

**Advanced Histology**

Code: 100784  
ECTS Credits: 6

| Degree          | Type | Year | Semester |
|-----------------|------|------|----------|
| 2500250 Biology | OB   | 2    | 1        |

**Contact**

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**Use of languages**

Principal working language: spanish (spa)  
Some groups entirely in English: No  
Some groups entirely in Catalan: No  
Some groups entirely in Spanish: No

**Teachers**

Joaquim Martí Clúa

**Prerequisites**

A working knowledge of Histology 1 course content is required.

To have the right to attend the laboratory classes, the student must show that he/she has passed the biosafety tests uploaded in the Virtual Campus.

**Objectives and Contextualisation**

Is an obligatory subject in the 2<sup>th</sup> year, concerning the cellular and tissue bases of animals and plants. It has been designed assuming students have a basic knowledge of histology 1 course content. Students who have passed both subjects, have the possibility of acquire a comprehensive understanding and an integrated approach to the organization of animals in the elective subject "Histology of organs and systems" and "developmental biology in the 4<sup>th</sup> year.

The subject consists of two distinct parts: Neurohistology and plant histology.

The theoretical and practical nature of this subject allows linking scientific concepts with practical work.

The main goals of the subject are:

1. Recognize, in terms of cell biology, the diversity of animal neuronal cells.
2. Acquire the integrative concept of neuron from a morpho-functional perspective.
3. Know about the structure, organization and basic functioning of different glial cells.
4. Identify the cytophysiological characteristics that define different plant tissues.
5. Understand the generation, differentiation and cell death that allow the survival of plant tissue.

6. Apply basic histological techniques to the diagnosis of different animal and plant tissue samples.
7. Recognize different neuronal and glial cells by microscopy.
8. Identify the variety of plant tissues and their intracellular and extracellular components by microscopy.

## **Skills**

- Be able to analyse and synthesise
- Be able to organise and plan.
- Design and carry out biodiagnoses and identify and use bioindicators.
- Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
- Isolate, identify and analyse material of biological origin.
- Respect diversity in ideas, people and situations
- Understand the processes that determine the functioning of living beings in each of their levels of organisation.
- Work in teams.

## **Learning outcomes**

1. Be able to analyse and synthesise.
2. Be able to organise and plan.
3. Describe animal and plant tissues, taking into account the morphology, microscopic and ultra-microscopic structure and cytophysiology of their components.
4. Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
5. Identify the cell types that, while maintaining their differentiation, coexist in a single tissue environment.
6. Obtain samples of animal or plant material and use histological methodologies to perform a microscopic analysis.
7. Respect diversity in ideas, people and situations.
8. Work in teams.

## **Content**

### **THEORY LECTURES**

#### **Tema 1. Nervous tissue.**

Cellular components of nerve tissue. Neuron: morphofunctional regionalization. Axonal flow. Structural bases of the generation and propagation of the nervous impulse. The interneuronal synapse: transmission mechanisms. Exciting or inhibitory effects of neurotransmitters. Neuromuscular junction: motor plate.

#### **Tema 2. Neuroglía.**

Concept of neuroglia. Glial types and distribution. Astrocytes. Oligodendrocytes. Microglia: functional meaning. Ependymocytes and epithelium of the choroid plexus. Satellite cells of the peripheral ganglia. Schwann cell. Nervous fiber. Myelin sheath.

#### **Tema 3. Characteristic of plant cell.**

The cell wall. Plasmodesmata and symplastic transport. Pits. Tissue concept in higher plants. Tissue growth and differentiation. Classification of plant tissues.

#### **Tema 4. Meristems.**

cyto physiological basis. Apical meristems: histogenic organization and proliferative patterns. Cambium: Fusiform initials and ray initials cells. axial and radial systems. Phellogen: structure and histogenesis.

#### **Tema 5. Parenchyma.**

Morphofunctional diversity of parenchyma cells. Tissular organization patterns. chlorenchyma and storage parenchyma. root endodermis. Passage cells.

#### **Tema 6. Mechanical plant tissues.**

Collenchyma: Collenchyma cells. Tissular distribution and organization. functional meaning in the primary growth. Sclerenchyma: fibers and sclereids. Sclerenchyma cells.

#### **Tema 7. Xylem.**

Tracheary elements: tracheids and vessel elements. Wall cell: secondary wall thickenings and perforation plates. xylem fibres and xylem parenchyma. Developmental Patterns of tracheary elements. Histogenesis and cellular differentiation. Primary Xylem: protoxylem and metaxylem in roots and stems. Secondary Xylem: morphogenesis in root and stem. Growth rings.

#### **Tema 8. Phloem.**

Sieve elements: sieve cells and sieve tube elements. Sieve area and sieve plate. Callose deposition. Phloem parenchyma: companion cells. sclereids and phloem fibres. Cytodifferentiation of sieve elements. Primary phloem: protophloem and metaphloem in root and stem. Secondary phloem: morphogenesis in root and stem.

#### **Tema 9. Dermal plant tissues.**

Epidermis: morphofunctional diversity. root epidermis: root hairs. Cuticle and epicuticular waxes. Trichomes. Stomata: structure and cytophysiology. Periderm: tissular organization.

### **LABORATORY PRACTICES**

**Práctica 1.** histological staining of neural tissue. Image Analysis of Micrographs.

**Práctica 2.** Cytochemical staining of nuclear DNA in apical meristems: feulgen staining technique. Microscopic identification of specialized cell wall structures. Microscopic identification of meristems. Image Analysis of Micrographs.

**Práctica 3.** Microscopic identification of parenchyma, mechanical and dermal tissues. Image Analysis of Micrographs.

**Práctica 4.** Microscopic identification of vascular tissues: primary and secondary plant growth. Image Analysis of Micrographs.

### **Methodology**

The subject includes theory lectures, seminars and practical classes.

#### **Theory Lectures**

The subjects of teaching units will be taught in 36 sessions. They will be taught using audiovisual material prepared by the teacher. Students will have such material available in the Virtual Campus.

#### **Seminars**

The scheduled seminars are designed in order to students work in small groups to acquire teamwork and critical thinking skills. Students will be divided into working groups for a common work outside and inside the classroom.

There are two types of seminars:

1. Diagnostic problems. Resolution of diagnostic problems by microscopy analysis related with lessons treated in the theory lectures. At the beginning of the session, each group of students will get a questionnaire related with the display of cells and tissues. Each workgroup must deliver in writing the resolution of their own diagnostic problem.

2. Work delivery. Students will be divided into working groups for a specific program topic, followed by oral presentations and collective discussion. The organization of the groups and the distribution of topics to be discussed will take place during the first seminar. In the remaining seminars, groups of students must deliver in writing their proposed topic to the professor. Each group of students will present the topic orally to the rest of the class with the resources available in the classroom.

The recommended bibliography and scientific articles related to the subject of study will be posted on the Virtual Campus.

Seminar attendance is mandatory.

### Tutorials

Tutoring will be done personally in the professor's office (times to be arranged). Tutorials should be used to clarify concepts and consolidate the knowledge acquired by the personal work of the student. They can also be useful to answer questions that students may have about the preparation of seminars.

### Laboratory practices

Practical sessions will be taught in small groups of students (about 20 per session) in the laboratory. They are designed to complement the theoretical training. Students will perform microscopy diagnoses and will deliver individual questionnaires.

Students will get a practice manual of practices (VC) at the beginning of the course. For a good work performance and acquire skills relevant to this subject, is essential a reading comprehension of the manual before carrying out each practice.

Monitoring the practical classes also involves the collection of individual observations from microscopic examination in a portfolio of activities (Virtual Campus).

Practical class attendance is mandatory.

### Activities

| Title                   | Hours | ECTS | Learning outcomes |
|-------------------------|-------|------|-------------------|
| <b>Type: Directed</b>   |       |      |                   |
| LABORATORY PRACTICES    | 14    | 0.56 | 5, 6, 1           |
| SEMINARS                | 6     | 0.24 | 3, 4, 7, 1, 8     |
| THEORY LECTURES         | 30    | 1.2  | 3, 4, 1           |
| <b>Type: Supervised</b> |       |      |                   |
| TUTORIALS               | 6     | 0.24 | 3, 1              |
| <b>Type: Autonomous</b> |       |      |                   |

|                           |     |     |               |
|---------------------------|-----|-----|---------------|
| PREPARATION OF SEMINARS   | 25  | 1   | 3, 4, 5, 1, 8 |
| QUESTIONNAIRES RESOLUTION | 2.5 | 0.1 | 5, 6, 1       |
| STUDY                     | 60  | 2.4 | 3, 1          |

## Evaluation

The evaluation of the course will be continued through individual tests of theoretical and practical knowledge and group activities scheduled on the seminars.

The evaluation system is organized into three sections, each of which is independently evaluated:

**Written exams** (weight 70% of the final mark). The knowledge acquired by students will be evaluated through test exams. There will be two midterm exams (eliminary) throughout the course and a final re-assessment test (see program of the subject).

**Seminars** (weight 10% of the final mark). This section assesses the ability of analysis and synthesis of students in each group, as well as cooperative learning and oral presentation skills.

Seminars will be assessed as follows:

|                   |      |                                                                                                        |
|-------------------|------|--------------------------------------------------------------------------------------------------------|
| Written work      | 40%  | The professor evaluates (from 1 to 10) the works delivered by each group of students.                  |
| Oral presentation | 15%  | The professor evaluates (from 1 to 10) the oral presentations skills of each group of students.        |
| Inter-group mark  | 5%   | Each working roup evaluates (from 1 to 10) the groups that present orally their subject of study.      |
| Problems          | 30%  | The professor evaluates (from 1 to 10) problems solved for each working wroup                          |
| Intra-group mark  | 10%  | Within each working group, each student assesses (from 1 to 10) to his co-workers at the last seminar. |
| TOTAL             | 100% |                                                                                                        |

Seminar attendance is mandatory. In case of absence to any session, without justification, there will be a penalization in the final mark of the seminar:

- Absence 1 session = 20% reduction of the mark
- Absence 2 sessions = 40% reduction of the mark
- Absence 3 sessions = 80% reduction of the mark

**Practicals** (weight 20% of the final mark). This section evaluates the practical knowledge acquired individually by each student.

Practicals will be assessed according with two modalities:

1. Evaluation of the content at the end of each practical class (50% of the mark). Students will respond, in a limited time, to a questionnaire and will make a diagnosis of structures using microscopic examination.

The grade will be the average of the marks obtained in each practical session.

2. Global test of microscopic diagnostic skills (50% of the mark). This test will consist in the diagnosis of structures through microscopic examination proposed along the course.

To weigh the marks obtained in these two modalities, the student must achieve a mark greater than or equal to 4 (out of 10) on each of them.

Attendance at practicals is mandatory. In case of absence to any session, without justification, the mark corresponding to this practical will be 0.

Students who obtain a final mark lower than 5 (out of 10) cannot compensate it with marks corresponding to written theory tests and seminars. Therefore, they must do a re-assessment final test consisting in a microscopic diagnosis plus questions and answers.

**To pass the course the requirements to be met are:**

- Obtain at least 5 points, out of 10, in the average score of written theory tests and seminars.
- Obtain at least 5 points, out of 10, in the practical sessions.

The presentation of the student to any re-assessment test (theory and/or practices) automatically removes the mark previously obtained.

Students who have shown evidence of learning with an overall score of less than 50% will be marked as "not evaluated".

**Repeat students:**

Repeat students will not repeat a particular written test, seminar or practical if he/she has obtained at least a minimum mark of 5 in any of them. This exemption will be maintained for a period of three additional enrolments in the subject.

**Evaluation activities**

| Title        | Weighting | Hours | ECTS | Learning outcomes   |
|--------------|-----------|-------|------|---------------------|
| PRACTICES    | 20%       | 1     | 0.04 | 3, 5, 1             |
| SEMINARS     | 10%       | 0.5   | 0.02 | 3, 4, 5, 7, 1, 2, 8 |
| THEORY EXAMS | 70%       | 5     | 0.2  | 3, 4, 5, 6, 1       |

**Bibliography**

**TEXTS**

**Neurohistology:**

Alberts y col. : Biología Molecular de la Célula (ed. Omega).

Gartner, L.P. Hiatt, J.L.: Texto atlas de Histología (ed. McGraw Hill).

Geneser, F.: Histología (ed. Panamericana).

Junqueira, L.C. y Carneiro, J.: Histología básica (ed. Masson).

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

Ross, M.H. y Pawlina, W.: Histología. Texto y atlas color con Biología celular y molecular (ed. Panamericana).

Stevens, A. y Lowe, J.: Histología humana (ed. Elsevier).

Welsch. U.: Sobotta Welsch Histología (ed. Panamericana).

### ***Histology of plants:***

Esau, K.: Anatomía vegetal (ed. Omega)

Fahn, A.: Anatomía vegetal (ed. Pirámide)

Mauseth, J.D.: Plant Anatomy. (ed. Benjamin/Cummings)

Paniagua, R. y col.: Citología e Histología vegetal y animal (ed. McGraw Hill).

### **Enllaços web**

<http://www.hiperbotanica.net/>

### **ATLAS**

### ***Neurohistology:***

Boya, J.: Atlas de Histología y Organografía microscópica (ed. Panamericana).

Cross, P.C. y Mercer, K.L.: Cell and tissue ultrastructure. A functional perspective (ed. Freeman and Company).

Eroschenko, V.P.: Di Fiore's atlas of Histology (ed. Lea and Febiger).

Gartner, L.P. y Hiatt, J.L.: Atlas color de Histología (ed. Panamericana).

Kühnel, W.: Atlas color de Citología e Histología (ed. Panamericana).

Stanley, L.E. y Magney, J.E.: Coloratlas Histología (ed. Mosby).

Young, B. y Heath, J.W.: Histología funcional (Wheater)(ed. Churchill Livingstone).

### ***Histology of plants:***

Bowes, B.G. A colour atlas of Plant Structure, ed. Manson Pbl.

Bracegirdle, B. & Miles, P.H. Atlas de Estructura Vegetal, ed. Paraninfo.

Krommenhoek, W., Sebus, J. & van Esch, G.J. Atlas de Histología Vegetal, ed. Marbán.

Ledbetter, M.C. & Porter, K.R. Introduction to the Fine Structure of Plant Cells, ed. Springer- Verlag.

Roland, J.C. & Roland, F. Atlas de Biologie Végétale, ed. Masson.

Román, B. Tejidos vegetales, ed. Bruño.