Universidad de Navarra

From the molecule to the cell I (F.Medicina)

Teaching guide 2026-27

INTRODUCTION

Description:

- **Degree:** Medicine
- **Module:** 1: Morphology, structure and function of the human body
- **Topic:** 1.1. Biochemistry and Cell Biology
- **Type of course**: Basic
- **ECTS**: 12
- **Year and trimester**: 1st year, 1st trimester
- **Schedule:** The schedule is available here: web. Check the Timeline for further detail.
- **Language**: English

Course director:

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LEARNING OUTCOMES (Competencies)

LO1 - Students should demonstrate possession and understanding of knowledge in a field of study that builds on general secondary education. This knowledge should reach a level that, while requiring the use of advanced textbooks, also includes aspects that involve knowledge at the forefront of their field of study.

LO2 - Students should be able to apply their knowledge in a professional manner to their work or vocation, demonstrating the skills typically associated with the preparation and defense of arguments and the resolution of problems within their field of study.

LO3 - Students should have the ability to gather and interpret relevant data (usually within their area of study) to express informed opinions, including reflections on relevant social, scientific, or ethical issues.

LO4 - Students should be able to communicate information, ideas, problems, and solutions to both specialist and non-specialist audiences.

LO5 - Students should have developed the learning skills necessary to pursue further studies with a high degree of autonomy.

LO10 - To recognize one's own limitations and the need to maintain and update professional skills, placing special emphasis on the autonomous acquisition of new knowledge and techniques and being driven by a pursuit of quality.

LO11 - To develop professional practice in collaboration with other health professionals, acquiring effective teamwork skills.

LO12 - To understand and recognize the structure and normal function of the human body at the molecular, cellular, tissue, organ, and system levels, across different stages of life and in both sexes.

LO13 - To recognize the foundations of normal human behavior and its alterations.

LO14 - To understand and recognize the effects, mechanisms, and manifestations of disease on the structure and function of the human body.

LO20 - To be capable of conducting an initial diagnostic evaluation and establishing a reasoned diagnostic strategy.

LO22 - To establish diagnosis, prognosis, and treatment by applying principles based on the best available information and under conditions of clinical safety.

LO28 - To communicate effectively and clearly, both orally and in writing, with patients, family members, the media, and other professionals.

LO29 - To develop strong interpersonal communication skills that facilitate efficient and empathetic interactions with patients, family members, the media, and other professionals.

LO31 - To recognize the determinants of a population's health, including genetic factors, sex, lifestyle, demographics, environment, and social, economic, psychological, and cultural factors.

LO36 - To be knowledgeable about, critically evaluate, and effectively use clinical and biomedical information sources to obtain, organize, interpret, and communicate scientific and health-related information.

LO47 - To know cellular structure and function.

LO48 - Biomolecules.

LO49 - Metabolism.

LO50 - Metabolic regulation and integration.

LO51 - To know basic principles of human nutrition.

LO52 - Cellular communication.

LO53 - Excitable membranes.

LO54 - The cell cycle.

LO55 - Cellular differentiation and proliferation.

LO56 - Genetic information, expression and regulation.

LO57 - Inheritance.

LO61 - Homeostasis.

LO62 - Adaptation to the environment.

LO63 - To manage basic laboratory material and techniques.

LO64 - To interpret normal laboratory analyses.

LO66 - To carry out functional tests, to determine vital signs and interpret them.

LO155 - To evaluate the risk/benefit relationship of diagnostic and therapeutic procedures.

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LO156 - To know the indications for biochemical, hematological, immunological, microbiological, anatomical - pathological tests and imaging.

LO158 - Inflammation.

LO161 - Biochemical, cytogenetic and molecular biological markers applied to clinical diagnosis.

LO185 - To know how to obtain and process a biological sample for study by means of the various diagnostic procedures.

LO186 - To know how to interpret the results of diagnostic laboratory tests.

PROGRAM

Didactic Unit I. Basic structure of eukaryotic and prokaryotic cells: Cellular organelles

- Lec 1.1. General organization of cells
- Lec 1.2. Light and electron microscopy. Immunofluorescence and immunohistochemistry
- TBL 1.1. Ultrastructure of the eukaryotic cell
- WS 1.1. Normal and pathological blood cells under the microscope

Didactic Unit II. Chemical structure and general functions of biomolecules in humans

- Lec 2.1. The chemistry of life
- Lec 2.2. Carbohydrates: monosaccharides, disaccharides and polysaccharides
- Lec 2.3. Proteins: structure and properties of amino acids, the peptide bond and protein conformation
- Lec 2.4. Enzymes: how enzymes work, regulatory enzymes
- Lec 2.5. Nucleotides and nucleic acids: types and structure
- Lec 2.6. Lipids: fatty acids, TAGs and biologically active lipids
- TBL 2.1. The importance of pH in biology
- TBL 2.2. Practical enzymology: enzyme kinetics and inhibition
- TBL 2.3. Protein structure-function relationship: the example of myoglobin and hemoglobin

Didactic Unit III. Membrane transport and cell-cell and cell-matrix interactions

- Lec 3.1. Components of the extracellular matrix and glycoconjugates
- Lec 3.2. Molecular structure of membranes: composition, architecture, function and transport
- Lec 3.3. Microtransport through the membrane
- Lec 3.4. Macrotransport through the membrane
- Lec 3.5. Plasma membrane specializations
- Lec 3.6. Organization of the cytoskeleton
- Lec 3.7. Endomembrane system
- WS 3.1. The cell in the tissue context. Importance of the cell-cell and cell-matrix interaction

Didactic Unit IV. Cell responses to external stimuli

- Lec 4.1. General mechanisms of cell signaling
- Lec 4.2. Signaling through ion channel receptors
- Lec 4.3. Signaling through GPCRs
- TBL 4.1. Signaling through tyrosine kinases

Didactic Unit V. Metabolism of carbohydrates, amino acids, lipids and nucleic acids

- Lec 5.1. Introduction to metabolism
- Lec 5.2. Bioenergetics and electron transport
- Lec 5.3. Carbohydrate catabolism: glycolysis and fermentation
- Lec 5.4. Krebs cycle
- Lec 5.5. Gluconeogenesis and glycogen metabolism
- Lec 5.6. Pentose phosphate pathway
- Lec 5.7. Oxidative phosphorylation and mitochondrial function
- Lec 5.8. Amino acid catabolism: the urea cycle
- Lec 5.9. Fatty acid catabolism and ketone bodies
- Lec 5.10. Lipid synthesis
- Lec 5.11. Cholesterol metabolism and lipid transport
- Lec 5.12. Nucleotide metabolism
- Lec 5.13. Amino acid synthesis
- TBL 5.1. Ethanol metabolism
- TBL 5.2. Metabolism-related clinical case
- TBL 5.3. Integration of metabolic pathways

Didactic Unit VI. Principles of laboratory medicine

- Lec 6.1. The clinical laboratory
- Lec 6.2. Preanalytical phase
- Lec 6.3. Analytical techniques
- Lec 6.4. Interpretation of test results
- Lec 6.5. Clinical enzymology: liver, muscle, pancreas and heart proteins
- TBL 6.1. Specimen collection and processing
- TBL 6.2. Analytical and clinical evaluation methods. Point of Care Testing
- TBL 6.3. Laboratory analysis of lipid metabolism
- TBL 6.4. Laboratory analysis of glucose metabolism: diabetes mellitus
- TBL 6.5. Plasma proteins

Didactic Unit VII. Genetic and cellular dynamics during the cell cycle

- Lec 7.1. The cell cycle: Mitosis
- Lec 7.2. Meiosis
- Lec 7.3. DNA replication
- Lec 7.4. Levels of chromatin packaging
- Lec 7.5. General features of the human genome
- Lec 7.6. Protein-coding and non-coding genes
- Lec 7.7. Genetic variation
- Lec 7.8. DNA damage, repair and recombination
- TBL 7.1. Apoptosis and senescence
- TBL 7.2. Gene editing with CRISPR/Cas9
- TBL 7.3. Forensic DNA analysis

Didactic Unit VIII. From DNA to protein: Gene expression regulation and protein fate

- Lec 8.1. DNA transcription
- Lec 8.2. Regulation of gene expression
- Lec 8.3. Epigenetics: DNA methylation and histone modifications
- Lec 8.4. The genetic code
- Lec 8.5. Protein synthesis
- Lec 8.6. Protein maturation, folding and targeting
- Lec 8.7. Protein degradation: lysosomes
- TBL 8.1. Epigenetic-related diseases: Diagnosis of Prader-Willi and Angelman syndromes

Didactic Unit IX. Transmission of genetic traits and examples of genome-related diseases

- Lec 9.1. General principles of clinical cytogenetics and genome analysis
- Lec 9.2. Patterns of single gene inheritance
- Lec 9.3. Polygenic inheritance and multifactorial diseases

- Lec 9.4. Cancer genetics
- Lec 9.5. Ethical considerations of genetics
- TBL 9.1. Polymerase chain reaction (PCR)
- TBL 9.2. Dysregulation of the cell cycle in cancer
- TBL 9.3. Gene mutations as therapeutic targets in cancer
- TBL 9.4. Diseases caused by expansion of trinucleotide repeats

EDUCATIONAL ACTIVITIES

- **Lectures** (2.9 ECTS, 72 hours): Lectures are designed to provide the conceptual framework for the main topics covered in the course. Professors will upload their PowerPoint presentations to Aula Virtual. A flipped-classroom methodology will be used in many sessions. Videos and reading materials will be provided to students in advance so that they can prepare for these sessions.

- **Active learning activities** (1.7 ECTS, 42 hours): Team-Based Learning (TBL) sessions and workshops. **Attendance at these activities is compulsory.**

- **Formative assessment** (0.3 ECTS, 7 hours): Quizzes and self-assessment tests.

- **Personal work** (6.8 ECTS, 170 hours): Students will be expected to prepare in advance for flipped-classroom sessions and to carry out regular personal study after class. Students should progressively integrate the material covered throughout the course.

- **Tutoring** (0.1 ECTS, 3 hours): Throughout the course, students may arrange individual or group tutoring sessions with the course director or any of the other professors.

- **Evaluation** (0.2 ECTS, 6 hours): Two final exams will assess achievement of the course learning objectives: one based on multiple-choice questions and another based on the practical application of concepts, problem solving, and related exercises.

ASSESSMENT

ORDINARY EXAMINATION PERIOD

Students' progress and learning will be assessed throughout the course through the following activities:

- **Continuous assessment**: Assessment through activities and tools such as Aula Virtual tests or Wooclap. Both individual and group activities will be included.
- **Formative assessment:** voluntary and with no contribution to the final grade. There will be two formative assessments based on multiple-choice tests. The feedback provided will allow students to assess their level of knowledge and identify areas that require further study.

- **Final exam of theoretical knowledge:** Based on multiple-choice questions.
- **Final exam of applied knowledge:** Based on questions involving the practical application of concepts, problem solving, and related exercises.

To pass the course, students must **attend at least 80% of the TBL sessions and both workshop sessions** and **pass both the theoretical and applied final exams**.

The final grade will be calculated from the marks obtained in the continuous assessment (20%), the final exam of theoretical knowledge (50%), and the final exam of applied knowledge (30%). Students with a final grade of **5.0 or higher** will pass the course.

After the final grades have been published, students will have the opportunity to review their exams and continuous assessment activities in a scheduled meeting with the course director.

EXTRAORDINARY EXAMINATION PERIOD

Students who do not pass the course in the ordinary call will take the following exams in the extraordinary call:

- **Final exam of theoretical knowledge:** multiple-choice questions.
- **Final exam of applied knowledge:** questions related to practical application of concepts, problems, etc.

To pass the course, students must **pass both the theoretical and applied final exams**.

In the extraordinary call, the student's final grade will be calculated using whichever of the following two methods results in the higher grade:

Option 1. Including the continuous assessment grade from the ordinary call: 20% continuous assessment, 50% final exam of theoretical knowledge, and 30% final exam of applied knowledge.

Option 2. Without including the continuous assessment grade: 65% final exam of theoretical knowledge and 35% final exam of applied knowledge.

The method that results in the higher final grade will be applied. Students with a final grade of **5.0 or higher** will pass the course.

After the final grades have been published, students will have the opportunity to review their exams in a scheduled meeting with the course director.

OFFICE HOURS

One-on-one teaching consultations should be requested by email:

Prof. Dr. Ruben Pio (Course Director): rpio@unav.es

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BIBLIOGRAPHY

- **LEHNINGER PRINCIPLES OF BIOCHEMISTRY.** David L. Nelson & Michael M. Cox. 7th edition. Macmillan Higher Education. 2017. Find it in the library (paper format)
- **CLINICAL BIOCHEMISTRY: AN ILLUSTRATED COLOUR TEXT.** Michael J. Murphy, Rajeev Srivastava & Kevin Deans. Fifth edition. Elsevier. 2013. Find it in the library
- **BIOLOGÍA CELULAR BIOMÉDICA.** Alfonso Calvo. 2nd ed. Elsevier. 2023. Find it in the library (electronic format). 2015 Find it in the library (paper format)

For all **GENETICS** Lectures and TBLs (Prof. Novo), you should use his **official class notes for this year**:

Class notes FMC I (Genetics) 2026.pdfThese notes are (loosely) based on the textbook: Tom Strachan and Anneke Lucassen: **Genetics and genomics in medicine.** CRC Press/Taylor & Francis Group, 2023. Find it in the Library (paper format)