

Cell Biology and Histology

Code: 100855
ECTS Credits: 6

Degree	Type	Year	Semester
2500251 Environmental Biology	FB	1	1

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Teachers

Marta Martin Flix

Prerequisites

Since the Cell Biology & Histology is a subject taught in the first semester of the first year of the Environmental Biology Degree, there are no compulsory pre-requisites. However, in order to make sure that the student is able to fluently follow the subject and to achieve the learning objectives proposed, it is recommended for the student to have achieved previous knowledge regarding the general structure of the eukaryotic cell and its basic metabolic routes, especially those referring to:

- General structure of the cells as well as their basic components (proteins, nucleic acids, lipids, carbohydrates).
- Basic functions of cell organelles
- Cellular metabolic pathways
- Basic characteristics of animal and vegetable tissues

It is highly advisable to have -at least-, a basic knowledge of english, as bibliography and information sources are mainly available in this language.

Objectives and Contextualisation

This is a compulsory first year subject of the Environmental Biology Degree that introduces students to the basics of cell biology and to the tissular organization of vertebrates and plants. The subject is divided into two thematic modules: (1) the study of the eukaryotic cell and (2) how the eukaryotic cells are organized to form different animal and plant tissues.

The central object of study of Cell Biology is the eukaryotic cell, the knowledge of the intracellular organelles and their functions and the relationship between these organelles and the metabolic pathways of the cell. On the other hand, the Histology module studies the cellular associations that constitute the animal and plant tissues and their relation to the tissue function.

The specific objectives of the Cell Biology & Histology subject are the following:

- 1- Describe the structure of the eukaryotic cell and understand the relationship of its structure with its specific cellular functions.
- 2- Understand the functions of cell organelles and compartments, relate their origin and functions and understand that their coordinated operation is essential so that the cells can develop their functions.
- 3 - Recognize cellular and tissue structures. Identify the differential characteristics of animal and plant tissues.
- 4- Use the appropriate scientific terminology and be able to express and describe the knowledge acquired with clearly and properly.
- 5- Work appropriately in a basic biology laboratory.
- 6- Use the optical microscope correctly. To know how to differentiate, basically, the animal cell of the plant, as well as to identify different characteristic components. Know how to identify the basic characteristics of various tissue and animal tissue organizations.
- 7- Search, analyze and synthesize information from different sources to create knowledge independently.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Develop analysis and synthesis skills.
- Identify organisms and recognise the different levels of biological organisation.
- Integrate knowledge of different organisational levels of organisms in their functioning.
- Obtain, observe, handle, cultivate and conserve specimens.
- Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
- Understand the bases of regulation of vital functions of organisms through internal and external factors, and identify environmental adaptation mechanisms.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Actuar en l'àmbit de coneixement propi avaluant les desigualtats per raó de sexe/gènere.
3. Apply the concept of tissue and differentiate between the tissue varieties in the animal and plant organism.
4. Develop analysis and synthesis skills.
5. Identify and analyse material of animal and plant origin and its anomalies.
6. Perform cell cultures and animal tissue cultures.
7. Recognise the histological structure of the principal organs of the animal and plant organism and the structure-function relationships.
8. Recognise the molecular, genetic, tissue- and organism-based levels of organisation.
9. Recognise the structure, morphology and dynamics of the eukaryotic chromosome in the mitotic and meiotic cell cycle.

Content

The subject of Cell Biology & Histology has a basic character in the Environmental Biology Degree. After finishing it, the student should have acquired solid knowledge about the structural organization, functioning and regulation of the eukaryotic animal and vegetal cell and of the animal and plant tissues that these form. This biological knowledge is complemented with those of other basic and compulsory subjects in the Degree, such as Genetics, Biochemistry, Plant and Animal Physiology or Phylogeny and Evolution. All of these subjects will provide the Environmental Biology student with a good understanding of the structural and functional organization of living organisms. On the other hand, the theoretical knowledge acquired in the Cell Biology &

Histology subject is complemented by practical training in the laboratory. The basis that this subject will provide are fundamental for the follow-up of many of the aforementioned subjects, as well as for the follow-up of some of the optional subjects that are included in the Degree, which is why this subject is taught in the first semester and the first year of the Degree.

DETAILED CONTENTS OF THE SUBJECT

CELLULAR BIOLOGY

Topic 1. Introduction to the eukaryotic cell.

Topic 2. Plasma membrane. Structure, composition and functions of the plasma membrane.

Topic 3. Transport of molecules through the plasma membrane. Simple diffusion and osmosis. Transport of ions and small molecules. Passive transport for permeases and for channel proteins. Primary and secondary active transport.

Topic 4. Nucleus. Structure, composition and functions: nuclear envelope, nuclear lamina and nucleolus. Bi-directional nucleus-cytoplasm transport. Chromatin: composition, organization and structure.

Topic 5. Cytosol. Composition, structural organization and functions of the cytosol. Intracellular compartments and intracellular protein trafficking.

Topic 6. Endoplasmic reticulum. Structure, composition and functions of the smooth and rough endoplasmic reticulum. Basis of the vesicular transport.

Topic 7. Golgi apparatus. Structure, composition and functions of the Golgi apparatus.

Topic 8. Endosomes, lysosomes and vacuoles: structure, composition, classification and function.

Topic 9. Mitochondria. Structure, composition, biogenesis and functions. Mitochondrial genome.

Topic 10. Microtubules. Structure, biogenesis, composition and functions. Polymerization of tubulin. Proteins associated with microtubules.

Topic 11. Microfilaments. Structure, biogenesis, composition and functions. Polymerization of actin. Actin-binding proteins.

Topic 12. Intermediate filaments. Structure, biogenesis, composition and functions. Polymerization proteins associated with intermediate filaments.

Topic 13. Introduction to cell cycle and cell division. Interphase and mitotic and meiotic cell division. Cytokinesis

HISTOLOGY

Animal tissues

Topic 1. Concept of animal tissue. Cellular and extracellular components. Classification of animal tissues.

Topic 2. Epithelial tissue. Differentiations of the surface of the epithelial cell. Cellular polarity and intercellular junctions. Basal sheet coating epithelium: structural and physiological characteristics. Types of coating epithelium. Glandular epithelia: secretory cell types. Classification and general properties of exocrine glands.

Topic 3. Connective tissue. Extracellular matrix: fibers and essential substance. Fixed and free cells of the connective tissue. Fibroblast and fibrogenesis. Mastocytes. Plasmocytes. Macrophages and mononuclear phagocytic system. Varieties of connective tissue.

Topic 4. Adipose tissue. The adipocyte. Unilocular and multilocular adipose tissue: structure, function and distribution.

Topic 5. Cartilaginous tissue. Cartilaginous matrix. Chondrocyte varieties of the cartilaginous tissue: hyaline, elastic and fibrous. Histophysiology.

Topic 6. Bone tissue. Architectural organization of the bone. Bony matrix osteoblasts-osteocytes: structure and function. Osteoclasts and bone resorption. Histophysiology. Varieties of the bone tissue: laminar and non-laminar. Osteons, interstitial and circumferential systems.

Topic 7. Blood. Plasma blood and elements forms. Erythrocyte: structure and function. Thrombocytes and platelets: blood clotting. Leukocytes: Granulocytes: neutrophils, eosinophils and basophils. Agranulocytes: monocytes and lymphocytes.

Topic 8. Muscle tissue. Varieties of muscle tissue. Striated muscular tissue: Contractile apparatus. Miofibrils and sarcomeres. Cytophysiology of muscle contraction. Cardiac muscle tissue: Intercalary discs. Smooth muscle tissue

Topic 9. Nervous tissue. Neuron: morpho-functional regionalization. Neuroglia.

Vegetal tissues

Topic 10. Peculiarities of the plant cell. Cellular wall. Specializations of the cell wall: plasmodesms and pores. Apoplastic and simplistic transport. Classification of plant tissues.

Topic 11. Meristems. Cytophysiological bases. Primary and secondary meristems. Apical meristems: histogenic organization and proliferative patterns. Cambium Vascular. Phellogen.

Topic 12. Parenchyma. Morphofunctional features of the parenchymatic cell. Patterns of tissue organization. Chlorophyll and reserveparenchyma.

Topic 13. Mechanical tissues. Colenchymal: General characteristics. Distribution, tissue organization and type. Sclerenchima: General characteristics. Fibers and sclereids.

Topic 14. Vascular tissues. Components, structural and histophysiological characteristics. Xylem: conductive elements: tracheids and members of the vessel. Secondary swabs and perforated wall plates. Floema: conductive elements: cribous cells and members of cribous tubes. Wall thicknesses, crankscreens and plaques. Organization of conductiveelements.

Topic 15. Dermal tissues. Structural and histophysiological characteristics. Primary tissues: epidermis; Secondary tissues: peridermis.

Methodology

THEORY LESSONS

The theoretical part of Cell Biology (CB) will be taught in 20 hours and that of Histology (H) in 20 hours. Theoretical classes will be given with support of slides and other audiovisual materials. During the theory classes, students will be asked to participate actively through brief questions related to the contents taught. In this way it is intended to stimulate the capacity for relating different topics, deduction and reasoning of the students, as well as to improve the degree of knowledge achieved.

PRACTICAL LESSONS

The practical lessons are compulsory. They will allow the student to become familiar with a basic biology and histology laboratory. Each group will perform 4 practical lessons in the laboratory: 2 related to the contents of CB and 2 related to the contents of H. The 2 main objectives of these practices are: (1) learning the handling of the optical microscope and (2) by means of the use of the optical microscope, the student will have to (2.1) differentiate the animal cell from the vegetal cell; (2.2) recognize subcellular structures of the two cell types; (2.3) recognize different cell types; (2.4) recognize the basic characteristics of animal and plant tissues; (2.5) recognize and identify the specific animal and vegetable tissues that form the cells.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Practical lessons	10	0.4	3, 5, 8, 7, 9
Theory lessons	40	1.6	3, 4, 8, 7, 9
Type: Autonomous			
Achievement of concepts and establishing relationships among them	96	3.84	4, 8, 7

Assessment

EVALUATION CRITERIA

The CB part supposes 50% of the mark, and the part of H the other 50%. Each of these parts will have a practical evaluation (10% of the mark each part) and a theoretical evaluation (40% of the mark each).

PRACTICAL CONTENTS

At the end of each practical session, a questionnaire of about 5 minutes will be carried out which will be the evaluation of that practice. Practices 1 and 2, corresponding to the CB part, will represent 10% of the final mark. Practices 3 and 4, corresponding to the H part, will represent 10% of the final mark. In H practices, in addition to the questionnaire, a test of visual recognition of tissues will be performed on the microscope. The average mark of the 4 questionnaires will be the practical mark, and it will represent 20% (10% CB + 10% H) of the final mark of the subject.

Attendance to the practical lessons is mandatory. Failure to attend to one practical lesson (of CB or H) without proper justification will result in the reduction of the average mark of the questionnaires to 75%.

Non-attendance to two or more practical lessons (of Cell Biology or Histology) without proper justification the student will not be able to pass the Cell Biology & Histology subject.

The mark obtained with the practical lessons will be averaged with the mark corresponding to the theory lessons (CB or H).

In order to be able to attend the practical lessons, the student must be able to demonstrate that they have passed the biosafety and security tests that he /she will find in the Virtual Campus / Moodle. These tests allow the student to learn the basic knowledge and behaviour rules of the laboratories of the Biosciences Faculty.

THEORETICAL CONTENTS

Cell Biology: the theory module of CB will be evaluated with 2 partial tests. The first test will be done when approximately half of the theory lessons have been taught, and will involve approximately 40% of the contents and of the final mark of the module. The second partial test will be carried out once the theoretical hours of the module have been completed and will involve approximately 60% of the contents and the final mark of the CB module. The sum of the two partials will suppose 40% of the final mark of the subject (Cell Biology & Histology).

In order to average both partial tests, a minimum mark of 3.5 must be obtained. Students who do not take one or any of the partial tests, or do not reach the minimum mark after taking them, can take the make-up test. The theory grade will be weighted average with the practical note as long as the qualification obtained in the theory part equal to or greater than 3.5

Histology: the theory module of H will be assessed with a single test that will represent 40% of the final mark of the subject (Cell Biology & Histology). The students who obtain a theory mark below 4 will have to present themselves to take the make-up test. The theory grade will be weighted average with the practical note as long as the qualification obtained in the theory part equal to or greater than 4.

Cell Biology & Histology:

Students who obtain a note of BC or Histology theory lower than 4, or who do not pass any of the two modules (BC or H), must attend the make-up tests.

In order to attend the make-up test, the students must have been evaluated in a minimum of two thirds of the total evaluation activities of the subject.

To pass the subject, the final weighted grade of Cell Biology & Histology must be greater than or equal to 5.

OTHER GENERAL CONSIDERATIONS:

- Those students who attend to less than 67% of the scheduled evaluation activities will be considered as NOT EVALUATED. Evaluation activities are: i) any partial test to evaluate the theoretical contents; ii) all the practices of each module (CB or H).

- The minimum mark to pass the subject is 5.

- In case a student fails the theoretical part of the subject, but passes the practical part (obtaining a minimum of 5 points out of 10 in this part), the practical mark will be saved during a period of three additional tuition fees (but they will have to pay the COMPLETE tuition fees again).

- In case a student fails one of the theoretical parts (CB or H) and passes the other (obtaining a minimum of 5 points out of 10), this mark will be saved during a period of three additional tuition fees (but they will have to pay the COMPLETE tuition fees again).

- Students who cannot attend a test for a justified reason (such as: health problem, death of a first- or second-degree relative, accident, mandatory activity or competition in the case of elite athletes, etc.) and deliver the official documentation (official medical certificate that explicitly certifies the inability to attend an examination, police attestation, justification by the competent sport committee, etc.) to the professors of the subject and to the coordinator of the degree, will have the right to take the test on another date. The coordinator of the degree, along with the professor will provide another examination date.

- Students who have passed both partial tests will have the opportunity to IMPROVE the MARK of the theoretical part if they have passed the theoretical partial exams. To improve the mark, the student will take the make-up exam of the whole subject. At least 3 days before the make-up exam, the student will write an e-mail to the professor informing that they resign from the already attained mark. The mark to evaluate the student will be that obtained in the last test (make-up test).

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
2nd partial theory test of Cell Biology	23%	1	0.04	4, 5, 8, 9
Cell Biology practical lessons	10%	0.25	0.01	1, 2, 4, 6, 9
First partial theory test of Cell Biology	17%	0.75	0.03	4, 5, 8, 9

Histology practical lessons	10%	0.25	0.01	1, 2, 3, 4, 7
Theory test of Histology	40%	1.75	0.07	3, 4, 8, 7

Bibliography

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Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walter P. (2007). *Molecular Biology of the Cell*. 5th Edition. Editorial: Garland Science.

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Lodish H, Berk, Kaiser, Krieger, Scott, Bretscher, Ploegh, and Matsudaira (2008) *Molecular Cell Biology*. 6th Edition. Editorial: W. H. Freeman

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Cooper GM. (2007). *La Célula*. Marbán Libros S.L. Madrid.

Karp G. (2011). *Biología Celular y Molecular. Conceptos y experimentos*. 6ª Edició. McGraw-Hill Interamericana de España S.L.

- Some contents of some books listed in the bibliography list can be accessed online:

Alberts: <http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=mboc4>

Cooper: <http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=cooper>

- Web page with simple animations that help understand basic cellular processes:

<http://www.johnkyrk.com/index.esp.html>

HISTOLOGY

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Krstic, R.V.: *Los tejidos del hombre y de los mamíferos* (ed. McGraw Hill).

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Ross, M.H. y Pawlina, W: 2007. Histología. Texto y Atlas color con biología celular y molecular. (ed. Panamericana).

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Virtual microscopy laboratory: <https://histologyguide.com>

Software

There are no concrete program/software specifications for this subject.