

**University of Split**

**School of Medicine**

**Department of Medical Biology**

**Subject: «MEDICAL BIOLOGY» - 2024. /25. academic year**

**Program: lectures (L=34 h), seminars (S=34 h) and practical courses (P=32 h).**

### **1. CELL BIOLOGY AND MEDICINE.**

L - Cell structure and function. Prokaryotes vs Eukaryotes. Cell chemistry. Macromolecules.

S - Cell research methods.

P - Microscopy. Visual field size. Sample preparation. (Microscopy room= M).

Slides:

1. arrow
2. cork cells
3. frog blood cells

### **2. NUCLEIC ACIDS - DNA.**

L - Deoxyribonucleic acid – DNA structure. Chromosome structure.

S - DNA replication.

P - DNA isolation. (M)

### **3. DNA REPAIR. GENES AND GENOMES.**

L - DNA repair mechanisms. Hereditary diseases associated with a defect in DNA repair.

S - The organisation and sequences of cellular genomes. Human genome.

P - Methods of DNA analysis. DNA electrophoresis. (M).

### **4. NUCLEIC ACIDS - RNA.**

L - Ribonucleic acid - RNA. Transcription in eukaryotes and prokaryotes.

S - Regulation of transcription in prokaryotes and eukaryotes. Processing of ribosomal and transfer RNAs.

P - Chromosomes and sex chromatin. (M).

Slides:

1. *Drosophila melanogaster* polytene chromosomes
2. Amphibian oocyte chromosomes
3. Human leucocyte chromosomes
4. Human buccal interphase cell sex chromatin

### **5. THE NUCLEUS.**

L - The nucleus (structure and transport)

S - mRNA processing. Nuclear bodies.

P - Nucleus in prokaryotes and eukaryotes. Cell size measurement (M).

Slides:

1. Prokaryotes: different types of bacteria
2. Eukaryotes: *Amoeba proteus*
3. Cellular fragmentation and centrifugation: animal liver cells

## **6. DNA - RNA - PROTEINS.**

L - Translation.

S - Protein folding and processing.

P - PubMed and genome databases (Computer room = CR).

## **7. MEMBRANE – STRUCTURE AND TRANSPORT.**

L - Cell membrane structure. Human erythrocyte membrane. Extracellular matrix.

S - Plasma membrane transport principles.

P - Human erythrocyte membrane isolation and biochemical analysis (M).

Slides:

1. Human erythrocytes in physiological solution
2. Human erythrocytes in hypotonic solution: „white ghosts“
3. Human erythrocyte membrane: protein and lipid detection
4. Human haemoglobin crystals

## **8. BIOENERGETICS. PROTEIN SORTING AND TRANSPORT I.**

L - Mitochondria, Chloroplasts and Peroxisomes.

S - Endoplasmic reticulum.

P - Membrane - transport. Mitochondria (M).

Slides:

1. Human erythrocytes in hypo-, iso- and hypertonic NaCl solution
2. Onion cells: plasmolysis and deplasmolysis
3. Rat liver cells mitochondria

## **9. CYTOSKELETON AND CELL MOVEMENT. PROTEIN SORTING AND TRANSPORT II.**

L - Cytoskeleton and cell movement.

S - Golgi apparatus and lysosomes (+ Gaucher disease).

P - Muscle cells (M)

Slides:

1. Skeletal muscle
2. Smooth muscle
3. Cardiac muscle

## **10. CELL CYCLE. FERTILIZATION.**

L - Cell cycle.

S - Meiosis, fertilization and early embryonic development. Stem cells.

P - Cell cycle. Interphase and mitosis. Mitotic index (M).

Slides:

1. Onion root cells
2. Yeast cells
3. Rat follicular ovarian cells
4. Human cervical cancer cells (HeLa)

## **11. CELL SIGNALING. APOPTOSIS.**

L - Intracellular signal transduction.

S - Cancer: signal transduction and the ras oncogenes (page 583). Apoptosis.

P - Gametogenesis, fertilization and early development (M).

Slides:

1. Rat ovaries, follicular maturation

2. Rat testis
3. Rat epididymis
4. Human sperm
5. Sea urchin fertilized oocytes and early stages of development

## **12. MEDICAL GENETICS BASICS. CANCER MOLECULAR GENETICS.**

L - Classical and molecular genetics. Basic principles of medical genetics.

S - Basics of molecular and cancer biology.

P - Embryonic and fetal developmental stages in rats. Tumors: teratomas and teratocarcinoma. (M).

Slides:

1. Rat embryo: 9 days old
2. Rat fetus: 20 days old
3. Rat fetus and placenta (*fetus in toto*)
4. Rat experimental teratoma
5. Human teratocarcinoma

## **13. X-LINKED INHERITANCE. LINKED GENES. MONOGENETIC DISORDERS. PRINCIPLES OF INHERITANCE.**

L - Monohybrid inheritance. X-linked inheritance and inheritance of sex.

S - Multiple alleles. Dihybrid inheritance. Independent assortment. Sickle-cell disease. Eye color.

P - PTC-test (Phenyl Thio Carbamide). Problem-solving (M).

## **14. DNA RECOMBINATION. MOLECULAR BIOLOGY TECHNIQUES.**

L - Recombinant DNA technology, application in medicine.

S - DNA, RNA and protein analysis methods.

P - DNA: PCR (Polymerase Chain Reaction). Problem-solving (M).

## **15. GENE THERAPY. PRENATAL DIAGNOSTICS.**

L - Gene therapy.

S - Prenatal diagnostics. Case report (Ion channels)

P - DNA: RFLP (Restriction Fragment Length Polymorphism). Problem-solving (M). 3D modeling of DNA and RNA molecules

## **16. MUTATIONS. CLINICAL CYTOGENETICS.**

L - Gene and chromosomal aberrations

S - Mutations and human health. Case report (diabetes).

## **17. MOLECULAR BIOLOGY IN MEDICINE. METHODS OF CYTOGENETIC TESTING.**

L - Gene cloning. Genetically modified organisms.

S - Karyotype. Chromosome *banding* methods. Case report (mushroom poisoning).

P - Human karyotype and metaphase plate formation from leucocytes (M).

*Teachers:*

Prof. Tatijana Zemunik, MD, PhD

Prof. Vesna Boraska Perica, PhD

Asst. prof. Ivana Gunjača, PhD

Dean Kaličanin, PhD

Jolanda Kunjašić, lab. technician

**Obligatory literature:**

1. Cooper GM, Adams KW. The Cell, a Molecular Approach. International 9th ed. Oxford University Press; 2023.
2. Campbell NA, Urry LA, Cain ML, Wasserman SA, Minorsky PV, Orr RB. Biology, A global approach, Pearson, London; 2021.

**Supplementary literature:**

1. Alberts B, Heald R, Johnson A, Morgan D, Raff M, Roberts K, Walter P. Molecular biology of the cell. 7th edition, W. W. Norton & Company, New York; 2022.
2. Turpenny PD, Ellard S, Cleaver R. Emery's elements of medical genetics and Genomics. 16th edition, Churchill Livingstone, London; 2022.
3. Gilbert SF. Developmental biology. 12th edition, Oxford University Press, New York and Oxford; 2019.

**Subject aims:** Understanding the fundamentals of contemporary biological science at the molecular level, in line with medical students' aspirations and future medical practice.

**Subject goals:** To demonstrate theoretical and practical knowledge of cell structure and function, developmental biology, genetics and basic principles of molecular biology.

**Subject components:** Basics of molecular biology (DNA structure, replication, transcription and translation), cell biology (cell structure and function, cell organelles, cell signaling, cell-to-cell communication, cell cycle, apoptosis), developmental biology, genetics (fertilization and early embryonic stage, teratogenesis, human genome, principles of inheritance, gene mutations, population genetics, molecular biology of cancer cells, gene therapy).

**Knowledge and skills that students need to obtain:** microscopy of prepared and wet-mount biological sample slides; cell analysis by fragmentation and centrifugation; plasma membrane analysis: osmosis, plasmolysis, haemolysis, isolation and biochemical analysis; DNA isolation and electrophoresis; performance of molecular biology methods: PCR and RFLP; biomedicine database search.

**Curriculum:** All classes (lectures, seminars and practicals) are interconnected, and attendance at each is mandatory. Students are expected to come to class prepared and actively engage in the pre-assigned discussion topic.

**Exams:** Written exam at the end of the course (minimum of 60% is required for a positive grade).

WINTER term	SUMMER term	AUTUMN term
<b>20. 12. 2024.</b>	<b>21. 7. 2025.</b>	<b>25. 8. 2025.</b>
		<b>8. 9. 2025.</b>

The medical biology course starts on the 13. 11. 2024. (timetable can be found at <https://mefst.unist.hr/education/courses/medical-biology/1406> and Merlin platform). Department for Medical Biology wishes all students successful medical studies at our school! Split, September 2024.



Prof. Tatijana Zemunik, MD, PhD  
Chair of the Department of Biology and Human Genetics