

Academic Year/course: 2022/23

29303 - Cellular and histological biology

Syllabus Information

Academic Year: 2022/23

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 Cell 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 fundamentals that are useful and 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 peridental tissues and tooth parts, as well as their references.
- To be able to topographically recognize the anatomical elements of the oral cavity and TMJ, as well as to initiate the interpretation of the anatomical images that will later be used in the different most frequent diagnostic imaging methods.

These proposals and goals are aligned with the following Sustainable Development Goals (SDGs) of the 2030 Agenda of the United Nations (<https://www.un.org/sustainabledevelopment/>), in such a way that the acquisition of the learning outcomes of the course provide training and competence to contribute to their achievement:

- Goal 3: Health
- Goal 5: Gender equality and women's empowerment
- Goal 12: Sustainable consumption and production
- Goal 17: Partnerships

1.2. Context and importance of this course in the degree

The subject will allow our students to acquire knowledge about the structural and functional foundations of both the cell and the fundamental animal tissues, using terminology of expression typical of Health Sciences and being able to discern among the different sources of information. In addition, students will be able to acquire skills in the management of basic experimental techniques in the fields of Cell Biology and Histology.

1.3. Recommendations to take this course

Those of the degree of Dentistry. It is advisable to have studied the subject of Biology during high school studies.

2. Learning goals

2.1. Competences

By passing the subject, the student will be more competent for:

? Identify, integrate and describe the origin, development, classification, microscopic structure and distribution of the elementary tissues of the human organism as well as the structures of the stomatognathic apparatus in health states.

? Recognize and describe the elementary cellular and molecular mechanisms of dental development (Odontogenesis) and subsequent processes of tooth eruption and periodontogenesis.

? Integrate the structure-function relationship of tissues and know how to relate microscopic morphological knowledge with that of other disciplines in the curriculum

? Properly handle the conventional light microscope, assess the methodology used in the study of cells and tissues and know the meaning and fundamentals of the basic techniques for preparing histological samples.

2.2. Learning goals

To pass this subject, the student must demonstrate the following results:

- Recognize and describe the elementary cellular and molecular mechanisms. Identify, integrate and describe the origin, development, classification, microscopic structure and distribution of the elementary tissues of the human organisms as well as the structures of the stomatognathic apparatus, in health states.
- Know the historical and conceptual development of Cell Biology and Histology, the concept of structure and organization levels and the general characteristics of cells and tissues.
- Manage the observation instruments and basic instrumental techniques. Know the basic practical operation of light microscope and the theoretical one of the electron microscope as well as the study methods in Cytology and Histology.
- Explain, analyse and orally assess relevant and current theoretical information to develop a project related to the subject's contents.

2.3. Importance of learning goals

At the end of the course, the students must know, critically assess and know how to use the sources of clinical and biomedical information to obtain, organize, interpret and communicate scientific and health information.

Likewise, they must have knowledge of the scientific method and have acquired the critical capacity that is necessary to assess established knowledge and new information. They must be able to formulate working hypothesis, select sources of information, as well as collect and critically assess information for problem solving, following the scientific method.

3. Assessment (1st and 2nd call)

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

The students must demonstrate that they have achieved the expected learning outcomes through the following assessment activities:

Continuous assessment will be carried out through a mandatory periodic evaluation. Midterm exams will be carried out according the established calendar published in this guide (see later). The overcoming of the midterm assessment supposes the elimination of matter.

1. Students with continuous assessment:

1. They must make two multiple choice midterm exams (40%+40%) of 30 questions in which wrongly answered questions will not be subtracted. Passing will be achieved by correctly answering 20 questions. The exam grade constitutes 80% of the overall grade for the subject.
2. It will be necessary to present a group work (2-3 people) of bibliographic information searching and oral presentation in class (10% final grade)
3. Laboratory sessions (10% of the final grade). The lab sessions are compulsory and will be evaluated by presenting a laboratory notebook. Failure to attend lab sessions implies passing them through a practical exam.

2. Students with global assessment:

1. They must make a written exam with short answer questions (80% of final grade)
2. It will be necessary to present a group work (2-3 people) of bibliographic information searching and voluntary oral presentation in class (10% final grade)
3. Laboratory sessions (10% of the final grade). The lab sessions are compulsory and will be evaluated by

presenting a laboratory notebook. Failure to attend lab sessions implies passing them through a practical exam.

RATINGS: In accordance with the provisions of article 5 of RD 1125/2003 (BOE September 18), the results obtained by the student will be scored based on the following numerical scale from 0 to 10:

- 0-4.9 Fail
- 5.0-6.9 Pass
- 7.0-8.9 Notable
- 9.0-10 Outstanding

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 lectures, practice sessions, assignments, and autonomous work.

Students are expected to participate actively in the class throughout the semester.

Classroom materials will be available via Moodle. These include a repository of the lecture notes used in class, the course syllabus, as well as other course-specific learning materials, including a discussion forum.

Further information regarding the course will be provided on the first day of class.

4.2. Learning tasks

This is a 6 ECTS course organized as follows:

? **Lectures** (40 hours). Whole group sessions of 50 minutes each one. The professor will explain the theoretical contents, which are available in advance on the virtual platform Moodle. 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 that they can revise them in detail before each lecture.

? **Practice sessions** (32 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.

? **Seminars** (12 hours). In small groups, students will prepare an essay (which includes bibliographical research, analysis, summary, scientific rigor, coherence of expression and citations). They will submit a written copy at the end of the course and will do an oral presentation (Cell Biology area). In Histology, the seminars will consist in the discussion about optical and electron micrographs of histological preparations related to the 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 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. Mucoïd 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. Synchronrosis. 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 18. INTRODUCTION TO THE BLOOD

COMPOSITION OF BLOOD. STAIN OF A BLOOD SAMPLE. FUNCTIONS OF BLOOD.

UNIT 19.- 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 20.- HEMATOPOIESIS

PRENATAL hematopoiesis. BONE MARROW: Location. Structure: stroma and parenchyma. ERYTHROPOIESIS: Granulopoiesis. MONOPOIESIS: Lymphopoiesis. Trombopoiesis.

ODONTOLOGIC HISTOLOGY

UNIT 21.- 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.

- Calendar of face-to-face sessions and presentation of works: It will be planned according to the schedules published by the Faculty of Health and Sports Sciences for the academic year: <http://fccsyd.unizar.es/es/horarios-y-calendarios-odontologia>

- Enrollment dates: <https://academico.unizar.es/calendario-academico/calendario>

- Calendar of school days: <https://academico.unizar.es/calendario-academico/calendario>

- Exams:

- Midterm exams: Second week of November and January
- The global exam dates are set by the center: <http://fccsyd.unizar.es/es/horarios-y-calendarios-odontologia>

4.5. Bibliography and recommended resources

To consult the bibliography and recommended resources, you must access the link *Recommended Bibliography* of the University of Zaragoza Library.

