Cell Biology and Histology

Code: 101955
ECTS Credits: 9

2024/2025

Degree	Type	Year
2500890 Genetics	FB	1

Contact

Name: Laura Tusell Padros

Email: laura.tusell@uab.cat

Teachers

Laura Tusell Padros

Albert Gubern Burset

Teaching groups languages

You can view this information at the end of this document.

Prerequisites

Sufficient knowledge of Biology during secondary school.

Erasmus students should consider that lessons are taught in Català.

Objectives and Contextualisation

This is a compulsory first-year course that introduces students to the fundamentals aspects of cell biology and tissue organization of vertebrates. In order to facilitate the learning process, the subject has been divided into two thematic modules that respectively comprise the study of the eukaryotic cell and how these cells organize themselves to form the different animal tissues.

The central object of study of cellular biology is the eukaryotic cell, the knowledge of intracellular molecules and the interactions between cells that allow the construction of multicellular organisms. On the other hand, the current object of the Histology is the study of the cellular groupings that constitute the animal tissues and their correlation with the integrating tissue function.

The specific objectives are:

1. To know the general structure, organization and functions of the different cellular organelles.

2. To acquire integrated cell concepts thanks to the ability to interrelate the different organelles from a morpho-functional perspective.

3. Master the basic terminology and be able to express concepts properly and correctly describe cellular structures.

4. To know the diversity of animal cells.

5. To know how to distinguish the cytophysiological characteristics that define the different animal tissues.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Apply scientific method to problem solving.
- Be able to analyse and synthesise.
- Be able to communicate effectively, orally and in writing.
- Describe the diversity of living beings and interpret it evolutionally.
- Develop self-directed learning.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Reason critically.
- Recognise and structurally and functionally describe the different levels of biological organisation, from macromolecules to ecosystems.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
- Use and manage bibliographic information or computer or Internet resources in the field of study, in one's own languages and in English.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Apply scientific method to problem solving.
3. Be able to analyse and synthesise.
4. Be able to communicate effectively, orally and in writing.
5. Describe the molecules, structures and processes involved in a cell's interaction and communication with the external environment and with other cells.
6. Develop self-directed learning.
7. Diagnose the cell types that, conserving their differentiation, coexist in the same tissue environment.
8. Identify animal and plant tissue in consideration of the morphology, microscopic and ultra-microscopic structure and the cytophysiology of their components.
9. Integrate the functions of the different organelles and cell structures with the overall functioning of the cell.
10. Interpret animal and plant diversity, their origin and their evolution.
11. Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
12. Reason critically.
13. Relate the methodologies used in cellular biology to the results obtained.
14. Relate the structure of the different parts of a cell with their functions.
15. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
16. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
17. Use and manage bibliographic information or computer or Internet resources in the field of study, in one's own languages and in English.

Content

The content of this course consists of two well differentiated parts: Cell Biology and Histology. The study of the cell constitutes the basis for the study of tissues, which are linked to the higher level of organization, the organs. During the first weeks of the semester cell biology contents are taught to acquire basic knowledge about the structure of the cell before starting to study the different tissues present in animal organisms. In the middle of the semester and until the end, the Cell Biology lectures will overlap with the Histology ones.

Cell Biology Module

I. GLOBAL VISION OF THE CELL

Unit 1. The cell. The origin of the cell. From prokaryotes to eukaryotes. Organization of the prokaryotic and eukaryotic cell.

II. CELLULAR SURFACE

Unit 2. Structure and composition of the plasma membrane. Functions, structure and composition. Characteristics of the membrane: fluidity and asymmetry. Occluding junctions (Tight junctions).

Unit 3. Transport of molecules through the membranes. Simple diffusion. Transport of ions and small molecules: Passive transport and active transport. Communicating junctions: Gap and plasmodesmata.

III. COMPARTMENTS OF THE EUKARYOTIC CELL

Unit 4. Introduction to intracellularcompartments and the cytosol. Cell compartmentation. Protein intracellular traffic. Composition and organization of the cytosol. Protein folding, post-translational modifications, protein processing and degradation.

Unit 5. Endoplasmic reticulum. Introduction to the endomembrane system: structure and composition. Functions of the smooth endoplasmic reticulum: synthesis of lipids. Functions of the rough endoplasmic reticulum: protein synthesis, protein modifications and quality control. Vesicular transport between the reticulum and the Golgi apparatus. Recovery of endoplasmic reticulum resident proteins.

Unit 6. Basic principles of vesicular transport. Type of vesicles, vesicle formation and fusion with the target membrane.

Unit 7. Golgi apparatus and secretion routes. Structure and composition of the Golgi apparatus. Glycosylation and modification of protein's oligosaccharides. Distribution of proteins in the trans-Golgi network: transport of lysosomal proteins, constitutive secretion and regulated secretion. Retention of Golgi apparatus resident proteins.

Unit 8. Routes of endocytosis. Endosomal compartment: structure, composition and classification. Endocytosis (pinocytosis and phagocytosis). Lysosomes: structure and composition. Digestion of material (autophagy and heterophagy) and genetic defects in acid hydrolases.

Unit 9. Mitochondria. Structure and composition. Biogenesis: mitochondrial genome and protein synthesis; import of lipids and proteins. Functions of mitochondria: oxidations, electron transport and ATP synthesis; transport through the internal mitochondrial membrane and heat production.

Unit 10. Peroxisomes. Structure and composition. Biogenesis: import of lipids and proteins; genetic diseases related to deficient protein import. General functions of peroxisomes: oxidative reactions and oxidation of fatty acids. Specific functions in animal cells: detoxification reactions and synthesis of plasmalogens and, in plant cells: photorespiration and glyoxylate cycle.

Unit 11. Nucleus. Nuclear envelope, nuclear lamina and pore complex structure. Bidirectional transport between nucleus-cytoplasm. Nucleolus: structure and synthesis of ribosomal RNA. Chromatin: composition and structure and DNA heterogeneity. Organization of chromatin in the interphase nucleus: euchromatin and heterochromatin. Organization and structure of the chromosome.

IV. CYTOSKELETON AND CELL MOVEMENT

Unit 12. Microfilaments. Structure and composition. Actin polymerization. Actin binding proteins (ABPs). Organization of microfilaments in muscle and non-muscle cells. Cell movement. Adherens junctions: adhesion belt and focal adhesions.

Unit 13. Microtubules. Structure and composition. Polymerization of tubulin. Proteins associated with microtubules (MAPs). Labile and stable microtubules. Centrioles, cilia and flagella: structure, biogenesis and functions.

Unit 14. Intermediate filaments. Structure and composition. Polymerization. Proteins associated with the intermediate filaments (IFAPs). Associated functions. Adherent junctions: Desmosome and Hemidesmosome.

V. THE VITAL CYCLE OF THE EUKARYOTIC CELL

Unit 15. Cell cycle and Mitosis. Phases of the cell cycle. Control of the cell cycle: system components and checkpoints. Phases of mitosis and organization of the mitotic spindle. Cytokinesis.

Unit 16. Meiosis. Phases of meiosis. Synaptonemal complex and synapses of the chromosomes. Genetic recombination.

Histology Module

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

Unit 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

Unit 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.

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

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

Unit 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.

Unit 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.

Unit 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

Unit 9. Nervous tissue. Neuron: morpho-functional regionalization. Axon flow interneuronal synapse n eurology

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Cases	8	0.32	2, 3, 4, 6, 9, 12, 13, 14, 17
Lectures	55	2.2	3, 5, 8, 9, 10, 13, 14, 17
Seminars	4	0.16	3, 4, 5, 8, 10, 12, 17
Type: Supervised			
Preparation	0.5	0.02	3, 6, 9, 13, 14, 17
Type: Autonomous			
Bibliography	9	0.36	3, 4, 5, 6, 9, 10, 12, 13, 14, 17
Oral presentation	12	0.48	3, 4, 5, 6, 10, 12, 17
Problem solving	20	0.8	2, 3, 4, 6, 9, 12, 14, 17
Reading	10	0.4	3, 6, 17
Study	97	3.88	3, 5, 6, 8, 9, 10, 12, 13, 14, 17

The subject will be taught following the guidelines imposed by the Convergence process towards the creation of a European Higher Education Area (EHEA), endorsed by the Bologna Declaration (1999). Basically, this implies a more active participation of students in their own learning process, which translates into greater participation of students in class, more interaction among students and of these with the teacher. In addition to classroom-based (lectures) methodology, the learning process is completed through remote activities during the school term that translates into an important weight of the final grade of the subject. Teaching methodology and modalities are described as follows:

Cell Biology Module

Lectures

The content of the theory program will be taught mainly by the teacher in the form of master classes. The theoretical classes will be complemented by the visualization of animations and videos related to the subjects covered in class. Teacher's presentations will be available in *pdf format in the Moodle platform. It is recommended that students take this material to class to use as support when taking notes. Although it is not essential to extend the contents of the classes taught by the teacher, unless it is specifically requested, students are advised to consult the books recommended in the Bibliography section on a regular basis to consolidate and clarify, if necessary, the contents explained in class.

In addition, the follow-up of the course also implies an active role of the students, through the preparation of some of the Units of the program. At the beginning of the course, the student will be provided with a list of the sections to be prepared and a detailed script of the aspects and contents that must be developed for each one of them. The detailed description of the contents that students must prepare will be collected in the form of a Self-Learning Work Guide, available in Moodle. The preparation of these Units by the

students will help them to achieve their skills in individual or group work. It is intended that students acquire the ability to seek information from different sources and synthesize all the information collected; as well as being responsible and independent in the study of a subject.

Scientific problems Sessions

The resolution of scientific problems allows to carry out a very interesting deduction and integration exercise for the scientific training of the students. Therefore, the theoretical knowledge is complemented with the resolution of 20 problems related to the Units covered in class. Thus, these classes involve an integration of concepts and knowledge that let the student know its level of learning and are a way of approaching the student to the scientific method.

The proposed problems, the response template as well as a delivery guideline will also be found in the Moodle platform. To solve the problems, students should form groups of four people that will meet outside of class hours. At the beginning of the course the students will organize themselves to arrange the groups *via* the Moodle platform.

The problems will then be discussed and corrected in class requiring the active participation of the students. A student will be asked, at random, to present the resolution of a problem and explain it to the rest of the classmates. This presentation will be evaluated by the teacher and the students through an online questionnaire. The evaluation rubric will be available in the Moodle platform in pdf format.

Finally, students will be asked to answer two questionnaires about teamwork (one in the middle and the other at the end of the problems sessions). The information collected in these questionnaires will be considered to verify and modulate, if necessary, the mark of the group work of each student. Scientific problems session's attendance is mandatory (the name of the students attending will be recorded), check evaluation.

Tutorials

The tutorials will be carried out in a personalized way in the teacher's offices at arranged hours. The students should contact the teacher in class or by e-mail to schedule a meeting. The tutorials should be used to clarify concepts, settle the knowledge acquired and facilitate the study by students. They can also be used to solve doubts that students have about the preparation of self-learning work, or the course in general.

Histology Module

Lectures

The content of the program will be mainly taught using a classroom-based (lectures) methodology. Lectures will be complemented in the classroom by the visualization of cartoons and videos related to the topics covered in each unit. Teacher's presentations will be available in * pdf format in the Moodle.

Although it is not essential to extend the contents of the classes taught by the teacher, unless it is specifically requested, students are advised to consult the books recommended in the Bibliography section on a regular basis to consolidate and clarify, if necessary, the contents of each lecture.

Seminars

Scheduled seminars are designed for students to work in small groups, and acquire team-building and critical thinking skills. Working groupswill consist of 4 to 6 students to develop a specific topic for the subsequent oral presentation and collective discussion. Thus, the follow-up of the seminars implies an active role of the students in presenting the specific topics.

The organization of the working groups and the distribution of the topics to be discussed will be carried out during the first seminar. In the remaining seminars some groups of students, chosen at random, having prepared the proposed subject, will deliver it in writing to the teacher. The same groups of students will orally present the topic to the rest of the class, with the available means in the classroom.

For the preparation of the seminars, the students should use the appropriate bibliography, as well as the scientific papers related to the topics.

Attendance at seminars is mandatory. In case of missing class for cause not justified there will be a penalty in the note of the seminars.

Tutorial

Tutorials will be done in a personalized way in the teacher's office (to be agreed with the teacher). The tutorials should be used to clarify concepts, settle the knowledge acquired and facilitate the study by students. They can also be used to solve doubts that students have about the preparation of seminars.

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.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Cell Biology	67%	5.5	0.22	1, 2, 3, 4, 6, 9, 11, 12, 13, 14, 15, 16, 17
Histology	33%	4	0.16	1, 3, 4, 5, 6, 7, 8, 10, 11, 12, 15, 16, 17

The evaluation of academic achievements is not simple and must take into consideration whether a level of knowledge, skills, abilities, and critical maturity has been acquired in accordance with the previously established objectives. This evaluation process involves different levels of assessment: (i) student's abilities towards assimilated information, (ii) student's comprehension and its ability to relate and integrate with other knowledge, (iii) determine whether the student understands and can apply the methodologies and techniques acquired during the semester, and, finally, (iv) determine if students can solve experimental problems.

As explained before, the content of this subject is divided into two well-differentiated thematic modules: Cell Biology and Animal Histology that have a weight of 67% and 33%, respectively, in the final grade of the subject. The 2 modules will only be weighted when each of the final mark in each module exceeds 5 points out of 10.

CELL BIOLOGY MODULE

The evaluation of the competences of this subject will be organized in two itineraries: (1) Continuous evaluation and (2) Single evaluation and within each itinerary there will be 2 sections, each one of which will be assigned a specific weight in the final qualification of the module:

(1) Continuous evaluation (CE)

Written tests-theory (75% of the global mark): In this section, the scientific knowledge reached by each student, as well as its capacity for analysis and synthesis, and for scientific reasoning is evaluated. The individual evaluation of the theoretical concepts studied will be carried out through two written tests throughout the course (see the syllabus of the subject) with a weight of 37,5% each.

Scientific problems (25% of the global mark):

-13% of the module will evaluate the public presentation of the resolution of the problems in the classroom by the students of each group. The mark of this part comes from the arithmetic mean of the sum of the grades obtained in the oral presentations of the students from each group. This final grade will

be shared by all the group members and will represent 11% of the final grade. Likewise, the delivery in time of the 2 teamwork questionnaires will be taken into consideration (2%).

The grade obtained in this block can be modulated individually, depending on the questionnaire and attendance at classes. Attendance at problem class is mandatory (list will be passed in class). In the event of unexcused absences from class due to problems, there will be a penalty in the final grade: absence 1 session = reduction of 10% of the grade. See reasons for justified cause in the Evaluation Criteria of the Faculty of Biosciences (Permanent Board Agreement of March 29, 2023).

- The remaining 12% of the overall mark for this section will come from the individual resolution of a scientific problem, similar to those worked on in class, on the day of the written test I (6%) and on the day of the written test II (6%).

- IMPORTANT: The grade for the scientific problem block of that student who misses more than one session of PAUL, justified or not, will be given solely for the individual resolution of the scientific problems on the day of the written test I and II. Each of these problems will have a weight of 12.5% of the overall grade (Total scientific problems = 25% overall grade).

(2) Single Evaluation (SE)

Written tests - theory (75% of the overall mark for the BC module): In this section, the theoreticalconcepts of the entire program will be evaluated in a single synthesis exam that will coincide with the same date set for the written test II of continuous assessment.

Scientific problems (25% of the global mark for the BC module): Two possible circuits are foreseen: a) Students who attend PAUL/SEM and participate in group work. The evaluation, in this case, will be equivalent to the corresponding part of the continuous evaluation (CE); b) Students who do not attend PAUL/SEM and do not participate in group work. These students will have to solve two scientific problems individually on the day of the synthesis test. Each of these problems will have a weight of 12.5% of the overall grade (Total scientific problems = 25% overall grade).

Global mark for the CB module

To pass the Cell Biology module, it is essential to obtain a final grade higher than 4,5 (out of 10) in the written tests-theory (75% of the module) and a final mark equal to or greater than 5 points (out of 10) after weighting all the sections (written tests + scientific problems).

CB Recovery Activities

Students who initially do not pass the subject through CE/SE can be eligible for the retake process. However, to participate in the recovery, students must have been previously evaluated in a set of activities whose weight is equivalent to a minimum of two thirds of the total module grade (67%). In summary, the recovery will consist of a multiple-choice exam, which will evaluate the achievement of the training objectives corresponding to the written-theory tests. All those activities corresponding to scientific problems are excluded from the recovery process. The different assumptions to appear for recovery may be:

- That the grade of the written tests I and/or II (CE) is less than 4.0 (out of 10).

-That the score obtained after weighing the written tests (CE) or single synthesis (SE) does not reach 4.5 (out of 10).

- That the weighted average of written tests + scientific problems is less than 5 points (out of 10).

In addition, those students who - having passed the subject through CE/SE - want to present themselves to upload a grade, may do so if they inform the teacher in advance. In this context, the students renounce the qualification obtained previously in the corresponding tests.

Global Considerations of the Cell Biology Module

A student will be considered as "Non-evaluated" when the assessment activities performed have a weight lesser than 67% in the qualification of the final score of the course or module. Students who do not pass the subject will be kept the grade they obtained in the problem classes (13% overall of the overall grade) and will be exempt from attending these classes. In the event that this grade is to be improved, the student must attend the problem classes again or must expressly inform the subject coordinator that 25% of the overall grade for the scientific problems will come solely from the individual resolution of the two scientific problems on the day of the written test I and II. Each of these problems will have a weight of 12.5% of the overall grade (Total = 25% overall grade).

HISTOLOGY MODULE

The evaluation of academic achievements is not simple and must take into consideration whether a level of knowledge, skills, abilities and critical maturity has been acquired in accordance with the previously established. Competences of this module will be evaluated through continuous assessment, which include individual tests of theoretical and practical knowledge and evaluation of group seminars.The evaluation system is organized into two sections, each of which is evaluated in an independent and assigned a specific weight in the final grade of the subject:

Written tests (80% of the overall mark): In this section, the knowledge obtained by each student is evaluated individually with test-type exams. A written test will be done at the end of the contents of the Histology program. Students who have obtained a grade lower than 4 (out of 10) in this test will not be able to weight it with the grade obtained in the seminars and, therefore, they will have to perform the final test of recovery.

Seminars (20% of the global grade): This section assesses the capacity for analysis and synthesis of students of each group, as well as the skills of group work and oral presentation. Seminars will not have a recovery test. Seminars will be evaluated as follows:

Report	30%	The teacher evaluates (out of 10) the works delivered by the students on the day of the seminar
Oral presentation	50%	The teacher evaluates (out of 10) the skills of each group of students in thepresentation of the work
Inter-group evaluation	20%	Each group of students evaluates (out of 10) the groups that perform the oral presentation

TOTAL 100%

Attendance at seminars is mandatory. In case of missing class for unjustified reasons there will be a penaltyin the seminar note: absence 1 session = reduction of 20% of the grade; absence 2 sessions = reduction of 40% of the grade; absence ≥3 sessions = reduction of 80% of the grade.

The histology module's recovery test will consist of a test type test of the whole theoretical programme.

In order to pass the Histology module, it will be essential to obtain a final grade, after the weighting of all the sections (written tests + seminars), equal or superior to 5 points (out of a total of 10).

Histology Module Considerations

Students who do not pass the module will retain the grade they have obtained in the seminars and will be exempt from attending these classes. This exemption will be maintained for a period of two additional registrations (3 registrations in total).

GLOBAL CONSIDERATIONS OF THE SUBJECT

A student will be considered as "Non-evaluated" when the assessment activities performed have a weight lesser than 67% in the qualification of the final score of the course or module.

NB: This text has not been proofreading by a native English, so in case of any doubt or incongruity, the information provided in the Catalan/Spanish version will prevail.

Bibliography

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https://histologyguide.org//index.html

Software

n/a

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	611	Catalan	first semester	morning-mixed
(PAUL) Classroom practices	612	Catalan	first semester	morning-mixed
(SEM) Seminars	611	Catalan	first semester	morning-mixed
(SEM) Seminars	612	Catalan	first semester	morning-mixed
(TE) Theory	61	Catalan	first semester	afternoon