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.
- **Room:** 4E02
- **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- Bio - molecules.

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.

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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.

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 structures of biomolecules: General functions 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: collagen, elastin and proteoglycans
- Lec 3.2. Molecule 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. Cell junctions
- 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. Resistance to insulin in type II diabetes

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

- Lec 5.1. Metabolism: Basic concepts
- Lec 5.2. Bioenergetics and electron transport in the metabolism
- 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 life cycle of a cell

- 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 VIII. From the DNA to the 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
- TBL 8.2. *In silico* gene analysis

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 (2.5 ECTS, 67 hours): lectures are given with the aim of providing the conceptual framework of the main themes. The professor will post on ADI the power point presentation. The flipped classroom methodology will be used in many of the sessions. Videos and reading material will be provided to the students prior to the sessions.

- Active learning activities (1.8 ECTS, 45 hours): team-based learning collaborative sessions (TBLs) and workshops. Attendance at these activities are required.

- Formative assessment (0.6 ECTS, 15 hours): quizzes and self-assessment tests.

- **Personal work** (6.7 ECTS, 170 hours): study prior to flipped classroom sessions will be required, as well as post-class personal study on a daily basis. Students will have to be able to integrate material learnt throughout the course.

- **Tutoring** (0.2 ECTS, 5 hours): throughout the course, students can arrange tutoring, individually or collectively, with the course director or with any of the other teachers.

- **Evaluation** (0.2 ECTS, 5 hours): two final exams to assess the accomplishment of the course objectives. One based on multiple-choice questions and one based on practical applications, concepts, problems, etc.

## ASSESSMENT

### ORDINARY CALL

Assessment of students' progression and learning will be made throughout the course by the following activities:

- **Continuous assessment**: evaluation through works or tools such as ADI examiner or Wooclap. There will be both individual and group activities.
- **Formative assessment** (voluntary and without weight in the final grade): there will be two formative evaluations based on multiple-choice tests. The feedback information will allow students to self-assess their degree of knowledge acquisition.
- **Final exam of theoretical knowledge:** based on multiple-choice questions.
- **Final exam of applied knowledge:** based on applied questions related to practical application of concepts, problems, etc.

To pass the course, students will need to **attend a minimum of 80% of the TBL sessions and the two workshop sessions**, and **pass both the multiple-choice and the applied 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 whose final grade is 5 points or more will pass the course.

After publication of the final grades, students will have the opportunity to review their exam and activity evaluations in a scheduled interview with the course director.

### EXTRAORDINARY CALL

Students who do not pass the course in the ordinary call will have to 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 will need to pass both the multiple-choice and the applied final exams**.

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In the extraordinary call, there will be two alternative methods of calculating the student's final grade:

Option 1) Considering the continuous evaluation as in the ordinary call: 20% continuous evaluation, 50% multiple choice test, 30% applied exam.

Option 2) Without considering the continuous evaluation: 65% final exam of theoretical knowledge and 35% final exam of applied knowledge.

The method that yields the highest grade for the student will be applied. Students whose final grade is 5 points or more will pass the course.

After publication of the final grades, students will have the opportunity to review their exam evaluations in a scheduled interview with the course director.

## OFFICE HOURS

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

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

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Prof. Dr. Alfonso Calvo: acalvo@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 Lectures and TBLs of **GENETICS** (Prof. Novo), you should use his **official class notes for this year**:

Class notes FMC I (Genetics) 2025.pdf

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These notes are (loosely) based on the textbook: GENETICS AND GENOMICS IN MEDICINE. Tom Strachan, Judith Goodship & Patrick Chinnery. Garland Science. 2019. Find it in the library (paper format)