1. BASIC INFORMATION

Course	Cell Biology and Human Genetics
Degree program	Odontology
School	Biomedical School
Year	First year
ECTS	6 ECTS
Credit type	Basic
Language(s)	English and Spanish
Delivery mode	Campus-based mode
Semester	Second
Academic year	2024/2025
Professor Coordinating	Dr. María Antonia Cid Torres
Professor	Dr.David Ballesteros, Dr.María Antonia Cid, Dr. Jose Enrique Aguiar, Dr. Noelia Pinal, Dr. Vinatha Sreerankhumar y Dr. Mariangela Tabone.

2. PRESENTATION

The education of future professionals is the principal goal of the University, and the subject of Biochemistry has become the foundation for understanding all biological processes in physiological conditions during development and adult life. It provides basic information about the causes of many diseases and pathologies in humans.

3. COMPETENCIES AND LEARNING OUTCOMES

Core competencies:

- CB1: That students have demonstrated to possess and understand knowledge in an area of study that starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that imply knowledge coming from the vanguard of his field of study.
- CB2: That students know how to apply their knowledge to their work or vocation in a professional manner and possess the skills that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.
- CB3: That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.
- CB5: That students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

Cross-curricular competencies:

- CT1: Autonomous learning: Process that allows the person to be the author of their own development, choosing the paths, the strategies, the tools and the moments that they consider

most effective to learn and independently implement what they have learned. The autonomous student, in short, selects the best strategies to achieve their learning objectives.

- CT5: Ability to apply knowledge to practice: Ability to use the knowledge acquired in the academic field in situations as similar as possible to the reality of the profession for which they are being trained, for example, by relating theoretical foundations with their application to real problems of everyday life, address problems and situations close to professional activity or solve real issues and / or problems.
- CT6: Oral communication / Written communication: Communication is the process by which we transmit and receive data, ideas, opinions and attitudes to achieve comprehension and action, oral being that is done through words and gestures, and written, through writing and / or graphic supports.
- CT12: Critical reasoning: Ability to analyze an idea, phenomenon or situation from different perspectives and assume a personal approach, built from rigor and argued objectivity, and not from intuition

Specific competencies: (SC):

- SC2. Know the biomedical sciences on which Dentistry is based to ensure correct oral-dental care. Among these sciences, appropriate content in Genetics, Biochemistry, Cellular and Molecular Biology have to be included.

Learning outcomes:

- LO1: Understanding the basis of the biological, physiological and physio-pathological processes of the human body
- LO2: Knowledge of the cell constituents
- LO3: Knowledge of cell division process and gametogenesis
- LO4: Basic knowledge of human genetics and understanding of diseases with a genetic basis
- LO5: Knowledge of the development of molecular tools with current application in dentistry

The following table shows the relationship between the competencies developed during the course and the learning outcomes pursued:

Competencies	Learning outcomes
CB1,CB2, CB3, CT1, CT5, CT6, CT12, SC2	LO1: Understanding the basis of the biological, physiological and physiopathological processes of the human body
CB1, CB3, CT1, CT5, CT12, SC2	LO2: Knowledge of cell constituens
CB1, CB2, CB3, , CT5, CT12, SC2	LO3: Knowledge of cell division process and gametogenesis
CB2, CB3, CB5, CT1, CT5, CT6, CT12, SC2	LO4: Basic knowledge of human genetics and understanding of diseases with a genetic basis
CB2, CB3, CB5, CT1, CT5, CT6, CT12, SC2	LO5: Knowledge of the development of molecular tools with current application in dentistry

4. CONTENT

The subject is organized into two learning units, which, in turn, are divided into lessons (four to nine topics depending on the units)

PART I. CELLULAR BIOLOGY

Lesson 1. Introduction to Cell Biology
1.1. Cell Theory
1.2. Biological Evolution. Classification of living organisms
1.3. Acellular forms: viruses, viroids and prions
1.4. Basic properties of the cells
1.5. Structural organization of the cells
1.6. Tools for the study of cells: Optical, Electronic and Fluorescence microscopy. Cell cultures. Stem cells

Lesson 2. Plasma membrane
2.1. Structure and chemical composition. Factors influencing the fluidity of the membrane
2.2 Types and Functions of membrane proteins
2.3 Transport through the membrane: channels and transporter proteins
2.3. Cell communication and membrane proteins
2.3.2. Receptors.
2.3.3. Amplification. Second messengers.
2.3.4. Signal integration and cellular response.

Lesson 3. Cytoskeleton
3.1. Cytoskeletal components. General Characteristics
3.2. Microtubules.
3.2.1. Composition, structure and function: maintenance of cell shape, cellular transport, mitotic spindle
3.2.2. Tubulogenesis, activators and inhibitors.
3.2.3. Associated proteins: MAP, kinesins and dyneins. Centrioles, cilia and flagella
3.3. Microfilaments.
3.3.1. Composition, structure and function, cytokinesis, cell movements and cellular changes phase, muscle contraction. Microvilli
3.3.2. Polymerization mechanism, inhibitors and activators.
3.4. Intermediate filaments.
3.4.1. Composition: nuclear lamins, keratins, neurofilaments, vimentin and desmin.
3.4.2. Structure. Network formation. Proteins associated; plectin
3.4.3. Function. Support and distribution of forces, structural stability and anchoring
3.5. Cell junctions

Lesson 4. Ribosomes
4.1. Structure and chemical composition of ribosomes. Proteins and rRNA. Differences between Prokaryotes and eukaryotes.
4.2. Ribosome biogenesis. Synthesis of rRNA: telomeric DNA and nucleolar organizer (NOR). Assembly of ribosome subunits.
4.3. Protein synthesis. Phases: initiation, elongation and termination.
4.4. Proteosomes
4.5. Polyribosomes.

Lesson 5. Endomembrane system
5.1. Cellular compartments with membranes.

5.2. Endoplasmic reticulum.
5.2.1. Rough endoplasmic reticulum. Structure. Function: post-translational processes of proteins: folding, proteolysis, glycosylation, phosphorylation.
5.2.2. Smooth endoplasmic reticulum. Structure. Function: lipid synthesis, detoxification. Specialization: sarcoplasmic reticulum
5.3. Golgi apparatus.
5.3.1. Structure and chemical composition.
5.3.2. Functions. Protein maturation: glycosylation, proteolysis, sulfation
5.4. Endosomes
5.5. Lysosomes
5.6. Peroxisomes
5.7. Protein secretory vesicles. Coating. Transport; secretory pathways

Lesson 6. Mitochondria
6.1. Characteristics and structure
6.2. Mitochondrial membranes
6.2.1. Outer mitochondrial membrane.
6.2.2. Inner mitochondrial membrane. Electron transport chain and ATP synthase
6.2.3. Internalization of proteins: Tim and Tom complexes.
6.2.4. Transport of lipids
6.3. Mitochondrial matrix.
6.3.1. Oxidative metabolism
6.3.2. Mitochondrial DNA
6.3.3. Ribosomes and mitochondrial protein synthesis
6.4. Mitochondrial diseases

Lesson 7. Nucleus and genetic material
7.1. Structure. Nuclear envelope, pores and lamins. Nuclear matrix. Nucleolus
7.2. Organization of DNA in the nucleus
7.2.1. Interphase nucleus. Chromatin. Barr bodies
7.2.2. Gene replication and transcription
7.2.3. Mitotic nucleus. Chromosomes. Karyotype. Chromosomal aberrations
7.3. Molecular cytogenetics. Cytogenetic maps: chromosome banding, FISH

Lesson 8. Cell division: mitosis
8.1. The cell cycle. Overview and cell cycle phases. Checkpoints
8.2. Structures involved: nuclear envelope, kinetochore, spindle, motor proteins.
8.3. Description of the phases of mitosis.
8.4. Cell cycle regulation. Cyclins and cyclin-dependent kinases (CDKs)
8.4.1. Interface-mitosis;
8.4.2. Progression through the cell cycle
8.5. Tumor suppressor genes. Protein Rb (retinoblastoma), p53 and cell cycle control

Lesson 9. Formation of gametes: meiosis
9.1. Stages of meiosis.
9.2. Differences and similarities with mitosis
9.3. Formation of gametes. Oogenesis and spermatogenesis
9.4. Biological significance of meiosis. Genetic recombination during meiosis

PART II. HUMAN GENETICS

Lesson 1O. General aspects of human genetics
10.1. Genetic concept. History of genetics. Primitive concepts of inheritance
10.2. Areas of genetics. Animal models for genetic studies

10.3. Basic concepts in classical genetics. Character, phenotype, genotype, gene, allele, locus, homozygous, heterozygous.
10.4. The human genome. The Human Genome Project. Characteristics of the nuclear genome.
10.5. Origin of genetic variation in humans: Polymorphisms.
10.6. Genetic analysis techniques
10.6.1. Purification and isolation of DNA by PCR Amplification
10.6.2. Restriction enzymes and sequencing
10.6.3. Applications in Dentistry

Lesson 11. Mendelian and non-Mendelian inheritance
11.1. Previous approaches. Pisum sativum characteristics. Qualitative characters. Homozygotes.
11.2. Mendel's laws. Monohybrid crossing. Dihybrid crossing
11.3. Gene interaction.
11.3.1. Interaction between alleles: dominance, incomplete dominance, codominance
11.3.2. Interaction between non-allelic genes: epistasis and pleiotropy
11.4. Concept of penetrance and expressivity
11.5. Ligation and recombination. Genes linked
11.6. Physical and genetic maps. Mapping human chromosomes: Diagnosis diseases and gene therapy
11.7. Chromosome theory of inheritance

Lesson 12. Monogenic and multifactorial inheritance
12.1. Monogenic and multifactorial inheritance
12.2. Inheritance in humans. Inheritance patterns
12.2.1. Linked autosomal or sex chromosome (linked)
12.2.2. Dominant or recessive inheritance
12.3. Study of heredity. Family trees (pedigrees)

5. TEACHING-LEARNING METHODOLOGIES

The types of teaching-learning methodologies used are indicated below:

- Master Classes or Lectures
- Case based methodology
- Cooperative learning
- Problem based learning
- Online activities (Multiple choice questions, Virtual labs)
- Integrated Laboratory work (WSLA model)

6. LEARNING ACTIVITIES

Listed below are the types of learning activities and the number of hours the student will spend on each one:

Learning activity	Number of hours
Master Classes or Lectures	40
Magistral classes, asynchronous way	5
Problem based learning /case study	5
Laboratory work and Integrated Laboratory Activities (WSLA model)	10
Office hours	10
Written Objetive examinations	5
Autonomous study and work	75
TOTAL	**150**

7. ASSESSMENT

In order to pass the subject in the ordinary session, the process of continuous evaluation of the different training activities must be passed. Listed below are the assessment systems used and the weight each one carries towards the final course grade:

Assessment system	Weight
Theoretical Tests	70
Mandatory Activities	10
Laboratory Practices/ Integrated Lab Activities	20

When you access the course on the *Campus Virtual*, you'll find a description of the assessment activities you have to complete, as well as the delivery deadline and assessment procedure for each one.

It is essential that the grade of each evaluable block is equal to or greater than 5. The final grade of the student will be obtained from the weighting of the partial grades of each of the blocks, as indicated in the table and detailed below. In the case of not having passed any of the evaluable blocks, the final score

in the academic certificate will always be the lowest one. The grades published in the virtual campus will be provisional until the review of the exam.

The evaluation methodology for the three evaluable blocks can be based on: test questions, short questions, open questions with and without extension limitation, correspondence questions, questions with embedded answers, information synthesis tables, papers, oral presentations, etc.

In the case of a modification of the evaluation date, according to the application of the rules for changing the date of evaluable tests (Annex 3), the format the test may vary with respect to the general call

- **Assessment of objective knowledge tests (70%):**

Two objective tests will be carried out with a respective weight of 50% and 50% each. Students will be able to do the second test independently if they have passed the first test.

In each of the two exams the student must obtain a grade of at least 5.0 to pass the block. Once the theoretical exams have been passed, the qualification of this block will be the weighted average of the first midterm exam and the final exams (50% + 50% respectively).

- **Assessment of mandatory activities (10%):**

The attendance to the activities, and the elaboration of requested works is mandatory to be able to pass this block. The evaluation of the activities will be done demonstrating the knowledge and skills acquired during them. In the virtual campus the evaluation modality of each one of these activities will be detailed before its realization.

The grade of the block will correspond to a weighted measure of all the included activities. It is necessary to obtain a minimum grade of 5 in this block to pass this section and be able make a weighted average with the other two blocks of the subject.

- **Assessment of laboratory practices (20%):**

Attendance at laboratory practices is mandatory to pass this block. The assessment of the practices will be done demonstrating the knowledge and skills acquired during the experiments carried out in the laboratory. In the virtual campus will be detailed the evaluation modality of each of these practices.
The grade of the block will correspond to a weighted measure of all the included activities. It is necessary to obtain a minimum grade of 5 in this block to pass this section and be able to make a weighted average with the other two blocks of the subject

Regarding attendance, as stated in the evaluation regulations for official degree programs at the European University of Madrid, students taking campus-based studies are required to demonstrate that they have attended at least 50% of their classes. Such attendance forms an essential part of the assessment process and is necessary to give the student the right to receive guidance, assistance and academic supervision from the professor. For such purposes, students must use the technological system put in place by the University to accredit their daily attendance at each of their classes. This system shall furthermore ensure that objective information is gathered regarding the active role of the student in the classroom. The failure to use the methods proposed by the University to demonstrate 50% attendance will give the professor the right to grade the course as a fail under the ordinary exam period. The foregoing does not affect other requirements of higher attendance percentages that each school may establish in their teaching guides or internal regulations. Therefore, it is the authority of the professor that students who have not fulfilled the 50% of attendance in the ordinary call must pass all the evaluation tests in the extraordinary call, for which they must obtain a grade greater than or equal to 5.0 out of 10.0 in all of them.

7.1. Ordinary call

To pass the subject in the ordinary call, student must obtain a final grade (weighted average) of 5.0 or higher out of 10.0.

In any case, it will be necessary to obtain a grade of 5.0 or higher in each of the assessable blocks (exams, mandatory activities and practical classes).

If student pass both exams in the ordinary call but there are pending assignments such as practical classes and/ or mandatory activities, student can retake pending assignments in the ordinary call as indicated below:

Recovery of Mandatory Activities:
To recover mandatory activities in the ordinary call, in addition to passing both exams, student must have completed at least half of the mandatory activities originally proposed.
Students must complete and pass all mandatory activities that were not completed before.

Recovery of Practical Activities:
To recover practical activities in the ordinary call, in addition to passing both exams, student must have completed at least three practical activities at the time they were assigned.
A test covering all practical activities need to be passed.

7.2. Extraordinary call

To pass the subject in the extraordinary call, student must obtain a final grade of 5 out of 10 (weighted average).

In any case, it will be necessary to obtain a grade of 5.0 or higher in each of the assessable blocks (exams, mandatory activities and practical classes).

To retake the mandatory activities, the student must complete and pass the mandatory activities not successfully completed in the ordinary call. To retake practical activities, a test of all the practices needs to be passed.

8. SCHEDULE

The table below includes the work plan for each learning unit with the temporal distribution of tasks.
The exact date will be published in Blackboard according to the progress of the course

Assessable activities	Deadline
Problem based learning and online evaluable quizz of the fundamental aspects of the structure and function of the cell and Human Genetics	Weeks 4, 7, 12 and 15
Laboratory work (microscopy) and laboratory associated with Integrated Activity of different biological aspects related to case studies	Weeks 3, 6, 9, 11 and 14
Written Objetive examinations	Weeks 8 and 16-17
Retake of laboratory practices and activities	Week 18

This schedule may be subject to changes for logistical reasons relating to the activities. The student will be notified of any change as and when appropriate.

9. BIBLIOGRAPHY

The main reference work for this subject is:

- The Cell: A Molecular Approach. 2nd edition. Cooper GM. Sunderland (MA): Sinauer Associates; 2000.
- Genetics Essentials: Concepts and Connections. Pierce, Benjamin A. W. H. Freeman, 2014

Further recommended Bibliography is:

BLOCK 1. CELLULAR BIOLOGY

- Molecular Cell Biology. 7th edition. Lodish H, Berk A, Zipursky SL, et al. New York: W. H. Freeman; 2012.
- Molecular Biology of the Cell. 6th edition. Alberts B, Johnson A, Lewis J, et al. New York: Garland Science; 2014. •
- J. De ROBERTIS, 2001. Cell and Molecular Biology.
- KARP, 2009. Cell and Molecular Biology, MCGRAW-HILL INTERAMERICANA , IBSN: 978970106925-
- ONLINE FREE BOOKS: http://www.ncbi.nlm.nih.gov/books -

BLOCK 2. HUMAN GENETICS.

- LEWIN, BENJAMIN. GENES IX . 1. 2009. Human Molecular Genetics, Fourth Edition [
- An Introduction to Genetic Analysis. 9th edition. Griffiths AJF, Miller JH, Suzuki DT, et al. New York: W. H. Freeman; 2000.
- Human Molecular Genetics, 2nd edition Tom Strachan and Andrew P Read. New York: Wiley-Liss; 1999. ISBN-10: 1-85996-202-5ç

OTHER RESOURCES ONLINE

- ONLINE FREE BOOKS: http://www.ncbi.nlm.nih.gov/books -
- http://www.dnalc.org/ (DNA Learning Center, Cold Spring Harbor Laboratory).

10. EDUCATIONAL GUIDANCE AND DIVERSITY UNIT

From the Educational Guidance and Diversity Unit we offer support to our students throughout their university life to help them reach their academic achievements. Other main actions are the students inclusions with specific educational needs, universal accessibility on the different campuses of the university and equal opportunities.

From this unit we offer to our students:

1. Accompaniment and follow-up by means of counselling and personalized plans for students who need to improve their academic performance.
2. In terms of attention to diversity, non-significant curricular adjustments are made in terms of methodology and assessment for those students with specific educational needs, pursuing an equal opportunities for all students.
3. We offer students different extracurricular resources to develop different competences that will encourage their personal and professional development.
4. Vocational guidance through the provision of tools and counselling to students with vocational doubts or who believe they have made a mistake in their choice of degree.

Students in need of educational support can write to us at:
orientacioneducativa@universidadeuropea.es

11. ONLINE SURVEYS

Your opinion matters!

The Universidad Europea encourages you to participate in several surveys which help identify the strengths and areas we need to improve regarding professors, degree programs and the teaching-learning process.

The surveys will be made available in the “surveys” section in virtual campus or via e-mail.

Your assessment is necessary for us to improve.

Thank you very much for your participation.