Universitat Autònoma de Barcelona

2019/2020

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

Albert Gubern Burset

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 previus knowledge regarding the general structure of the eukaryotic cells and their 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 foundations 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

- 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.
- Understand the bases of regulation of vital functions of organisms through internal and external factors, and identify environmental adaptation mechanisms.

Learning Outcomes

1. Apply the concept of tissue and differentiate between the tissue varieties in the animal and plant organism.
2. Develop analysis and synthesis skills.
3. Identify and analyse material of animal and plant origin and its anomalies.
4. Perform cell cultures and animal tissue cultures.
5. Recognise the histological structure of the principal organs of the animal and plant organism and the structure-function relationships.
6. Recognise the molecular, genetic, tissue- and organism-based levels of organisation.
7. 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 sublject 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. Organization of the prokaryotic and eukaryotic cell. Main characteristics and differences between prokaryotic and eukaryotic cells. Main characteristics and differences between animal and plant cells. Introduction to intracellular compartments.

Topic 2. Plasma membrane. Structure, composition and functions of the plasma membrane. Characteristics of the membrane: fluidity and asymmetry.

Topic 3. Transportation 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. Nucleous. Structure, composition and functions: nuclear envelope, nuclear lamina and nucleolus. Bi-directional nucleus-cytoplasm transport. Chromatin: composition and structure; Organization of chromatin in the interphase nucleus: eucromatin and heterochromatin; Organization and structure of the chromosome.

Topic 5. Composition and structural organization. Functions of the cytosol: folding of proteins, post-translational modification and processing; protein degradation. Introduction to intracellular compartments and intracellular protein trafficking.

Topic 6. Endoplasmic reticulum. Structure and composition of the endoplasmic reticulum. Functions of the smooth endoplasmic reticulum: synthesis of lipids and cell detoxification. Functions of the rough endoplasmic reticulum: soluble protein synthesis and membrane; Modifications of the proteins; Quality control

Topic 7. Golgi apparatus. Structure and composition of the Golgi apparatus. Basis of the vesicular transport: types of vesicles, formation and fusion of the vesicles with the target membrane. Transport of the lattice at the Golgi and inside the Golgi. Protein distribution in the trans-Golgi network: transport of lysosomal proteins, constitutive secretion and regulated secretion; Retention of proteins residing in Golgi.

Topic 8. Endosomes, lysosomes and vacuoles. Endosomes: structure and composition; Classification; Function of endosomes: endocytosis. Lysosomes: structure and composition; Genetic defects in acid hydrolases. The vacuole of the plant cells.

Topic 9. Mitochondria. Structure, composition and biogenesis. Mitochondrial genome, protein synthesis, lipid and protein import. Functions of the mitochondrion: metabolites oxidation, transport of electrons, cell respiration, ATP synthesis and heat production. Transport through mitochondrial membranes.

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

Topic 11. Microfilaments. Structure, biogenesis, composition and functions. Polymerization of actin. Actin-binding proteins. Organization of microfilaments in muscle cells and non-muscle cells. Cell movement.

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

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

HISTOLOGY

ANIMAL TISSUES AND ORGANIZATION LEVELS

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. Conjunctive tissue: Extracellular matrix: fibers and essential substance. Fixed and free cells of the connective tissue. Fibroblast and fibrogenosis. 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. <spantitle="Varietats del teixit ossi: laminar i no laminar.">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. Axon flow interneuronal synapse n eurology

VEGETABLE TISSUES AND ORGANIZATION LEVELS

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.

Topic12. Parenchyma: morphofunctional features of the parenchymatic cell. Patterns of tissue organization. Chlorophyll and reserve parenchyma.

Topic 13. Mechanical tssues: 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 conductive elements.

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

Methodology

THEORY LESSONS

The theoretical knowledge of Cell Biology (CB) will be taught in 20 hours and that of Histology (H) in 20 hours more. 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 relatng different topics, deduction and reasoning of the students, as well as to improve the degree of knowledge achievement.

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 thevegetal 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

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Practical lessons	10	0.4	1, 3, 6, 5, 7
Theory lessons	40	1.6	1, 2, 6, 5, 7
Type: Autonomous			
Achievement of concepts and establishing relationshps among them	96	3.84	2, 6, 5

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 bethe 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) as long as the mark obtained is equal to or greater than 4.
If the practical mark of any part (Cell Biology and Histology) is less than 4, the students will have to do a make-up written test regarding the practical lessons at the same time as they do the theory exam.

In order to be able to attend the practical lessons, the student must be able to demostrate that he /she has 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 35-40% 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 65-60% 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 miminum 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.

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.

Cell Biology & Histology:The theory grade will be weighted average with the practical note (BC or H) as long as the qualification obtained in the theory and in the practical part of each module is equal to or greater than 4.

Students who obtain a note of BC theory or Histology less 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 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) any test to evaluate the practical contents.

- The minimum mark to pass the subject is 5. In the case that 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 the student will have topay the COMPLETE tuition fees again).

- In the case that 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 the student will have to pay the COMPLETE tuition fees again).

- Studentswho cannot attend a test for a justified reason (suchas: 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 certify the inability to attend an examination, police attestation, justification by the competent sport comitee, etc.) 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 to the student.

- Students who have passed both partial tests will have the opportunity to IMPROVE the MARK of the theoretical part if they wish to do so. 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 email to the professor informing that he or she resigns from the the already attained mark. The final mark, that will be used 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	2, 3, 6, 7
Cell Biology practical lessons	10%	0.25	0.01	2, 4, 7
Fisrt partial theory test of Cell Biology	17%	0.75	0.03	2, 3, 6, 7
Histology practical lessons	10%	0.25	0.01	1, 2, 5
Theory test of Histology	40%	1.75	0.07	1, 2, 6, 5

Bibliography

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- Part del contingut d'alguns llibres proposats a la bibliografia es poden consultar *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

Lodish: https://www.ncbi.nlm.nih.gov/books/NBK21475/?term=lodish

- Pàgina web on es poden veure animacions senzilles que ajuden a entendre molts delsprocessos cel·lulars bàsics: http://www.johnkyrk.com/index.esp.html

HISTOLOGY

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