

## 29303 - Cellular and histological biology

### Syllabus Information

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**Academic Year:** 2020/21

**Subject:** 29303 - Cellular and histological biology

**Faculty / School:** 229 - Facultad de Ciencias de la Salud y del Deporte

**Degree:** 442 - Degree in Odontology

**ECTS:** 6.0

**Year:** 1

**Semester:** First semester

**Subject Type:** Basic Education

**Module:** ---

## 1.General information

### 1.1.Aims of the course

The subject and its expected results respond to the following approaches and objectives:

The subject of Cellular Biology and Histology is part of the basic training module within the Degree of Dentistry and is essential for understanding the structure of the cell and the metabolic reactions that take place in it. Obtaining all these basic principles is important for the knowledge of the growth and development of organisms. The main objective of this subject is to show students the basic and useful basics necessary to facilitate the understanding of subsequent subjects.

Goals:

- Be able to describe, and explain the structure and function of the different cellular organelles.
- Understand and use the terminology used in health sciences related to the composition and function of the cell.
- Be able to explain the functional differences of each cell depending on the tissue of which they are part.
- Be able to explain and outline the anatomical development from the embryology of different tissues and especially those related to the oral cavity with a precise terminology.
- Be able to explain the different components, functions and structures of the stomatognathic apparatus.
- Know how to define and be able to identify dentitions and handle in a practical way the nomenclature, dental formula, dental numbering systems.
- Define, describe and identify peridentary tissues and tooth parts, as well as their references.
- To be able to topographically recognize the anatomical elements of the oral cavity and ATM, as well as to initiate the interpretation of the anatomical images that will later be used in the different diagnostic methods by more frequent images.

### 1.2.Context and importance of this course in the degree

### 1.3.Recommendations to take this course

## 2.Learning goals

### 2.1.Competences

### 2.2.Learning goals

## 2.3.Importance of learning goals

## 3.Assessment (1st and 2nd call)

### 3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

## 4.Methodology, learning tasks, syllabus and resources

### 4.1.Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as laboratory practices lectures, laboratory sessions, seminars, and autonomous work and study.

### 4.2.Learning tasks

This course is organized as follows:

- **Lectures** (40 hours): The theoretical contents of the course will be taught in the lectures. The classes are participatory and are structured in 11 lessons of Cell Biology and 26 lessons of Histology. Students will find materials for each lesson in Moodle at least one week before their beginning, so they can revise them in detail before each lecture.

Given the exceptional situation of the 2020-2021 academic year, if there is no availability of physical spaces to develop lectures according to the regulations approved by the University of Zaragoza, the online format will be adopted for both master classes and seminars with the whole group. In this case, the lectures will be carried out electronically and synchronously by connecting through technologies such as Google Meet. To ensure that all students have the possibility of teaching online, the sessions will be recorded and made available to students in Moodle through links to Google Drive.

- **Laboratory sessions** (12 hours). The practical classes will be carried out in the laboratory and in the microscopy room and will be distributed as follows: 8 hours correspond to Cell Biology area and 24 hours to Histology. In these practice sessions, the students will learn to use the light microscope to observe different cellular structures and to study histological preparations obtained from different tissues. Laboratory practices will be held in sessions of 2 hours for each group of 12 students. Practice sessions will be evaluated within the final exam and through continuous evaluation in the lab. Students will prepare a written report with the main results obtained during laboratory sessions. This sessions will take place face-to-face, adopting the recommended security measures.
- **Seminars**. In Cell Biology, the students will expose an assignment in which they will explain in depth some Cell Biology tools or in which they will study the relationship between defects in cell composition or function and pathology. In Histology, the seminars will consist in the discussion about optical and electron micrographs of histological preparations related to lessons previously studied.

### 4.3.Syllabus

This course will address the following topics:

#### LECTURES.

##### Cell biology lectures.

- **1.-Introduction to Cell Biology.**
  - Cell classification. Eukaryotic cell organization. Cells as experimental models. Tools of Cell Biology: Immunocytochemistry; Nucleic acids hybridization; Microscopy; cell isolation and subcellular fractionation; Cell culture.
- **2.- The Origin and Evolution of Cells.**
  - Cell theory. The first cells. The endosymbiotic theory. Prokaryotic cells. The origin of eukaryotes. Level organization of cells. Cell evolution. The tissue level of organization. Animal cells and plant cells.
- **3.- The Plasma Membrane**
  - General functions of cell membranes. Chemical composition and structure. Transport of small molecules through membranes. Endocytosis.
- **4.- The Nucleus**
  - The nuclear envelope and traffic between the nucleus and the cytoplasm. The internal organization of the nucleus. The nucleolus and rRNA processing. Mitotic nucleus.
- **5.- Protein Sorting and Transport: ER, Golgi, and Lysosomes**
  - Endoplasmic reticulum: structure and function. The Golgi apparatus: organization and function. The mechanism of vesicular transport. Lysosomes: structure and function.

- **6.- Bioenergetics and Metabolism: Mitochondria, Chloroplasts, and Peroxisomes**
  - Organization and function of mitochondria. The genetic system of mitochondria. Protein import and mitochondria assembly. Chloroplasts: structure and function. The chloroplast genome. Import and sorting of chloroplast proteins. Peroxisomes
- **7.- The Cytoskeleton and Cell Movement**
  - Microfilaments, microtubules and intermediate filaments.
- **8.- The Cell Cycle**
  - The eukaryotic cell cycle. Regulators of cell cycle progression. Mitosis. Meiosis and fertilization.
- **9.- Cell Signaling**
  - General principles of Cell Signaling. Signaling molecules and their receptors. Functions of cell surface receptors. Pathways of intracellular signal transduction. Signal transduction and the cytoskeleton.
- **10.- Cell Differentiation and Tissue Formation**
  - The proliferation of differentiated cells. Stem cells and the maintenance of adult tissues. Pluripotent stem cells, nuclear reprogramming, and regenerative medicine.
- **11.- Cell Biology of Cancer**
  - Cancer concept. Development and causes of cancer. Properties of cancer cells. Transformation of cells in culture. Oncogenes. Tumor suppressor genes. Cancer invasion and metastasis.

### Histology lectures

In these classes, theoretical content of the subject should be studied taking into account that students have to previously have studied each unit, always based upon the information contained in the web site.

- **UNIT 1.- INTRODUCTION TO HISTOLOGY.** Definition of Histology. Definition of tissue. Basic types of tissues.
- **EPITHELIAL TISSUE**
- **UNIT 2. EPITHELIAL TISSUE**
  - **DEFINITION. EMBRYONIC ORIGIN OF THE EPITHELIUM:** Ectoderm-derived epithelium. Endoderm-derived epithelium. Mesoderm-derived epithelium. Epithelial tissue functions. **TYPES OF EPITHELIUM:** Lining epithelium. Glandular epithelium.
- **UNIT 3.- EPITHELIUM**
  - **CLASSIFICATION. EPITHELIUM TYPES:** Simple squamous epithelium. Simple cubic epithelium. Simple columnar epithelium. Pseudostratified columnar epithelium. Transitional epithelium. Stratified squamous epithelium. Stratified columnar epithelium. **CYTOLOGICAL FEATURES:** Specializations of the lateral surface. Specializations of the free surface. Specializations of the basal surface. **PROPERTIES** of the epithelium.
- **UNIT 4. EXOCRINE GLANDS**
  - **GENERAL:** Mechanism of secretion. Release mechanisms for the secreted product. Regulation of exocrine secretion. **EXOCRINE GLAND CLASSIFICATION:** Depending on the number of cells. According to the excretory duct. According to the secretory portion. Depending on the nature of the secreted product
- **TYPES OF EXOCRINE GLANDS:** Goblet cells. Secretory sheet. Intraepithelial glands. Simple tubular glands. Simple tubular glands. Simple branched tubular glands. Simple branched acinar glands. Composite tubular glands. Compound acinar glands. Compound saccular glands. **HISTOLOGICAL ORGANIZATION OF An Exocrine gland.** **EXOCRINE GLAND FUNCTIONS.**
- **UNIT 5. ENDOCRINE GLANDS**
  - Mechanisms of intercellular communication. Autocrine secretion. Paracrine secretion. Endocrine secretion. Synaptic secretion. Morphology: isolated endocrine cells. Endocrine cells grouped inside other structures. Endocrine cells that are true endocrine glands. Cytologic features: polypeptide secreting cells. Steroid-secreting cells. **STORAGE OF HORMONES:** Inside secretory granules. As follicular colloid (thyroid).
- **SUPPORT AND CONNECTIVE TISSUES**
- **UNIT 6. INTRODUCTION**
  - **DEFINITION OF CONNECTIVE TISSUE.** Connective tissue components: Extracellular matrix and Cells. **VARIETY OF CONNECTIVE TISSUE.**
- **UNIT 7. EXTRACELLULAR MATRIX**
  - Collagen fibers: Structure. Ultrastructure. Arrangement of molecules of tropocollagen. Collagen types. Reticulin fibers: Structure. Ultrastructure. Elastic fibers: Structure. Ultrastructure. **ADHESIVE GLYCOPROTEINS:** Laminin. Fibronectin. Entactin. Tenascin. **PROTEOGLYCANS:** Types of glycosaminoglycans and location. Cartilage proteoglycan. Nomenclature. Functions.
- **UNIT 8. CELLULAR TYPES**

- **FIBROBLAST:** Structure. Ultrastructure. Function. Macrophage: mononuclear phagocyte system. Structure / ultrastructure. Biological properties. The macrophage in the immune system. **PLASMA CELL:** Origin and location. Structure. Ultrastructure. Function. **MASTOCYTE:** Origin and location. Structure. Ultrastructure. Function.
- **UNIT 9. VARIETY OF CONNECTIVE TISSUE**
  - Soft Connective Tissue : Features. Location. Dense Connective Tissue. Muroid Connective Tissue: Features. Location. **ELASTIC CONNECTIVE TISSUE:** Features. Location. **RETICULAR** Connective Tissue: Features. Location. Connective tissue functions.
- **UNIT 10. ADIPOSE TISSUE**
  - **INTRODUCTION.** WHITE or unilocular adipose tissue: Distribution. Structure. Ultrastructure. BROWN or multilocular adipose tissue: Distribution. Structure. Ultrastructure. Histogenesis of adipose tissue. Histophysiology OF Adipose TISSUE.
- **UNIT 11.- CARTILAGE TISSUE**
  - **INTRODUCTION.** Hyaline cartilage: Histogenesis. Location. Structure. Ultrastructure: chondrocyte and extracellular matrix. **ELASTIC CARTILAGE:** Location. Structure. **FIBROUS** Cartilage: Location. Structure.
- **UNIT 12.- BONE TISSUE**
  - **DEFINITION. PROPERTIES OF BONE TISSUE. FUNCTIONS OF BONE TISSUE. STRUCTURE OF A BONE** Macroscopic **STRUCTURE. MICROSCOPIC STRUCTURE. BONE MATRIX. BONE CELLS:** osteoprogenitor cells. Osteoblasts. Osteocytes. Osteoclasts. **FORMATION OF BONE TISSUE:** endochondral ossification and membranous ossification.
- **UNIT 13.- JOINTS**
  - Sinartrosis: syndesmosis. Synchondrosis. Synostosis. Amphiarthrosis: Ligaments. Joint capsule.
- **MUSCLE TISSUE**
- **UNIT 14. INTRODUCTION**
  - **CONCEPT OF MUSCLE TISSUE. CLASSIFICATION OF MUSCLE TISSUE. OTHER TYPES OF contractile cells:** myoepithelial cells. Myofibroblasts. Pericytes.
- **UNIT 15.- SMOOTH MUSCLE**
  - **LOCATION. SMOOTH MUSCLE FIBER:** Structure. Ultrastructure. Modes of association. Histophysiology.
- **UNIT 16.- STRIATED SKELETAL MUSCLE**
  - **HISTOLOGICAL ORGANIZATION OF MUSCLE. STRIATED SKELETAL FIBER MUSCLE:** Structure. Fiber types. Ultrastructure. **CHEMICAL COMPOSITION. BASIC MECHANISM MUSCLE CONTRACTION**
- **UNIT 17.- CARDIAC MUSCLE**
  - **DIFFERENCES BETWEEN SKELETAL AND CARDIAC STRIATED MUSCLE. STRIATED CARDIAC MUSCLE FIBER:** Structure. Ultrastructure. **DIFFERENCES BETWEEN atrial and ventricular cells. CARDIAC CONDUCTION TISSUE:** nodal cells. Purkinje cells.
- **BLOOD**
- **UNIT 23. INTRODUCTION TO THE BLOOD**
  - **COMPOSITION OF BLOOD. STAIN OF A BLOOD SAMPLE. FUNCTIONS OF BLOOD.**
- **UNIT 24.- BLOOD CELLS**
  - Erythrocytes: Structure. Ultrastructure. Function. Platelets: Structure. Ultrastructure. Function. Neutrophil: Structure. Ultrastructure. Function. Eosinophil: Structure.
  - Ultrastructure. Function. Basophil: Structure. Ultrastructure. Function. Lymphocyte:
  - Structure. Ultrastructure. Types of lymphocytes.
- **UNIT 25.- HEMATOPOIESIS**
  - **PRENATAL hematopoiesis. BONE MARROW:** Location. Structure: stroma and parenchyma. **ERYTHROPOIESIS:** Granulopoiesis. **MONOPOIESIS:** Lymphopoiesis. Trombopoiesis.
- **ODONTOLOGIC HISTOLOGY**
- **UNIT 26.- ENAMEL, PERIODONTAL LIGAMENT, Alveolar BONE, GUM, dentogingival UNION, PRIMARY TEETH, buccal mucosa, lips, cheeks, the floor of the mouth, palate, tongue. Physical properties. Chemical composition. Histological structure**

## **LABORATORY SESSIONS:**

### Cell biology

- 1.- Light Microscope use: Plant cells and organelles
- 2.- Observation of prokaryotic cells.
- 3.- Animal cell: observation and culture

- 4.- Mitosis

### Histology

In practical sessions, the students will observe different histological preparations including

- Basic Histology tools: light microscope use
- Lining epithelium
- Exocrine glands
- Endocrine glands
- Connective tissue
- Adipose tissue
- Cartilage tissue
- Bone tissue
- Muscle tissue
- Teeth and periodontal tissue

### **4.4.Course planning and calendar**

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the Faculty of Health and Sports Sciences website and Moodle.

### **4.5.Bibliography and recommended resources**

- La célula / Geoffrey M. Cooper, Robert E. Hausman. 6ª ed., [reimp.] Madrid : Marbán, cop. 2014 (BB)
- Biología Celular Biomédica/ Calvo, A.; 1ª Edición. Ed. Elsevier, 2015 (BB)
- Introducción a la biología celular / Bruce Alberts ... [et al.] . 3ª ed. Buenos Aires ; Madrid [etc.] : Editorial Médica Panamericana, cop. 2011 (BB)
- Biología molecular de la célula / Bruce Alberts ... [et al.] ; traducido por Mercé Durfort i Coll, Miquel Llobera i Sande . 5ª ed. Barcelona : Omega, D.L .2010 (BB)
- Biología celular y molecular / Luis Felipe Jiménez García y Horacio Merchant Larios (coords.). Mexico : Pearson Educación de México, S.A., 2003 (BB)
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- Biología celular y molecular / E.D.P.de Robertis, E.M.F. de Robertis . - 11ª ed., 5ª reimp. Buenos Aires : Editorial El Ateneo, 1994 (BB)
- Biología celular y molecular : conceptos y experimentos / Gerald Karp ; 6ª Edición. McGraw Hill, 2014 (BB)
- Citología e histología vegetal y animal : biología de las células y tejidos animales y vegetales / Ricardo Paniagua Gómez-Alvarez ... [et al.] . 3a ed.,[reimpr.] Madrid [etc.] : McGraw-Hill.Interamericana, 2004 (CB)
- Biochemistry and Molecular Biology of Plants/Buchanan BB, Gruissem W, Jones RL; American Society of Plant Physiologists, 2002 (CB)