological and edaphological variables and processes.
- Learn how to plan and interpret the results of experimental analyses from a statistical context.
- Learn how to operate the databases and software employed in the field of Biosciences.
- Apply scientific experimentation protocols and regulations.
- Development, discussion and solution of ecological problems.

Contents of the modules

ECOLOGY BLOCK

- General methods in the study of ecosystems: Complex systems. The statistical context in analysis and quantification. Error quantification. Types of errors.
- Fundamentals of the analysis of biological variables (I): Abundance of organisms and population density, richness of communities. Sampling techniques.
- Fundamentals of the analysis of biological variables (II): Biomass. Direct and indirect quantifications. Production and decomposition. Space-time variability.
- Modeling ecological processes. Correlations, regressions and predictions. Continuous measurements. Long-term studies.

EDAPHOLOGY BLOCK

- Introduction to edaphology. Edaphic parameters. Soil composition.
- Soil texture and structure. Texture determination by tact. Granulometry determination in a laboratory.
- Water potential and content in soil.
- Soil reaction. Potentiometry. - soil pH. Soil acidification.
- Conductometry. - Soil salinity. Soil salinization and sodification.
- Gasometry. Soil carbonates.
- Volumetric methods. Soil nitrogen. N-Kjeldahl determination. Soil organic matter. C/N ratio. Numerical assumptions.
- Methods for evaluating the chemical degradation of soil.
- Physical degradation of soil. General aspects of physical degradation of soil. Soil erosion. Methods for measuring soil erosion and evaluating erosion risk.
- Spatial analysis. Cartography. Photointerpretation. Geo-referenced databases. Geographic information systems.

Learning activities

THEORY LECTURES

Attending hours: 18

Non-attending hours: 32

Teaching-learning methodology

The subject matter is available at WebCT. Each module presents the concepts in diverse interactive ways. Moreover, they include the bibliography, recommended readings and references for the student to expand his/her knowledge (either directing the student to the URL of each book in the FAMA catalogue of the University of Seville or downloading the appropriate files).

Skills developed

- Reasoning: inductive and deductive thinking.
- Synthesis ability.

APPLIED THEORY LECTURES

Attending hours: 15
Non-attending hours: 30

Teaching-learning methodology

Each topic includes an interactive questionnaire presenting the type of questions (with their respective answers) that may be found in the exam. From this individual work, groups will be formed for the development, discussion and solution of problems in practical lectures.

Skills developed

- Problem solving.
- Teamwork ability: communication, discussion and representation of experimental ideas and results.

LABORATORY PRACTICALS

Attending hours: 19
Non-attending hours: 38

Teaching-learning methodology:

Practical lectures will take place in the laboratory, where the basic principles of the scientific method will be applied in the quantification and experimentation of variables and processes. Students will be guided by protocols and questionnaires that will help them learning techniques and fundamentals.

Skills developed:

- Use of the basic instruments in the quantification of ecological and edaphological variables and processes.
- Apply protocols and regulations of the scientific experimentation.

COMPUTER PRACTICALS

Attending hours: 8
Non-attending hours: 16

Teaching-learning methodology:

Lectures in the computer room.

Skills developed:

Learn how to operate databases and software employed within the field of Biosciences.

Evaluation systems and criteria

Continuous assesment:

Continuous evaluation of each topic by questions, problems and reports (each module will have a different score). Final mark: 50% of each module of the subject.

Attending exam:

Attending exam of the subject: combination of test type questions (multiple choice with penalty), problems and/or questions. Each module will have a different score, but the final mark of the attending exam will be 50% of each module of the subject.

Module	**Principles, Implementation and Methodologies in Genetics and Biochemistry**
Certification	Degree in Biology
Code	1530008
Stage	1
Type	Core module
Duration	Four months (Second term)
Total Credits	6
Theory Credits	4.8
Practicals Credits	1.2
Departments	GENETICS (FACULTY OF BIOLOGY), PLANT BIOCHEMISTRY AND MOLECULAR BIOLOGY (FACULTY OF BIOLOGY)

Lecturers

- GARCIA GONZALEZ, MERCEDES
- GARCIA MARTINEZ, JORGE
- GARCIA RONDON, ANA BEATRIZ
- LIMON MIRON, MARIA CARMEN
- MURDOCH, PIEDAD DEL SOCORRO
- RAMOS MORALES, FRANCISCO
- RODRIGUEZ MARTINEZ, HERMINIA
- ROSA ACOSTA, FRANCISCO FERNANDO DE LA

Module program

Specific teaching objectives

- Learn how to operate basic laboratory material, including safety rules.
- Learn the elemental principles about pH-metry, spectrophotometry, chromatography and electrophoresis.
- Learn how to prepare buffers and to obtain absorption spectra.
- Study, at an introductory level, gene nature, expression and regulation.
- Understand the basic principles of Mendelian genetics: the laws of heredity that are the base of genetic counseling.
- Learn how to amplify DNA fragments by Polymerase Chain Reaction (PCR) and separate and visualize them in an electrophoresis gel.

Generic transversal skills

- Analysis and synthesis ability (Intense training)
- Basic general knowledge (Intense training)
- Solid basic knowledge of the profession (Intense training)
- Written communication in the native language (Moderate training)
- Problem solving (Intense training)
- Teamwork skills (Moderate training)
- Ability to apply theory to practice (Moderate training)

- Learning skills (Intense training)
- Oral communication in the native language (Moderate training)

Specific skills

Cognitive (know):

-Basic tools in Biochemistry.
-Basic concepts and procedures of Genetics.
-Ability to analyze, interpret, value, discuss and communicate data from genetic experiments.

Procedural/Instrumental (know how to):

-Development of the ability to apply the scientific method
-Skill for experiment designing
-Practical skills in the methodologies of these disciplines
-Proper use of the regular equipment in a biochemistry and genetics laboratory
-Handling biological material
-Techniques for analyzing and identifying biomolecules
-Genetic analysis techniques (both classical and molecular techniques)

Attitudinal (being/doing):

-Show interest for acquiring new knowledge and learning skill
-Development of critical attitudes based on knowledge
-Ability to obtain and analyze information from different sources

Contents of the module

- 1. Material and safety in a biochemistry laboratory
- 2. Introduction to Biochemistry
- 3. Spectrophotometry
- 4. Chromatrography
- 5. Electrophoresis
- 6. Chemical equilibrium
- 7. Genetic material
- 8. Genetic engineering
- 9. Life cycles
- 10. Heredity and genetic counseling

Learning activities

THEORY LECTURES

Attending hours: 32
Non-attending hours: 54

Teaching-learning methodology:

Master lectures. The lecturer will present the contents using the blackboard and the computer. Students will solve their doubts during the lecture. The lecturer will propose questions and exercises in order to foster the thinking and discussion about the matter taught. Self-evaluation questionnaires will be proposed in some lectures. Students will spend the non-attending hours studying the subject matter using the notes taken in the lectures, the artwork used in the lectures and provided to the students through the

University´s virtual platform, and using the books recommended in the bibliography of the module.

Skills developed:

-Synthesis and analysis skills
-Oral and written communication
-Autonomous learning and critical thinking
-Teamwork and interaction abilities
-Basic tools in Biochemistry
-Basic concepts and procedures of Genetics
-Ability to analyze, interpret, value, discuss and communicate data from genetic experiments
-Development of the ability to apply the scientific method
-Genetic analysis techniques (both classical and molecular techniques)
-Show interest for acquiring new knowledge and learning skill
-Development of critical attitudes based on knowledge
-Ability to obtain and analyze information from different sources

LABORATORY PRACTICALS

Attending hours: 12
Non-attending hours: 6

Teaching-learning methodology:

Three laboratory practicals, two of Biochemistry (practicals 1 and 2) and one of Genetics (practical 3):
-Practical 1. Absorption spectroscopy: One three-hour session. Students are expected to learn how to obtain absorption spectra of a compound and use them to determine the concentration of such compound.
-Practical 2. Protein chromatography and electrophoresis: One three-hour session.
-Practical 3. Polymorphisms of a single nucleotide and ability to detect bitter taste: Two sessions, in consecutive days, of two to three hours in length. The aim of this practical is to apply some of the basic concepts of classical and molecular Genetics seen in the lectures and show some of the techniques in Genetics

Skills developed:

-Synthesis and analysis skills
-Oral and written communication
-Problem solving and ability to apply theory knowledge to practice
-Teamwork and interaction abilities
-Basic tools in Biochemistry
-Basic concepts and procedures of Genetics
-Ability to analyze, interpret, value, discuss and communicate data from genetic experiments
-Development of the ability to apply the scientific method
-Skill for experiment designing
-Practical skills in the methodologies of these disciplines
-Proper use of the regular equipment in a biochemistry and genetics laboratory
-Handling biological material
-Techniques for analyzing and identifying biomolecules
-Genetic analysis techniques (both classical and molecular techniques)
-Show interest for acquiring new knowledge and learning skill

-Development of critical attitudes based on knowledge

APPLIED THEORY LECTURES

Attending hours: 16

Non-attending hours: 30

Teaching-learning methodology:

Numerical calculations and problems.

-Biochemistry: one part of the lecture will be spent on a theory introduction while the other part will be spent on problem solving

-Genetics: there will be lectures of non-assessed problem and lectures of assessed problems. In the lectures of non-assessed problems, the lecturer will explain how to solve some types of problems, indicate guidelines to face new problems and propose exercises to be performed by the students, both during the lectures and at non-attending hours. For the lectures of assessed problems, a set of problems will be assigned in advance to be performed by the students at non-attending hours. The students will have to hand in the assignments completed, before the corresponding lecture, through the website of the module in the virtual platform (or the method established). The student who hands in the solution of a problem will be committed to attend the lecture and to solve the problem at the lecture, if required by the lecturer. The solutions presented will be discussed with the rest of students and the lecturer.

Skills developed

-Oral and written communication

-Problem solving and ability to apply theory knowledge to practice

-Autonomous learning and critical thinking

-Teamwork and interaction abilities

-Basic tools in Biochemistry

-Basic concepts and procedures of Genetics

-Ability to analyze, interpret, value, discuss and communicate data from genetic experiments

-Development of the ability to apply the scientific method

-Genetic analysis techniques (both classical and molecular techniques)

-Show interest for acquiring new knowledge and learning skill

-Development of critical attitudes based on knowledge

Evaluation systems and criteria

Written exam

Written test involving questions that refer to the different activities of the module: theory, problems and laboratory practicals

Activities of theory lectures

Short tests of knowledge may be proposed to be performed during the theory lectures, which could contribute to a part of the final mark

Assessed problems

Problems may be proposed to be performed during attending or non-attending hours, which will be assessed according to the criteria specified in the teaching project

Attendance and questionnaire of laboratory practicals

Laboratory practicals may be evaluated through attendance, performance, results and completion of questionnaires or exams.

Module	**Principles, Implementation and Methodologies in Zoology and Animal Physiology**
Certification	Degree in Biology
Code	1530009
Stage	1
Type	Core module
Duration	Four months (Second term)
Total Credits	6
Theory Credits	2.5
Practicals Credits	3.5
Departments	PHYSIOLOGY, ZOOLOGY (FACULTY OF BIOLOGY)

Lecturers

- ARREBOLA BURGOS, JOSE RAMON
- BALBOTIN ARENAS, JAVIER
- BENITEZ TEMIÑO, BEATRIZ
- CANO SANCHEZ, ESPERANZA
- CERVANTES CARDENAS. LUCIA
- ESCUDERO GONZALEZ, MIGUEL
- GOMEZ TUBIO, ANA MARIA
- LOPEZ GONZALEZ, PABLO JOSE
- LUQUE LAO, M. ANGELES
- MEGINA MARTINEZ, CESAR
- MORCUENDE FERNANDEZ, SARA ROSALIA
- RODRIGUEZ DE LA CRUZ, ROSA MARIA
- RODRIGUEZ MATARREDONA, ESPERANZA
- SANCHEZ MOYANO, JUAN EMILIO

Module program

Specific teaching objectives

ANIMAL PHYSIOLOGY

- Analysis of diverse aspects of the nervous, muscular, respiratory, endocrine and cardiovascular systems from a practical approach.
- Knowledge and training on the techniques used to understand the functioning of the different biological systems.
- Familiarize the student with basic equipment used in animal behavior studies.
- Use of models of simulating the metabolic functioning and energy consumption in humans.
- Introduce the students to the techniques used for the morphological study of the nervous system.

ZOOLOGY

- Initiate the students in the knowledge of the diversity and classification of Metazoans.

- Familiarize the students with the laboratory techniques of specimen sampling.
- Knowledge on some of the software that is most used in zoology studies.
- Understand the relevance of the reproductive strategies in metazoans.
- Knowledge on the trophic strategies present in metazoans.
- Become familiar with the processing of data obtained from different information sources.

Specific skills

Acquire an applied approach of Animal Physiology
Integrated view of the functioning of the different physiological systems
Work with basic research equipment in Animal Physiology
Draw conclusions from own results
Ethical commitment necessary in animal research

Contents of the module

ZOOLOGY BLOCK

- 1.- Classification of metazoans, source of characteristics, taxonomic tendencies, monophyly and metazoan diversification from cladistics
- 2.- Sample preparation techniques and subsequent observation through optical or electron microscopy
- 3.- Image analysis, diversity, community studies, etc.
- 4.- Reproductive strategies (sexual and asexual) in metazoans. Embryology, larval development, parental care.
- 5.- Trophic strategies in metazoans. Structures, diet analysis.

ANIMAL PHYSIOLOGY BLOCK

- 1.- Basic implementation in electrophysiology
- 2.- Introduction to the study of animal behavior, identification of behavioral patterns
- 3.- Obtain vital parameters at rest and after physical activity. Calculation of the breathing and heart rates, temperature, blood pressure
- 4.- Analysis of the metabolic requirement in mammalians
- 5.- Introduction to the morphological techniques to study the nervous system

Learning activities

THEORY LECTURES

Attending hours: 25
Non-attending hours: 37.5

Teaching-learning methodology:

Master lectures

Skills developed:

Acquisition of the theory knowledge needed to perform the practical activities

LABORATORY PRACTICALS

Attending hours: 25
Non-attending hours: 37.5

Teaching-learning methodology:

Evaluation of basic theory contents for the development of the practical lecture
Description of the development of the session

Activities performed by groups
Results discussion and consensus
Students may be required to hand in a final report of the activities
Skills developed:
Analysis and synthesis ability
Organization and planning ability
Basic general knowledge
Problem solving
Decision making
Judgment and self-judgment abilities
Teamwork
Teamwork skills
Ability to apply theory to practice
Research skills
Learning skills
Ability to generate new ideas
COMPUTER PRACTICALS
Attending hours: 10
Non-attending hours: 15
Teaching-learning methodology:
Evaluation of basic theory contents for the development of the practical lecture
Description of the development of the session
Activities performed by groups
Results discussion and consensus
Students may be required to hand in a final report of the activities
Skills developed:
Analysis and synthesis ability
Organization and planning ability
Basic general knowledge
Elemental skills in informatics
Problem solving
Decision making
Judgment and self-judgment abilities
Teamwork
Teamwork skills
Ability to apply theory to practice
Research skills
Learning skills
Ability to generate new ideas

Evaluation systems and criteria

Contents related to Animal Physiology:

50% of the final mark will be assigned to this section.

- At the beginning of each practical session, there will be an evaluation of the theory knowledge needed for these to be carried out. 40% of the mark from the contents related to Animal Physiology will be assigned to this evaluation.
- At the end of the term, there will be a written exam about the global knowledge of the matter taught. 60% of the mark from the contents related to Animal Physiology will be assigned to this evaluation.
- The final mark of the module will be obtained from the sum of the two sections (Animal Physiology and Zoology), as long as both are passed separately.
- If one section (Animal Physiology and Zoology) is passed at the first examination session, its mark will remain until the 3rd examination session (December).

Contents related to Zoology:

50% of the final mark will be assigned to this section.

- During each practical session, a set of activities will be assigned and evaluated by the lecturers. 20% of the mark from the contents related to Zoology will be assigned to this evaluation.
- At the end of the term, there will be a written exam about the global knowledge of the matter taught (from theory and practicals). 80% (40% theory and 40% practicals) of the mark from the contents related to Zoology will be assigned to this evaluation.
- The final mark of the module will be obtained from the sum of the two sections (Animal Physiology and Zoology), as long as both are passed separately.
- If one section (Animal Physiology and Zoology) is passed at the first examination session, its mark will remain until the 3rd examination session (December).

General rules for exams:

- Those students who sit for an exam will be taken into account that they are expending that examination session.
- The students are recommended to be present outside the lecture theater assigned for the examination 5-10 minutes before this starts.
- Once all the students are in their positions and have begun the examination, the doors of the lecture theater will be closed. Once the doors are closed nobody will be allowed in. -
- Those students who arrive late will lose their chance, and will be called for the next examination session of the module (September or December).
- Once the examination has begun, no student will be allowed to leave the lecture theater within the first 15 minutes.
- The students who sit for an examination must be clearly identified, with their national ID or University card.

Module	Biochemistry I
Certification	Degree in Biology
Code	1530012
Stage	2
Type	Compulsory
Duration	Four months (First term)
Total Credits	6
Theory Credits	5.4
Practicals Credits	1.6
Department	PLANT BIOCHEMISTRY AND MOLECULAR BIOLOGY (FACULTY OF BIOLOGY)

Lecturers

- ARMARIO NAJERA, MARIA VICTORIA
- CEJUDO FERNANDEZ, FRANCISCO JAVIER
- HERVAS MORON, MANUEL
- PEREZ RUIZ, JUAN MANUEL
- ROSA ACOSTA, FRANCISCO FERNANDO DE LA
- RUIZ PEREZ, JOSE FRANCISCO

Module program

Specific teaching objectives

The main objective of this module is to provide the students with updated theory-practical knowledge on the part of Biochemistry that comprises structural biology, enzymology and bioenergetics, which are essential for understanding all the biological processes. Therefore, the student will be intended to acquire knowledge, at an adequate level within the context of the module, on:

- Structure of nucleic acids and proteins, as well as structure/function relationships.
- Enzyme function and its regulation.
- Energy transductions within the cell and the mechanisms by which these are produced.
- Structure and function of the biological membrane, including the study of complex transport processes of innumerable substances that occur through it.
- Furthermore, the student will be expected to acquire a quantitative view of Biochemistry.

These specific teaching objectives are complemented with those of the second term module Biochemistry II, which involves the study of metabolism and its regulation, including the metabolism of genetic information.

Specific skills

-Solid basic biochemistry knowledge on biological processes.
-Proper use of the Biochemistry language.
-Know the structure of nucleic acids and proteins, as well as structure/function relationships.
-Enzyme function and its regulation.
-Konw the energy transductions that occur within the cell and the mechanisms by which these are produced.

-Acquire a quantitative view of Biochemistry.
-Ability to prepare, present and defend a paper.
-Become familiar with the general and specific infrastructure of a biochemistry laboratory.
-Learn basic techniques for isolation and characterization of biological macromolecules.
-Learn enzime analysis techniques.
-Use the computer to visualize and analyze the structure of macromolecules.
-Learn to handle the bibliography, both traditionally and through new technologies of access to scientific information.

Contents of the module

The module consists of the following blocks:

- 1) Structure and function of biological macromolecules
- 2) Enzymology
- 3) Bioenergetics
- 4) Biological membranes

Learning activities

THEORY LECTURES

Attending hours: 40
Non-attending hours: 60

Teaching-learning methodology:

These will last one hour and will be lectured three days per week in a lecture theater of the Red Building of the Biology Faculty, according to the schedule approved by the Board of the Center. Students may interrupt the lecturers to ask for clarifications or to solve doubts, and also to request additional information. Likewise, lecturers may require the participation of students in the discussion. In order to help students to follow up the lectures, the contents of these will be available in advance in the virtual platform WebCT of the University. These theory lectures will be evaluated through a written test.

Skills developed:

Solid basic biochemistry knowledge on biological processes.
Proper use of the Biochemistry language.
Know the structure of nucleic acids and proteins, as well as structure/function relationships.
Understand enzyme function and its regulation.
Know the energy transductions that occur within the cell and the mechanisms by which these are produced.
Analysis and synthesis ability.
Skills for gathering and analyzing information from different sources.
Judgment and self-judgment abilities.

PRESENTATIONS AND SEMINARS

Attending hours: 6
Non-attending hours: 10

Teaching-learning methodology:

This is a voluntary activity. Those students interested in carrying out this activity must register before the deadline established at the beginning of the term. It will be performed in groups (of 4 students each), about a topic of choice from a set of topics proposed by the lecturer within the objectives of the module. The assignment will be handed in at the day of the presentation and an abstract of it, including basic bibliography, will be handed in one week in advance in order to make this information available to students. The

presentation will be carried out by one of the members of each group chosen by lot before the presentation. It will be 20 minutes long, at public meeting. The student may use any of the presentation means available; computer presentation tools are recommended. After the presentation, the students and the lecturer may ask questions and express their comments.

Skills developed:

Ability to prepare, present and defend a paper.
Research skills.
Skills for gathering and analyzing information from different sources.
Teamwork skills.
Analysis and synthesis ability.

LABORATORY PRACTICALS

Attending hours: 4
Non-attending hours: 2

Teaching-learning methodology:

This activity will consist of one practical lecture of approximately 4 hours, which will be carried out in the laboratories of the Department of Plant Biochemistry and Molecular Biology, located in the 1st floor of the Green Building of the Biology Faculty. This activity will be evaluated through a written test, which will be performed by the students at the end of the practical lecture.

Skills developed

Become familiar with the general and specific infrastructure of a biochemistry laboratory.
Learn basic techniques for isolation and characterization of biological macromolecules.
Learn enzime analysis techniques.
Analysis and synthesis ability.
Ability to apply theory to practice.
Teamwork skills.

COMPUTER PRACTICALS

Attending hours: 2
Non-attending hours: 1

Teaching-learning methodology:

These will be carried out in the computer rooms of the Faculty in a one-hour session. Students will learn how to use different software, available for free on the internet, for visualizing and analyzing the structure of macromolecules, using different molecules of nucleic acids and proteins as examples. This activity will be evaluated through a written test, which will be performed by the students at the end of the practical lecture.

Skills developed:

Use the computer for visualizing and analyzing the structure of macromolecules.
Analysis and synthesis ability.
Research skills.
Skills for gathering and analyzing information from different sources.
Ability to apply theory to practice.
Elemental skills in informatics as an instrument for analysis and research.
Teamwork skills.

Teaching-learning methodology:

Internet search and use of bibliography.

Voluntary assignments for the students, which they may complete wherever they will, and under the supervision of the lecturer. The readings recommended by the lecturers may be consulted in the Library of the Biology Faculty, and even borrow them according to the rules of the Library.

Skills developed:

Skills for gathering and analyzing information from different sources.
Ability to apply theory to practice.
Learning skills.

APPLIED THEORY LECTURES

Attending hours: 8
Non-attending hours: 14

Teaching-learning methodology:

These will be one-hour long and will be carried out in eight sessions at a lecture theater of the Red Building of the Biology Faculty, according to the schedule approved by the Board of the Center. Active participation will be requested from the students. The main purpose of these practicals is to teach students to apply the concepts taught in the theory lectures into solving specific problems. Sets of exercises with their answers will be available for students in order to help them to become familiar with the quantitative concepts of biochemistry.

The distribution in time of these practicals will be in line with the development of the theory contents. This activity will be evaluated through a written test.

Skills developed:

Acquire a quantitative view of Biochemistry.
Solid basic biochemistry knowledge on biological processes.
Problem solving.
Analysis and synthesis ability.
Skills for gathering and analyzing information from different sources.
Ability to apply theory to practice.
Teamwork skills.

Evaluation systems and criteria

Written exam

The knowledge acquired in the theory and practical lectures will be evaluated through a final written exam that will be performed at the date established in the examination schedule approved by the Board of the Faculty. The score obtained in this exam will represent 75% of the final mark of the module.

For the second and third examination sessions there will be a final exam on the contents of the theory lectures and on the practical lectures at a lecture theater.

Students will be required to obtain a minimum score of 4 over 10 in the exam so that the score obtained in the rest of the activities of the module are considered in the final mark.

A final mark of 5 or above is required in order to pass this module.

The scores obtained in the seminar will remain until the examination session of December 2012 and those obtained in the laboratory and computer practicals will be saved up to two years, that is, until 2013-2014 included.

Seminars

The preparation of the topic chosen, with special attention to the update of the bibliography used, and its presentation and defense, will be valued. 10% of the score obtained in this activity will be included in the final mark.

Laboratory practicals

Participation and good use by the student and valuation of a written assignment.
10% of the score obtained in this activity will be included in the final mark.

Computer practicals

Participation and good use by the student and valuation of a written assignment. 5% of the score obtained in this activity will be included in the final mark.

Module	Biochemistry II
Certification	Degree in Biology
Code	1530013
Stage	2
Type	Compulsory
Duration	Four months (Second term)
Total Credits	6
Theory Credits	5.4
Practicals Credits	1.6
Department	PLANT BIOCHEMISTRY AND MOLECULAR BIOLOGY (FACULTY OF BIOLOGY)

Lecturers

- GARCIA HEREDIA, JOSE MANUEL
- LARA CORONADO, CATALINA
- MURDOCH, PIEDAD DEL SOCORRO
- RONCEL GIL, MERCEDES
- VARGAS MUÑOZ, MARIA DE LOS ANGELES

Module Program

Specific teaching objectives

The main purpose of this module is to provide students with basic knowledge on cellular metabolism and expression of genetic information. From this main target, we can determine a set of specific teaching objectives in the program of the module:

- Understand the dynamics of cellular metabolism and grasp the convergent designs of the degradative pathways and the divergent designs of the biosynthetic pathways
- Know the main degradative and biosynthetic pathways of carbohydrates, lipids, nitrogen compounds and nucleotides, and their regulation
- Learn how to analyze biosynthetic and degradative pathways that share common reactions and enzymes, and understand the mechanisms of concerted and mutual regulation
- Understand oxidative phosphorylation as the final step of respiratory metabolism and phosphorylation as the initial step of photosynthetic metabolism
- Understand the photosynthetic fixation of inorganic carbon and nitrogen as the fundamental initial pathways of the biosynthesis of carbohydrates, lipids and amino acids in photosynthetic organisms and in the biosphere
- Visualize congenital anomalies in enzymes of metabolic pathways and their physiological and pathological consequences
- Understand the metabolic specialization of different organs and tissues in mammals and the integration and regulation of metabolism within the organism
- Know the main processes of genetic information expression and its regulation

Generic transversal skills

-Elemental skills in informatics (Moderate training)
-Analysis and synthesis ability (Intense training)
-Organization and planning ability (Intense training)
-Solid basic knowledge of the profession (Intense training)
-Skills for gathering and analyzing information from different sources (Intense training)

-Problem solving (Intense training)
-Teamwork (Intense training)
-Ability to apply theory to practice (Intense training)
-Research skills (Moderate training)
-Learning skills (Intense training)
-Decision making (Moderate training)

Specific skills

Acquire the basic biochemistry knowledge on metabolism, its regulation and expression of genetic information
Ability to select information and to prepare, present and defend a paper in public
Become familiar with the general and specific infrastructure of a biochemistry laboratory
Interpretation of experimental data
Learn basic methods for the determination of cellular components
Learn methods for the determination of enzyme activities and their regulation *in vivo*
Manage databases for the analysis of sequences of genes and proteins

Contents of the module

The list of topics may be arranged in 8 blocks:

- Introduction to metabolism
- Metabolism of carbohydrates
- Respiration and photosynthesis
- Metabolism of lipids
- Metabolism of nitrogen compounds
- Metabolism of nucleotides
- Integration of metabolism
- Expression of genetic information and its regulation

Learning Activities

THEORY LECTURES

Attending hours: 40
Non-attending hours: 60

Teaching-learning methodology:

The one hour long theory lectures will be taught three days a week in a lecture theater of the Red Building of the Biology Faculty throughout the second term according to the schedule approved by the Board of the Center). These lectures will be taught, mainly, using the computerized presentation method by which the exposition of the contents is supported in the screen by graphs, figures, etc. that exemplify and improve the lecture. In order to help students following up the lectures, the complete presentation of each topic will be available in the webCT of the virtual platform of the University. The students may ask questions and request additional information. Likewise, they may be required to participate in the discussion.

Skills developed:

Acquire the basic biochemistry knowledge on metabolism, its regulation and expression of genetic information
Analysis and synthesis ability
Solid basic knowledge of the profession

Problem solving
Ability to apply theory to practice
Ability to learn and come up with new ideas
Skills for gathering and analyzing information from different sources

PRESENTATIONS AND SEMINARS

Attending hours: 5
Non-attending hours: 11

Teaching-learning methodology:

The seminars will be voluntary. Students interested in this activity will have to register before the deadline established at the beginning of the term. These will be performed in groups (of 4 students each), and will consist of a topic of choice from a set of choices proposed by the lecturer within the objectives of the module. The presentation of the seminars will be performed by one of the members of each group, chosen by lot before the presentation. It will be 20 minutes long, at public meeting. The student may use any of the presentation means available; computer presentation tools are recommended. After the presentation, the students and the lecturer may ask questions and express their comments. The assignment will be handed in at the day of the presentation.

Skills developed:

Ability to select information and prepare, present and defend a paper in public
Teamwork skills
Ability to come up with new ideas
Organization and planning ability
Judgment and self-judgment abilities
Decision making

LABORATORY PRACTICALS

Atetnding hours: 6
Non-attending hours: 2

Teaching-learning methodology:

This activity will consist of two practicals, which will be carried out throughout the second term, according to the schedule approved by the Board of the Center, in sessions of approximately 3 hours each, at the laboratories of the Department of Plant Biochemistry and Molecular Biology, located in the 1st floor of the Green Building of the Faculty. The lecturer will present the objectives, will orientate the work and will be monitoring the practicals. The students will have to carry out the practicals following the instructions provided by the lecturer and the previous explanations, and will be encouraged to ask questions about theory and/or methodology.

Skills developed:

Learn basic methods for the determination of cellular components
Learn methods for the determination of enzyme activities and their regulation *in vivo*
Interpretation of experimental data
Ability to apply theory to practice
Teamwork skills
Become familiar with the general and specific infrastructure of a biochemistry laboratory
Solid basic knowledge of the profession

COMPUTER PRACTICALS

Attending hours: 2
Non-attending hours: 1

Teaching-learning methodology:

These practicals will take place in the computer rooms of the Faculty, at the date scheduled by the Center, in a two-hour session. The lecturer will present the objectives, will inform students on the databases to be applied and will show how to navigate them and how to extract information of interest. The students will perform the searches orientated by the lecturer and ask questions.

Skills developed:

Manage databases for the analysis of sequences of genes and proteins
Ability to obtain relevant biochemical information from sequences of amino acids and proteins
Analysis and synthesis ability
Ability to apply theory to practice
Teamwork skills
Solid basic knowledge of the profession

ACADEMIC ACTIVITIES PERFORMED IN THE ABSENCE OF THE LECTURER

Attending hours: 0
Non-attending hours: 3

Teaching-learning methodology:

Internet search and use of bibliography.
Voluntary assignments for the students, which they may complete wherever they will, and under the supervision of the lecturer. The readings recommended by the lecturers may be consulted in the Library of the Biology Faculty, and even borrow them according to the rules of the Library.

Skills developed:

Analysis and synthesis ability
Skills for gathering and analyzing information from different sources
Ability to apply theory to practice
Learning skills
Continuous work habit

APPLIED THEORY LECTURES

Attending hours: 7
Non-attending hours: 13

Teaching-learning methodology:

These practical lectures will take place in a lecture theater of the Red Building of the Faculty, distributed in 7 sessions of one hour, adapting its program to the development of the theory contents. The aim of these practical lectures is to help understanding and settling the concepts and experimental parameters analyzed in the theory lectures and to show how to operate them quantitatively. In these lectures, which are much more interactive than the theory lectures, the students will be required to participate actively.

Skills developed:

Solid knowledge on the energetic basis of metabolism
Ability to calculate the energetic yields and requirements of metabolism
Ability to analyze metabolic and experimental situations and to interpret data
Ability to apply theory to practice
Ability to analyze and solve problems

Evaluation systems and criteria

Evaluation of theory lectures and practical lectures at a lecture theater

The knowledge acquired in the theory lectures and practical lectures at a lecture theater will be evaluated through a final exam in June, according to the examination schedule of

the Faculty. This exam will consist of essay questions to assess the student´s ability to associate knowledge, and some questions of numerical calculations. Each question will have a maximum score. 75% of the final mark will correspond to this exam. 25% of the final mark will correspond to the rest of the academic activities. A minimum score of 4 over 10 will be required in this exam for the score obtained in the rest of the academic activities to be considered in the final mark. A final mark of 5 or above is required in order to pass this module, taking into account that the score obtained in the exam on the theory lectures and practical lectures at a lecture theater represents 75% of the final mark.
In the examination session of September, there will be a final exam on the contents of the theory lectures and practical lectures at a lecture theater, and the marks obtained in the seminar and in the laboratory and computer practicals will remain.
Throughout the delivery of the theory lectures, short tests (15-20 minutes long) on the contents taught will be performed at the end of a topic or block of topics. These tests will serve as an attendance control and follow up, and will represent a maximum of 10% of the mark obtained in the final exam, as long as the later is 4 or above.

Evaluation of laboratory practicals

The laboratory practicals will be evaluated through both the participation and good use of the student and by the result of a written, short questionnaire on the contents, methodology and results obtained, which will be performed at the end of every practical. A maximum of 10% of the final mark will be represented by these practicals.

Evaluation of the computer practical

The computer practical will be evaluated through both the participation and good use of student and by the result of a written, short exercise on the contents of the practical, which will be performed at the end of it. A maximum of 5% of the final mark will be represented by this practical.

Evaluation of seminars and presentations

The seminars will be evaluated through the preparation of the topic chosen, with special attention to the update of the bibliography used and its logical organization, and its presentation and defense answering the questions asked by the lecturer and classmates. A maximum of 10% of the final mark will be represented by the score obtained in the seminar.

Module	**Cell Biology and Histology I**
Certification	Degree in Biology
Code	1530045
Stage	2
Stage	Compulsory
Duration	Four months (First term)
Total Credits	6
Theory Credits	4.5
Practicals Credits	1.5
Department	CELL BIOLOGY (FACULTY OF BIOLOGY)

Lecturers

- DIAZ NAVARRO, MARIA PAULA
- DOMINGUEZ GARCIA, INMACULADA
- MATEOS CORDERO, SANTIAGO
- ORTIZ SALLES, TRINIDAD
- PASTOR CARRILLO, NURIA MARIA
- SANCHEZ AGUAYO, INMACULADA
- TORREBLANCA LOPEZ, JOSE

Module program

Specific teaching objectives

The aim of this module is to pass on to the student knowledge about general cell organization and interrelationships between different cell structures (Cell Biology), general organization and composition of plant and animal tissues (Plant Histology and Animal Histology), their integration to form organs and systems (Plant Organography and Animal Organography) and their origin during development (Plant Embryology and Animal Embryology).

Cells and tissues represent a privileged position among the levels of molecular and organic organization, to which they serve as links. Likewise, the cell is the point of integration and coordination essential for understanding the processes that occur at both more complex, macroscopic levels and simpler, molecular levels. Thereby, the Cell Theory, on which this module is based, is a basic conceptual mainstay that will allow the student understanding and integrating the information obtained not only in this module but also in those modules involving the study of biochemical, genetic, microbiological, physiological, zoological, botanical processes. Therefore, it is considered that Cell Biology, Histology and Plant and Animal Organography are essential matters for knowing and understanding the fundamental processes of life. Therefore, mastering them is essential in the formation of Biologists and in their professional projection, especially in the fields of research, health, environment, education, agriculture, analysis, quality control, etc.

Generic transversal skills

- Analysis and synthesis ability (Moderate training)
- Organization and planning ability (Smooth training)
- Basic general knowledge (Intense training)
- Solid basic knowledge of the profession (Intense training)
- Oral communication in the native language (Intense training)

- Written communication in the native language (Intense training)
- Skills for gathering and analyzing information from different sources (Intense training)
- Problem solving (Moderate training)
- Decision making (Smooth training)
- Judgment and self-judgment abilities (Smooth training)
- Teamwork (Moderate training)
- Ability to apply theory to practice (Intense training)
- Research skills (Moderate training)
- Learning skills (Intense training)
- Ability to come up with new ideas (Moderate training)
- Ability to work autonomously (Moderate training)
- Planning and management (Moderate training)
- Concern about quality (Moderate training)
- Concern about success (Smooth training)

Specific skills

- Acquire an integrated concept of the cell from a morphofunctional perspective: know the structure and function of the different cell compartments.
- Know the mechanisms of proliferation, growth, differentiation and cell death.
- Know the integration of cells in tissues: adhesion and integrating extracellular components.
- Know, from a morphofunctional perspective, the different tissues that integrate organs.
- Know, from a morphofunctional perspective, the different organs that integrate a living being.
- Acquire, develop and exercise the specific skills for laboratory work, especially techniques of histological preparation and staining.
- Identify and describe the different tissues and organs in histological preparations.

Contents of the module

- Unit 1. CONCEPT OF CELL. CELL MEMBRANES
- Unit 2. CELL NUCLEUS
- Unit 3. RIBOSOMES. ENDOMEMBRANE SYSTEM
- Unit 4. MITOCHONDRIA, PLASTIDS AND PEROXISOMES
- Unit 5. CYTOSKELETON. CENTRIOLES AND CENTRIOLAR DERIVATIVES
- Unit 6. CELL DIVISION.
- Unit 7. PLANT EMBRYOGENESIS
- Unit 8. PLANT CELLS AND TISSUES
- Unit 9. PLANT ORGANS
- Unit 10. ANIMAL EMBRYOGENESIS

Learning activities:

THEORY LECTURES

Attending hours: 42.5

Non-attending hours: 77

PRESENTATIONS AND SEMINARS

Attending hours: 2.5
Non-attending hours: 10
LABORATORY PRACTICALS
Attending hours: 15
Non-attending hours: 3

Evaluation systems and criteria
Theory exam
The theory contents taught will be evaluated.
Practical exam
The practical contents of the module will be evaluated in the last laboratory session.
Managed activities, self-evaluations and seminars.
Managed activities and self-evaluations may be performed through the platform of the university. The lecturers may propose seminars about contents of the module.

Module	**Cell Biology and Histology II**
Certification	Degree in Biology
Code	1530046
Stage	2
Stage	Compulsory
Duration	Four months (Second Term)
Total Credits	6
Theory Credits	4.5
Practicals Credits	1.5
Department	CELL BIOLOGY (FACULTY Of BIOLOGY)

Lecturers

- HIDALGO JIMENEZ, JOSEFA
- ORTA VAZQUEZ, MANUEL LUIS
- ORTIZ SALLES, TRINIDAD
- SANCHEZ AGUAYO, INMACULADA
- TORREBLANCA LOPEZ, JOSE
- VELASCO LOPEZ, ANGEL

Module program

Specific teaching objectives

The aim of this module is to pass on to the student knowledge about general cell organization and interrelationships between different cell structures (Cell Biology), general organization and composition of plant and animal tissues (Plant Histology and Animal Histology), their integration to form organs and systems (Plant Organography and Animal Organography) and their origin during development (Plant Embryology and Animal Embryology).

Cells and tissues represent a privileged position among the levels of molecular and organic organization, to which they serve as links. Likewise, the cell is the point of integration and coordination essential for understanding the processes that occur at both more complex, macroscopic levels and simpler, molecular levels. Thereby, the Cell Theory, on which this module is based, is a basic conceptual mainstay that will allow the student understanding and integrating the information obtained not only in this module but also in those modules involving the study of biochemical, genetic, microbiological, physiological, zoological, botanical processes. Therefore, it is considered that Cell Biology, Histology and Plant and Animal Organography are essential matters for knowing and understanding the fundamental processes of life. Therefore, mastering them is essential in the formation of Biologists and in their professional projection, especially in the fields of research, health, environment, education, agriculture, analysis, quality control, etc.

Generic transversal skills

- Analysis and synthesis ability (Moderate training)
- Organization and planning ability (Smooth training)
- Basic general knowledge (Intense training)
- Solid basic knowledge of the profession (Intense training)
- Oral communication in the native language (Intense training)
- Written communication in the native language (Intense training)

- Skills for gathering and analyzing information from different sources (Intense training)
- Problem solving (Moderate training)
- Decision making (Smooth training)
- Judgment and self-judgment abilities (Smooth training)
- Teamwork (Moderate training)
- Ability to apply theory to practice (Intense training)
- Research skills (Moderate training)
- Learning skills (Intense training)
- Ability to come up with new ideas (Moderate training)
- Ability to work autonomously (Moderate training)
- Planning and management (Moderate training)
- Concern about quality (Moderate training)
- Concern about success (Smooth training)

Specific skills

- Acquire an integrated concept of the cell from a morphofunctional perspective: know the structure and function of the different cell compartments.
- Know the mechanisms of proliferation, growth, differentiation and cell death.
- Know the integration of cells in tissues: adhesion and integrating extracellular components.
- Know, from a morphofunctional perspective, the different tissues that integrate organs.
- Know, from a morphofunctional perspective, the different organs that integrate a living being.
- Acquire, develop and exercise the specific skills for laboratory work, especially techniques of histological preparation and staining.
- Identify and describe the different tissues and organs in histological preparations.

Contents of the module

- Unit 1. EPITHELIAL TISSUE
- Unit 2. CONNECTIVE TISSUES. BLOOD
- Unit 3. MUSCLE TISSUE
- Unit 4. NERVOUS TISSUE
- Unit 5. NERVOUS SYSTEM. SENSE ORGANS
- Unit 6. CIRCULATORY SYSTEM AND LYMPHOID ORGANS
- Unit 7. ENDOCRINE SYSTEM
- Unit 8. DIGESTIVE SYSTEM
- Unit 9. RESPIRATORY SYSTEM
- Unit 10. URINARY SYSTEM
- Unit 11. REPRODUCTIVE SYSTEMS
- Unit 12. INTEGUMENT

Learning activities

THEORY LECTURES

Attending hours: 42.5

Non-attending hours: 77

PRESENTATIONS AND SEMINARS
Attending hours: 2.5
Non-attending hours: 10
LABORATORY PRACTICALS
Attending hours: 15
Non-attending hours: 3

Evaluation systems and criteria
Theory exam
The theory contents taught will be evaluated.
Practical exam
The practical contents of the module will be evaluated in the last laboratory session.
Managed activities, self-evaluations and seminars.
Managed activities and self-evaluations may be performed through the platform of the university. The lecturers may propose seminars about contents of the module.

Module	Botany I
Certification	Degree in Biology
Code	1530049
Stage	2
Type	Compulsory
Duration	Four months (First Term)
Total Credits	6
Theory Credits	4.5
Practicals Credits	1.5
Department	PLANT BIOLOGY AND ECOLOGY (FACULTY OF BIOLOGY)

Lecturers

- DIAZ DAPENA, MARIA JOSEFA
- FERNANDEZ GONZALEZ, INMACULADA
- LUQUE PALOMO, MARIA TERESA
- ORTIZ HERRERA, MARIA ANGELES
- PASTOR DIAZ, JULIO
- ROMERO ZARCO, CARLOS MANUEL
- VALDES CASTRILLON, BENITO

Module Program

Specific teaching objectives

-Acquire the theory basis and fundamentals of botany required for the development of the professional activity, mainly: Basis of plant organization; Main structural types; Life cycles; Plant diversity and phylogenetic lines.
-Acquire the knowledge that allows identifying plant diversity and phylogenetic lines, and their interrelationships
-Acquire the knowledge that allows identifying resources (mainly flora and vegetation) susceptible to management toward the good use, protection and/or conservation

Specific skills

Cognitive (Know):
- Show the diversity of plants and fungi.
- Know the different types of reproduction in plants and fungi.
- Learn the phylogenetic implications derived from evolutionary processes.
- Introduce the elemental concepts needed to know the vegetation in the Iberian Peninsula.

Procedural/Instrumental (Know how to):
- Proper use of the binocular loupe and optical microscope.
- Learn the use of keys for determining plants and fungi.
- Identify plant and fungi species in the countryside.
- Apply the knowledge on the structural and function basis of living beings to understanding the functioning of the systems they inhabit

- Integration of the knowledge acquired within the context of Biology
Attitudinal (being/doing):
- Solid basic knowledge of the profession
- Skills for gathering and analyzing information from different sources
- Research skills
- Ability to apply theory to practice
- Analysis and synthesis ability
- Judgment and self-judgment abilities
- Ability to associate the matter with other disciplines
- Feeling for the profession, respecting the environment
- Valuation of the environmental aspects of different groups of plant and fungi organisms
- Valuation of the social aspects of different groups of plant and fungi organisms

Contents of the module

Theory lectures schedule

- Unit 01. Introduction to Botany
- Unit 02. Basic principles of Botany: organization levels
- Unit 03. Basic principles of Botany: reproduction
- Unit 04. Prokaryote organisms and origin of eukaryotes
- Unit 05. Introduction to the study of fungi: amoeboid fungi and pseudofungi
- Unit 06. True fungi
- Unit 07. Algae I
- Unit 08. Algae II
- Unit 09. Bryophytes

Laboratory practicals schedule

- 01. Plant organization
- 02. Fungi I
- 03. Fungi II
- 04. Lichens
- 05. Algae I
- 06 Algae II
- 07 Algae III
- 08. Briophytes

Learning Activities

THEORY LECTURES

Attending hours: 45

Non-attending hours: 68

LABORATORY PRACTICALS

Attending hours: 15

Non-attending hours: 15

Evaluation systems and criteria

Theory exam

There will be two discharge partial theory exams and one final exam. Those students who passed the two partial exams may take the final exam in June to raise the mark, which requires the students to renounce the score obtained in the two partial exams. It may be a multiple-choice test or a set of short or essay questions. In both cases, it will be required to obtain a score of 5 over a maximum of 10 in order to pass the exam. The mode of the exam will be notified by the corresponding lecturer at the beginning of the academic year. There will be a final exam with the same characteristics in September and in December, only for those students who did not pass in June.

Practical exam

The practical exam will consist of identifying and/or interpreting the samples observed or explained in the lectures. A score of 5 over a maximum of 10 will be required to pass this exam. Only for those students who did not pass in June, another exam with the same characteristics will take place in September and in December. The mode of evaluation will be notified by the lecturers at the beginning of the academic year.

Important aspects to be considered

It will be required to pass both theory and practical exams independently in order to pass this module. Attendance to the practicals is compulsory, allowing a maximum of 4 excused or 2 unexcused absences. Exceeding the number of absences previously indicated will represent that the student renounces to sit for the practical exam in all the examination sessions (June, September and December). The mean score of the two partial theory exams, or the score obtained in the final exam, will represent 75% of the final mark and 25% will be represented by the score obtained in the practical exam.

For those students who passed the theory section in June (and did not pass the practical section), the score obtained in the theory section will remain until the examination session of September, sitting only for the practical exam. For those students who passed the practical exam in June (and did not pass the theory exam), the score obtained in the practical exam will remain until the examination session of December, sitting only for the theory exam. If a student leaves a final exam, once the questions have been given, the examination session will count, unless otherwise stated, as it is the case of the mentioned exam to raise the mark.

Other important aspects: the dates of the exams, both theory and practical, are published in the Exam Schedule, previously approved by the Board of the Center.

- It is strictly forbidden to bring mobile phones to the exams.

Module	Botany II
Certification	Degree in Biology
Code	1530050
Stage	2
Type	Compulsory
Duration	Four months (second term)
Total Credits	6
Theory Credits	4.5
Practicals Credits	1.5
Department	PLANT BIOLOGY AND ECOLOGY (FACULTY OF BIOLOGY)

Lecturers

- ARROYO MARIN, JUAN
- DIAZ DAPENA, MARIA JOSEFA
- GARCIA CASTAÑO, JUAN LUIS
- ORTIZ HERRERA, MARIA ANGELES
- TERRAB BENJELLOUN, ANASS
- VALDES CASTRILLON, BENITO

Module Program

Specific teaching objectives

-Acquire the theory basis and fundamentals of botany required for the development of the professional activity, mainly: Basis of plant organization; Main structural types; Life cycles; Plant diversity and phylogenetic lines.
-Acquire the knowledge that allows identifying plant diversity and phylogenetic lines, and their interrelationships
-Acquire the knowledge that allows identifying resources (mainly flora and vegetation) susceptible to management toward the good use, protection and/or conservation

Specific skills

Cognitive (Know):
- Show the diversity of plants and fungi.
- Know the different types of reproduction in plants and fungi.
- Learn the phylogenetic implications derived from evolutionary processes.
- Introduce the elemental concepts needed to know the vegetation in the Iberian Peninsula.

Procedural/Instrumental (Know how to):
- Proper use of the binocular loupe and optical microscope.
- Learn the use of keys for determining plants and fungi.
- Identify plant and fungi species in the countryside.
- Apply the knowledge on the structural and function basis of living beings to understanding the functioning of the systems they inhabit
- Integration of the knowledge acquired within the context of Biology

Attitudinal (being/doing):
- Solid basic knowledge of the profession
- Skills for gathering and analyzing information from different sources
- Research skills
- Ability to apply theory to practice
- Analysis and synthesis ability
- Judgment and self-judgment abilities
- Ability to associate the matter with other disciplines
- Feeling for the profession, respecting the environment
- Valuation of the environmental aspects of different groups of plant and fungi organisms
- Valuation of the social aspects of different groups of plant and fungi organisms

Contents of the module

Theory lectures schedule

- Unit 1. Thallophytes
- Unit 2. Pteridophytes
- Unit 3. Introduction to Spermatophytes
- Unit 4. Gymnosperms
- Unit 5. Angiosperms I
- Unit 6. Angiosperms II
- Unit 7. Plant evolution
- Unit 8. Geobotany and Plant conservation

Laboratory practicals schedule

- 1. Ferns
- 2. Gymnosperms
- 3-8. Determination of Angiosperms

Learning Activities

THEORY LECTURES

Attending hours: 45

Non-attending hours: 68

LABORATORY PRACTICALS

Attending hours: 15

Non-attending hours: 15

Evaluation systems and criteria

Theory exam

There will be two discharge partial theory exams and one final exam. Those students who passed the two partial exams may take the final exam in June to raise the mark, which requires the students to renounce the score obtained in the two partial exams. It may be a multiple-choice test or a set of short or essay questions. In both cases, it will be required to obtain a score of 5 over a maximum of 10 in order to pass the exam. The mode of the exam will be notified by the corresponding lecturer at the beginning of the academic year.

There will be a final exam with the same characteristics in September and in December, only for those students who did not pass in June.

Practical exam

The practical exam will consist of identifying and/or interpreting the samples observed or explained in the lectures. A score of 5 over a maximum of 10 will be required to pass this exam. Only for those students who did not pass in June, another exam with the same characteristics will take place in September and in December. The mode of evaluation will be notified by the lecturers at the beginning of the academic year.

Important aspects to be considered

It will be required to pass both theory and practical exams independently in order to pass this module. Attendance to the practicals is compulsory, allowing a maximum of 4 excused or 2 unexcused absences. Exceeding the number of absences previously indicated will represent that the student renounces to sit for the practical exam in all the examination sessions (June, September and December). The mean score of the two partial theory exams, or the score obtained in the final exam, will represent 75% of the final mark and 25% will be represented by the score obtained in the practical exam.

For those students who passed the theory section in June (and did not pass the practical section), the score obtained in the theory section will remain until the examination session of September, sitting only for the practical exam. For those students who passed the practical exam in June (and did not pass the theory exam), the score obtained in the practical exam will remain until the examination session of December, sitting only for the theory exam. If a student leaves a final exam, once the questions have been given, the examination session will count, unless otherwise stated, as it is the case of the mentioned exam to raise the mark.

Other important aspects:

- The dates of the exams, both theory and practical, are published in the Exam Schedule, previously approved by the Board of the Center.
- It is strictly forbidden to bring mobile phones to the exams.

Module	Zoology I
Certification	Degree in Biology
Code	1530052
Stage	2
Type	Compulsory
Duration	Four months (First term)
Total Credits	6
Theory Credits	4.5
Practicals Credits	1.5
Department	ZOOLOGY (FACULTY OF BIOLOGY)

Lecturers

- BELTRAN GALA, JUAN FRANCISCO
- CONRADI BARRENA, MERCEDES
- GARCIA GOMEZ, JOSE CARLOS
- GUERRA GARCIA, JOSE MANUEL
- LOPEZ GONZALEZ, PABLO JOSE
- LOPEZ MARTINEZ, MARIA ANGELES
- LOPEZ-FE DE LA CUADRA, CARLOS MARIA
- NIETO RUBIO, MARIA DEL PILAR
- ROS CLEMENTE, MACARENA
- SANTOS LOBATON, MARIA DEL CARMEN
- SORIA IGLESIAS, FRANCISCO JAVIER

Module program

Specific teaching objectives

Knowledge on the concept and origin of animals and the general mechanisms of evolution applied to them.
Knowledge on animal phylogeny and classification techniques.
Knowledge on the different types of animal organization, structural plans and development processes.
Knowledge on animal phyla regarding their basic characteristics, adaptations, phylogenetic relationships between them and interactions with humans.
Examination of the main groups and use of identification codes.

Specific skills

Examine different organization levels in animals
Perform phylogenetic analyses
Identify and use biomarker species
Localize, obtain, identify, handle, conserve and observe specimens
Analyze and interpret animal behavior

Know how to recognize and describe adequately the traits of animals in order to determine and classify them
Use basic techniques of dissection
Know how to operate optical and laboratory material
Search the literature making use of the library, databases and Internet
Analysis and synthesis skills
Sample, characterize and handle populations and communities
Manage, conserve and restore populations and ecosystems
Perform and interpret schemes of animals and structures

Contents of the module

- 1.- General Concepts:
  Definition and origin of animals, evolution in animals, classification techniques.
  Basic functions of animals.
  Structural plans and general patterns of reproduction and growth of animals.
- 2.- Animal diversity: Non-arthropod invertebrates.

Learning activities

THEORY LECTURES
Attending hours: 45
Non-attending hours: 62.25
LABORATORY PRACTICALS
Attending hours: 15
Non-attending hours: 18
Teaching-learning methodology:
Handle and examine mostly conserved animal specimens and, sometimes, when technically possible, live animal specimens
Skills developed
Examine different organization levels in animals
Identify and use biomarker species
Localize, obtain, identify, handle, conserve and observe specimens
Know how to recognize and describe adequately the traits of animals in order to determine and classify them
Use basic techniques of dissection
Know how to operate optical and laboratory material
Analysis and synthesis skills
Sample, characterize and handle populations and communities
Manage, conserve and restore populations and ecosystems
Perform and interpret schemes of animals and structures

Evaluation systems and criteria

Theory and practical exams

Two partial theory exams and one practical exam will be performed. The practical exam will take place the same day as the 2nd partial theory exam. Passing these exams will allow the students to pass the module prior to the final exam, pursuant to Article 8.1 of the current Evaluation and Qualification Policy.
The scores obtained in the partials and practical exams will remain until the examination session in September.
If they want, those students who pass the theory or the practical section in September, but not both, may keep the score of the passed section only until the examination session of December of the next academic year, since this will be performed on the subject matter taught in the previous academic year.
The theory exams will consist of short essay questions.
The practical exams will consist of questions about images (photographs or schemes) related to the laboratory practical lectures, about which some activity will be performed: recognize structures, recognize the zoological group the specimen belongs to, determine it by a code, etc.
All the exams must be passed with a score of 5.
Once all the exams are passed, the final mark will be calculated by weighting the theory section by 70% and the practical section by 30%.

Module	Zoology II
Certification	Degree in Biology
Code	1530053
Stage	2
Type	Compulsory
Duration	Four months (Second Term)
Total Credits	6
Theory Credits	14.5
Practicals Credits	1.5
Department	ZOOLOGY (FACULTY OFBIOLOGY)

Lecturers

- BELTRAN GALA, JUAN FRANCISCO
- CONRADI BARRENA, MERCEDES
- ESPINOSA TORRE, FREE
- LOPEZ MARTINEZ, MARIA ANGELES
- LOPEZ-FE DE LA CUADRA, CARLOS MARIA
- OCETE RUBIO, MARIA ELVIRA
- OCETE RUBIO, RAFAEL
- SANTOS LOBATON, MARIA DEL CARMEN
- SORIA IGLESIAS, FRANCISCO JAVIER
- VILLAGRAN PINTEÑO, MIGUEL

Module program

Specific teaching objectives

Knowledge on the concept and origin of animals and the general mechanisms of evolution applied to them.
Knowledge on animal phylogeny and classification techniques.
Knowledge on the different types of animal organization, structural plans and development processes.
Knowledge on animal phyla regarding their basic characteristics, adaptations, phylogenetic relationships between them and interactions with humans.
Examination of the main groups and use of identification codes.

Specific skills

Examine different organization levels in animals
Perform phylogenetic analyses
Identify and use biomarker species
Localize, obtain, identify, handle, conserve and observe specimens
Analyze and interpret animal behavior

Know how to recognize and describe adequately the traits of animals in order to determine and classify them
Use basic techniques of dissection
Know how to operate optical and laboratory material
Search the literature making use of the library, databases and Internet
Analysis and synthesis skills
Sample, characterize and handle populations and communities
Manage, conserve and restore populations and ecosystems
Perform and interpret schemes of animals and structures

Contents of the module

- 1. Animal diversity: Arthropods.
- 2. Animal diversity: Chordates.

Learning activities
THEORY LECTURES
Attending hours: 45
Non-attending hours: 62.25
LABORATORY PRACTICALS
Attending hours: 15
Non-attending hours: 18
Teaching-learning methodology
Handle and examine mostly conserved animal specimens and, sometimes, when technically possible, live animal specimens
Skills developed
Examine different organization levels in animals
Identify and use biomarker species
Localize, obtain, identify, handle, conserve and observe specimens
Know how to recognize and describe adequately the traits of animals in order to determine and classify them
Use basic techniques of dissection
Know how to operate optical and laboratory material
Analysis and synthesis skills
Sample, characterize and handle populations and communities
Manage, conserve and restore populations and ecosystems
Perform and interpret schemes of animals and structures

Evaluation systems and criteria
Theory and practical exams
Two partial theory exams and one practical exam will be performed. The practical exam will take place the same day as the 2nd partial theory exam. Passing these exams will allow the students to pass the module prior to the final exam, pursuant to Article 8.1 of the current Evaluation and Qualification Policy.

The scores obtained in the partials and practical exams will remain until the examination session in September.
If they want, those students who pass the theory or the practical section in September, but not both, may keep the score of the passed section only until the examination session of December of the next academic year, since this will be performed on the subject matter taught in the previous academic year.
The theory exams will consist of short essay questions.
The practical exams will consist of questions about images (photographs or schemes) related to the laboratory practical lectures, about which some activity will be performed: recognize structures, recognize the zoological group the specimen belongs to, determine it by a code, etc.
All the exams must be passed with a score of 5.
Once all the exams are passed, the final mark will be calculated by weighting the theory section by 70% and the practical section by 30%.

Module	Genetics I
Certification	Degree in Biology
Code	1530051
Stage	2
Type	Compulsory
Duration	Four months (First term)
Total Credits	6
Theory Credits	5
Practical vredits	1
Department	GENETICS (FACULTY OF BIOLOGY)

Lecturers

- GARCIA MUSE, TATIANA BEATRIZ
- GUTIERREZ POZO, GABRIEL
- HUERTAS SANCHEZ, PABLO
- JIMENO GONZALEZ, SONIA
- LOPEZ CALDERON, ISABEL
- MILLAN ZAMBRANO, GONZALO
- MUÑOZ CENTENO, MARIA DE LA CRUZ
- RINCON ROMERO, ANA MARIA
- WELLINGER, RALF-ERIK

Module program

Specific teaching objectives

- Know the principles that govern the heredity of traits between generations.
- Study the molecular basis of gene structure, function and regulation.
- Understand the causes of the genetic variation of living beings.
- Analyze the processes that change the structure of populations.
- Understand the basic mechanisms of genetic evolution.
- Integrate the principles of genetics with the rest of the subject matters.
- Understand the genetic basis of human pathology.
- Operate simple models of genetic analysis in the laboratory.

Specific skills

- Basic concepts and typical procedures of Genetics.
- Genetic analysis techniques.
- Ability to solve genetic problems.

Contents of the module

- Chapter 1 Introduction. Reproduction and life cycles
- Chapter 2 Mendelism
- Chapter 3 Linkage and recombination
- Chapter 4 Chromosomal alterations
- Chapter 5 Heredity and sex
- Chapter 6 Cytoplasmic heredity
- Chapter 7 Genetic analysis in bacteria and bacteriophages
- Chapter 8 Evolution
- Chapter 9 Variabilty and genetic structure of populations
- Chapter 10 Random crossing over: the panmictic model
- Chapter 11 Changes in allele frequencies I: mutation and selection
- Chapter 12 Changes in allele frequencies II: migration and drift
- Chapter 13 Heredity of quantitative traits
- Chapter 14 Speciation

Learning activities

THEORY LECTURES
Attending hours: 34
Non-attending hours: 50
LABORATORY PRACTICALS
Attending hours: 8
Non-attending hours: 4
COMPUTER PRACTICALS
Attending hours: 2
Non-attending hours: 1
APPLIED THEORY LECTURES
Attending hours: 16
Non-attending hours: 35

Evaluation systems and criteria

Half-term exams
There will be two half-term exams. The acquisition of skills, abilities and knowledge of each part of the module will be evaluated.
Final exam
For those students who do not pass the half-term exams, there will be a single final exam of all the contents of the module. The acquisition of skills, abilities and knowledge of each part of the module will be evaluated.
Short assessments
Throughout the course, there will be 2 short written assessments at a lecture day chosen by the lecturer, which could be announced in advance.
Practical questionnaires

At the end of the practicals, the students will be given a questionnaire on the contents of these practicals. The final mark of the practicals will depend on the attendance and the score obtained in the questionnaire.

Sets of problems

During the course there will be 4 sets of problems, which will be announced in advance at the website of the module. The problems will be solved publicly in sessions announced in advance.

Module	Genetics II
Certification	Degree in Biology
Code	1530044
Stage	2
Type	Compulsory
Duration	Four months (Second term)
Total Credits	6
Theory Credits	5
Practicals Credits	1
Department	GENETICS (FACULTY OF BIOLOGY)

Lecturers

- CORTES LEDESMA, FELIPE
- GAILLARD, HELENE
- GODER, VEIT
- GUTIERREZ POZO, GABRIEL
- LUNA VARO, ROSA Mª

Module program

Specific teaching objectives

- Study the molecular basis of the structure, function and regulation of genes.
- Know the metabolism and dynamics of genetic material.
- Understand the cell cycle and its regulation.
- Study the development of multicellular organisms.
- Understand the molecular basis of human pathology and evolution.
- Analyze biological sequences through computer methods.
- Integrate the principles of genetics with the rest of subject matters.

Specific skills

- Basic concepts and typical procedures of genetics.
- Genetic analysis techniques (both classic and molecular).
- Ability to solve genetic problems.
- Practical skills in the typical methodology of the discipline.
- Ability to design genetic experiments.
- Ability to analyze, interpret, value, discuss and communicate the data obtained from genetic experiments.
- Experience in the application of statistical methods in the analysis of genetic data.
- Correct operation of the usual equipment in a genetics laboratory.
- Ability to apply the acquired knowledge to the future development of professional activities, like genetic diagnosis, empirical risk prediction and genetic advice for families, or

biomedical research.
- Valuation of the social aspects of research in Genetics.
- Introduction to the use of computer programs of sequence analysis.

Contents of the module

- Lesson 1: Identification of the genetic material and its structure
- Lesson 2: Replication of the genetic material
- Lesson 3: DNA mutation and repair
- Lesson 4: Recombination and transposition
  Lesson 5 : Gene expression I: relationship between genes and proteins; transcription and RNA processing
- Lesson 6: Gene expression II: translation and genetic code
- Lesson 7: Regulation of gene expression
- Lesson 8: Genetics of the development of multicellular organisms
- Lesson 9: Cell cycle control and genetic basis of cancer
- Lesson 10: Genetic engineering
- Lesson 11: Genomics
- Lesson 12: Molecular evolution

Learning activities

THEORY LECTURES
Attending hours: 34
Non-attending hours: 50
LABORATORY PRACTICALS
Attending hours: 8
Non-attending hours: 4
COMPUTER PRACTICALS
Attending hours: 2
Non-attending hours: 1
APPLIED THEORY LECTURES
Attending hours: 16
Non-attending hours: 35

Evaluation systems and criteria

Theory exam
An exam with all the contents of the module will be held. The acquisition of skills, abilities and knowledge of the subject matter will be valued.
Short assessments
Throughout the module, 4 written mini-evaluations will take place on a class day chosen by the lecturer, which might not be announced in advance.
Practicals questionnaires
At the end of the practicals, the students will be given a questionnaire about the contents of the practicals. The final mark of the practicals will depend on the attendance and the

score obtained in the questionnaire.

Sets of problems

During the course, 8 sets of problems will be carried out and will be announced in advance at the website of the module. The problems will be solved later in public sessions, which will be announced in advance.

Module	Animal Physiology I
Certification	Degree in Biology
Code	1530054
Stage	3
Type	Compulsory
Duration	Four months (First term)
Total Credits	6
Theory Credits	5.1
Practicals Credits	0.9
Department	PHYSIOLOGY (FACULTY OF BIOLOGY)

Lecturers

- DAVIS LOPEZ DE CARRIZOSA, M. AMERICA
- HERRERO RAMA, LUIS JACINTO
- LUQUE LAO, M. ANGELES
- PASTOR LORO, ANGEL MANUEL
- TORRES RUIZ, BLAS

Module program

Specific teaching objectives

General:

Integrate knowledge on the structure and function of organisms, and the physiological processes that take place inside them, regarding the external and internal environments, applying general ideas about homeostasis.

Study the different physiological systems with relation to the organs they are composed of, their interrelationships, the organic variables they control, the physiological (physical and chemical) mechanisms they are composed of and the regulation systems they depend on to be stable.

Examine the compartments involved in a physiological process, the interfaces between them and the flows of matter, energy and information, as well as gradients and active mechanisms.

Understand the physical-chemical laws that associate organic variables, the control and regulation mechanisms and learn how to interpret flowcharts that associate physiological variables.

Study the physiological adaptations that allow acclimatization to changes of the external and internal environments and compare the function of physiological systems throughout the phylogenetic scale.

Critically differentiate the well-established knowledge from that in the field of hypotheses and theories.

Use and value the information sources of this discipline.

Methodological:

Use specific instruments to measure physiological variables. Handle organisms to determine physiological variables under laboratory conditions.

Perform physiological preparations in which to apply assay concepts, dependent variable, independent variable, model and contrast.

Use software models and simulation programs to reduce animal experimentation.

Generate graphs, flowcharts and models from experimentation.

Specific skills

This module fosters the acquisition of basic knowledge on Animal Physiology as the only module focused on this matter in the whole degree, although it lays the groundwork for other related modules in further courses and integrates knowledge on topics from previous courses. The theory lectures are a first approach to the matter that requires the attention and active participation of the students in the lecture theater, as well as to previously prepare the recommended readings in order to make the later study easier. The theory lectures aim to develop the sense of criticism in the student, and the oral communication skills through their participation in the lectures.

It is intended that the students develop skills at operating laboratory instruments, which will be occasionally replaced by software or didactic models that simulate physiological processes without the need for using laboratory animals. Thereby, this module fosters the ethical commitment in animal experimentation and switching from theory to practice and vice versa, as well as operating the fundamental concepts and calculations of units and systems of physiological measures.

Resolution and discussion of problems in groups and laboratory sessions in shared positions allow encouraging teamwork, the ability to communicate using the terminology of the discipline and the sense of criticism and self-criticism of whatever it is presented. Finally, the tests in the classroom, the individual assignments on readings and questions and the use of the literature are in pursuit of verbal and written development.

Contents of the module

- I. INTRODUCTION (topic 1)
  Unit1: Introducción
- II. GENERAL PHYSIOLOGY OF EXCITABLE CELLS (topics 2-5)
  Unit 2: Physiology of the neuron
- III. NERVOUS SYSTEM (topics 6-15)
  Unit 3: Functional Organization of the Nervous System
  Unit 4: Sensory systems
  Unit 5: Effector systems
  Unit 6: Sensorimotor integration
  Unit 7: Complex Nervous Functions
- IV. CIRCULATION (topics 16-19)
  Unit 8: Circulatory system
  Unit 9: Cardiac Function
  Unit 10: Cardiovascular Function and Regulation
- V. RESPIRATION (topics 20-24)
  Unit 11. Respiration
  Unit 12. Regulation of Respiration

Learning activities

THEORY LECTURES

Attending hours: 45

Non-attending hours: 60

LABORATORY PRACTICALS

Attending hours: 4.5

Non-attending hours: 8

COMPUTER PRACTICALS
Attending hours: 4.5
Non-attending hours: 8
DISCUSSION SESSIONS
Attending hours: 6
Non-attending hours: 14

Evaluation systems and criteria

Evaluation by qualifying midterm exams

There will be a first midterm mixed exam on the first four topic blocks, including the corresponding practicals, and a second midterm mixed exam on the other five topic blocks, including the corresponding practicals. Each exam will consist of 30 multiple-choice questions (5 points) and 5 essay questions or problems on the theory and practical contents (5 points). Those who pass both midterm exams will obtain the arithmetic mean as the final mark, to which a bonus score of up to 1.5 points for the good use and participation in the practicals (1 point) and in the theory lectures (0.5 points) will be added.

Evaluation through the first ordinary examination session

In the end (1st ordinary examination session) the student must take as many midterm exams as he/she has failed or did not attend. There will be an exercise per midterm exam with 5 theory and practical questions (10 points). The final mark will be the mean score of the two midterm exams, as long as the student achieves more than 3 points. Those who pass by midterm exams will obtain the mean score of both midterm exams without the need for taking the final exam.

Those who pass (by midterm exams or in the final exam) will receive, in addition to the final mark, a bonus score of up to 1.5 points for the good use and participation in the practicals (1 point) and in the theory lectures (0.5 points).

Evaluation through the second ordinary and extraordinary examination sessions

At the second ordinary and extraordinary examination sessions, there will be only one exercise about the whole course, which will consist of 10 questions on both theory and practical lectures (usually 8 of theory and 2 of practicals, for a total of 10 points, without bonus score).

Module	Animal Physiology II
Certification	Degree in Biology
Code	1530055
Stage	3
Type	Compulsory
Duration	Four months (Second term)
Total Credits	6
Theory Credits	5.1
Practicals Credits	0.9
Department	PHYSIOLOGY (FACULTY OF BIOLOGY)

Lecturers

- CERVANTES CARDENAS, LUCIA
- GAYTAN GUIA, SUSANA PILAR
- LUQUE LAO, M. ANGELES
- MORCUENDE FERNANDEZ, SARA ROSALIA
- PASARO DIONISIO, MARIA ROSARIO
- PASTOR LORO, ANGEL MANUEL
- RODRIGUEZ DE LA CRUZ, ROSA MARIA

Module program

Specific teaching objectives

General:

Integrate knowledge on the structure and function of organisms, and the physiological processes that take place inside them, regarding the external and internal environments, applying general ideas about homeostasis.

Study the different physiological systems with relation to the organs they are composed of, their interrelationships, the organic variables they control, the physiological (physical and chemical) mechanisms they are composed of and the regulation systems they depend on to be stable.

Examine the compartments involved in a physiological process, the interfaces between them and the flows of matter, energy and information, as well as gradients and active mechanisms.

Understand the physical-chemical laws that associate organic variables, the control and regulation mechanisms and learn how to interpret flowcharts that associate physiological variables.

Study the physiological adaptations that allow acclimatization to changes of the external and internal environments and compare the function of physiological systems throughout the phylogenetic scale.

Critically differentiate the well-established knowledge from that in the field of hypotheses and theories.

Use and value the information sources of this discipline.

Methodological:

Use specific instruments to measure physiological variables. Handle organisms to determine physiological variables under laboratory conditions.

Perform physiological preparations in which to apply assay concepts, dependent variable, independent variable, model and contrast.
Use software models and simulation programs to reduce animal experimentation.
Generate graphs, flowcharts and models from experimentation.

Specific skills

This module fosters the acquisition of basic knowledge on Animal Physiology as the only module focused on this matter in the whole degree, although it lays the groundwork for other related modules in further courses and integrates knowledge on topics from previous courses. The theory lectures are a first approach to the matter that requires the attention and active participation of the students in the lecture theater, as well as to previously prepare the recommended readings in order to make the later study easier. The theory lectures aim to develop the sense of criticism in the student, and the oral communication skills through their participation in the lectures.

It is intended that the students develop skills at operating laboratory instruments, which will be occasionally replaced by software or didactic models that simulate physiological processes without the need for using laboratory animals. Thereby, this module fosters the ethical commitment in animal experimentation and switching from theory to practice and vice versa, as well as operating the fundamental concepts and calculations of units and systems of physiological measures.

Resolution and discussion of problems in groups and laboratory sessions in shared positions allow encouraging teamwork, the ability to communicate using the terminology of the discipline and the sense of criticism and self-criticism of whatever it is presented. Finally, the tests in the classroom, the individual assignments on readings and questions and the use of the literature are in pursuit of verbal and written development.

Contents of the module

- VI. OSMORREGULACIÓN Y EXCRECIÓN (topics 25-29)
  Unit 13. Osmoregulation and Regulation of pH
  Unit 14. Excretion
- VII. NUTRITION AND ENERGY METABOLISM (topics 30-34)
  Unit 15. Nutrition, Metabolism and Thermal Relationships
  Unit 16. Digestion and Absorption
- VIII. ENDOCRINE SYSTEM (topics 35-46)
  Unit 17. Basic Principles of Endocrinology
  Unit 18. Endocrine Regulation of Metabolism and Growth
  Unit 19. Endocrine Regulation of other Physiological processes
- IX. REPRODUCTIVE SYSTEM (topics 45-46)
  Unit 20. Reproduction

Learning activities

THEORY LECTURES
Attending hours: 45
Non-attending hours: 60
LABORATORY PRACTICALS
Attending hours: 4.5
Non-attending hours: 8
COMPUTER PRACTICALS
Attending hours: 4.5
Non-attending hours: 8

DISCUSSION SESSIONS
Attending hours: 6
Non-attending hours: 14

Evaluation systems and criteria
Evaluation by qualifying midterm exams
There will be a first midterm mixed exam on the first four topic blocks, including the corresponding practicals, and a second midterm mixed exam on the other five topic blocks, including the corresponding practicals. Each exam will consist of 30 multiple-choice questions (5 points) and 5 essay questions or problems on the theory and practical contents (5 points). Those who pass both midterm exams will obtain the arithmetic mean as the final mark, to which a bonus score of up to 1.5 points for the good use and participation in the practicals (1 point) and in the theory lectures (0.5 points) will be added.
Evaluation through the first ordinary examination session
In the end (1st ordinary examination session) the student must take as many midterm exams as he/she has failed or did not attend. There will be an exercise per midterm exam with 5 theory and practical questions (10 points). The final mark will be the mean score of the two midterm exams, as long as the student achieves more than 3 points. Those who pass by midterm exams will obtain the mean score of both midterm exams without the need for taking the final exam.
Those who pass (by midterm exams or in the final exam) will receive, in addition to the final mark, a bonus score of up to 1.5 points for the good use and participation in the practicals (1 point) and in the theory lectures (0.5 points).
Evaluation through the second ordinary and extraordinary examination sessions
At the second ordinary and extraordinary examination sessions, there will be only one exercise about the whole course, which will consist of 10 questions on both theory and practical lectures (usually 8 of theory and 2 of practicals, for a total of 10 points, without bonus score).

Module	Ecology I
Certification	Degree in Biology
Code	1530042
Stage	3
Type	Compulsory
Duration	Four months (First term)
Total Credits	6
Theory Credits	4
Practicals Credits	2
Department	PLANT BIOLOGY AND ECOLOGY (FACULTY OF BIOLOGY)

Lecturers

- DIAZ ANTUNES-BARRADAS, MARIA CRUZ
- ENCINA ENCINA, MARIA LOURDES
- FIGUEROA CLEMENTE, MANUEL ENRIQUE
- GALLEGO FERNANDEZ, JUAN BATUISTA
- GRANADOS LORENCIO, CARLOS ANTONIO
- JAUREGUI ARANA, JUAN
- LEIVA MORALES, MARIA JOSE
- MATEOS NARANJO, ENRIQUE
- MUÑOZ REINOSO, JOSE CARLOS
- RODRIGUEZ RUIZ, AMADORA
- SERRANO MARTIN, LAURA
- ZUNZUNEGUI GONZALEZ, MARIA

MODULE PROGRAM

Specific teaching objectives

- Acquire a body of basic knowledge of ecological science (principles, laws and theories, hypotheses, models, patterns and processes), and the adequate vocabulary and terminology to express it in a precise manner.
- Establish the relationships between ecology and other disciplines and acquire an integrating perspective of the knowledge acquired that allow to better understand the ecological processes.
- Basically understand the reality of nature, its elements and their relationships (which is essential for later interpretation), and develop a critical spirit that allow to value and take part in a case by different explanations, theories and hypotheses for the same ecological event.
- The student should learn how to move in the different integration levels embraced by Ecology, from the ecosystem level, recognizing which magnitude, space and time scales are relevant in each case, the main ecological features of each, and the patterns and processes that underlie them, transmitting the idea of globality and intercommunication that exist between the components of the ecological systems.
- Know the main techniques and scientific methods used in ecological research, which allow students to analyze data and draw their own results and conclusions.
- Search and handle information sources (bibliographic documentation). Through this activity, the student becomes more independent in his/her continuous education.

- Acquire observation and methodological rigor habits, and appreciation of coherence and realism.
- Identify, know and be able to apply the basic statistical and computational methods that are used in these sciences.
- Be able to transfer ecological knowledge to the resolution of applied problems, as well as to perform critical comments and use logical reasoning for different questions or problems proposed.
- Foster the spirit of research and criticism in students, which will allow them to value and take part in a case by different explanations, theories and hypotheses for the same ecological event and reasonably acquire a personal criteria of interpretation about the information taught by the lecturer, while they develop their intellectual curiosity, accepting the limits of knowledge and showing consideration for the work of other specialists.
- Students are intended to learn how to deal appropriately with the environment.

Specific skills

-Learn how to analyze, model and predict the functioning ecological systems.
-Learn techniques, protocols and strategies to obtain information from the natural environment.
-Propose, discuss and solve ecological problems.
-Gain the ability to view the functioning of nature from a systemic perspective.

CONTENTS OF THE MODULE

Theory

- 1.- What is ecology?
- 2.- Environment and individuals
- 3.- Abundance and distribution of species
- 4.- Adaptation of organisms to a multifactorial environment
- 5.- Biogeography
- 6.- Introduction to demography. Single-species populations
- 7.- Competition within a population (intraspecific competition)
- 8.- Interspecific competition
- 9.- Mutualism
- 10.- Predation

Numerical questions

- 1.- Sampling techniques for plant communities.
- 2.- Sampling techniques for animal populations in terrestrial and aquatic environments.
- 3.- Determination of the size and number of samples for the study of vegetation.
- 4.- Sampling of the physical environment and organisms in aquatic environment.
- 5.- Data analysis: Univariate.
- 6.- Determination of the spatial distribution of organisms.
- 7.- Life tables

Practicals

- 1.- Field sampling of vegetation.
- 2.- Analysis of the data collected.
- 3.- Population dynamics model.
- 4.- Perform the life tables of a population.

- 5.- Univariate methods.

Learning Activities

THEORY LECTURES

Attending hours: 30

Non-attending hours: 60

Teaching-learning methodology:

- Presentation of concepts. The students may prepare and present specific aspects of the module to their classmates.
- Self-evaluation activities. Revised questionnaires will be available to the students at WebCT
- Presentation of seminars. The students may present a seminar proposed by the lecturer to go in greater depth into the aspects studied in each section of the module.
- Practical assignments. These may be performed individually or in pairs.

Skills developed:

-Learn how to analyze, model and predict the functioning ecological systems.
-Learn techniques, protocols and strategies to obtain information from the natural environment.
-Propose, discuss and solve ecological problems.
-Gain the ability to view the functioning of nature from a systemic perspective.

LABORATORY PRACTICALS

Attending hours: 14

Non-attending hours: 0

Skills developed:

-Learn how to analyze, model and predict the functioning ecological systems.
-Learn techniques, protocols and strategies to obtain information from the natural environment.
-Propose, discuss and solve ecological problems.
-Gain the ability to view the functioning of nature from a systemic perspective.

COMPUTER PRACTICALS

Attending hours: 2

Non-attending hours: 0

Skills developed:

-Learn how to analyze, model and predict the functioning ecological systems.
-Learn techniques, protocols and strategies to obtain information from the natural environment.
-Propose, discuss and solve ecological problems.
-Gain the ability to view the functioning of nature from a systemic perspective.

FIELD PRACTICALS

Attending hours: 4

Non-attending hours: 0

Skills developed:

-Learn how to analyze, model and predict the functioning ecological systems.
-Learn techniques, protocols and strategies to obtain information from the natural environment.
-Propose, discuss and solve ecological problems.

-Gain the ability to view the functioning of nature from a systemic perspective.

NUMERICAL QUESTIONS

Attending hours: 10

Non-attending hours: 20

Skills developed:

-Learn how to analyze, model and predict the functioning ecological systems.

-Learn techniques, protocols and strategies to obtain information from the natural environment.

-Propose, discuss and solve ecological problems.

-Gain the ability to view the functioning of nature from a systemic perspective.

Evaluation systems and criteria

There will be an exam about the theory section, which must be passed.

Essay questions, short questions, reasoning and problem questions and multiple-choice questions.

The academic activities will be reflected in the final mark as long as the exam is passed.

There will be an exam about the problems section, which must be passed.

Diverse problems to be solved satisfactorily.

The academic activities will be reflected in the final mark as long as the exam is passed.

There will be an exam about the practical section of the module (in case this section was not passed through the practical sessions), which must be passed.

Essay questions, reasoning questions, short questions and multiple-choice questions about the matter of the module.

Module	Ecology II
Certification	Degree in Biology
Code	1530043
Stage	3
Type	Compulsory
Duration	Four months (Second term)
Total Credits	6
Theory Credits	4
Practicals Credits	2
Department	PLANT BIOLOGY AND ECOLOGY (FACULTY OF BIOLOGY)

Lecturers

- CASTILLO SEGURA, JESUS MANUEL
- DIAZ ANTUNES-BARRADAS, MARIA CRUZ
- ENCINA ENCINA, MARIA LOURDES
- FIGUEROA CLEMENTE, MANUEL ENRIQUE
- GALLEGO FERNANDEZ, JUAN BAUTISTA
- LEIVA MORALES, MARIA JOSE
- MANCILLA LEYTON, JUAN MANUEL
- MATEOS NARANJO, ENRIQUE
- MUÑOZ REINOSO, JOSE CARLOS
- RODRIGUEZ RUIZ, AMADORA
- ZUNZUNEGUI GONZALEZ, MARIA

Module Program

Specific teaching objectives

- Acquire a body of basic knowledge about principles, laws and theories, hypotheses, models, patterns and processes that are important in ecology.
- Basically understand the reality of nature, its elements and their relationships (which is essential for later interpretation), and develop a critical spirit that allow to value and take part in a case by different explanations, theories and hypotheses for the same ecological event.
- Know the main scientific techniques and methods used in ecological research, which allow students to analyze data and draw their own results and conclusions.
- Know the relationships between ecology and certain processes in our society, be able to perceive the human action on the environment and understand the need to protect and conserve our environment.
- Search and handle information sources (bibliographic documentation). Through this activity, the student becomes more independent in his/her continuous education.
- Acquire observation and methodological rigor habits, and appreciation of coherence and realism.
- Identify, know and be able to apply the basic statistical and computational methods that are used in these sciences.
- Be able to transfer ecological knowledge to the resolution of applied problems, as well as to perform critical comments and use logical reasoning for different questions or problems proposed.

- Foster the spirit of research and criticism in students, which will allow them to value and take part in a case by different explanations, theories and hypotheses for the same ecological event and reasonably acquire a personal criteria of interpretation about the information taught by the lecturer, while they develop their intellectual curiosity, accepting the limits of knowledge and showing consideration for the work of other specialists.
- Students are intended to learn how to deal appropriately with the environment.

Specific skills

Learn how to analyze, model and predict the functioning ecological systems.
Learn techniques, protocols and strategies to obtain information from the natural environment.
Propose, discuss and solve ecological problems.
Gain the ability to view the functioning of nature from a systemic perspective.

Contents of the module

Theory

- 1.- Primary production and biomass in terrestrial ecosystems
- 2.- Primary production and biomass in aquatic ecosystems
- 3.- Consumers. Secondary production, animal biomass and energy flow in the trophic network.
- 4.- Decomposition and its role in nutrient regeneration
- 5.- Diversity
- 6.- The cycles of matter
- 7.- The ecosystem in time. Paces, fluctuations and succession
- 8.- The ecosystem in space. Landscape ecology

Numerical questions

- 1.- Data analysis: Multivariate. Management and Classification.
- 2.- Determination of biodiversity and diversity.
- 3.- Estimación of primary production in aquatic ecosystems.
- 4.- Estimación of secondary production.
- 6.- Energy flow through the trophic network.

Practicals

- 1.- Visit to the Doñana National Park
- 2.- Multivariate methods: Management and Classification.
- 3.- Sampling of an aquatic ecosystem.
- 4.- Estimation of the primary production of an aquatic ecosystem.
- 5.- Analysis and interpretation of phytoplankton and zooplankton.

Learning Activities

THEORY LECTURES

Attending hours: 30
Non-attending hours: 65

Teaching-learning methodology:

- Presentation of concepts. The students may prepare and present specific aspects of the module to their classmates.

- Self-evaluation activities. Revised questionnaires will be available to the students at WebCT
- Presentation of seminars. The students may present a seminar proposed by the lecturer to go in greater depth into the aspects studied in each section of the module.
- Practical assignments. These may be performed individually or in pairs.

Skills developed:

-Learn how to analyze, model and predict the functioning ecological systems.
-Learn techniques, protocols and strategies to obtain information from the natural environment.
-Propose, discuss and solve ecological problems.
-Gain the ability to view the functioning of nature from a systemic perspective.

LABORATORY PRACTICALS

Attending hours: 6
Non-attending hours: 0

Skills developed:

-Learn how to analyze, model and predict the functioning ecological systems.
-Learn techniques, protocols and strategies to obtain information from the natural environment.
-Propose, discuss and solve ecological problems.
-Gain the ability to view the functioning of nature from a systemic perspective.

COMPUTER PRACTICALS

Attending hours: 2
Non-attending hours: 0

Skills developed:

-Learn how to analyze, model and predict the functioning ecological systems.
-Learn techniques, protocols and strategies to obtain information from the natural environment.
-Propose, discuss and solve ecological problems.
-Gain the ability to view the functioning of nature from a systemic perspective.

FIELD PRACTICALS

Attending hours: 12
Non-attending hours: 0

Skills developed

-Learn how to analyze, model and predict the functioning ecological systems.
-Learn techniques, protocols and strategies to obtain information from the natural environment.
-Propose, discuss and solve ecological problems.
-Gain the ability to view the functioning of nature from a systemic perspective.

NUMERICAL QUESTIONS

Attending hours: 10
Non-attending hours: 25

Skills developed

-Learn how to analyze, model and predict the functioning ecological systems.
-Learn techniques, protocols and strategies to obtain information from the natural environment.
-Propose, discuss and solve ecological problems.

-Gain the ability to view the functioning of nature from a systemic perspective.

Evaluation systems and criteria

There will be an exam about the theory section, which must be passed.
Essay questions, short questions, reasoning and problem questions and multiple-choice questions.
The academic activities will be reflected in the final mark as long as the exam is passed.
There will be an exam about the problems section, which must be passed.
Diverse problems to be solved satisfactorily.
The academic activities will be reflected in the final mark as long as the exam is passed.
There will be an exam about the practical section of the module (in case this section was not passed through the practical sessions), which must be passed.
Essay questions, reasoning questions, short questions and multiple-choice questions about the matter of the module.
The academic activities will be reflected in the final mark as long as the exam is passed

Module	Microbiology I
Certification	Degree in Biology
Code	1530047
Stage	3
Type	Compulsory
Duration	Four months (First term)
Total Credits	6
Theory Credits	4.5
Practicals credits	1.5
Department	MICROBIOLOGY (FACULTY OF BIOLOGY)

Lecturers

- BELLOGIN IZQUIERDO, RAMON ANDRES
- CALVO RUIZ, PURIFICACION
- CRESPO RIVAS, JUAN CARLOS
- JIMENEZ GUERRERO, IRENE
- LOPEZ BAENA, FRANCISCO JAVIER
- TORRES RUEDA, ANTONIO ILDEFONSO
- VINARDELL GONZALEZ, JOSE MARIA

Module program

Specific teaching objectives

- Acquire knowledge of the historical development of Microbiology and the situation of microorganisms in the living world.
- Know the general characteristics of prokaryotes and the observation, culture and conservation methods.
- Know in detail the prokaryotic cell structure.
- Know the characteristics of prokaryote metabolism.
- Know the processes of prokaryote growth and the factors that influence it.
- Acquire knowledge of the genetics of prokaryotes and the mechanisms of genetic material transfer.
- Know the taxonomy of prokaryotes.
- Acquire basic knowledge of viruses.
- Know the main groups of eukaryotic microorganisms.

Specific skills

- Training in the study of prokaryotic microorganisms in natural samples.
- Problem solving in Microbiology.
- Use of basic equipment in a Microbiology laboratory.
- Preparation of culture media.
- Observation and handling of microorganisms.

- Know how prokaryotic populations grow and how this growth is controlled.

Contents of the module

- SECTION I: Introduction
- SECTION II: Structure of prokaryotes I: Superficial components
- SECTION III: Structure of prokaryotes II: Internal components
- SECTION IV: Metabolism of prokaryotes
- SECTION V: Prokaryote growth and its control
- SECTION VI: Genetics of prokaryotes
- SECTION VII: Taxonomy and evolution
- SECTION VIII: Introduction to viruses
- SECTION IX: Eukaryotic microorganisms

Learning activities

THEORY LECTURES

Attending hours: 36

Non-attending hours: 70

Teaching-learning methodology:

Attendance to the theory lectures will be voluntary. These will be taught in one hour sessions, three days a week during the first term. They will be master lectures in which the participation of the students will be encouraged.

Skills developed:

- Basic general knowledge.
- Analysis and synthesis ability.
- Self-learning and teamwork.
- Judgment and self-judgment abilities.
- General training as a future professional in Biology.
- Ability to search scientific information and value it in a critical way.
- Know the social aspects of this science.
- Fluidity and proper use of the oral and written communication.

PRESENTATIONS AND SEMINARS

Attending hours: 9

Non-attending hours: 10

Teaching-learning methodology

The students will be distributed in small groups. Each group will prepare one of the topics proposed at the beginning of the course and one of the members of the group, chosen at random, will present it in 20 minutes. After the presentation, there will be a session of questions and debate regarding the topic presented.

Skills developed

- Analysis and synthesis ability.
- Self-learning and teamwork.
- Judgment and self-judgment abilities.

- General training as a future professional in Biology.
- Ability to search scientific information and value it in a critical way.
- Ability to apply theory to practice.
- Know the social aspects of this science.

LABORATORY PRACTICALS

Attending hours: 15

Non-attending hours: 10

Teaching-learning methodology

The techniques to be carried out will be explained in the blackboard and then in the corresponding practical. The work will be performed individually.

Skills developed

- Problem solving in Microbiology.
- Use of basic equipment in a Microbiology laboratory.
- Observation and handling of microorganisms.
- How to study the growth of microorganisms.
- Know how to control the growth of microorganisms.

Evaluation systems and criteria

Exams will be held about the theory and practical contents of the module, and also the attendance to the lectures and the performance of the diverse activities will be considered.

Exams

- 2 half-term exams of the theory contents of the module. These half-term exams will discharge the students of subject matter if they obtain at least 4.5 points over 10.
- 1 final exam of the non-discharged subject matter or to raise the mark obtained in 1 or both half-term exams.
- 1 practical exam, passed with at least 5 points over 10.

In order to pass the module, the students are required to obtain at least 4.5 points over 10 in the theory part, 5 points over 10 in the practicals, and the sum of the marks of all the activities (theory, practicals, attendance and other activities) must be equal to or higher than 5 over 10.

$T \times 0.65 + P \times 0.25 + O \times 0.1 + A \times 0.5$

T= theory mark over 10 points.
P= practicals mark over 10 points.
O= other activities mark over 10 points.
A= attendance (up to 0.5 points).

Module	Microbiology II
Certification	Degree in Biology
Code	1530048
Stage	3
Type	Compulsory
Duration	Four months (Second term)
Total Credits	6
Theory Credits	4.5
Practicals Credits	1.5
Department	MICROBIOLOGY (FACULTY OF BIOLOGY)

Lecturers

- BELLOGIN IZQUIERDO, RAMON ANDRES
- ESPUNY GOMEZ, MARIA DEL ROSARIO
- LIMON MORTES, MARIA CRISTINA
- ROMERO PORTILLO, FRANCISCO
- VINARDELL GONZALEZ, JOSE MARIA

Module program

Specific teaching objectives

- Know the taxonomic diversity of prokaryotes.
- Know the general characteristics of the different groups of prokaryotes.
- Know the metabolic characteristics of the main groups of prokaryotes.
- Know the physiological diversity of prokaryotes, with preferential attention to the activities of special interest in Biology.
- Acquire basic knowledge of viruses and the infection mechanisms of both bacteria and eukaryotes.
- Know the distribution and ecological diversity of microorganisms, and their relationship with other living beings.
- Know the usefulness of microorganisms in industry and biotechnology.

Specific skills

-Training in the study of prokaryotic microorganisms in natural samples.
- Problem solving in Microbiology.
- Use of basic equipment in a Microbiology laboratory.
- Observation and handling of microorganisms.
- Identification of microorganisms through biochemical techniques.
- Know the interaction mechanisms of phages with bacteria.

Contents of the module

- SECTION I: Photosynthetic bacteria

- SECTION II: Chemolithotrophic, methanotrophic and metylotrophic bacteria
- SECTION III: Aerobic proteobacteria
- SECTION IV: Facultatively aerobic and anaerobic proteobacteria
- SECTION V: Other diverse bacterial groups
- SECTION VI: Gram-positive bacteria
- SECTION VII: Archaea
- SECTION VIII: Virology
- SECTION IX: Microorganism-host interactions
- SECTION X: Applied microbiology

Learning activities

THEORY LECTURES

Attending hours: 38

Non-attending hours: 80

Teaching-learning methodology

Attendance to the theory lectures will be voluntary. These will be taught in one hour sessions, three days a week during the first term. They will be master lectures in which the participation of the students will be encouraged.

Skills developed

- Basic general knowledge.
- Analysis and synthesis ability.
- Self-learning and teamwork.
- Judgment and self-judgment abilities.
- General training as a future professional in Biology.
- Ability to search scientific information and value it in a critical way.
- Know the social aspects of this science.
- Fluidity and proper use of the oral and written communication.

LABORATORY PRACTICALS

Attending hours: 15

Non-attending hours: 6

Teaching-learning methodology

The techniques to be carried out will be explained in the blackboard and then in the corresponding practical. The work will be performed individually.

Skills developed

-Problem solving in Microbiology.
- Use of basic equipment in a Microbiology laboratory.
- Observation and handling of microorganisms.
- Identification of microorganisms through biochemical techniques.
- Know the interaction mechanisms of phages with bacteria.

GUIDED ACADEMIC ACTIVITIES IN THE PRESENCE OF THE LECTURER

Attending hours: 7

Non-attending hours: 4

Teaching-learning methodology

Diverse activities involving the search of answers to questions asked in the lecture theater and which the students will have to find in the bibliography, comment articles of microbiology journals, etc… with the subsequent debate.

Skills developed

- Analysis and synthesis ability.
- Self-learning and teamwork.
- Judgment and self-judgment abilities.
- General training as a future professional in Biology.
- Ability to search scientific information and value it in a critical way.
- Ability to apply theory to practice.
- Know the social aspects of this science.
- Fluidity and proper use of the oral and written communication.

Evaluation systems and criteria

Exams will be held about the theory and practical contents of the module, and also the attendance to the lectures and the performance of the diverse activities will be considered.

- 2 half-term exams of the theory contents of the module. These half-term exams will discharge the students of subject matter if they obtain at least 4.5 points over 10.
- 1 final exam of the non-discharged subject matter or to raise the mark obtained in 1 or both half-term exams.
- 1 practical exam, passed with at least 5 points over 10.

In order to pass the module, the students are required to obtain at least 4.5 points over 10 in the theory part, 5 points over 10 in the practicals, and the sum of the marks of all the activities (theory, practicals, attendance and other activities) must be equal to or higher than 5 over 10.

$T \times 0.65 + P \times 0.25 + O \times 0.1 + A \times 0.5$

T= theory mark over 10 points.
P= practicals mark over 10 points.
O= other activities mark over 10 points.
A= attendance (up to 0.5 points).

Module	Plant Physiology
Certification	Degree in Biology
Stage	3
Type	Compulsory
Duration	Annual
Total Credits	12
Theory Credits	9
Practicals Credits	3
Department	PLANT BIOLOGY AND ECOLOGY (FACULTY OF BIOLOGY)

Lecturers

- ALVAREZ MORALES, MARIA ROSARIO
- ECHEVARRIA RUIZ DE VARGAS, CRISTINA
- FERIA BOURRELLIER, ANA BELEN
- GARCIA-MAURIÑO RUIZ-BERDEJO, SOFIA
- MONREAL HERMOSO, JOSE A
- RODRIGUEZ DOMINGUEZ, CELIA MODESTA
- RUBIO CASAL, ALFREDO E.
- RUIZ BALLESTA, ISABEL MARIA

Module program

Specific teaching objectives

The general objective of Plant Physiology is that the student knows, in an actualized way, what a plant organism is and how it works. This objective is specified in the following aspects:

Conceptual objectives:

-Knowledge on the fundamental characteristics of plants: autotrophy, photosynthesis, water and nutrient absorption. -Knowledge on plant structure, organization, growth, regulation of processes and interaction with the environment.

Procedural objectives:

-Use of basic technical means and laboratory equipment in Plant Physiology, analysis of data and resolution of problems proposed on plant experimentation. Drafting and presentation of results, regarding the updated literature.

Attitudinal objectives:

-Develop self-learning skills, the willingness to work as a team, ability to analyze and comment scientific contents and experimental results.

Specific skills:

- Apply the basic principles of the scientific thinking and method.
- Know how to gather information from the observation of plants, the functional processes they develop and the interactions established between them.
- Value the environmental aspects of the different groups of live organisms (plants).
- Use the basic terminology required to gain knowledge in the field of Plant Physiology.

- Know the function of each one of the organic systems and their interaction.
- Carry out functional assays and determine vital parameters.
- Analyze the influence of environmental factors on photosynthesis and plant production.
- In vivo and in vitro control of biological processes of plants.
- Diagnose the hydric and nutritional status of plants.
- Know how to perform fundamental, practical applications of plant hormones to control the physiology of the plant.
- Carry out advisory services related to Plant Biology.
- Know the pharmacological and industrial uses of plants and their components
- Know the signaling mechanisms of plant cells.
- Know the Developmental Biology.
- Know the structure and function of plant genomes.
- Understand, at a molecular level, the response of plants to different types of stress.
- Understand the basic techniques for the genetic transformation of plants and the generation of transgenic organisms.
- Know the use of biotechnology in plant improvement.
- Acquire a solid theory base on the functional and molecular processes that govern the functioning of plants.

Contents of the module

Theory program

- **INTRODUCTION**
  1. Plant Physiology
  2. The plant cell. The cell wall
- **WATER AND PLANTS**
  3. Water inside plant cells. Hydric potential and its components
  4. Water in soil. Absorption and transport of water in plants
  5. Transpiration. Stomas: opening-closing mechanisms and their regulation
- **NUTRITION AND SOLUTE TRANSPORT**
  6. Mineral nutrition
  7. Absorption and transport of mineral nutrients
  8. Transport within the phloem
- **PHOTOSYNTHESIS AND METABOLISM**
  9. Photosynthetic pigments
  10. Photochemical reactions. Reaction centers. Photosystems
  11. Photosynthetic electron transport. Photophosphorylation
  12. CO_2 fixation via the Calvin cycle. Biosynthesis of saccharose and starch
  13. Photorespiration
  14. Other pathways of CO_2 fixation: the C4 pathway and the Crassualcean Acid Metabolism (CAM)
  15. Photosynthesis under natural conditions
  16. Respiration in plants
  17. Nitrogen and sulfur fixation

18. Secondary metabolism

- **GROWTH REGULATION IN PLANTS**

19. Plant hormones: auxins, gibberellins, cytokinins, abscisic acid and ethylene. Physiological effects. Mechanisms of action
20. Phytochrome and photomorphogenesis
21. Plant movement: tropisms and nasties
22. Physiology of the flowering process
23. Physiology of stress: biotic and abiotic

Program of practicals

The practical knowledge and skills are organized through the performance of a short scientific project, in which the student will become familiar with real problems, functioning dynamics, equipment and protocols of a general laboratory of Plant Physiology.
The title of the practical training project is: "**Determination of the photosynthetic metabolism of higher plant**" and consists of the following contents:

1) Theory introduction and project presentation.
2) Visualization of the photosynthetic structure of leaves. Kranz anatomy determination in leave cuts.
3) Pot planting and preparation of nutritive solution for plants.
4) Preparation of plant samples for: i) enzyme determination: measure the activity of phosphoenolpyruvate carboxylase and its regulation by metabolites; ii) chlorophyll determination and iii) organic acid measurement.
5) Protein pattern analyses in acrylamide gels: protein pattern analyses of leaves in SDS-acrylamide gel electrophoresis: preparation, development, processing and gel drying.
6) Determination of the hydric content of plant material: determination of the mesophyll´s succulence index.
7) Titration of organic acids in plant samples: determination of organic acids fluctuation in succulent plants.
8) Use of basic laboratory equipment. Microscopes and magnifiers, pHmeters, centrifuges, scales, thermostatic baths, drying ovens, spectrophotometers and general laboratory material.
9) Drafting, presentation and discussion of results.

Learning activities

THEORY LECTURES

Attending hours: 88
Non-attending hours: 135

Teaching-learning methodology

The theory will be taught in master lectures at which each lecturer, depending on his/her teaching project, will devote some time to encourage the students to participate through seminars, questionnaires, discussions and problem solving. Each lecture will be backed up with the projection of slides or videos that will be previously distributed as a dossier of photocopies and will be available to the students through the virtual teaching platform webCT of the University of Seville. In any case, the students are recommended to periodically use the bibliographic references provided, as well as to make use of the tutorship sessions.

Skills developed

- Develop de ability to gather and interpret relevant data within the field of Biology in order to make judgments that include a reflection about relevant issues of scientific, social or ethical character.
- Transmit information, ideas, problems and solutions of the field of Biology to both a specialized audience and to a non-specialized audience.
- Develop the learning skills required to undertake further studies with a high degree of autonomy.

- Develop critical attitudes based on knowledge.
- Acquire organization, planning and teamwork skills.
- Acquire oral and written communication within the scientific context, both in spanish and in a foreign language, important for the profession.
- Use the information sources in the field of Biosciences.
- Apply the basic principles of the scientific thinking and method.
- Know how to gather information from the observation of plants, the functional processes they develop and the interactions established between them.
- Value the environmental aspects of the different groups of live organisms (plants).
- Value the social aspects of the biological reseach.
- Use the basic terminology required to gain knowledge in the field of Plant Physiology.
- Know the function of each one of the organic systems and their interaction.
- Carry out functional assays and determine vital parameters.
- Analyze the influence of environmental factors on photosynthesis and plant production.
- In vivo and in vitro control of biological processes of plants.
- Diagnose the hydric and nutritional status of plants.
- Carry out advisory services related to Plant Biology.
- Know the pharmacological and industrial uses of plants and their components
- Know the signaling mechanisms of plant cells.
- Know the structure and function of plant genomes.
- Acquire a solid theory base on the functional and molecular processes that govern the functioning of plants.
- Know the functional characteristics of living beings provided for research, teaching and exploitation of results.

PRESENTATIONS AND SEMINARS

Attending hours: 2

Non-attending hours: 3

Teaching-learning methodology

If proposed by the lecturer, those students who desire to perform a seminar may do so within the hours scheduled for the theory lectures. This activity will be considered as a complementary activity and the evaluation, topics proposed and presentation will be described in the teaching projects of each lecturer.

Skills developed

- Develop de ability to gather and interpret relevant data within the field of Biology in order to make judgments that include a reflection about relevant issues of scientific, social or ethical character.
- Transmit information, ideas, problems and solutions of the field of Biology to both a specialized audience and to a non-specialized audience.
- Develop the learning skills required to undertake further studies with a high degree of autonomy.
- Develop critical attitudes based on knowledge.
- Acquire organization, planning and teamwork skills.
- Acquire oral and written communication within the scientific context, both in spanish and in a foreign language, important for the profession.
- Use the information sources in the field of Biosciences.
- Use the basic terminology required to gain knowledge in the field of Plant Physiology.
- Acquire a solid theory base on the functional and molecular processes that govern the functioning of plants.
- Know the functional characteristics of living beings that allow research, teaching and exploitation of results.

LABORATORY PRACTICALS

Attending hours: 28
Non-attending hours: 30.6

Teaching-learning methodology

The practical knowledge and skills are organized through the performance of a short scientific project, in which the student will become familiar with real problems, functioning dynamics, equipment and protocols of a general laboratory of Plant Physiology.

The title of the practical training project is: “Determination of the photosynthetic metabolism of higher plant”. This research project will be carried out in the laboratories of the Green Building of the Biology Department. It will be developed intensively, two days a week for three consecutive weeks, a total of 6 practical sessions, at which a Plant Physiology laboratory, fully equipped, will be available to students. The students will be given a work protocol they will have to perform throughout the 6 practical sessions, for which it would be important to show initiative and common sense. There will be a side lecturer who will start each practical session with a briefing of the theory and practical aspects to be developed throughout the 6 sessions. Once completed the theory introduction, the laboratory work will begin.

Skills developed

- Develop de ability to gather and interpret relevant data within the field of Biology in order to make judgments that include a reflection about relevant issues of scientific, social or ethical character.
- Develop the learning skills required to undertake further studies with a high degree of autonomy.
- Develop critical attitudes based on knowledge.
- Acquire organization, planning and teamwork skills.
- Acquire oral and written communication within the scientific context, both in spanish and in a foreign language, important for the profession.
- Use the information sources in the field of Biosciences.
- Apply the basic principles of the scientific thinking and method
- Know how to gather information from the observation of plants, the functional processes they develop and the interactions established between them.
- Use the basic terminology required to gain knowledge in the field of Plant Physiology.
- Carry out functional assays and determine vital parameters.
- Analyze the influence of environmental factors on photosynthesis and plant production.
- Diagnose the hydric and nutritional status of plants.
- Understand, at a molecular level, the response of plants to different types of stress.
- Know the functional characteristics of living beings that allow research, teaching and exploitation of results.

SEMINARS AND OTHER COMPLEMENTARY ACTIVITIES

Attending hours: 2
Non-attending hours: 4.2

Teaching-learning methodology:

The complementary activities, such as problem solving and discussion, will be performed within the lectures schedule and will be specified in the teaching projects of each lecturer.

Skills developed

- Develop critical attitudes based on knowledge.
- Use the information sources in the field of Biosciences.
- Know how to gather information from the observation of plants, the functional processes they develop and the interactions established between them.
- Use the basic terminology required to gain knowledge in the field of Plant Physiology.

Evaluation systems and criteria

Multiple-choice test and short essay questions.

Evaluation of the module

There will be one theory exam and one practical exam. The score of the theory section will represent 70% of the final mark and 30% will correspond to the practicals. The module will be passed with a final mark of 5 over a maximum of 10, and both exams will be compensative with a minimum score of 4. The score or the midterm and practical exams passed, and the scores of the complementary activities will remain until the next examination session in September or December.

Evaluation of the theory section:

All the groups will perform two partial written exercises, which will discharge those students who pass it with a score of 5 or above. In order to pass the whole matter of the module, the two midterm exams will compensate each other as long as their scores are 4 or above. The theory exams will consist of 50 multiple-choice questions and two short essay questions, which will represent 70% and 30% of the final mark, respectively.

Evaluation of the practical section:

Attendance to the practicals will be compulsory. The practicals will be evaluated through an exam of 50 multiple-choice questions and an essay section that will consist of a set of problems and practical cases or the performance of results with a scientific publishing format. Each part of the exam will represent 50% of the mark. The practical exam will take place within the hours scheduled for the practical lectures. Those students who do not pass this exam may resit for it in the final exam. The exam will be passed with a score of 5 and will only compensate the mark of the theory section with a score of 4 or above. Those students who do not pass the module must retake the practical exam in the next academic year, although retaking the practical sessions is not compulsory.

Evaluation of questions, seminars and other complementary activities:

These complementary activities performed in each group and each midterm exam will be performed within the hours scheduled for the lectures, depending on each lecturer´s demand, and will complement the mark of the theory section.

The final exam or official examination sessions:

At the examination sessions of June-July, September or December, the exam of the module will consist of one theory exam and one practical exam. The theory exam will include 50 multiple-choice questions and two short essay questions for each one of the midterm exams. Those students who did not pass the practical exam may resit for it at the final exam. This practical exam will have the same characteristics as the one described in the section of practical exam. Both the theory and practicals will be passed with a minimum score of 5. In order to pass the whole matter of the module, the two midterm exams and the mark obtained in the practicals will compensate each other as long as their scores are 4 or above. The mark of the midterm exams and practicals passed will remain until the next examination sessions of September or December. Those students who want to obtain a higher score they may do so at the final exam. In the latter case, they must apply for it and renounce the former mark. Passing the module at the official examination session cannot be waived.

Module	Immunology
Certification	Degree in Biology
Code	1530021
Stage	3
Type	Elective
Duration	Four months (First term)
Total Credits	6
Theory Credits	4
Practicals Credits	2
Department	MEDICAL BIOCHEMISTRY AND MOLECULAR BIOLOGY (FACULTY OF MEDICINE)

Lecturer

- MALDONADO Y AIBAR, MARIA DOLORES

Module Program

Specific teaching objectives

- Know the fundamental basis of the innate and adaptive immune responses, and the cells organs and tissues involved. - Learn the maturation process of the cells of the immune system and the mechanisms of central and peripheral self-tolerance.
- Know the structure and function of antibodies and the mechanism that generate their diversity.
- Analyze the processing of antigens and activation of the defensive response.
- Know and weigh up the role of MHC, its genetics, and its relevance at antigen presentation.
- Analyze the communication system, cytokines and chemokines between immune system cells and between the immune system and other systems related.
- Know the coordinated functioning and defensive strategies against bacterial, viral, parasitic and fungal infections. The evasion mechanisms of these pathogens against the immune system and the purpose of vaccines at prevention.

Know the basic principles of immunopathology: immunodeficiencies, autoimmunity, hypersensitivity reactions and cancer.

Specific skills

Students are expected to acquire the basic knowledge, abilities and skills to the practice of Immunology, both in the field of research and medicine or industry.

CONTENTS OF THE MODULE

Theory program

- **WELCOME**

  0. Welcome lecture:

  0.1. Description of the module program.
  0.2. Methodology of the lectures.
  0.3. Methodology of evaluation and qualification system.
  0.3.1. Scheduled examination dates.
  0.3.2. Exam model.

0.4. Class dynamics and environment.
0.5. Attending and on-line tutorship sessions.
0.6. E-learning for Immunology.

- **INTRODUCTION TO THE STUDY OF IMMUNOLOGY**

1. Concept of Immunology and characteristics:
1.1. Origin and history of Immunology
1.2.1. From the microbiological time to the serological time
1.2.2. The discovery of the chemical structure of antibodies
1.2.3. Discoveries about the role of immune system cells
1.2.4. Nobel prizes in Immunology
1.2. Why is it important to study Immunology?
1.3. Influence areas of Immunology
1.3.1. Transplantation, autoimmuny and biotechnology
2. General properties of immune responses:
2.1. Innate and adaptive (or acquired) immune response
2.2. Natural (or innate) immunity, defensive barriers:
-Physical or anatomical barriers
-Biochemical barriers
-Phagocytic barrier: cells and soluble factors involved (the complement)
-Inflammatory barrier: inflammation process, beneficial and harmful aspects
2.3. Molecular structures of innate immunity: PRR and PAMP
2.4. Recognition of self molecules by the innate immune system
3. Specific or acquired immune response (characteristics):
3.1. Types of specific immune responses: humoral and cellular
3.2. Stages of the immune response
3.3. B lymphocytes: antibody producers and humoral immunity mediators
3.4. T lymphocytes: cell immunity mediators. Types and biological functions
3.5. Clonal selection hypothesis
4. Characteristics and functions of the immune system cells:
4.1. Hematopoiesis.
4.2. Lymphocytos: development and heterogenicity
4.3. Clusters of differentiation (CD) and their purpose
4.4. Mononuclear phagocytes (Monocytes): development, activation and function
4.5. Antigen-presenting cells
4.6. Natural killer (NK) cells
4.6. PMN phagocytes: neutrophils, eosinophils, masto cells and basophils
5. Functional anatomy of the lymphoid organs:
5.1. Primary or generator lymphoid organs: Órganos linfoides primarios ó generadores: bone marrow and thymus
5.2. Secondary or peripheral lymphoid organs: lymph nodes, spleen and mucosa-associated lymphoid tissue

- **II. ANTIGEN RECOGNITION: CELLS AND MOLECULES INVOLVED**

6. Antibody structure and function:

6.1. Biosynthesis of antibodies
6.2. Basic structure of antibodies:
- Light and heavy chains
- Variable and constant regions
- Molecular domains
- Hypervariable regions
- Spatial structure of antibodies

6.3. Antigenic variations of antibodies: isotypes, allotypes and idiotypes
6.4. Characteristics of the main isotypes
6.5. Distribution and purification of antibodies
6.6. Monoclonal antibodies and their uses

7. Antibody-antigen interaction:

7.1. Structural characteristics of biological antigens
-Concept of antigen, immunogen and hapten
-Factors on which the immunogenecity of an antigen depends
-Concept of adjuvant
-Antigen determinants and their types
7.2. Classificacion of antigens
7.3. Structural basis of antigen binding
-Forces involved in antigen-antibody binding
7.4. Affinity, avidity and specificity
7.5. Biological functions of antibodies
-Functions of antibodies as membrane receptors
-Functions of antibodies as secreted forms
7.6. Cellular receptors for the Fc portion of immunoglobulins IgG, A and E.

8. The complement system:

8.1. Concept and nomenclature of its components
8.2. General characteristics of the complement activation
-Classical pathway activation
-Alternative pathway activation
-Lectins pathway activation
-Lytic phase common to all activation pathways
8.3. Activation regulation
8.4. Biological functions and alterations of the complement

9. Development of B lymphocytes and generation of the diversity of antibodies:

9.1. B lymphocytes maturation and the hormonal context of the bone marrow
9.2. Organization of immunoglobulin genes in germ line cells

9.3. Sequence and mechanisms of the realignment of immunoglobulin genes
9.4. Productive and unproductive realignments
9.5. Processes involved in the generation of the repertoire of antibodies
10. Expression of the different types of immunoglobulins:
10.1. Surface and secreted immunoglobulins
10.2. Immunoglobulin type change
10.3. Somatic mutations and affinity maturation
10.4. Transcriptional and translational control of the production of antibodies
10.5. Other surface molecules of B lymphocytes
11. Generation of the repertoire of T lymphocytes and self-tolerance:
11.1. Migration and development of T cells in the thymus
11.2. Subpopulations of lymphocytes and markers depending on the different stages of maturation
11.3. T cell receptor genes:
-Organization in germ line
-Realignment and generation of the diversity
11.4. Ontogeny of the expression of TCR and accessory molecules TCR
11.5. Possitive and negative selection of T lymphocytes in the thymus
11.6. Regulator T lymphocytes
12. Major Histocompatibility Complex (MHC):
12.1. Concept, role and relevance
12.2. Structure and distribution of class I and II MHC molecules
12.3. Binding of peptides to class I and II molecules
12.4. Organization and polymorphism of MHC genes
12.5. MHC in human (HLA) and in mouse (H2)
12.6. Expression and regulation of MHC molecules
12.7. Transcription factors
13. Antigen receptor of T cells (TCR):
13.1. Structure, characteristics and types of TCR (alpha and beta genes, and gamma and delta genes)
13.2. Differences between T and B cells receptors
13.3. Role of alpha and beta TCR in antigen recognition with MHC
13.4. Components of the TCR complex
14. Antigen recognition and presentation to T lymphocytes:
14.1. Antigen-presenting cells
14.2. Characteristics of antigen presentation and processing
14.3. Restriction of T lymphocytes by self MHC
14.4. Mechanisms of antigen presentation to CD4 and CD8 cells
14.5. Physiological significance of antigen presentation associated to MHC
15. Accessory molecules of T cells: Immunological synapse and leukocyte trafficking:
15.1. Concept and characteristics of these molecules

15.2. Co-receptors CD4 and CD8, structure and function
15.3. Co-stimulators CD28/CTLA-4 and B7, structure and function
15.4. Adhesion molecules: integrins, adresins and Ig superfamily
15.5. Other accessory molecules involved in cell to cell adhesion

- **III. LYMPHOCYTE PROCESSING AND ACTIVATION**

16. Activation of the innate immune response:
16.1. Components of the innate immune response
16.2. Recognition of foreign matter by the innate immune system
16.3. Phagocytosis of microorganisms
16.4. Cytokines in the innate response
16.5. Other cellular components of the innate response: NK cells and dendritic cells
16.6. Local inflammatory reaction
16.7. Communication between innate and specific immune response

17. Activation of T cells:
17.1. Activation of T virgin and memory lymphocytes
17.2. Role of co-stimulator molecules in T activation
17.3. Signal transmission by the TCR complex
17.4. Membrane events:
-Activation of protein tyrosine kinases PTKs and adaptor proteins
-Inositol-phospholipid metabolism
17.5. Activation of cytoplasmic pathways of signal transmission:
-Ras-Map kinases pathway
-Rac-SAP-kinases pathway
-Activation of protein kinase C (PKC)
-Activation of calcineurin
17.6. Activation of transcription factors: c-fos, IL-2, alpha IL-2r
17.7. T cell proliferation and production of effector cells CD4 (Th1,2 and 17) and CD8

18. Activation of B cells and production of antibodies:
18.1. The humoral immune response and its general characteristics
18.2. Primary and secondary humoral immune response
18.3. Antigen recognition and activation of B lymphocytes
18.4. Signal transmission by the complex-antigen receptor of B cells
18.5. Antigen presentation by B cells to T cells and production of antibodies
18.6. Cytokines that regulate the response mediated by antibodies
18.7. Development of the germinal center: somatic hypermutation and affinity maturation
18.8. Thymus-independent antigens

- **IV. EFFECTOR MECHANISMS OF THE IMMUNE RESPONSE**

19. Effector mechanismos of the cellular immune response
19.1. Effector T lymphocytes

19.2. Cooperator lymphocytes: Th1,Th2 and Th17. Differentiation and functions
19.3. Cytokines: Concept and general characteristics
19.4. Cytokine receptor family and signal transmission
19.5. Cytokines of natural immunity
19.6. Cytokines of specific immunity
19.7. Hematopoietic cytokines

20. Cell-mediated cytotoxicity

20.1. Typos of immune response mediated by T cells
20.2. Functions of cytokines in cell-mediated immunity
20.3. Delayed Type Hypersensitivity (DTH), concept and stages of the response
-Recognition and activation stage
-Effector stage: inflammation and macrophage activation
20.4. Cytotoxic T lymphocytes, concept and functions
- Activation and differentiation
- Mechanisms of lysis
20.5. The role of Th2 cells in the regulation of cell-mediated immunity
20.6. NK cells

21. Effector mechanisms of the humoral immune response

21.1. Effector molecules of the humoral immune response: antibodies
21.2. Primary and secondary responses of antibodies
21.3. Neutralization of viruses, bacteria and toxins.
21.4. Antibody-mediated opsonization and phagocytosis
21.5. Antibodies in phagocytosis
21.6. Antibody-dependent cell-mediated cytotoxicity (ADCC).
21.7. IgE-mediated activation of accessory cells
21.8. IgA transport through the epithelium
21.9. Neonatal immunity

22. The immune system in action: immune response to microorganisms:

22.1. General characteristics and pathogen nature
22.2. Evasion strategies of microorganisms against the immune system
22.3. Immunity against extracellular and intracellular bacteria
22.4. Immunity against viruses
22.5. Immunity against parasites: protozoa and helminths
22.6. Immunity against fungi

◆ **BLOCK IV. IMMUNOPATHOLOGY**

23. Hypersensitibity reactions: types and general concepts:

23.1. Type I hypersensitibity reactions, concept, characteristics and stages
23.2. Biology of IgE:
- High affinity receptor for the Fc of IgE

- The role of IgE in allergy
- Factors that influence allergy
- Possible causes of the increase of allergies in developed countries
23.3. Biology of mast cells, basophyls and eosinophyls
- Signaling pathways
- Mediators of the granules of these cells
23.4. Mechanisms and treatments of some allergic manifestations
24. Type II-IV hypersensitivity reactions:
24.1. Type II hypersensitibity reactions and related diseases
24.2. Type III hypersensitibity reactions and diseases by immune complexes
24.3. Type IV or delayed hypersensitibity reactions. Intradermal tests
25. Immunodeficiencies. Concept, classification and consequencies:
25.1. Primary or congenital immunodeficiencies. Example diseases
25.2. Secondary or acquired immunodeficiencies. Example diseases
26. The immune system against the Human Immunodeficiency Virus (HIV):
26.1. Molecular characteristics and mechanisms of action of the virus
26.2. Pathogeny and transmission of the infection
26.3. Immune responses to HIV
26.4. Diagnostic, treatment and prevention
27. Immunological tolerance and autoimmune diseases:
27.1. Tolerance general characteristics and mechanisms of generation
27.2. Central and peripheral tolerance
27.3. Loss of tolerance to self tissues
27.4. Immunologically priviledged places
27.5. Autoimmune diseases: organ-specific and systematic
27.6. Relationship between HLA and autoimmunity
27.8. Diagnostics and treataments
28. Immunology of organ, tissue and cell transplantation:
28.1. Types of transplantation
28.2. Complications and rejections of transplants
28.3. HLA antigens and histocompatibility
28.4. Types of rejection, their prevention and treatments
28.5. Bone marrow transplantation
28.6. Histocompatibility tests
28.7. The future of transplantation
29. Antitumoral immune response:
29.1. Cancer etiology
29.2. Protection mechanisms of the immune system against cancer
29.3. The immunological surveillance theory

29.4. Specific or common antigens of cancer cells
29.5. Immunotherapy against cancer
29.6. Tumor markers and their uses
30. Immunomodulation:
30.1. The immune system and its relationship with other organs and systems around it
30.1. Positive modulation of the immune response
30.2. Negative modulation of the immune response
30.3. Biological and chemical modifiers of the immune response

Laboratory practicals program
The practicals aim to provide the students with essential complementary knowledge of the theory lectures through their active participation.
- Antigen-antibody interaction techniques: precipitation and agglutination.
- Precipitation: Ouchterlony double immunodiffusion, Mancini radial immunodiffusion, immunoelectrophoresis and nephelometry.
-Agglutination: Immuno-agglutination techniques with determination of ABO antigens, immunofluorometric techniques (flow cytometry) and immunoenzymatic techniques (ELISA).

Learning activities
THEORY LECTURES
Attending hours: 35
Non-attending hours: 52.5
Teaching-learning methodology
The lecturer will explain the theory fundamentals of the module and their medical and experimental commitments. She will propose questions and discussions within the context of the lecture.
PRESENTATIONS AND SEMINARS
Attending hours: 8
Non-attending hours: 12
Teaching-learning methodology
The lecturer will present the objectives, and orientate and monitorize the work.
LABORATORY PRACTICALS
Attending hours: 15
Non-attending hours: 22.5
Teaching-learning methodology:
The lecturer will present the objectives, and orientate and monitorize the work.

Evaluation systems and criteria
Theory lectures
There will be a final exam with 30 multiple-choice questions and 2 reserve questions, and 2 practical cases to be solved or 2 essay questions with scheme making. The final mark will be composed of the score obtained in the theory exam (75%) and the score of the practical cases or essay questions (25%): 75% + 25% = 100%.
Students will be required to pass the theory exam in order to validate this calculation. Each multiple-choice question has 5 options of which only one answer is correct. Those

multiple-choice questions wrongly answered will have a negative score; that is, every 4 multiple-choice questions failed will deduct one correct answer.
Students will have 4 days, after the exam, to ask questions about it. After this deadline, the students will not be allowed to ask about the exam.

Practical lectures

The following aspects will be considered for the evaluation of the practicals: attendance, which is compulsory; the quality of the work performed, based on the lecturer´s observation; and student´s participation in general discussion.

Seminars

The teaching innovation works will be evaluated according to the quality of the work, its oral presentation and the ability of the student to lead the debate of questions and answers derived from the final discussion. These works will increase the final mark of the student record in 2.1 and 0.5 points.

These are voluntary works, although the contents described in them may be asked in the final exam of the module.

Those students who register for these works will sign a contract accepting its basis and submitting to the times and forms established

Module	Advanced Botany
Certification	Degree in Biology
Code	1530017
Stage	3
Type	Elective
Duration	Four months (First Term)
Total Credits	6
Theory Credits	3
Practicals Credits	3
Department	PLANT BIOLOGY AND ECOLOGY (FACULTY OF BIOLOGY)

Lecturers

- ARISTA PALMERO, MONTSERRAT
- HERRERA MALIANI, FRANCISCO JAVIER
- ORTIZ BALLESTEROS, PEDRO LUIS

Module Program

Specific teaching objectives

- Obtain a perspective of the antagonistic and mutualistic interactions of plants
- Provide students with the chance to handle and study live plants in their natural environment

Specific skills

Learn how to associate shapes and functions of plant organs
Understand the evolutionary origin of plant organs

Contents of the module

- 1. Introduction: antagonistic and mutualistic interactions of plants with other organisms. History of interactions. Fossil record of plants, insects and vertebrates. Variation of herbivory types throughout time. Herbivory by vertebrates: Mesozoic, Cenozoic and Quaternary.
- 2. Why and how plants change throughout time. Concepts of selection and speciation. Types of natural selection. Evolutionary processes independent of selection. Genetic revolutions and poliploidy.
- 3. Antagonisms: fighting herbivores. Mechanical, chemical, constitutive and inducible, plant defenses. Secondary metabolism in plants: quantitative defenses (digestibility reducers) and qualitative defenses (toxins and poinsons).
  4. Antagonisms: differences between herbivory by insects and herbivory by vertebrates. Polyphagia and monophagia. How resistance to plant poisons evolve in insects. Sequestration of toxins.
- 5. Plant sexuality: why and what for. Gene flow. Sexual reproduction vs vegetative propagation. Implications for speciation. The biological concept of species.
- 6. Mutualisms: vectors of gene flow. Differences between physical agents of transport and live agents. Dynamics of particle dispersion (pollen and seeds).
- 7. Mutualismos: flores y frutos. Para qué sirven. Órganos implicados. Fisiología y ecología de la reproducción sexual.
- 8. Plant sexuality: types. Sexual (breeding) systems. Self-incompatibility (SI) systems. Gametophytic Self-Incompatibility (GSI), Sporophytic Self-Incompatibility (SSI) and

Late-acting Self-Incompatibility (LSI). Experimental techniques to elucidate the breeding system of a plant.

- 9. Mutualisms: insects and vertebrates that act as vectors of genes in plants. Requirements, diversity, distribution.
- 10. Mutualisms: field methods to study vectors. Census. Identification. Quantitative and qualitative components.
- 11. Mutualisms: decoy and reward (in flowers and fruits). Pigments, scents, nectar, pollen, pulp. Quantification methods.
- 12. Flower "syndromes", or a typology of flowers according to their pollination system.
- 13. "Syndromes" in fruits, or a typology of fruits according to their dispersion system.
- 14. The particular case of Mediterranean vegetation.

Learning Activities

THEORY LECTURES

Attending hours: 30

Non-attending hours: 45

Teaching-learning methodology

Master lectures

Skills developed

Learn how to associate shapes and functions of plant organs

Evolutionary origin of plant organs

LABORATORY PRACTICALS

Attending hours: 24

Non-attending hours: 24

Teaching-learning methodology

Experimental determination of morpho-functional characteristics in plants

Skills developed

Ability to handle plant material

Use of magnifiers and microscopes

Simple statistical analyses

FIELD PRACTICALS

Attending hours: 6

Non-attending hours: 24

Teaching-learning methodology:

Field work with live plants

Experimental study of mutualistic flower organs and insects

Skills developed:

Observation and development of a research protocol

Evaluation systems and criteria

One final exam will be performed. This will be a multiple-choice test with 100 questions. Each question will have four different choices.

The score obtained in this exam will represent 70% of the final mark. There will be no practical exam, although some questions in the final exam will be about the practicals carried out. The score obtained in the practicals (attendance to laboratory + field practicals) represents 30% of the final mark.

Qualification system. The Final Mark is calculated as: Final Mark = (0.3 x practicals score) + (0.7 x exam score)

Module	Molecular Genetics
Certification	Degree in Biology
Code	1530035
Stage	3
Type	Elective
Duration	Four months (Second term)
Total Credits	6
Theory Credits	5
Practicals Credits	1
Department	GENETICS (FACULTY OF BIOLOGY)

Lecturer

- AGUILERA LOPEZ. ANDRES

Module Program

Specific teaching objectives

The students will be able to understand how to tackle a biological problem from a genetic perspective and to apply the knowledge acquired to acquire further knowledge. It is also essential that they understand how scientific reasoning, along with experimentation, can lead to new knowledge.

The students must be able, using the available theory knowledge from a specific biological problem, to propose the adequate experiments to investigate some unknown aspect, and to interpret the results correctly. In the process, the students must learn which are the weaknesses and strengths of the scientific method in order to think critically about how scientists work.

Specific skills:

Students must:

- Acquire a solid theory base about the molecular processes that govern the functioning of living beings.
- Know the scientific methods by which this knowledge has been obtained.
- Understand the basis of the techniques used in a Molecular Biology laboratory, and the basis for the genetic improvement of microorganisms, animals and plants.
- Employ some of the basic techniques of a Molecular Biology laboratory and know the basic elements of this type of laboratory.
- Choose the adequate technique to solve the problems that may arise in the different fields of the profession.
- Evaluate the validity of the reports and results obtained with these techniques.
- Know the bibliographical sources that contain the knowledge of this field, use them with ease and, facing a specific problem, be able to establish the degree of knowledge on it and the possible ways to solve it.
- Write a scientific report adequately, which gathers the basis, the methodology followed, the results obtained and a discussion of these regarding the previous knowledge.

Students will acquire competence for:

Competence 1. Acquire a solid theory base about the molecular processes that govern the functioning of living beings.

The theory knowledge to be acquired in this module is organized in blocks (see program). At the lecture theater, each topic will be presented, the corresponding references and other academic material will be provided, some problems will be proposed to be solved autonomously by the students and some topics will also be proposed to be explained by the students in groups.

Competence 2. Know the scientific methods by which this knowledge has been obtained.
Competence 3. Understand the basis of the techniques used in a Molecular Biology laboratory, and the basis for the genetic improvement of microorganisms, animals and plants.
The relationship between the available knowledge on a certain topic and the practical way through which this knowledge was acquired will be established at both the lecture theater and the laboratory. Furthermore, it will be explained how new techniques derive from theory knowledge.
Competence 4. Employ some of the basic techniques of a Molecular Biology laboratory and know the basic elements of this type of laboratory.
At the laboratory, some of the most significant and illustrative techniques of this scientific activity will be practiced.
The units of this competence are:
1. Know the fundamentals of each technique and its limitations
2. Decide the material required to perform them
3. Operate the equipment required for the development of the technique or identify the way to acquire the appropriate skills.
4. If it is possible to use alternative techniques estimate which are better to achieve the target desired.
5. Write the protocol followed in detail.
6. Gather systematically the results obtained and draw conclusions from them.
7. Establish the reproducibility of the experiments so the results are significant.
Competence 5. Choose the adequate technique to solve the problems that may arise in the different field of the profession. The lecturers will propose problems based on real scientific papers so these techniques are exercised.
Competence 6. Evaluate the validity of the reports and results obtained with these techniques.
Competence 7. Know the bibliographical sources that contain the knowledge of this field, use them with ease and, facing a specific problem, be able to establish the degree of knowledge on it and the possible ways to solve it.
Competence 8. Write a scientific report adequately, which gathers the basis, the methodology followed, the results obtained and a discussion of these regarding the previous knowledge.
Topics will be proposed for seminars and written assignments which will be performed and presented by the students in public sessions and that will be evaluated jointly by the lecturer and the students present in the discussion.

Contents of the module

- PART I. STRUCTURE, DYNAMICS AND PLASTICITY OF GENOMES
- PART II. EXPRESSION OF GENES

Learning activities

Theory lectures

Attending hours: 40
Non-attending hours: 40

Teaching-learning methodology

The methodology followed is mixed, since it consists of:
- Teaching based on tutored learning projects
- Master lectures
- Methods based on case studies
- Methods based on problems
- Methods based on laboratory experimentation

Skills developed
Those specified as general skills.
PRESENTATIONS AND SEMINARS
Attending hours: 8
Non-attending hours: 25
Teaching-learning methodology
There will be a training workshop on informational skills, in collaboration with the director of the Library of the Biology Faculty. In this context, students will be trained in literature search and oral presentation of papers, and each student will rehearse the skills acquired handing in an assignment on literature search and performing a 10 minute-long presentation. This activity will be relatively important in the final mark.
Skills developed
Informational skills
LABORATORY PRACTICALS
Attending hours: 10
Non-attending hours: 10
Teaching-learning methodology
Laboratory practicals for which the students must register previously in the groups with the schedule that suits them best. The practical activity will consist of carrying out some experiments of genetic analysis with microorganisms in the laboratories assigned to the Genetics Department at the ground floor of the Green Building of the Faculty.
Skills developed
-Follow an experimental protocol and interpret experimental data
-Handle microorganisms under sterile conditions
-Learn planting techniques and manipulation of fungi
-Interpret cell dilution processes
-Apply genetic concepts to real situations
OTHER COMPLEMENTARY ACTIVITIES
Attending hours: 2
Non-attending hours: 15
Teaching-learning methodology:
Planning, discussion and solutions of problems
Skills developed:
Problem solving skills

Evaluation systems and criteria
Qualifications of exams, participation in the informational skills workshop, practicals, presentation and attendance to seminars, and active participation in the sessions.
#Qualification of midterm written exams and final oral exam
#Qualification of written assignments
#Qualification of seminars
#Qualification of attendance and evaluation of the results obtained in the practical lectures
#Qualification of handed results from proposed problems
#Score obtained from attendance to seminars and other attending activities

#Score obtained from attendance to and results from the informational techniques workshop
The structure of this module is different from that of the regular modules. It consists of basic and complementary activities, none of which is strictly or entirely compulsory.
The program is distributed in three midterm examinations, each one with two sections. Each midterm examination includes theory lectures and other activities and will consist of one exam (except the first midterm examination, which will consist of two exams). The global score for the six exams will be 90 points.
Scores weighted according to the module program
#Qualification of midterm written exams and final oral exam
#Qualification of written assignments
#Qualification of seminars
#Qualification of attendance and evaluation of the results obtained in the practical lectures
#Qualification of handed results from proposed problems
#Score obtained from attendance to seminars and other attending activities
#Score obtained from attendance to and results from the informational techniques workshop

Module	Applied Microbiology and Biotechnology
Certification	Degree in Biology
Code	1530037
Stage	3
Type	Elective
Duration	Four months (Second Term)
Total Credits	6
Theory Credits	3.6
Practicals Credits	2.4
Department	MICROBIOLOGY (FACULTY OF BIOLOGY)

Lecturers

- BUENDIA CLAVERIA, ANA MARIA
- ROMERO PORTILLO, FRANCISCO
- VILLALOBO POLO, EDUARDO
- VINARDELL GONZALEZ, JOSE MARIA

Module Program

Specific teaching objectives

- Define Biotechnology and know its historical development.
- Know the basic instruments and the biological material used in Biotechnology.
- Know the biotechnological process and its stages.
- Develop biotechnological processes.
- Assimilate the role of microorganisms in nature.
- Apply the traditional microbiological techniques for isolation and purification of microorganisms.
- Focus in greater depth in the biotechnological processes with microorganisms.
- Think about environmental problems and know their biotechnological solutions.
- Apply molecular techniques to diagnosis.
- Assimilate the scientific process provided by Biotechnology focused on diagnosis and therapy within the field of Health.

Specific skills

- Theory training in the use of important basic instruments and biological material in Biotechnology.
- Theory training in biotechnological processes with microorganisms, gene diagnosis-therapy and cellular therapy.
- Practical training in basic microbiological and molecular biology techniques applied to Biotechnology.
- Ability to apply theory to the practice of any biotechnological activity.
- Technical and scientific skills to solve problems related to Biotechnology.
- Understand the social and ethical problems of Biotechnology.
- Solve environmental problems through Biotechnology.

- Show knowledge of the scientific and technical literature in Biotechnology.
- Experience to perform professional activities in a company of the biotechnological sector.
- Show oral and written communication skills at presenting results to colleagues, managers and reviewers.

Contents of the module

- **Unit 1 Introduction to Biotechnology**
  Definition of Biotechnology. Origin and history of Biotechnology. Current framework of Biotechnology. Relevant biological material in Biotechnology: microorganisms, plants, animals and their components. Important basic molecular instruments in biotechnology: techniques of recombinant DNA (extraction, amplification, hybridization and other manipulations of DNA and RNA; heterologous expression of proteins) and post-genomic techniques (genomics, transcriptomics, proteomics, metabolomics). Systems Biotechnology.
- **Unit 2 Industrial Biotecnology**
  Microorganisms as cellular factories. Food processing. Production of biomass and enzymes. Production of metabolites. Isolation, purification and conservation of microorganismos. Cultivation of microorganisms: thermodinamics, stoichiometry and kinetics. Bioreactors: designs, culture media, inoculation and sterilization. Scaling. Post-fermentation processing: sample processing, separation, recovery and product concentration.
- **Unit 3 Biotechnology of microorganisms that are beneficial for agriculture.**
  The role of microorganisms in the carbon, sulfur and nitrogen cycles. Microorganisms beneficial for agriculture. The use of Rhizobium and mycorrhizal inoculants as ecological biofertilizers. Rhizospheric bacteria with plant growth promoting activity. Processing of inoculants and quality control methods. Evaluation of inoculants in field. Estimation of soil microbial populations: the Most Probable Number technique.
- **Unit 4 Environmental Biotechnology**
  The great environmental problems. Contamination. Greenhouse effect and climate change. Natural sources depletion. Contribution of Biotechnology to the resolution of these problems. Environment monitoring. Bioindicators and biomarkers. Biosensors. Types of contamination. Treatment of urban, agricultural and industrial waste. Bioremediation: general aspects. Bioremediation of heavy metals, oil spills, xenobiotics. Phytoremediation. Clean technologies. Directed enzyme evolution. Renewable energy. Biofuels: biomass, biogas, biodiesel, bioethanol, biohydrogen. Biological plastics. Use of transgenic plants.
- **Unit 5 Biotechnology applied to medical processes**
  Fundamentals of modern Biotechnology in Medicine. Nucleic acids as diagnostic tools. Genetic tests. Microarrays. The cell as an instrument of drug production. Therapeutic recombinant proteins. Monoclonal antibodies. The use of the immune system. Biotechnological vaccines. Tumor immunotherapy. Modification of the genetic program. Oligonucleotides as modulators of gene expression. Autonomous units of gene expression. Gene transference vectors. Genetically modified animals. Gene therapy. The cell as a therapeutic agent: regenerative medicine. History of regenerative medicine. Therapy with adult stem cells. Therapy with embryonic stem cells. Tissue Engineering. Clinical aspects of Tissue Engineering.

Learning activities

THEORY LECTURES

Attending hours: 36

Non-attending hours: 60

Teaching-learning methodology

Lecturer: Explains the theory fundamentals.

Student: Assimilates information and takes notes. Raises doubts and asks complementary questions.

With the aim of making the lectures interesting and stimulate the participation of the students, these may download, through the virtual platform, the material to be taught by the lecturer.

Skills developed
Analysis skills. Ability to gather and analyze information from different sources. Learning skills. Solid basic knowledge of the profession. Basic general knowledge.
SEMINARS AND OTHER COMPLEMENTARY PRACTICAL ACTIVITIES
Attending hours: 24
Non-attending hours: 40
Teaching-learning methodology
This is a voluntary activity.
Lecturer: will provide the students with bibliographic material (whenever it may be done through the virtual platform) so that they prepare the seminar.
Students: individually or in small groups, will orally present a short paper about some point of the program.
In order to do so, students will make use of the bibliographic material provided by the lecturer. After that, there will be a debate on the most relevant aspects.
Skills developed
Analysis skills. Teamwork. Problem solving. Apply theory to practice. Learning skills. Criticism. Basic knowledge of the area.

Evaluation systems and criteria
Continuous evaluation system, at which the final mark is the sum of the scores obtained in the following sections:
-THEORY: 80% of the final mark.
There will be a final exam to evaluate the theory contents. The exam will consist of essay questions, multiple-choice questions, and analysis and interpretation of results. It will be assessed over 8 points, and it will be passed with a minimum score of 4 points.
-PRACTICALS: 20% score.
Attendance will be valued (1 point) and students will be required to hand in a written report on the practicals performed (1 point). This section of the module will be passed achieving 0.75 points in attendance and 0.25 points in the report.
100% of the Theory and Practicals scores will be 10 points. The module will be passed with a minimum score of 5 points.
In addition to that:
-ATTENDANCE AND PARTICIPATION IN THE LECTURES AND OTHER ACTIVITIES: 1 point.
Attendance to the theory lectures and active participation in these will be valued with 0.5 points each.

Module	Project Writing and Implementation
Certification	Degree in Biology
Code	1530023
Stage	4
Type	Compulsory
Duration	Four months (First term)
Total Credits	6
Theory Credits	0.8
Practicals Credits	5.2
Department	PLANT BIOLOGY AND ECOLOGY (FACULTY OF BIOLOGY)

Lecturers

- CAMBROLLE SILVA, JESUS
- DIAZ ANTUNES-BARRADAS, MARIA CRUZ
- ENCINA ENCINA, MARIA LOURDES
- ESQUIVIAS SEGURA, Mª PAZ
- LEIVA MORALES, MARIA JOSE
- MANCILLA LEYTON, JUAN MANUEL
- MATEOS NARANJO, ENRIQUE
- REDONDO GOMEZ, SUSANA
- SERRANO MARTIN, LAURA
- ZUNZUNEGUI GONZALEZ, MARIA

Module program

Specific teaching objectives

The main purpose of the module Project Writing and Implementation is to provide the student with knowledge about the professional activity of biologists and the aspects related to the development and performance of projects in Biology.

Specific objectives:

- Know the biologist competencies.
- Know the laws applied to the different areas of Biology.
- Know the basic techniques to design and write a project within the scope of Biology.
- Know the basic aspects about the economy applied to projects.
- Know the notions required to determine the economic viability of a project.
- Acquire organization and planning capabilities.
- Acquire the capability to work as part of a team and to organize, design, write up and lead a project.

Specific skills

- Be able to apply the knowledge acquired to the future development of professional activities in Biology, Biotechnology or Research within the field of Life Sciences.
- Direct, write up and implement projects in Biology.
- Gain basic knowledge about Laws (Administrative Procedure; Sectoral Legislation on Health, Education, Biodiversity and natural heritage, mountains, different infrastructures, fishing, environmental assessment, bioethics, working with living organisms, patents in biotechnology, etc.)
- Know how to interpret economic balances.
- Know, develop and value the professional competences of biologists.
- Implement and develop management systems related to Biology.
- Carry out advisory services related to Biology.

Contents of the module

- Unit 1. Professional Competences of Biologists.
  Main activities in: environment, health, production, professional responsibilities and regulations.
  Professional deontology.
- Unit 2. Labor Market: Supply and Demand.
  Structure and legislation of the labor market in the public and private sectors.
  Access to the labor market: job search.
  Writing up of the CV and cover letters.
  Job interviews.
  Self-employment.
- Unit 3. Legal Regulations.
  Introduction to legislation.
  Types of regulations and agencies that promulgate them.
  Access to legislative information.
- Unit 4. Project Design and Writing up.
  Technical documents, reports and projects.
  Typology of projects. Public calls and rules statement.
  Requirements to projects in: environment, quality control, research.
- Unit 5. Economic and Technical Viability of a Project.
  Budget making.
  Expert outsourcing.
  Economic management.
- Unit 6. Project Implementation and Management.
  Teamwork.
  The Multidisciplinary Team.
  Project management and organization.
  Project planning, programming, monitoring and control.
- Unit 7. Project Assessment.
  Evaluation and indicators of the result of a project.

Learning activities

SEMINARS

Attending hours: 8

Non-attending hours: 8

Teaching-learning methodology

Seminars by invited professionals in the field of Biology will be followed by the student questions and discussion guided by the lecturer. The opening seminar is regularly given by the President of the Official Association of Biologists in Andalucia. Other seminars include credited professionals in biological research, biotechnological companies, environmental policy-makers, entrepreneurs and consultants.

Skills developed

- Transmit information, ideas, problems and solutions of the field of Biology to both a specialized audience and to a non-specialized audience.
- Acquire oral and written communication skills within the scientific context, both in Spanish and in a foreign language, important for the profession.

LABORATORY PRACTICALS

Attending hours: 52

Non-attending hours: 82

Teaching-learning methodology

Different methodologies will be used according to the activities scheduled and the contents to be taught: searching and selection of information related to practical cases, learning based on problems, writing up and defense of reports and guided discussions.

Skills developed

- Develop the ability to gather and interpret relevant data within the field of Biology in order to make judgments that include a reflection about relevant issues of scientific, social or ethical character.
- Acquire organization, planning and teamwork skills.
- Use the information sources in the field of Biosciences.
- Develop creativity, initiative capacity, business management capability and enterprising culture.

Evaluation systems and criteria

Continuous assessment of each unit regarding attendance, questionnaires, problems, reports and seminars.

The module will be assessed continuously, through attendance, questionnaires, reports and seminars, which will be proposed in each unit.

The units are scored over 10. At the final mark, the score of each unit will be weighted according to its length.

The lack of punctuality will be penalized, with 0.1 points less for every 5 minutes late, in each unit, as well as misspelling in the written assessments, up to 1 point in every paper or test.

On the other hand, active participation in the classroom will be positively valued, up to 1 point per unit, as well as oral communication and expression in spoken tests, and teamwork, up to 1 point per unit.

However, there will be a final exam, which must be attended, of theory-practical contents only for those students who did not pass the continuous assessment or failed three units (with a mark below 4), or for those who have more than three unjustified absences.

Module	Final Degree Project
Certification	Degree in Biology
Code	1530040
Stage	4
Type	Compulsory
Duration	Annual
Total Credits	12
Department	ALL DEPARTMENTS IN THE FACULTY OF BIOLOGY

Lecturers

Any teacher of the Faculty of Biology is elegible by a student as her/his tutor. Each department will provide a board of examiners composed by at least four teachers to evaluate the student project within each particular field. More information on this panel at www.biologia.us.es

Module program

Specific teaching objectives

The Final Degree Project is a compulsory activity in order to obtain the Degree in Biology as designated by law in the current educational policy . Only those students which have already passed all compulsory courses of the Degree in Biology will be able to present their Final Degree Project.

Specific skills

- Be able to apply the knowledge acquired to the development of a project within the field of Life Sciences.
- Oral and written communication skills.

Contents of the module

The students are provided with several project modalities to chose one: a) field and/or laboratory research work as specified in the annual offers issued by each department every June; b) the content of the activity is entirely proposed by the student; c) a stage in a company or organization when that arrange is possible. Any project, whether its activity is located within or outside the Faculty facilities, requires the supervision of a tutor from the teaching staff of the Faculty of Biology. More information at www.biologia.us.es

Evaluation system and criteria

The board of examiners will evaluate each student's project after a short oral presentation followed by questions and discussion. The specific evaluation criteria can be found at www.biologia.us.es

Module	Developmental Cell Biology
Certification	Degree in Biology
Code	1530026
Stage	4
Type	Elective
Duration	Four months (Second term)
Total Credits	6
Theory Credits	4
Practicals Credits	2
Department	CELL BIOLOGY (FACULTY OF BIOLOGY)

Lecturers

- MARTIN RUBIO, MARIA ESTHER
- MUÑIZ GUINEA, MANUEL ANTONIO

Module program

Specific teaching objectives

Through the module Developmental Cell Biology the student is expected to acquire integrated knowledge of the diverse cellular and molecular mechanisms that lead to the development of an animal organism. The student will learn how many different cell types originate from a single cell, which are organized in functional structures and assemble to form an organism. The analysis of different processes that control the development of an animal organism is dealt from the perspective of the complex molecular interactions that take place within the cell. Special attention will be paid to the study of the most relevant cellular processes during the embryonic development, like genetic expression, proliferation and programmed cell death, as well as the mechanisms that keep such differentiated state, its regulation and pathology.

Specific skills

- Molecular understanding of the cellular processes that control embryonic development
- Basic knowledge of the most common experimental procedures
- Perform functional tests, determine vital parameters and interpret them
- Design models of biological processes
- Analyze and interpret cell behavior during development
- Obtain information, design experiments and interpret the results
- Handle model organisms
- Critical analysis of specialized scientific literature
- Develop deductive capability
- Public presentation and discussion of results

Contents of the module

THEORY PROGRAM

- 1. Basic concepts in Developmental Biology
- 2. Model organisms
- 3. Gametogenesis and fecundation
- 4. Execution of the developmental genetic program
- 5. Cellular interactions during development: communication, adhesion and migration
- 6. Regulation of the cell cycle during development: proliferation and programmed cell death
- 7. Determination and differentiation
- 8. Formation of the body pattern

PRACTICALS

- 1. Experimental analysis of cell
- 2. Observation and monitoring of the stages of embryonic development
- 3. Interpretation and assessment of mutant phenotypes

Learning activities

THEORY LECTURES

Attending hours: 30

Non-attending hours: 50

Teaching-learning methodology

Master lecture

Reviewing of specialized bibliography

Presentation and discussion of scientific reviews

Skills developed

Knowledge of molecular and cellular mechanisms that govern embryonic development

PRESENTATIONS AND SEMINARS

Attending hours: 9

Non-attending hours: 19

Teaching-learning methodology

Presentation of a current scientific review related to one issue of those included in the program

Skills developed

- Judgment and self-judgment abilities
- Fluid and proper oral communication
- Personal commitment to learn
- Learning skills
- Analysis and synthesis ability

LABORATORY PRACTICALS

Attending hours: 15

Non-attending hours: 15

Teaching-learning methodology
- Analyze cell signalling processes
- Observation and recognition of the different stages of embryonic development in different model organisms
- Interpretation of mutant phenotypes

Skills developed
- Molecular understanding of the cellular processes that control biological development
- Basic knowledge of the most common experimental procedures
- Perform functional tests, determine vital parameters and interpret them
- Design models of biological processes
- Analyze and interpret cellular behavior
- Obtain information, design experiments and interpret the results
- Develop deductive capability
- Public presentation and discussion of the results

Evaluation systems and criteria

Practicals exam

Evaluation of the contents taught at the practical lectures. The students will have to demonstrate the skills acquired through an exam, which could be written and/or by showing such skills in a Biology laboratory.

Seminars and/or presentations

The evaluation will be performed on the presentations of the works in which the students will have to demonstrate the skills acquired. Both the contents and the presentation of these will be assessed.

Directed activities and/or self-evaluations

The correct resolution of problems proposed and the use of adequate bibliography will be assessed. These activities could require attendance.

Theory exam

Oral and/or written exams. The evaluation will be performed on the exams, in which the students will have to demonstrate the skills acquired. Passing all the tests will not be achieved without uniform and balanced knowledge of the whole subject.

Attendance

Attendance could be assessed.

Module	Ecology of the Global Change
Certification	Degree in Biology
Code	1530028
Stage	4
Type	Elective
Duration	Four months (Second term)
Total Credits	6
Theory Credits	3.8
Practicals Credits	2.2
Department	PLANT BIOLOGY AND ECOLOGY (FACULTY OF BIOLOGY)

Lecturers

- DIAZ ANTUNES-BARRADAS, MARIA CRUZ
- FIGUEROA CLEMENTE, MANUEL ENRIQUE
- REDONDO GOMEZ, SUSANA

Module program

Specific teaching objectives

Know the impact that human activities cause on ecosystems and their consequences.
Know the methods for minimizing these impacts.

Contents of the module

- Natural changes, changes in the physical medium, climate, oceans, lithosphere.
- Transformations caused by humans. Relation with social organization.
- Resource exploitation. Resources used by humans, agriculture, animal husbandry, fishing, minery, water, fuels, quarries, etc. Urban medium.
- Consequences of these transformations. Change in the landscape structure, changes in the biogeochemical cycles, changes in the species (invasions). Urban medium.
- Conservation and restoration.

Learning activities

THEORY LECTURES

Attending hours: 6
Non-attending hours: 14

Teaching-learning methodology

Master lectures.

Skills developed

Understanding of the determinant factors of global change.

PRESENTATIONS AND SEMINARS

Attending hours: 32
Non-attending hours: 50
Teaching-learning methodology
The lecturer will explain the conceptual framework.
The students will perform and present case studies.
COMPUTER PRACTICALS
Attending hours: 6
Non-attending hours: 3
Teaching-learning methodology:
Processing of data obtained in the field
Skills developed
Obtain information provided by nature
FIELD PRACTICALS
Attending hours: 16
Non-attending hours: 6
Teaching-learning methodology
Field work carrying out field study techniques in ecology.
Skills developed
Identify the impact of human activities in the landscape
Obtain information from nature

Evaluation systems and criteria
Continuous evaluation
Evaluation of the activities performed throughout the module: seminars, field works and research studies. Test of knowledge in master lectures.
Exam
Those students who do not pass the continuous evaluation will have an exam on the whole module matter in the second and third calls.

Module	Applied Zoology
Certification	Degree in Biology
Code	153041
Stage	4
Type	Elective
Duration	Four months (Second term)
Total Credits	6
Theory Credits	4
Practicals Credits	2
Department	ZOOLOGY (FACULTY OF BIOLOGY)

Lecturers

- NIETO RUBIO, MARIA DEL PILAR
- OCETE RUBIO, MARIA ELVIRA
- OCETE RUBIO, RAFAEL
- SANTOS LOBATON, MARIA DEL CARMEN

Module program

Specific teaching objectives

Know concepts about applied zoology, with further focus on current topics.
Know the main problems caused by animals that carry diseases or are considered pest species.
Know how to identify the problems caused by pest species, their symptoms and damages, and know the solutions or control methods for these.
Become a competent biologist in these matters.

Specific skills

Recognition of animals considered pest species or those who cause diseases.
Localize, obtain, identify and preserve specimens.
Identificy and learn the use of bioindicator species.
Identificy and learn the use of controler species.
Know and identify control methods for pest species.
Learn techniques of sampling, characterization and handling of populations and communities.
Know the techniques used in the laboratory and in the field.
Acquire also a positive perspective of Applied Zoology in topics like food production, hunting, museums, zoo parks, etc.

Contents of the module

The module consists of three topic blocks. The first part tackles Nematology, the second is dedicated to Entomology and the third is for Vertebrates. All these fields are taught from the applied perspective.

Second term learning activities

THEORY LECTURES

Attending hours: 34

Non-attending hours: 70

Teaching-learning methodology

Theory sessions of the contents taught by the lecturer. The students are free to ask questions in order to make the lecture more participatory.

Skills developed

Learning of basic knowledge, in order to be able to carry out the practicals.

Oral understanding skills.

PRESENTATIONS AND SEMINARS

Attending hours: 6

Non-attending hours: 3

Teaching-learning methodology

Attending seminars prepared by the lecturers and students.

Skills developed

Strengthen acquired knowledge.

Become aware of the relevance of Zoology from the applied perspective.

Learn teamwork.

Gain skills to give a public presentation.

Raise curiosity for topics previously unknown.

LABORATORY PRACTICALS

Attending hours: 14

Non-attending hours: 15

Teaching-learning methodology

Practical sessions in the laboratory.

Skills developed

Collate the practical knowledge with the theory knowledge.

Teamwork.

Information analysis skills.

Strengthen theory knowledge.

FIELD PRACTICALS

Attending hours: 6

Non-attending hours: 2

Teaching-learning methodology

Trips to different places with the students so that they see practical cases of pests.

Skills developed

Strengthen knowledge acquired in the theory sessions.

Raise curiosite for practical cases by comparing them to the acquired knowledge.

Teamwork skills.

Become aware of the relevance of Zoology from the practical perspective.

Evaluation systems and criteria

Exam of all the module contents and evaluation of the activities carried out.
The exam will consist of a set of different types of questions: multiple-choice, essay, image identification, practical cases, etc.
Also evaluated: attendance to practicals, seminars, field trips and the seminars presented by the students.

Module	Cell Microbiology
Certification	Degree in Biology
Code	1530028
Stage	4
Type	Elective
Duration	Four months (First term)
Total Credits	6
Theory Credits	4
Practicals Credits	2
Department	MICROBIOLOGY (FACULTY OF BIOLOGY)

Lecturers

- CUBO SANCHEZ, MARIA TERESA
- RUIZ SAINZ, JOSE ENRIQUE
- TORTOLERO GARCIA, MARIA DOLORES

Module program

Specific teaching objectives

- Know how the microbial world has established throughout evolution a close relationship with the human body, and the different types of relationship.
- Know which are the factors that determine the human microbiome.
- Know which are the requirements for microorganisms to be part of the human microbiome.
- Know the distribution and diversity of the microorganisms that make up the human microbiome.
- Know which are the adhesion mechanisms of microorganisms to human surfaces.
- Know the different mechanisms by which microorganisms invade animal cells and the consequences of the invasion.
- Know the different mechanisms by which pathogens cause damage to the host.
- Know the molecular basis of the impact of the toxins of the main pathogens.
- Know the main phytopathogen microorganisms and the physiological disturbances they cause in plants.
- Know the cellular and molecular basis of symbiosis between nitrogen fixing bacteria and plants.

Specific skills

- Training in the study of microorganisms that interact with animals and plants.
- Resolution of problems in Cellular Microbiology.
- Preparation of culture media for the isolation of microorganisms of the human microbiome.
- Handling of microorganisms of the human microbiome.
- Identification of microorganisms of the human microbiome through biochemical techniques.
- Learning of techniques for the study of protein-protein interactions.
- Handling of microorganisms of the rhizosphere.
- Observation of nodules and determination of nitrogenase activity of nodules of legumes through chromatography.

- Learning of techniques of Molecular Biology used in the study of plant-bacterium interactions.

Contents of the module

- Unit 1. Nature of the symbiotic associations of microorganisms with the human species.
  The human microbiome: resident, transient and opportunistic microorganisms. Types of symbiosis between the human body and its microbiome: commensalism, mutualism and parasitism. Factors that determine the human microbiome and its localization. Controversy about the beneficial or harmful effect of the human microbiome. Concept of pathogen. Concept of infection. Challenges for pathogenic microorganisms: 1) Survive in the infection reservoirs. Living and inanimate reservoirs. 2) Access a new host. Transmittion pathways. 3) Establishing in the bodily surfaces. Adhesion. 4) Penetrating the inner tissues. Invassion.5) Eluding the host defenses. 6) Multiplying in the inner tissues of the host. Origin of pathogenesis. 7) Moving from one host to another one. Exit pathways from the host.
- Unit 2. Adhesion of microorganisms to the surfaces of animal hosts. Preadhesion stage: Van der Walls and electrostatic forces. Molecular mechanisms of adhesion. Structures and molecules of the host involved in adhesion. Components of the extracellular matrix involved in pathogen adhesion. Adhesion molecules that establish cell-extracellular matrix unions used by pathogens: integrins. Cell-cell adhesion molecules used by pathogens: cadherins, selectins and the superfamily of immunoglobulins. Bacterial structures and molecules involved in adhesion. Consequences of adhesion on microorganisms and host cells. Degradation of the extarcellular matrix governed by pathogens: concept of bacterial metastasis.
- Unit 3. Invasion of the animal cell by microorganims.
  Concept of cellular invasion. Invasion pathways: phagocytosis, endocytosis/ induced phagocytosis, active invasion and paracytosis. Manipulation of the host cell cytoskeleton by microorganisms: invasion mechanisms of non-phagocytic cells, inhibition of phagocytosis by phagocytic cells and intracellular mobility. Intracellular niches that hold pathogens. Adaptation mechanisms to survive in lysosomal intravacuolar compartments. Non-lysosomal intravacuolar pathogens: adaptation mechanisms to survive in modified vacuoles and in suppressed compartments. Adaptation mechanisms to survive in the host cell cytosol. Consequences of invasion.
- Unit 4. Bacterial toxins
  Concept of toxin. Classification of toxins: classification criteria. Endotoxins and exotoxins, differencies. Physiopathogical effects of endotoxins of Gram-negative bacteria. Toxins that act on the host cell surface: actions mechanisms. Toxins that act inside the host cell: interference of toxins with the synthesis of proteins, signal transmission, polimerization of actin and membrane vessels traffic. Bacterial toxins that interfere with the cell cycle. Bacterial toxins that manipulate cell death by apoptosis. Basic and applied interest of bacterial toxins.
- Unit 5. Bacterial secretion systems
  Types and differential characteristics of the bacterial secretion systems. General secretion pathway, GSP. Functions of the Sec genes in the transport of proteins to the membrane, in the translocation through the membrane and in the release outside the cell or to the periplasmic space. General secretion pathway TAT: characteristics of the proteins recognized by this system. Sec-dependent secretion systems: components and functioning of Type II and V secretion systems. Sec-independent secretion systems: components and functioning of Type I, III and IV secretion systems.
- Unit 6. Interactions among microbial populations and between these and plants.Positive interactions among microorganism populations: commensalism, synergism and mutualism. Negative interactions: competition, amensalism, parasitism and predation. Plants as nutrient sources for microorganisms. Interactions of roots and leaves with microbial populations: generalities of microorganisms of the rhizosphere and phyllosphere. Phytopathogenic and symbiotic microorganisms. General basic concepts of phytopathology. Defense responses of plants. Entry pathways of phytopathogens in plants. Main disturbances in plant physiology as a consequence of the attack of phytopathogenic bacteria. Biology of the phytopathogenic bacterium Agrobacterium tumefaciens: tumor-inducing plasmids and transformation of the plant cell.
- Unit 7. Plant root and cell invasion by nitrogen fixing microorganisms.
  Main microorganisms that establish nitrogen fixing symbioses with legumes and non-legumes. Taxonomy of the bacteria that form nitrogen fixing nodules. Phases of the nodulation process in legumes. The role of lectins and rhicadhesins in the binding process of bacteria to plant roots. Penetration mechanisms of bacteria into plant roots. Intracellular infection of the plant cells of the nodule. Structure of mature nodules and nitrogen fixation. Similarities and differences between the processes of symbiotic and pathogenic invasion. Self-regulation of nodulation. Studies with double root systems and grafts. Evolutionary advantages for plants and bacteria as a consequence of

the formation of nitrogen fixing nodules. The concept of trap and penalties in symbioses.

- Unit 8. Molecular Biology of Plant-Microorganism interactions.
  Early molecular signals in the interaction of rhizobia with legumes. Symbiotic structure and function of the bacterial nodulation factors and plant flavonoids. Symbiotic plasmids. Gene organization: regulation and function of nodulation genes. Type III secretion system: its relevance in the determination of symbiotic compatibility/incompatibility. Structure of the main bacterial surface polyssacharides (SP): cyclic glucans, exopolyssacharides, lipopolyssacharides and type K antigen capsule polyssacharides. Relevance of SPs in the infectious capacity of bacteria, in nodule development and in attenuating plant defense systems. Main methodological strategies in the molecular studies on the interaction of microorganisms with plants.

Learning activities

THEORY LECTURES

Attending hours: 40

Non-attending hours: 87

Teaching-learning methodology

Master lecture and discussion about the topics taught.

Skills developed

- Know how the microbial world has established throughout evolution a close relationship with the human body, and the different types of relationship.
- Know which are the factors that determine the human microbiome.
- Know which are the requirements for microorganisms to be part of the human microbiome.
- Know the distribution and diversity of the microorganisms that make up the human microbiome.
- Know which are the adhesion mechanisms of microorganisms to human surfaces.
- Know the different mechanisms by which microorganisms invade animal cells and the consequences of the invasion.
- Know the different mechanisms by which pathogens cause damage to the host.
- Know the molecular basis of the impact of the toxins of the main pathogens.
- Know the main phytopathogen microorganisms and the physiological disturbances they cause in plants.
- Know the cellular and molecular basis of symbiosis between nitrogen fixing bacteria and plants.

LABORATORY PRACTICALS

Attending hours: 15

Non-attending hours: 3

Teaching-learning methodology

Application of the scientific method: elaboration of a hypothesis, design of an experiment, and obtainment and discussion of results.

Skills developed

- Training in the study of microorganisms that interact with animals and plants.
- Resolution of problems in Cellular Microbiology.
- Preparation of culture media for the isolation of microorganisms of the human microbiome.
- Handling of microorganisms of the human microbiome.
- Identification of microorganisms of the human microbiome through biochemical techniques.
- Learning of techniques for the study of protein-protein interactions.
- Handling of microorganisms of the rhizosphere.
- Observation of nodules and determination of nitrogenase activity of nodules of legumes through chromatography.

- Learning of techniques of Molecular Biology used in the study of plant-bacterium interactions.

Evaluation systems and criteria

The module will be assessed through an evaluation system in which the final mark is calculated as the sum of the score obtained in the theory and practicals exams.
Theory exam: There will be two half-term exams. If these are not passed, the final exam will have to be taken. The maximum score is 8 points.
Practicals exam: It will be taken at the end of the practicals. The maximum score is 2 points.

Module	Ecology and Management of Freshwater systems
Certification	Degree in Biology
Code	1530028
Stage	4
Type	Elective
Duration	Four months (First term)
Total Credits	6
Theory Credits	2.2
Practicals Credits	3.8
Department	PLANT BIOLOGY AND ECOLOGY (FACULTY OF BIOLOGY)

Lecturers

- ENCINA ENCINA, MARIA LOURDES
- GRANADO LORENCIO, CARLOS ANTONIO
- TOJA SANTILLANA, JULIA

Module program

Specific teaching objectives

Operate mathematical models.
Operate conceptual models in Ecology.
Learn techniques for the study of lifestyles in animals.
Integrate historical contributions of Limnology and Ichthyology to the Ecological Theory.
Become familiar with bibliographic sources.
Use computer programs for the analysis of information.

Specific skills

Study, characterization and management of aquatic ecosystems.
Research, development and control of processes in the heart of aquatic ecosystems.
Conservation and sustainable use of aquatic ecosystems.
Biological studies and control of the impact of chemical and biological products used in the management of aquatic ecosystems (biological analyses, control and depuration of waters, pisciculture, etc).
Environmental education.
Rational planning and exploitation of natural resources.
Studies on environmental impact.
Teaching of Ecology, Biology, Earth Sciences and Environment in secondary education.
Scientific advice and technical assistance for ecological and environmental problems.

Contents of the module

- Unit 1.- Generalities about inland aquatic ecosystems: The water cycle. The role of epicontinental aquatic ecosystems in the functioning of biosphere. Types of inland water ecosystems. Properties of water. Differences of composition between marine and inland waters. Main factors that influence the functioning of aquatic ecosystems. Spatiotemporal organization: Differential functioning of the different types of aquatic ecosystems. Disturbance in aquatic ecosystems.
- Unit 2.- Physicochemical characteristics: Physical factors. Radiation. Colour. Ultraviolet radiation. Heat and temperature. The thermal cycle. Other physical events with ecological effects: turbulence, water speed. Renewal rate. Salinity. Proportion of cations and anions. Adaptation of organisms. Dissolved gases. Balance with the atmosphere. Oxygen. Carbonate-bicarbonate-carbonic system, relationship with pH. Nutrients. Nitrogen and phosphorus. Silicon. Sulphur. Iron and manganese. Other trace elements. The organic matter cycle. Detailed distribution. The importance of interphases. Sediments as a nutrient reserve. Exchange with column of water.
- Unit 3.- Inland aquatic organisms: Relative representation of the main groups of organisms in inland and marine waters. Characteristics of inland water organisms. Spatial distribution of organisms in inland aquatic ecosystems. Phytoplankton: Main groups and characteristic genera. Periphyton: Main groups and characteristic genera. Strategies. Coastal and benthic vegetation. Zooplankton. Groups of animals found in plankton. Zoobenthos. Groups of animals found in the benthos. Spatial distribution: the coast, the deep benthos, the benthos of rivers.
- Unit 4.- Approaches to the ecology of fish: Origin and evolution of fish. Morphological and ecofunctional adaptations. Richness and distribution. Biogeography of the main families.
- Unit 5.- Aquatic bacteria: The role of bacteria in aquatic ecosystems. Autecology of aquatic bacteria. Bacterial guilds. Spatial distribution. Influence of bacteria in the cycle of elements.
- Unit 6.- Primary production in aquatic ecosystems: Primary producers. Seaweeds. Factors affecting their growth. Ecological types according to nutritional requirements. Macrophytes: Strategies. Factors affecting their growth. Primary production. Bacterial production: photosynthesis and chemosynthesis. Plant production: Regulating and limiting factors. Models of primary production in plankton. The benthos case. Contribution of the planktonic and benthonic subsystems to the total production of the system. Eutrophy and eutrophycation.
- Unit 7.- Secondary production in aquatic ecosystems: Feeding types of zooplankton. Relationship between food availability and the nutritional state of individuals. Feeding types of zoobenthos. Benthic metabolism. Fish production. Trophic relationships. Lifestyles: age, growth, reproduction and feeding. Biomass and production estimations. Models of evaluation of natural populations.
- Unit 8.- Organization of aquatic ecosystems I: Organization in time. The annual cycle of a lake. Seasonal variations in lagoons. Seasonal variations in rivers. Succession of the phytoplankton community: Regulating factors. Periphyton: Strategies. Coastal and benthic vegetation: Zonation. Coastal and benthic successions: Regulating factors. Competition with plankton. Zooplankton: Interrelationship among the different groups. Succession. Cyclomorphosis.
- Unit 9.- Organization of aquatic ecosystems II: Organization in space. Zooplankton: Vertical migrations. The zoobenthos: The effect of habitat. Relationships among all the studied organisms. Attachment of overproducing subsystems with overrespirating subsystems. Comparison of the functioning of lakes, reservoirs, rivers and wetlands. Space as an ecological resource for fish. Space occupancy patterns. Habitat, vital domain and migration. Conflicts in the coexistence of species.
- Unit 10.- Structure of communities: The Top-down theories vs. Bottom-up theories, the cascade effect and other models.
- Unidad 11.- Applied limnology: Management of aquatic ecosystems. Disturbance of aquatic ecosystems: Biological indicators and biotic indices. Eutrophication of lakes and reservoirs. Contamination of rivers. Reservoirs as manifold resources. The Water Framework Directive for water policies.
- Unit 12.- Applied ichthyology: Stability and disturbance. Ecology of species with fishing interest. Management and operation of fisheries. Increase of fishing production. Problems with exotic species. Conservation plans.

Learning activities

THEORY LECTURES

Attending hours: 12

Non-attending hours: 0

LABORATORY PRACTICALS
Attending hours: 38
Non-attending hours: 0
GROUP TUTORSHIP SESSIONS OF SCHEDULED CONTENTS
Attending hours: 10
Non-attending hours: 0
Teaching-learning methodology:

Evaluation systems and criteria
Multiple evaluation
Final assignment: 50%
Group assignment: 20%
Individual homework: 30%
It is required to attend a minimum of 80% of the lectures. otherwise the module will be evaluated through a final exam.

Module	Neurophysiology
Certification	Degree in Biology
Code	1530039
Stage	4
Type	Elective
Duration	Four months (First term)
Total Credits	6
Theory Credits	4.5
Practicals Credits	1.5
Department	PHYSIOLOGY (FACULTY OF BIOLOGY)

Lecturers

- HERRERO RAMA, LUIS JACINTO
- MORCUENDE FERNANDEZ, SARA ROSALIA
- RODRIGUEZ DE LA CRUZ, ROSA MARIA
- RODRIGUEZ MATARREDONA, ESPERANZA

Module program

Specific teaching objectives

-Integrate knowledge of the structure and function of the nervous system, and the physiological processes that take place in it.
Understand the higher functions of the central nervous system, as well as its control and regulation mechanisms.
Differentiate in a critical way the well-established knowledge from that in the area of hypotheses and theories.
Use and value the information sources of this discipline.

Methodological objectives

-Use measuring instruments for physiological variables.
Elaborate physiological preparations in which to apply concepts of essay, dependent variable, independent variable, model and contrast.
Use computerized models and simulation programs to reduce animal experimentation.
Generate graphs from experimentation.

Contents of the module

THEORY PROGRAM

- Unit 1 - Introduction to nerve cells. Concept, purpose and history of Neurophysiology. The neuron doctrine: Golgi and Cajal. The neuron. The glia.
- Unit 2 - Development of the nervous system. Molecules involved in the development. Migration and guidance. Formation and removal of synapses.
- Unit 3 - Organization of the nervous system. Functional organization of the nervous system.
- Unit 4 - Techniques in the study of the nervous system. Morphological and electrophysiological techniques. Brain imaging techniques.
- Unit 5 - Cellular and molecular neurophysiology. Fundamentals of biophysics. Synpatic transmission. Neurotransmitters systems.
- Unit 6 - Sensory systems. Fundamentals of sensory systems. General physiology of sensory receptors.

- Unit 7 - Motor systems. Fundamentals of motor systems. Spinal control of movement. Central control of movement.
- Unit 8 - Regulatory systems. Sexual behavior. Intake of food and liquids. Biological rhythms. Sleep.
- Unit 9 - Vegetative functions. Central control of autonomous functions. Neural regulation of the cardiovascular system. Neural control of breathing.
- Unit 10 - Cognitive neurophysiology. Memory systems. Learning types. Invertebrate and vertebrate learning models. Language and attention.
- Unit 11 - Psychopharmacology. Principles of psychopharmacology. Dependence and adiction. Most commonly abused drugs.
- Unit 12 - Brain disorders. Anxiety and depression. Schizophrenia. Neurodegenerative diseases.

Learning activities

THEORY LECTURES

Attending hours: 45

Non-attending hours: 80

Teaching-learning methodology

Theory lectures of voluntary attendance. They will be taught two days a week in 90 minutes sessions each.

LABORATORY PRACTICALS

Attending hours: 15

Non-attending hours: 10

Teaching-learning methodology:

They will be carried out in the laboratory or in the computer room depending on the matter to be taught. They will be of voluntary attendance and will be taught in five sessions, wich will last between two and four hours. The program will be as follows:

1. Stereotaxy
2. Action potential
3. Postsynaptic potentials
4. Neurological exploration I
5. Neurological exploration II

Evaluation systems and criteria

Continuous evaluation system

Three half-term exams will be held throughout the term within the class timetable, which will consist of 10 multiple-choice questions, which in turn will count 1 point each. The first exam will take place at the end of unit 4, the second one at the end of unit 8 and the third one at the end of unit 12, and they will be announced in advance. Those students who are in any of the situations comprised in the article 17, section 1, of the regulation of exams of the University of Seville, will have the right to a second call for the three half-term exams.

A final exam on all the module contents will be held. Such exam will count 7 points and consist of 15 multiple-choice questions (3 points), 3 essay questions about the theory contents (3 points) and a question about the practicals contents (1point).

In order to obtain the final mark, the scores of the half-term exams and the score obtained in the practical activities (up to a maximum of 1 point) will be added to the score obtained in the final exam. IMPORTANT: In order to sum the score obtained in the half-term exams and the score obtained in the practical activities, students are required to pass the final exam.

In the second and third regular calls and in the special calls, an exam will be held which will count 10 points and will consist of 20 multiple-choice questions (5 points), 4 essay questions about the theory contents (4 points) and a question about the practical contents (1 point). In the case of these calls, no other bonus will be considered.

Module	Structure and Biosynthesis of Macromolecules
Certification	Degree in Biology
Code	1530029
Stage	4
Type	Elective
Duration	Four months (Second term)
Total Credits	6
Theory Credits	5
Practicals Credits	1
Department	PLANT BIOCHEMISTRY AND MOLECULAR BIOLOGY (FACULTY OF BIOLOGY)

Lecturers

- RONCEL GIL, MERCEDES
- RUIZ PEREZ, JOSE FRANCISCO

Module program

Specific teaching objectives

THEORY OBJECTIVES

- Know the fundamentals of macromolecules structure.
- Know the processes of macromolecules biosynthesis.
- Know the structure of nucleic acids and proteins, as well as the structure/function relationships.
- Understand the systems of macromolecules processing, maturation and modification.

METHODOLOGY OBJECTIVES

- Learn basic techniques for the analysis of biological macromolecules.
- Learn basic techniques of isolation and characterization of biological macromolecules.
- Learn basic techniques of biochemistry and molecular biology.
- Understand the experimental approach to tackle the study of regulated processes.
- Become familiar with the general and specific infrastructure of a biochemistry laboratory.

Specific skills

Cognitive (know):

- Basic biochemical knowledge of biological processes.
- Basic knowledge of the structure of macromolecules.
- Knowledge of the specific techniques for the structural analysis of macromolecules.
- Knowledge of the most important processes of macromolecule biosynthesis.

Procedures/Equipment (know how to):

- Use the specific methods and techniques for the functional and structural analysis of macromolecules.
- Analyze information from different sources.

- Make use of the literature, both traditionally and through the new technologies of scientific information access.
- Prepare, present and defend a study in front of an audience.
- Use informatics as a tool for analysis and research.

Attitudinal:

- Solid basic biochemical knowledge of biological processes.
- Know the most important processes of macromolecule biosynthesis.
- Analysis and synthesis ability.
- Judgment and self-judgment abilities.
- Ability to apply theory to practice.
- Ability to come up with new ideas.
- Interpretation of data from experimental observations in terms of their significance and the basis that support them.

Contents of the module

- 1. STRUCTURE OF NUCLEIC ACIDS.
- 2. PROTEIN STRUCTURE.
- 3. DNA BIOSYNTHESIS.
- 4. RNA BIOSYNTHESIS AND PROCESSING.
- 5. PROTEIN BIOSYNTHESIS.

Learning activities

THEORY LECTURES

Attending hours: 40

Non-attending hours: 80

Teaching-learning methodology

Voluntary attendance. Each theory lecture will consist of a master lecture in which the contents of each unit will be presented, questions will be asked for debate and different learning activities will be proposed. These will be 90 minutes long and will be taught two days per week at a lecture theater of the Red Building of the Faculty of Biology, according to the calendar approved by the Centre Board.

The students will be given a copy of the audiovisual material used during the year, through the WebCT platform. Lecturer-student interaction will be enhanced. Doubts and enquiries will be solved through the WebCT platform both individually and in groups, as well as tutorship sessions if required by the students.

The use of the WebCT platform will be encouraged in order to establish on-line discussions (chat) about issues of the module according to what the students determine and moderated by the lecturers.

Skills developed

- Solid basic knowledge of macromolecules structure and the techniques used to determine it.
- Solid basic biochemical knowledge of biological processes.
- Know the regulation of the intermediary metabolism.
- Analysis and synthesis ability.
- Judgment and self-judgment abilities.

PRESENTATIONS AND SEMINARS

Attending hours: 10

Non-attending hours: 10

Teaching-learning methodology

Voluntary. According to the lecturer, each student will choose a recent scientific paper that tackles aspects related to the module contents.

The oral presentation will have an approximate length of 20 min, after which the students will proceed with the discussion about the results, techniques, conclusions, etc.

Skills developed

1. Solid basic biochemical knowledge of biological processes.
2. Analysis and synthesis ability.
3. Judgment and self-judgment abilities.
4. Ability of prepare, present and defend a study.

LABORATORY PRACTICALS

Attending hours: 8

Non-attending hours: 6

Teaching-learning methodology:

Attendance to the laboratory practicals is compulsory and an essential requirement to pass the module. They will be carried out in 4 hour sessions at the laboratories of the Green Building of the Faculty of Biology, according the calendar approved by the Centre Board.

The practicals will be assessed through the presentation by the students of a laboratory handbook with the results obtained, which will include critical discussion and conclusions, and the answers to the questions related with these at the end of each session.

Skills developed

- Solid basic biochemical knowledge of biological processes.
- Analysis and synthesis ability.
- Research skills.
- Judgment and self-judgment abilities.
- Ability to apply theory to practice.
- Teamwork skills.

COMPUTER PRACTICALS

Attending hours: 2

Non-attending hours: 5

Teaching-learning methodology

Attendance to the laboratory practicals is compulsory and an essential requirement to pass the module. They will be carried out in 2 hour sessions at the computer rooms of the Red Building of the Faculty of Biology, according the calendar approved by the Centre Board. These will consist of learning the use of both servers and data bases of macromolecule structures and graphic programs for the structural analysis of macromolecules, under supervision and at a basic level.

They will be evaluated through the presentation by the students of a report on such practicals.

Skills developed:

- Solid basic biochemical knowledge of biological processes.
- Analysis and synthesis ability.
- Judgment and self-judgment abilities.
- Ability to prepare a study.

Evaluation systems and criteria

Evaluation of the Theory Lectures

Written Exam (75%).

As it is a four month long module, during June there will be only one final exam, applying the same criterion for the calls of September and December.

The knowledge degree of the student will be assessed through a written exam of 10 short essay questions limited to the contents of the theory lectures with a maximum length of 3 hours.

Evaluation of the Practical Lectures

Laboratory and Computer Practicals (15%)

Participation in the practicals and the skills shown by the students for the analysis of the data obtained during these, as expressed in the scientific report, will be assessed.

Evaluation of the Seminars

Presentations and Seminars (10%)

Those written works that will be presented as a seminar will be assessed based on the synthesis ability, clarity in the expression of the presented data, the recentness of these, the adequacy of the bibliography used in the preparation of the studies and the difficulty of the topic chosen. Likewise, answers and explanations about questions or doubts proposed by the students and the lecturer will be valued.

Global Evaluation

The marks obtained in the THEORY, PRACTICALS and SEMINARS sections will be summed in order to make up a final qualification, regarding that attendance to and performance of the practicals are compulsory. The marks obtained in the PRACTICALS and SEMINARS will be valid until the December call.

Module	Human Genetics
Certification	Degree in Biology
Code	1530034
Stage	4
Type	Elective
Duration	Four months (Second term)
Total Credits	6
Theory Credits	5
Pratical Credits	1
Department	GENETICS (FACULTY OF BIOLOGY)

Lecturers

- CRUZ DIAZ, JESUS DE LA
- GUTIERREZ POZO, GABRIEL
- HUERTAS SANCHEZ, PABLO
- LOPEZ CALDERON, ISABEL

Module program

Specific teaching objectives

In this module, some of the knowledge acquired in the module of General Genetics is consolidated and extended, and some aspects of Genetics referred to the human species are tackled, perhaps for the first time. The aim is to provide the foundations to understand and evaluate the reach of the knowledge produced in this field.

Specific skills

Ability to analyze available information about the structure of the human genome.
Ability to calculate risks and its application in genetic advice.
Ability to interpret the knowledge of human genetics in evolution.

Contents of the module

- The development of Human Genetics.
- Gametogenesis in the human species.
- Human chromosomes.
- The mitochondrial genome.
- Human genome mapping: genetic and physical maps.
- Databases of the human genome.
- Identification of genes that cause diseases and other phenotypes.
- Molecular pathology: hemoglobin as a model.
- Risk estimation and genetic advice.

- Evolution of the human species.

Learning activities

THEORY LECTURES

Attending hours: 50

Non-attending hours: 70

Teaching-learning methodology

Master lectures of theory and problems. In these sessions, the lecturer will present the contents using the blackboard and the computer. The students may ask questions about topics taught during the lecture or in previous lectures. The contents will be studied from the notes taken in the lectures and other material recommended by the lecturer.

The lectures usually combine theory and problems, that is, there are no lectures focused specifically on problems. During the lectures, the text book of Stachan and Read "Human Molecular Genetics 2" is frequently used, and it is available on-line at the NCBI. Also, during the lectures, the teacher will demonstrate how to track and consult genetic databases, and the students may reproduce and extend such task from any computer with internet connection.

Throughout the lectures, the units of the contents are not followed in sequential order. For example: although the calculation of probabilities using the Bayes´ theorem appears at the end of the content index, this method will be used since the beginning of the module when analyzing some genealogies. Another example: when teaching the inactivation of chromosome X, the lecturer may also tackle the topic of positional cloning for the identification of the gene responsible for Duchenne muscular dystrophy (DMD). That is, the contents of the module are not presented in linear order; instead, the lecturer deliberately tackles different topics in order to give a more integrating perspective of the module.

LABORATORY PRACTICALS

Attending hours: 5

Non-attending hours: 15

Teaching-learning methodology

The practical activities (laboratory/informatics) will be announced in advance so that the students may organize their activities conveniently.

COMPUTER PRACTICALS

Attending hours: 5

Non-attending hours: 5

Evaluation systems and criteria

Written exams

Half-term exam of theory and problems (no discharge) on the first week of April that could represent up to 10% of the final mark.

Final exam of theory (~ 50 %) and problems (~ 50 %).

Module	Cell Biology
Certification	Degree in Biology
Code	1530025
Stage	4
Type	Elective
Duration	Four months (First term)
Total Credits	6
Theory Credits	5.9
Practicals Credits	1.1
Department	CELL BIOLOGY

Lecturers

- VELASCO LOPEZ, ANGEL

Module program

Specific teaching objectives

The main objective is that the student acquires basic, although quite complete, knowledge of the fundamentals of eukaryote cell physiology. It is intended to provide a unitary perspective of cell organization from the integration of structural and functional knowledge. Cell activities depend on highly sophisticate molecular machineries, developed throughout evolution. Such components are bound to control and supervision. Therefore, we pay special attention to those regulating mechanisms that are responsible for the coordination and integration of cell processes.

Ultimately, after completing the module, the student will be able to value the advances that are continuously achieved in this branch of science and, if it was their wish, to get involved in the development and growth of some of the issues dealt.

Specific skills

- Molecular understanding of cell processes
- Basic knowledge of the most common experimental procedures
- Perform functional tests, determine vital parameters and interpret them
- Design models of biological processes
- Analyze and interpret cell behavior
- Obtain information, design experiments and interpret the results
- Perform cell and tissue cultures
- Handle genetic material
- Critical analysis of specialized scientific literature
- Develop deductive capability
- Public presentation and discussion of results

Contents of the module

THEORY LECTURES PROGRAM

- 1.- Cell compartments. Synthesis and distribution of proteins. Bidirectional traffic of molecules between the nucleus and the cytoplasm. Transport of proteins to: mitochondrion, chloroplast and peroxisome.
- 2.- Cytoskeleton. Concept. Molecular and functional properties of microtubules, actin filaments and intermediate filaments. Motor activities. Spatial organization.
- 3.- Vesicular transport. Principles. Secretory routes. Structural and molecular organization of the endoplasmic reticulum and Golgi apparatus. Endocytic pathways.
- 4.- Cell signalling. Types of receptor molecules. Signalling pathways mediated by G receptors and receptors with enzymatic activity.
- 5.- Cell cycle. Regulatory mechanisms. Control and supervision points. Mitosis
- 6.- Apoptosis. Functional importance. Cellular basis of cancer

PRACTICAL LECTURES PROGRAM

- PRACTICAL 1: Fluorescent stainings
- PRACTICAL 2: Assessment of fluorescent stainings
- PRACTICAL 3: Observation with EM
- PRACTICAL 4: Observation with EM
- PRACTICAL 5: Practical exam

Learning activities

THEORY LECTURES

Attending hours: 25

Non-attending hours: 45

Teaching-learning methodology

Master lecture

Reviewing of specialized bibliography

Presentation and discussion of scientific reviews

Skills developed

- Structure and function of the eukaryote cell
- Structure and function of biomolecules
- Regulation and integration of cellular functions
- Cell adaptations to the medium
- Translation and modification of genetic material
- Mechanisms of molecular selection and classification
- Molecular flows between organelles and compartments
- Structure, composition and properties of cytoskeletal elements
- Transport of organelles and molecules throughout microtubules and actin filaments
- Pathways that regulate and determine changes in the cytoskeletal network
- Cell signalling
- Control mechanisms that govern the cell cycle
- Physiological importance of apoptosis
- Cellular basis of oncogenic cell transformation

PRESENTATIONS AND SEMINARS

Attending hours: 10

Non-attending hours: 12

Teaching-learning methodology

Presentation of a current scientific review related to one issue of those included in the program

Skills developed

- Judgment and self-judgment abilities
- Fluid and proper oral communication
- Personal commitment to learn
- Learning skills
- Analysis and synthesis ability

LABORATORY PRACTICALS

Attending hours: 10

Non-attending hours: 10

Teaching-learning methodology

- Perform cellular stainings
- Assessment of stainings using a light microscope
- Recognition of cellular organelles using an electron microscope
- Interpretation of micrographies

Skills developed

- Molecular understanding of cellular processes
- Basic knowledge of the most common experimental procedures
- Perform functional tests, determine vital parameters and interpret them
- Design models of biological processes
- Analyze and interpret cellular behavior
- Obtain information, design experiments and interpret the results
- Develop deductive capability
- Public presentation and discussion of the results

Evaluation systems and criteria

Practical exam

Evaluation of the contents taught at the practical lectures. The students will have to demonstrate the skills acquired through an exam, which could be written and/or by showing such skills in a Biology laboratory.

Seminars and/or presentations

The evaluation will be performed on the presentations of the works in which the students will have to demonstrate the skills acquired. Both the contents and the presentation of these will be assessed.

Directed activities and/or self-evaluations

The correct resolution of problems proposed and the use of adequate bibliography will be assessed. These activities could require attendance.

Theory exam

Oral and/or written exams. The evaluation will be performed on the exams, in which the students will have to demonstrate the skills acquired. Passing all the tests will not be achieved without uniform and balanced knowledge of the whole subject.

Attendance

Attendance could be assessed.

Module	Biodiversity and Animal Species Conservation
Certification	Degree in Biology
Code	1530024
Stage	4
Type	Elective
Duration	Four months (First term)
Total Credits	6
Theory Credits	4
Practicals Credits	2
Department	ZOOLOGY (FACULTY OF BIOLOGY)

Lecturers

- BELTRAN GALA, JUAN FRANCISCO
- GARCIA GOMEZ, JOSE CARLOS

Module program

Specific teaching objectives

-Gain essential knowledge related to biodiversity, impact and conservation, especially applied for their characterization, environmental diagnosis (bioindicator species and communities), handling and management.
-Characterize the environmental variables that influence biodiversity and how their changes -both natural and anthropic- may affect it.
-Acquire general knowledge of the matter, from an applied perspective. To achieve this, the information will be given at a multidirectional flow, in order to facilitate the analysis of local issues from global issues.
-Train the students with practical and theory examples related to the use of essential basic and applied concepts. Special emphasis will be given to environmental impacts and preventive and mitigation measures, as well as to programs of environmental monitoring and vigilance.

Specific skills

Know general aspects of biodiversity in the marine, epicontinental and land systems, as well as their spatial and temporal distribution.
- Understand the difficulty of taxa identification and its management in order to use analytical methods to determine ecological diversity, as well as their strengths and weaknesses.
- Learn how to detect and identify bioindicator species and communities, and to predetermine environmental diagnoses of habitats and ecosystems from them.
- Know the threats that hang over the world´s biodiversity, the impacts produced on it and learn methods for planning and analyzing environmental impacts, focused on the quantitative use of taxa.
- Learn how to use computer programs for the management and analysis of biodiversity.

Contents of the module

- Analysis of biodiversity at a global and spatial scale. Essential aspects for its consideration and measurement at a local level. Identification of taxa and their complexity for quantifying biodiversity.
- Analytical methods of ecologic diversity. Strengths and weaknesses of these. Potentiality of their use in previous stages and monitoring in basic and applied ecological

studies. Identification of indicator organisms and its application to studies of environmental impact and monitoring.

- Marine and land media, physicochemical characterization and their potentialities to show biodiversity and different levels of fragility in the case of different types of threats and impacts. Influence of atmospheric, epicontinental and oceanic circulations.
- Reproduction and dispersion in marine and land systems. Incidence in the management and conservation of biodiversity.
- Reflections about the species concept. Genetic isolation, endemisms and speciation processes. Taxa expansion, regression and extinction.
- Protected areas, exploitable biological resources and biodiversity in artificial systems (artificial biotopes). Exploitation vs conservation.
- Natural and anthropogenic threats and impacts. Reversible changes vs irreversible changes in ecosystems.
- Environmental legislation and the use of its knowledge.

Learning activities

THEORY LECTURES

Attending hours: 30

Non-attending hours: 70

Teaching-learning methodology

Continuous, assisted deductive method of questions that allow a permanent state of motivation and "attention" in students, so that they think about them and try to find adequate answers. These will be solved later, either in the same lecture or next lectures, and the students will always be given considerable time to think and draw their own conclusions. Thereby, the lectures will be participatory.

Skills developed

Learning or reinforcement of basic knowledge and its implementation. Training in the selection of basic and applied specific, descriptive analyses, which will help the students throughout their professional development, with special attention to the technical and business contexts, regarding future careers.

PRESENTATIONS AND SEMINARS

Attending hours: 10

Non-attending hours: 3

Teaching-learning methodology

Attend seminars prepared by visiting lecturers and/or by those who belong to the module, which will be participatory for the students and in which they will be given a brief summary of contents they must assimilate. The seminars will be previously agreed with the lecturer who gives them, making sure that at least part of them includes applied contents.

Skills developed

Increase the "broadmindedness" of the students by giving them the chance to listen to expert researcher speakers from specific issues of basic or applied research, who will show them, among other things, matters of project planning and design or research works, and will encourage them to discover the numerous problems that may arise, and solve them. Strengthen previously acquired knowledge. Become aware of the importance of implemented conservationism.

LABORATORY PRACTICALS

Attending hours: 20

Non-attending hours: 17

Teaching-learning methodology

The practicals are aimed to initiate the student in the performance of biodiversity estimations, and in the use of programs of population dynamics simulation, estimation of population effective size and genetic drift effects, environmental and demographic stochasticity in small populations. Moreover, population size estimations based on censuses through linear transects which will consist of a field phase and a laboratory phase. In the marine field, the student will be taught how to apply *in situ* theory knowledge about identifying bioindicator species that allow environmental diagnoses of the quality of the marine medium and their application to studies of environmental impact and monitoring, ecological vigilance and conservation of the coastal environment. Likewise, depending on the availability of resources, field trips will be arranged, preferably to protected areas.

Such trips will be voluntary, but they will be conditioned to attendance at practical lectures.

Skills developed

Improve and fix part of the knowledge acquired in the theory lectures, and gain other new knowledge directly related to the specific objectives of the practicals. Develop skills for problem detection, diagnosis and resolution, as well as to understand the fragility of ecosystems and stipulate preventive measures to avoid its loss or degradation.

Evaluation systems and criteria

Theory will represent 70% of the total evaluation of the module (the remaining 30% corresponds to the practicals)

Theory will represent 70% of the total evaluation of the module (the remaining 30% corresponds to the practicals)

The theory exam will consist of essay questions, which could include images and reasoning questions.

Both parts (theory and practicals) must be passed (i.e. mark >5) independently, so that the average qualification may be weighted.

The evaluation of the practicals will consist of:

- 2 points for attendance (80% of the lectures, i.e. 4 practicals out of 5)
- 3 points (maximum) for the assessment of the Practical Notebook (a report on the work performed during the first four practicals -written as a scientific paper- of a maximum of 10 pages; the fifth practical could be evaluated in the theory exam, as it is directly related to a specific issue within the preset program). The global qualification of the practicals will be performed over the first four.
- 5 points for the practical exam

Module	Molecular Biology and Plant Biotechnology
Certification	Degree in Biology
Code	1530027
Stage	4
Type	Elective
Duration	Four months (First term)
Total Credits	6
Theroy Credits	5
Practicals Credits	1
Department	PLANT BIOCHEMISTRY AND MOLECULAR BIOLOGY (FACULTY OF BIOLOGY)

Lecturers

- FLORENCIO BELLIDO, FRANCISCO JAVIER
- HUERTAS ROMERA, MARIA JOSE
- ROBLES RENGEL, ROCIO

Module program

Specific teaching objectives

The students are expected to acquire specific skills in the world of plants through the molecular and biotechnological perspective that it may involve. Therefore, the students will have to gain the capabilities required for integrating knowledge of different disciplines that allow them to develop an integrated perspective of the role of plants at the molecular level and the relevant aspects of the processes they carry out, especially the photosynthetic conversion as the most important characteristic. From this basic conception the students will acquire skills that will allow them to:

- Handle problems related to plants regarding metabolic analysis.
- Analyze in a critical and synthetic way different aspects of plant growth.
- Develop skills in researching and handling plants and the molecular information obtained from them through specific techniques.
- Develop skills in the use and raking of information, especially through the reviewing of the best journals in the field, and discern the relevance of the information found.

Specific skills

Discern between applicability and critical knowledge of plants with their environment

Scientific language - research performance

From this basic conception, the students will acquire skills that will allow them to:

- Handle problems related to plants regarding metabolic analysis.
- Analyze in a critical and synthetic way different aspects of plant growth.
- Develop skills in researching and handling plants and the molecular information obtained from them through specific techniques.
- Develop skills in the use and raking of information, especially through the reviewing of the best journals in the field, and discern the relevance of the information found.

Contents of the module

- GENETIC MATERIAL. PLANT GENOME. GENE EXPRESSION IN PLANTS. EPIGENETICS and REGULATION BY RNAs

- THE CHLOROPLAST: STRUCTURE AND REGULATION.
- PHOTOSYNTHESIS AND PROTEIN TRANSPORT.
- THE MITOCHONDRIA.
- CONTROL OF GENE EXPRESSION:
- PHOTOREGULATION: PHOTOMORPHOGENESIS, RECEPTORS AND TRANSCRIPTION.
- HORMONE CONTROL OF GENE EXPRESSION:
- I. ABA AND GIBBERELLINS
- II. AUXINS AND CYTOKININS.
- III. ETHYLENE AND NEW HORMONES
- PLANT-PATHOGEN INTERACTIONS
- GROWTH AND REPRODUCTION
- DEVELOPMENTAL MOLECULAR BIOLOGY. PLANT ORGANS. THE FLOWER.
- PLANT BIOTECHNOLOGY. APPLICATION OF GENETIC ENGINEERING IN PLANTS.

Learning activities

THEORY LECTURES

Attending hours: 40

Non-attending hours: 62.5

Teaching-learning methodology

Theory will be taught through master lectures, using appropriate technological means, mainly computer presentations and interactive communication with the students.
It is intended to analyze the degree of knowledge, skills and ability of the students, thereby the theory-practical knowledge and its specific reflection will be the target of the different educational techniques, with the top purpose of achieving a good training in this matter.

Skills developed

Basic general knowledge
Oral communication in the native language
Knowledge of a second language
Information handling ability
Judgment and self-judgment abilities
Ability to apply theory to practice
Learning skills
Ability to come up with new ideas

PRESENTATIONS AND SEMINARS

Attending hours: 10

Non-attending hours: 10

Teaching-learning methodology

Learn the research systems in plants. Handle scientific methodology. Discern relevant studies in the scientific literature. Write and present a scientific study. Oral presentation of scientific studies. Capability to analyze and discuss results with the classmates about scientific issues.

Skills developed
Basic general knowledge
Oral communication in the native language
Knowledge of a second language
Information handling ability
Judgment and self-judgment abilities
Learning skills
Ability to come up with new ideas

LABORATORY PRACTICALS
Attending hours: 10
Non-attending hours: 15

Teaching-learning methodology
- Operate systems for the analysis and study of processes related to the development of plants, especially of growth under light vs darkness.
- Handle model plants (Arabidopsis) for phenotypic analysis and understanding of genetic manipulation techniques in plants.
- Learn the analysis systems in research through experimental design and other resources of laboratory techniques.

Skills developed
Analysis and synthesis ability
Organization and planning ability
Basic general knowledge
Solid basic knowledge of the profession
Written communication in the native language
Knowledge of a second language
Elemental skills in informatics
Skills for gathering and analyzing information from different sources
Problem solving
Decision making
Teamwork
Abilities in interpersonal relationships
Teamwork abilities
Ability to apply theory to practice
Research skills
Learning skills
Ability to adapt to new situations
Ability to come up with new ideas
Leadership
Planning and management

Evaluation systems and criteria
Exam on the theory contents, evaluation of the seminars, evaluation of the practicals
The exam will be 3 hours long, and it will consist of a set of questions by which the knowledge of the student will be measured. The questions will be also designed to assess the

ability of the student to analyze the results of experiments. The value of the exams will be 75% of the final mark of the module.
Evaluation of the seminars and assignments about specific articles
This will represent 10% of the final mark and will be based on the presentation, its contents and its preparation, for example, bibliography consulted, etc.
Evaluation of the practicals
This will represent 15% of the final mark and it will include attendance and the laboratory handbook as the main element for the evaluation.

Module	Ethology
Certification	Degree in Biology
Code	1530030
Stage	4
Type	Elective
Duration	Four months (Second term)
Total Credits	6
Theory Credits	5.4
Practicals Credits	0.6
Department	PHYSIOLOGY (FACULTY OF BIOLOGY)

Lecturers

- DAVIS LOPEZ DE CARRIZOSA, M. AMERICA
- ESCUDERO GONZALEZ, MIGUEL

Module program

Specific teaching objectives

GENERAL OBJECTIVES

- Identify and characterize animal behavior
- Understand which is the evolutionary basis of animal behavior
- Understand how natural selection acts on the behavior of the individual
- Think about how the physiological, ecological and social restrictions mould behavior
- Use mathematical models to explain the strategies carried out by individuals and populations
- Develop a critical perspective for science
- Learn how to explain the knowledge through discussions at the lecture theater
- Learn how to speak in public through presentations and seminars

METHODOLOGY OBJECTIVES

- Learn how to observe, assess and quantify behavior and learning.
- Analyze behavior statistically and perform predictive models.
- Use genetic algorithms, cellular automata and artificial life to simulate individual and group behavior.

Specific skills

- Multiple focus approach to complex problems.
- Skills for the evolutionary approach to the resolution of biological problems.
- Mathematical description of biological phenomena.
- Extension of the scientific and technical background.
- Stimulation of the analytical and synthetical processes.

Contents of the module

THEORY PROGRAM

- Block 1: INTRODUCTION TO THE STUDY OF ANIMAL BEHAVIOR
  - Unit 1. Study of the evolutionary principles of animal behavior.
  - Unit 2. Natural selection and evolution of behavior.
- Block 2: PROXIMATE CAUSES OF ANIMAL BEHAVIOR
  - Unit 3. Neurobiological basis of behavior.
  - Unit 4. Learning and memory.
  - Unit 5. Use of time: biological rhythms.
  - Unit 6. Migration and orientation.
- Block 3: ULTIMATE CAUSES OF ANIMAL BEHAVIOR
  - Unit 7. Use of space: territoriality.
  - Unit 8. Decission making.
  - Unit 9. Animal communication.
  - Unit 10. Agonistic behavior.
  - Unit 11. Conflict and sexual selection.
  - Unit 12. Parental care.
  - Unit 13. Animal societies.

PRACTICALS PROGRAM

Computer room:

- - 1. STUDY OF EXPLORATORY LEARNING BY MEMORY TEST. Analysis of tests of exploratory learning and short and long term memory in mice (Mus musculus).
- - 2. CHARACTERISTICS AND ANALYSIS OF ACOUSTIC SIGNALS. Record of acoustic signals. Interference. Breakdown. Fourier analysis. Sonograms. Parameters. Comparison of signals.

Laboratory:

- - 1. FACIAL RECOGNITION. Identification and quantification of the characteristics that are modified in the basic facial expressions. Study of the adaptive advantages of facial recognition; Dunbar´s number.

Learning activities

THEORY LECTURES

Attending hours: 45

Non-attending hours: 65

Teaching-learning methodology

These will be voluntary. They will be one and a half hours long (13-14:30h) and will be taught two days a week (mondays and tuesdays) in a lecture theater of the Red Building of the Faculty, according to the calendar approved by the Board of the Centre. The lectures will be based on the theory fundamentals and will be aimed to foster student participation.

PRESENTATIONS AND SEMINARS

Attending hours: 9

Non-attending hours: 16

Teaching-learning methodology

The students will perform a bibliographic work in groups, which will be presented as a seminar. The presentation will take place the 3rd, 10th and 24th of April and 8th, 15th and 22nd of May, in the same timetable as the theory lectures (13-14:30h). The topics corresponding to the seminars will be reported at the beginning of the course. Following the seminar, the students will have the chance to gather with the lecturer and discuss any doubts.

Skills developed

Learn how to write and present a bibliographical work about topics related to the physiological, genetic, ecological and evolutionary bases of animal behavior and learning.

LABORATORY PRACTICALS

Attending hours: 3

Non-attending hours: 4

Teaching-learning methodology

These will be voluntary and will be performed in a two hour long session. The place where it will be carried out is still under deliberation. At the end of the practical, the assignments proposed by the lecturer will be picked up. Attendance will be positively counted.

COMPUTER PRACTICALS

Attending hours: 3

Non-attending hours: 4

Teaching-learning methodology

These will be voluntary and will be performed in two sessions of two hours each, in one of the computer rooms of the Faculty (Red Building). At the end of the practical, the assignments proposed by the lecturer will be picked up. Attendance will be positively counted.

Evaluation systems and criteria

Theory-practical midterm exam (70%) + practicals (15%) + seminar (15%) / Final exam

- Objective exam of theory lectures (70% of the final mark of the module). It will consist of multiple-choice questions (30% of the final mark of the module) + 3 essay questions (30% of the final mark of the module) + 1 question about the contents of the practicals (10% of the final mark of the module).
- Evaluation of the bibliographic work and seminar presentation (15% of the final mark of the module = 8% oral presentation+7% bibliographic work)
- Evaluation of the practical lectures (15 % of the final mark of the module). In each practical lecture (there are 3) students can get a maximum of 5% of the final mark of the module. Attendance will count 2% and the practicals handbook will count 3%. The contents of the practicals will also be assessed in the written exam.

In order to pass the module and for the mark of the seminar and the practicals to count, students are required to pass the theory exam. For those who do not pass the theory exam there will be a final exam which will count 100%. This exam will consist of a multiple-choice test section (40% of the mark), another section with short questions (40% of the mark) and two questions about the practicals (20% of the mark of the exam).

Module	Environmental Plant Physiology
Certification	Degree in Biology
Code	1530031
Stage	4
Type	Elective
Duration	Four months (First term)
Total Credits	6
Theory Credits	4
Practicals Credits	2
Department	PLANT BIOLOGY AND ECOLOGY (FACULTY OF BIOLOGY)

Lecturers

- DE CIRES SEGURA; ALFONSO
- RODRIGUEZ DOMINGUEZ, CELIA MODESTA

Module program

Specific teaching objectives

Fix and integrate previous knowledge, learned in previous modules, about the main physiological processes in plants.
Understand the effects of the main external agents (biotic and abiotic) on the physiological processes of plants.
Obtain a comprehensive perspective of the complex physiological adaptive mechanisms of plants to different adverse environmental situations.
Carry out simulations and predictions of different adverse environmental conditions by using computer models.
Interpret graphs of physiological variables and their interrelationships inside and outside the physiological range.

Specific skills

Stimulation of analysis and synthesis processes to write up a scientific paper.
Ability to search updated information in scientific data bases.
Ability to operate available audiovisual methods to communicate information.
Ability to learn autonomously and transmit what was learnt.
Ability to analyze the data obtained from a scientific experience and to draw and present conclusions derived from them.

Contents of the module

- -Plant-soil, plant-atmosphere relationship, under stress situations.
- -Metabolism-environment relationship in plants under stress situations.
- -Structure-function relationship in adaptations to stress situations.
- -Development of corrective strategies against stress situations applicable to practical cases, with further focus on agriculture.

Learning activities

THEORY LECTURES

Attending hours: 40
Non-attending hours: 70

Teaching-learning methodology

These will be voluntary. They will be one and a half hour long and will be taught two days a week in a lecture theater of the Red Building of the Faculty, according to the calendar approved by the Board of the Centre. The students will be free to interrupt the lecture as many times as they want to participate, ask for clarifications or solve doubts, as well as to request additional information. Likewise, the lecturer may request the participation of the students in the discussion.

Skills developed

Those described in previous sections.

PRESENTATIONS AND SEMINARS

Attending hours: 10
Non-attending hours: 10

Teaching-learning methodology

This will be compulsory, due to its training potential in aspects that are undetected by other means. It will be performed in groups (2-3 students), about a topic agreed with the lecturer within the objectives of the module. All the groups will hand in a written version within a deadline agreed between the lecturer and the students, and always before the beginning of the last third of the course. The performance of each group will take place in this last third of the course and will last between 45 and 60 minutes in a public session, which will be held in the same lecture theater of the Red Building that was used for the theory lectures, and the students may use any equipment they want for the presentation, after which, those attendants who wish to, may ask the questions they want.

Skills developed:

LABORATORY PRACTICALS

Attending hours: 10
Non-attending hours: 10

Teaching-learning methodology

These will be compulsory and will be take place in the laboratories assigned to the department of Plant Physiology, in the ground floor or in the premises of the Division, situated in the fourth floor of the Green Building of the Faculty. The number of groups needed will be established and the calendar for each practical will be shown, after an agreement between the students and the lecturer has been made.

Evaluation systems and criteria

Theory lectures

These will be evaluated through a written test that will combine multiple-choice and essay questions. Its length will be, at least, two hours. It will consist of no more than 100 multiple-choice questions with a single degree of freedom, marked according to the formula (correct-incorrect)/10, and no more than 4 essay questions. Each section represents 50% of the total mark of this test, which will be 70% of the final mark of the module. This test will include the contents seen in the seminars. There will be a similar test in June, for those students who have not passed the module in February.

Seminars

The evaluation of the seminars will represent 20% of the final mark of the module: 1) 15 % for the written version, based on the quality of the work and, 2) 5% for the presentation, based on its quality and performance, as well as on the answers to the questions asked.

Laboratory practicals

Each student will have to write up and hand in a report about the work carried out and the results obtained, which assessment will represent 10% of the final mark.

Module	Mediterranean Flora and Vegetation
Certification	Degree in Biology
Code	1530032
Stage	4
Type	Elective
Duration	Four months (Second Term)
Total Credits	6
Theory Credits	3
Practicals Credits	3
Department	PLANT BIOLOGY AND ECOLOGY (FACULTY OF BIOLOGY)

Lecturers

- ORTIZ HERRERA, MARIA ANGELES
- TALAVERA LOZANO, SALVADOR
- VALDES CASTRILLON, BENITO

Module program

Specific teaching objectives

- Understand criteria that allow separating and characterizing higher plants into discrete units (taxa), especially at the species level, applying them to the flora of the Mediterranean region.
- Recognize the relevance of classification as an essential tool to determine biodiversity and its later conservation and use.
- Establish the basic rules according to which the species and other taxonomic groups are named with the aim of using the botanic names adequately.
- Recognize the diversity in chromosome count among land plants and understand its relevance in speciation processes, with focus on examples of the Mediterranean region.
- Analyze the interest of the techniques of molecular phylogeny and analysis of population genetic variability for the differentiation of plant species and the study of their evolutionary history, with focus on representative species of the Mediterranean region.
- Analyze and understand the geophysical and biological factors that determine the evolution of the flora in the Mediterranean region and recognize their characteristics and relevance regarding the world´s flora.
- Recognize the diversity of plant formations in the Mediterranean area and analyze its distinctive particularities.
- Know the methodology used in studies of vegetation reconstruction.
- Understand the relevance of the Mediterranean region as an area of endemism concentration and know the criteria that determine the scientific-technical activities aimed at its conservation.
- Develop and value a floristic inventory of an area of Western Andalucia.
- Recognize by sight at least 60% of the wild flora families of the Mediterranean taken at random, with further focus on Western Andalucia.
- Collect, handle, document and identify samples of wild mediterranean plants to elaborate a herbarium with scientific florae.

Specific skills

- General knowledge of the biological basis of plant biodiversity.
- Specific knowledge of the cytogenetic and reproductive processes that influence plant speciation.
- Ability to adequately use the names of plants, which is the basis for identifying the experimental material of any discipline.

- Knowledge of the relevance of classification as an essential tool for determining biodiversity and its later conservation and usage.
- Theory and practical knowledge to interpret the processes and patterns related to the distribution of plants.
- General knowledge of vegetation at a global scale.
- Ability to interpret the specific characteristics of vegetation in the Mediterranean region.
- Ability to prepare and value a floristic inventory.
- Ability to obtain, document and identify samples of wild mediterranean flora with a minimum efficacy of 90% in the family category, 75% in the genus category and 33% in the species category, from samples taken at random.
- Sight recognition of wild flora of Western Andalucia with a minimum efficacy of 60% in the family category, 40% in the genus category and 20% in the species category, from samples taken at random.

Contents of the module

THEORY

- Unit 1.- Plant taxonomy and evolution in the Mediterranean.
  Lesson 1.- Botanic classifications: the concept of species.
  Lesson 2.- Mechanisms of speciation.
  Lesson 3.- Principles of taxonomic nomenclature.
  Lesson 4.- Taxonomic analysis: characters used.
  Lesson 5.- Chromosome count in higher plants: relevance in speciation.
  Lesson 6.- Phylogenetic methods in Taxonomy.
  Lesson 7.- Phylogeography and population evolution.
- Unit 2.- Mediterranean Flora and Vegetation.
  Lesson 8.- Methods of plant reconstruction.
  Lesson 9.- Origin and evolution of the mediterranean vegetation.
  Lesson 10.- Global mediterranean biogeography.
  Lesson 11.- The plant landscape of the Mediterranean I: Forests.
  Lesson 12.- The plant landscape of the Mediterranean II: Scrubland.
  Lesson 13.- The plant landscape of the Mediterranean III: Herbaceous communities.
  Lesson 14.- Endemisms and relicts in the Mediterranean.
  Lesson 15.- Conservation of the mediterranean flora.

LABORATORY PRACTICALS

- Recognition of the main families of the mediterranean flora, determination of species and preparation of a herbarium (2.4 credits).

FIELD PRACTICALS

- Herborizations.

Learning activities

THEORY LECTURES

Attending hours: 30
Non-attending hours: 52

Teaching-learning methodology

The master lecture will be the main source, especially due to the need for thoroughly describing a great number of natural events and processes. The didactic means and resources used will be the image documents (e.g. PowerPoint) available in the platform WebCT and other telematic means of the University of Seville. PDF files of relevant texts and some voluntary questions will also be included.

Skills developed

- General knowledge of the biological basis of plant biodiversity.
- Specific knowledge of the cytogenetic and reproductive processes that influence plant speciation.
- Ability to adequately use the names of plants, which is the basis for identifying the experimental material of any discipline.
- Knowledge of the relevance of classification as an essential tool for determining biodiversity and its later conservation and usage.
- Theory and practical knowledge to interpret the processes and patterns related to the distribution of plants.
- General knowledge of vegetation at a global scale.
- Ability to interpret the specific characteristics of vegetation in the Mediterranean region.

LABORATORY PRACTICALS

Attending hours: 20

Non-attending hours: 22

Teaching-learning methodology

Through diverse didactic resources (explanatory PowerPoint documents, pressed material, didactic and scientific works about plant morphology, etc), those aspects of greater interest for the determination of plant taxa will be shown, as well as their diversity of states. From this knowledge, sight recognition of the most important families in our region and the Mediterranean region will be taught and the students will be trained in the determination through scientific keys. The material used will basically consist of that provided by the students for the preparation of a herbarium, which they must hand in at the end of the course as the result of their work in the practicals.

Skills developed

- General knowledge of the biological basis of plant biodiversity.
- Ability to adequately use the names of plants, which is the basis for identifying the experimental material of any discipline.
- Knowledge of the relevance of classification as an essential tool for determining biodiversity and its later conservation and usage.
- Ability to prepare and value a floristic inventory.
- Ability to obtain, document and identify samples of wild mediterranean flora with a minimum efficacy of 90% in the family category, 75% in the genus category and 33% in the species category, from samples taken at random.
- Sight recognition of wild flora of Western Andalucia with a minimum efficacy of 60% in the family category, 40% in the genus category and 20% in the species category, from samples taken at random.

FIELD PRACTICALS

Attending hours: 10

Non-attending hours: 20

Teaching-learning methodology

If finance allows so, a didactic field trip will be organized in order to show the students how herborizations must be carried out. From this trip the students will be responsible of collecting the material needed to prepare their own herbarium.

Skills developed

- General knowledge of the biological basis of plant biodiversity.
- Ability to adequately use the names of plants, which is the basis for identifying the experimental material of any discipline.
- Knowledge of the relevance of classification as an essential tool for determining biodiversity and its later conservation and usage.
- Theory and practical knowledge to interpret the processes and patterns related to the distribution of plants.

- Ability to interpret the specific characteristics of vegetation in the Mediterranean region.
- Ability to prepare and value a floristic inventory.
- Ability to obtain, document and identify samples of wild mediterranean flora with a minimum efficacy of 90% in the family category, 75% in the genus category and 33% in the species category, from samples taken at random.
- Sight recognition of wild flora of Western Andalucia with a minimum efficacy of 60% in the family category, 40% in the genus category and 20% in the species category, from samples taken at random.

Evaluation systems and criteria

THEORY CONTENTS. These will be evaluated through written tests based on objective items (multiple choice questions), probably including as well some short questions. Two modes are proposed:

Continuous Evaluation. Two half-term tests will be taken throughout the course; one at the end of each block. In order to pass the theory contents for this mode, the students will have to achieve a qualification of 5.0 or higher in the arithmetic mean of the two tests, without obtaining a mark below 4.0 in any of them.

Final Exam. All those students who prefer it or do not accomplish to pass the theory contents in the previous mode may opt for a final exam, which will include the complete contents of the theory program. This exam will be passed with a mark of 5.0 or higher. This is the only possible mode in the calls of September, December and February.

PRACTICAL CONTENTS. In order to pass the practical contents, two modes are also proposed:

Continuous Evaluation. This will be assessed through the control of attendance to the practical activities and work carried out in them, plus the valuation of a herbarium prepared in groups. In order to opt for this mode it is required to attend 80% of the practical activities (24 hours). The corresponding qualification for the attendance to an academic course may also be calculated in the call of September of the same year and the one of December of the next course which, consequently, may be passed in this mode.

The herbarium will be prepared in groups of 3-5 students who will be freely designed by the students. It will consist of a total of 100 sheets corresponding to as many different species belonging to 40 families, plus an explanatory report of the environmental characteristics and plant formations of the area of origin of the plant material presented. The sum of the different factors evaluated in this mode must be 5.0 or higher.

Final Exam. All those students who prefer it may opt for a Final Exam, which will include sight recognition of herbarium sheets. This exam will be passed with a score of 5.0 or higher.

FINAL MARK: In order to pass the module, the students are required to achieve a score of 5.0 or higher in the evaluations of the theory and practical contents, independently. The final mark will be obtained by multiplying the theory and practical marks by factors 0.6 and 0.4, respectively, and adding the products, according to the formula:

Final Mark = (Theory qualification × 0.6) + (Practical qualification × 0.4)

Module	Secondary Metabolism in Plants and Defenses against Pathogens and Herbivores
Certification	Degree in Biology
Code	1530036
Stage	4
Type	Elective
Duration	Four months (First term)
Total Credits	6
Theory Credits	4.5
Practicals Credits	1.5
Department	PLANT BIOLOGY AND ECOLOGY (FACULTY OF BIOLOGY)

Lecturers

- FERIA BOURRELLIER, ANA BELEN
- GARCIA-MAURIÑO RUIZ-BERDEJO, SOFIA

Module program

Specific teaching objectives

Objectives related to the contents of the module:
- Integrate secondary metabolites into a functional group.
- Recognize the main biochemical families of secondary metabolites and the metabolic routes involved in their synthesis.
- Understand the main mechanisms of recognition and response of plants against pathogens and herbivores.

Objectives related to the learning and/or training tools:
- Prepare a research work and present to a public audience and as a scientific report.
- Elaborate a project of a laboratory experiment and analyze its interest and viability.

Objectives linked to values or attitudes:
- Develop analysis and synthesis abilities.
- Develop organization and planning abilities.

Specific skills

- Stimulation of analysis and synthesis processes to elaborate a written scientific paper.
- Ability to search up-to-date information in scientific databases.
- Ability to adjust the audiovisual methods available to communicate the information.
- Self-learning capacity and ability to transmit what was learnt.
- Ability to analyze data obtained from a scientific experiment and to present conclusions drawn from it.

Contents of the module

- Part 1: SECONDARY METABOLISM
  It includes chapters 1, 2, 3 and 4. It is focused on the biochemical and functional study of secondary metabolism in plants.
- Part 2: DEFENSE METABOLISM
  It includes chapters 5, 6, 7 and 8. It is focused on the defensive responses of plants, their relationship with secondary metabolism and the biochemical and molecular mechanisms involved.

Learning activities

THEORY LECTURES

Attending hours: 33

Non-attending hours: 66

Teaching-learning methodology

The contents of the theory lectures of the module consist of 8 chapters, distributed in two main areas: secondary metabolism and defense metabolism.

In each lecture, the lecturer will reinforce the daily explanation with audiovisual methods. The students will be given a detailed program of each chapter that will include the bibliography used for its elaboration, as well as the main part of their contents in computerized form. In any case, the students are recommended to use the bibliographic references proposed, as well as consulting the lecturers in their corresponding tutorship hours.

Skills developed

Analysis and synthesis ability
Solid basic knowledge of the profession
Written communication in the native language
Knowledge of a second language
Elemental skills in informatics
Skills for gathering and analyzing information from different sources
Learning skills
Ability to search up-to-date information in scientific databases

PRESENTATIONS AND SEMINARS

Attending hours: 10

Non-attending hours: 5

Teaching-learning methodology

Comments about scientific papers.

The lecturer will prepare a list of recent scientific publications. Each student will read and analyze one of these publications, prepare an abstract and present to their classmates the main aspects of it: abstract of the contents, main results, reviews of the conclusions obtained. The presentation will be performed during the hours of the theory lectures.

Skills developed

Analysis and synthesis ability
Organization and planning ability
Solid basic knowledge of the profession
Oral communication in the native language
Written communication in the native language
Knowledge of a second language

Elemental skills in informatics
Skills for gathering and analyzing information from different sources
Problem solving
Decision making
Judgment and self-judgment abilities
Ability to work within an international context
Research skills
Ability to adapt to new situations
Ability to work autonomously
Ability to operate available audiovisual methods to communicate information
Self-learning capacity and ability to transmit what was learnt

LABORATORY PRACTICALS

Attending hours: 15
Non-attending hours: 5

Teaching-learning methodology

Performance of a laboratory experiment, in the timetables assigned for each group. The experimental data obtained must be processed by the students and discussed in public at the corresponding session.

Skills developed

Analysis and synthesis ability
Organization and planning ability
Solid basic knowledge of the profession
Written communication in the native language
Elemental skills in informatics
Problem solving
Decision making
Judgment and self-judgment abilities
Teamwork
Abilities in interpersonal relationships
Teamwork abilities
Ability to work within an international context
Ability to apply theory to practice
Research skills
Ability to come up with new ideas
Planning and management
Stimulation of analysis and synthesis processes to elaborate a written scientific paper
Ability to analyze data obtained from a scientific experiment and to present conclusions drawn from it

OTHER ACADEMIC ACTIVITIES IN THE ABSENCE OF THE LECTURER

Attending hours: 2
Non-attending hours: 12

Teaching-learning methodology

The students will prepare in groups a laboratory experiment project, which must include objectives, material needed, methodology, presentation and interpretation of results and specific bibliography.
The students will publicly present such projects in the timetable of the practical lectures assigned for such activity.

Skills developed

Analysis and synthesis ability
Organization and planning ability
Solid basic knowledge of the profession
Oral communication in the native language
Written communication in the native language
Knowledge of a second language
Elemental skills in informatics
Skills for gathering and analyzing information from different sources
Problem solving
Decision making
Judgment and self-judgment abilities
Ability to work within an international context
Research skills
Ability to adapt to new situations
Ability to work autonomously
Ability to operate available audiovisual methods to communicate information
Self-learning capacity and ability to transmit what was learnt

Evaluation systems and criteria

Theory, through a written assignment.

All the students will have to do a written assignment in order to obtain the theory credits. The assignment will consist of a multiple-choice test, with true, false or unanswered alternatives, and an exam of short essay questions. Scored over 10 points.
The mark obtained will represent 55% of the final mark.

Theory, through the discussion of scientific papers.

The activity will be evaluated by the lecturer after the oral presentation. The corresponding score will be 0, 5 or 10.
The mark obtained will represent 15% of the final mark.

Practicals, through the performance of laboratory practicals and preparation of a report.

The laboratory practicals will be evaluated by the lecturer considering the performance of the student in the laboratory and the written report of the results. Score of 0, 5 or 10.
The mark obtained will represent 15% of the final mark.

Practicals, through the preparation of practicals projects.

The practicals projects will be evaluated according to the written and oral presentations. Scored over 10 points.
The mark obtained will represent 15% of the final mark.

Assessable aspects

THEORY EXAM: The correct answer to the tests and the analysis and synthesis ability in the essay questions, as well as the adjustment of the content to the question. Maximum of 5.5 points.
COMMENTS OF SCIENTIFIC PAPERS: The analysis and synthesis ability of the contents, and the communication skills in the oral presentation. Maximum of 1.5 points.

LABORATORY PRACTICALS: Completion of the laboratory experiment, obtainment of results, preparation, analysis and presentation of these. Maximum of 1.5 points.
PRACTICALS PROJECTS: The adjustment of the topic to the module, the preparation of the project and its presentation, as well as its usefulness for hypothetical students. Maximum of 1.5 points.
The students are required to obtain a minimum mark of 2.8 in the theory (exam and papers) and 1.2 in the practicals (laboratory and seminar) in order to pass the module.