Universitat Autònoma de Barcelona

2023/2024

Cell Biology and Animal Histology

Code: 100990
ECTS Credits: 9

Degree	Type	Year	Semester
2500502 Microbiology	FB	1	1

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject.
Please note that this information is provisional until 30 November 2023.

Teachers

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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 Animal Histology is the study of the cellular groupings that constitute the animal tissues and their
correlation with the integrating tissue function.
The student who has enrolled this course has the possibility of reaching a deeper and more integrated vision of animal organisms by taking the optional course "Developmental Biology" in the fourth year.

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.
- Communicate orally and in writing.
- Develop critical reasoning skills in the field of study and in relation to the social context.
- Identify and solve problems.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Obtain, select and manage information.
- Recognise the different levels of organization of living beings, especially animals and plants, diversity and bases of regulation of vital functions of organisms and identify mechanisms of adaptation to the environment.
- Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
- Use bibliography or internet tools, specific to microbiology or other related disciplines, both in English and in the first language.
- Work individually or in groups, in multidisciplinary teams and in an international context.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Communicate orally and in writing.
3. Develop critical reasoning skills in the field of study and in relation to the social context.
4. Identify and solve problems.
5. Identify animal and plant tissues, taking into account the morphology, microscopic and ultra-microscopic structure and cytophysiology of their components.
6. Identify the cell types that, while maintaining their differentiation, coexist in a single tissue environment
7. Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
8. Obtain, select and manage information.
9. Relate the methodologies used in cell biology to the knowledge they generate.
10. Relate the structure of the different parts of a cell to its functioning and integrate the functions of the different organelles and cell structures with the overall functioning of the cell.
11. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
12. Use bibliography or internet tools, specific to microbiology or other related disciplines, both in English and in the first language.
13. Work individually or in groups, in multidisciplinary teams and in an international context.

Content

The content of this course consists of two well differentiated parts: Cell Biology and Animal 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. After three weeks and until the end, the Cell Biology lectures will overlap with the Animal Histology ones.

MODULE I. Cell Biology

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.

Unit 2. Visualization of cells and their components. Microscopy. Detection of molecules in dead and living cells.

II. CELLULAR SURFACE

Unit 3. Structure and composition of the plasma membrane. Functions, structure and composition. Characteristics of the membrane: fluidity and asymmetry. Occluding junctions (Tight junctions).

Unit 4. 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 5. Introduction to intracellular compartments and the cytosol. Cell compartmentation. Protein intracellular traffic. Composition and organization of the cytosol. Protein folding, post-translational modifications, protein processing and degradation.

Unit 6. 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 7. Basic principles of vesicular transport. Type of vesicles, vesicle formation and fusion with the target membrane.

Unit 8. 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 9. Routesof 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 10. 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 11. Chloroplasts. Structure and composition. Biogenesis: chloroplast genome; protein import. Functions of chloroplast: Photosynthesis. Light reactions: absorption of light, transport of electrons and production of NADPH and ATP. Dark reactions: Calvin's cycle and photo-respiration.

Unit 12. 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 13. 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 theinterphase nucleus: euchromatin and heterochromatin. Organization and structure of the chromosome.

IV. CYTOSKELETON AND CELL MOVEMENT

Unit 14. 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 15. 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 16. 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 17. 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 18. Meiosis. Phases of meiosis. Synaptonemal complex and synapses of the chromosomes. Genetic recombination.

MODULE II. Animal Histology

Topic 1.Concept of animal tissue. Cellular and extracellular components. Intercellular relationships: communication and coordination. Maintenance of tissue integrity. Classification of animal tissues.

Topic 2. Epithelial tissue. Differentiation of the surface of the epithelial cell. Cellular polarity and intercellular junctions. Basal lamina. Lining epiteliums: structural and physiological characteristics. Types of coating epithelia. Glandular epithelia: types of secretory cells. Classification and general properties of the exocrine glands. Integrative functions of the endocrine glands.

Topic 3. Connective tissue. Extracellular matrix: fibers and fundamental substance. Fixed and free cells of connective tissue. Fibroblast and fibrogenesis. Mastocytes, plasmocytes, macrophages and mononuclear phagocytic system. Varieties of connective tissue. Epithelial-conjunctive relations.

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

Topic 5. Cartilaginous tissue. Cartilaginous matrix. Chondrocyte. Varieties of the cartilaginous tissue: hyaline, elastic and fibrous. Histo-physiology and involutive processes.

Topic 6. Bone tissue. Architectural organization of the bone. Bone matrix Osteoblasts-osteocytes: structure and function. Osteoclast and bone resorption. Histo-physiology. Varieties of bone tissue: laminar and non-laminar. Osteonas, interstitial and circumferential systems. Osteogenesis: intramembranous and endochondral ossification. Bone remodeling.

Topic 7. Blood. Blood plasma and formed elements. Erythrocyte: structure and function. Thrombocytes and platelets: blood coagulation. Leukocytes. Granulocytes: neutrophils, eosinophils and basophils. Agranulocytes: monocytes and lymphocytes.

Topic 8. Muscle tissue. Varieties of muscle tissue. Histo-architecture of skeletal muscle. Striatedmuscle fiber. Contractile device. Myofibrils andsarcomeres. Cytophysiology of muscle contraction. Cardiac muscle fiber. Intercalary discs. Smooth muscle fiber: contraction mechanism.

Topic 9. Nervous tissue. Neuron: morpho-functional regionalization. Axonic flow. Structural bases of the generation and propagation of the nervous impulse. Interneuronal synapse Neuroglia.

Methodology

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:

Teaching methodology in Cell Biology

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 contentsthat 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 guidelines will also be found in the Moodle platform. To solve the problems, students should form groups of four people that will meet outside of the 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). If a session of problems is missed in an unjustified way -medical cause- there will be a penalty in the corresponding mark of the module.

Tutorials

The tutorials will be carried out in a personalized way in the teacher's offices at arranged hours. The students should contact to the teacher at 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.

Teaching methodology in Animal Histology

Master Classes

The content of the program will be taught mainly by the teacher in the form of master classes. The theoretical classes will be complemented by the visualization of cartoons and videos related to the topics covered in class. The teacher's presentations will be available in * pdf format in the Moodle.

It is recommended that students print this material and take it to class, to use it 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 recommendedin the Bibliography section on a regular basis to consolidate and clarify, if necessary, the contents explained in class.

Seminars

Scheduled seminars are designedfor students to work in small groups, and acquire skills of group work and critical thinking. Students will be divided into groups of 4 to 6 to work on a specific topic of the program proposed by the teacherfor the subsequent oral presentation and collective discussion. Thus, the follow-up of the seminars will imply an active role of the students in the exposed 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.

Tutorials

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			

Lectures	58	2.32	6, 5, 8, 10, 9, 12
Scientific Problems	6	0.24	3, 4, 8, 9, 2, 13, 12
Seminars	4	0.16	6, 5, 8, 2, 12
Type: Supervised			
Preparation	0.5	0.02	6, 5, 8, 10, 12
Type: Autonomous			
Bibliography	7	0.28	8, 12
Oral presentation	13	0.52	6, 5, 8, 2, 12
Problem solving	21	0.84	3, 4, 8, 10, 9, 2, 13, 12
Reading	10	0.4	3
Study	98	3.92	3, 6, 5, 8, 10, 9, 12

Assessment

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 is able to 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 the 11% of the final grade. Likewise, the delivery in time of the 2 teamwork questionnaires will be taken into consideration (2%). Finally, the obtained grade in this block can be individually modulated depending on the portfolio and attendance. Scientific problems sessions are mandatory. In case of unjustified missed classes a penalty will be imposed: absence 1

session = reduction of 10% of the mark; absence 2 sessions = 50% reduction of the mark, absence ≥3 sessions = 0.

- The remaining 12% of the overall mark of this section will come from the individual resolution of a scientific problem the day of the written test I (6%) and the day of the written test II (6%).

(2) Single Evaluation (SE)

Written tests - theory (75% of the overall mark for the BC module): In this section, the theoretical concepts 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 only be able to obtain, in this block, a maximum of 12% of the mark corresponding to the individual resolution of two scientific problems on the day of the synthesis test (SE).

Global mark for the 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).

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 ofthe 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.

Animal Histology Module

Competences of this subject will be evaluated only through continuous evaluation, which will include individual tests of theoretical and practical knowledge and group seminars.

The evaluationsystem is organized into two sections, each of which is evaluated in a 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. The seminars will be evaluated as follows:

Report	50%	The teacher evaluates (out of 10) the works delivered by the students on the day of the seminar
Oral presentation	20%	The teacher evaluates (out of 10) the skills of each group of students in the presentation of the work
Inter-grup evaluation	15%	Each group of students evaluates (out of 10) the groups that perform the oral presentation
Intra-grup evaluation	15%	Within each group, each student evaluates (out of 10) each one of the classmates that make up their work group. This evaluation will be carried out in the last seminar
TOTAL	100%	

Attendance at seminars is mandatory. In case of missingclass for unjustified reasons there will be a penalty in 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.

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).

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.

Students who have not passed one of the two modules (grade less than 5 out of 10) will not pass the course. However, in the following registrations for the subject, repeating students must only be evaluated for the specific module that they have not passed. In addition, students attending the EUa itinerary (BC module) will be exempt from attending these classes if a grade equal to or greater than 5 points out of 10 has been obtained in the problem classes (13% overall of the module grade) and the grade obtained will be recorded for the following academic year. The same will apply for HA module seminars (20% overall of the module grade). This exemption will be maintained for a period of two additional registrations (3 registrations in total).

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.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Scientific Problems	16.8%	1.5	0.06	1, 11, 4, 8, 10, 9, 2, 12
Seminars	6.6%	0	0	1, 11, 3, 6, 5, 8, 2, 13, 12
Writen test Cell Biology 2	25,1%	1.75	0.07	6, 5, 7, 8, 10

Written test Animal Histology 1	26.4%	2.5	0.1	3, 6, 5, 4, 7, 8, 10, 9, 2, 13, 12
Written test Cell Biology 1	25,1%	1.75	0.07	3, 6, 5, 4, 7, 8, 10, 9, 2, 13

Bibliography

MODULE I. Cell Biology

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Biología Molecular de la Célula (6ª Edición). Alberts B, Johnson A, Lewis J, Morgan D, Raff M, Roberts K, Walter P. Ediciones Omega S.A., 2016.

Molecular Cell Biology (9th Edition). Harvey Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; Hidde Ploegh; Kelsey C. Martin; Michael Yaffe; Angelika Amon. Macmillan learning, 2021.

Biología Celular y Molecular (7ª Edición). Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Amon A, Martin KC. Editorial Médica Panamericana 2016. (Enllaç aquest registre estudiants UAB, https://tuit.cat/qpwSa)

Karp's Cell and Molecular Biology (9th Edition). Gerald Karp, Janet Iwasa, Wallace Marshall. Wiley, 2021.

Karp. Biología Celular y Molecular (8ª Edición). Gerald Karp, Janet Iwasa, Wallace Marshall. McGraw-Hill, 2019. (Enllaç aquest registre estudiants UAB, https://tuit.cat/173A2)

Essential Cell Biology (6th Edition). Bruce Alberts, Karen Hopkin, Alexander Johnson, David Morgan, KeithRoberts, Peter Walter, Rebecca Heald. Norton, 2023.

Introducción a la Biología Celular (3ª Edición). Alberts B, BrayD, Johnson A, Lewis J, Raff M, Roberts K, Walter P. Editorial Médica Panamericana, 2011. (Enllaç aquest registre estudiants UAB, https://tuit.cat/5HmT2)

The Cell. A Molecular approach (9th Edition). Geoffrey Cooper and Kenneth Adams. Oxford University Press, 2023.

La Célula (7ª Edición). Cooper GM & Hausman RE. Marbán Libros S.L., 2017.

The contents of some books can be consulted online at NCBI, at the following address: http://www.ncbi.nlm.nih.gov/sites/entrez?db=Books&itool=toolbar.

MODULE II. Animal Histology

Books

Fawcett, D.W.: Tratado de Histología (ed. Interamericana-McGraw Hill).

Gartner, L.P. Hiatt, J.L.: Texto Atlas De Histología, (ed. McGraw Hill).

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

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

Krstic, R.V.: Human Microscopic Anatomy (ed. Springer-Verlag).

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).

Atlases

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).

Digital atlases

http://www.histologyguide.com/

http://histologyatlas.wisc.edu/

https://patologi.com/atlas%20cytologi%20histologi.pdf

http://www.histology-world.com/

https://www.anatomyatlases.org/

https://www.ouhsc.edu/histology/

https://histology.medicine.umich.edu/

https://histologylab.ctl.columbia.edu/HistologyLabManual.pdf

Digital books

https://onlinelibrary-wiley-com.are.uab.cat/doi/book/10.1002/3527604669

https://onlinelibrary-wiley-com.are.uab.cat/doi/book/10.1002/9781118789568

https://www.visualhistology.com/text-atlas-book/free-online-histology-text-atlas/

https://allmedicalpdfs.com/download-wheaters-functional-histology-pdf-6th-edition-latest/

https://www.kasem.info/links/text-books

https://www.pdfdrive.com/human-histology-books.html

Relevant literature

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

Krstic, R.V.: Human Microscopic Anatomy (ed. Springer-Verlag).

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

https://www.pdfdrive.com/human-histology-books.html

Software

The computer software used (HA module) is: "Microsoft PowerPoint".