

1.	Subject	MORPHOLOGY AND PHYSIOLOGY OF THE CELL			
2.	Code	MLD – 114			
3.	Study program:	Three-year professional studies of medical laboratory diagnostics			
4.	Conducted by	UKIM Medical Faculty – Skopje Department of Histology and Embryology and Department of Physiology			
5.	Degree of education (first or second cycle)	First cycle			
6.	Academic year/semester	First/I- II	7.	Credits	8
8.	Professor	Responsible professor for cell morphology: prof. d-r Elida Mitevaska Responsible professor for cell physiology: prof. d-r Sanja Manchevska			
9.	Prerequisite	None			
10.	Goals	<p>Make the student able to show understanding of the cell as basic morphofunctional unit of the human organism and to be able to:</p> <ul style="list-style-type: none"> • Define and describe the basic structure of prokaryotic cells and all the structural components of eukaryotic cells, connecting their structure to their function • Define and describe the morphological changes that happen during mitosis, meiosis, aging and apoptosis of cells. • Define and describe the key terms related to homeostasis and homeostatic mechanisms. • Define and describe the functions of separate functional cell systems. • Define and describe the cell's production processes, the cell's information processes and the interaction of the cell with the environment. • Show basic skills of using a microscope. • Handle basic laboratory equipment to prepare a sample for cytological analysis. • Perform particular practical procedures in the medical laboratory. 			
11.	Content summary:	<p>Theoretical lessons:</p> <ul style="list-style-type: none"> • Origin and evolution of cells • Basic cytological characteristics of prokaryotic cells • Eukaryotic cells: <ul style="list-style-type: none"> - Differentiation of eukaryotic cells - Structure of eukaryotic cells: <ul style="list-style-type: none"> o basic plan of cell organization o biomembranes: biomembranes organization, fluid mosaic model and transport of material through the membranes o plasmalemma (lipids, proteins, carbohydrates) o cytoplasm: topographic regions of the cytoplasm; cytosol; cell organelles (ribosomes, endoplasmic reticulum, golgi body, mitochondria, lysosomes, peroxisomes); cell inclusions and cytoskeleton (microfilaments, intermediate filaments, microtubules), centrioles, flagella and flagellum. • Nucleus: nuclear membrane, nuclear matrix, chromatin and chromosomes, from DNA to chromosomes, RNA and nucleolus) • Cell cycle; morphological characteristics of the cells during mitosis, meiosis (meiosis characteristics of the gametes), aging and apoptosis. 			

- Structural specifications of different types of cell in the human organism (epithelial cells, cell that synthesize matrix, cell with the ability to absorb, cells that perform phagocytosis, cells with cilium and flagella, keratinocytes, nerve cells and skeletal muscle cells).
- Organization of the cells and the extracellular matrix as a primary source of life of the multicellular organisms
- Cellular motility and their communication with the environment and the other cells
- Homeostasis and control mechanisms
- Transport through the cell membranes
- Organized functional systems of the cell (physiological processes inside the cell organelles)
- Functional characteristics of the specialized cells
- Communication between the cells

Practical lessons:

- The microscope in morphological science
- Special types of microscopes
- Techniques of using an optical microscope
- Micro-technique (steps in the preparation of a microscope sample)
- Preparation and staining of smears for microscopic verification and differentiation of different cell types:
 - Preparation, staining and microscopy of blood smear
 - Preparation, staining and microscopy of a urine sediment
 - Preparation, staining and microscopy of a vaginal smear
 - Preparation, staining and microscopy of buccal smear swab for identifying Barr body.
 - Preparation, staining and microscopy of smears for identification of prokaryotic cells from throat, buccal and spitum swab.
- Microscopy of eukaryotic cells with different forms and sizes
- Nucleus microscopic analysis with an optical microscope:
 - Single-nuclear cells and nuclear-cytoplasmic ratio
 - Binoculated, multinucleate and prokaryote cells
 - Different nucleus shapes in different types of cells
- Microscopy of cell during cell division
- Microscopy of cell during apoptosis
- Microscopy of cells with different structural specifications
- Physiological transport principles through the cell membrane (passive and active transport)
- Transport of material across cell membranes of a living cell (preparation and staining blood elements sample under a microscope, osmotic fragility and hemolysis)
- Physiology of cell organelles and cytoskeleton (nucleus, endoplasmic reticulum, Golgi complex)
- Physiological processes in the lysosomes, peroxisomes, mitochondria and functional characteristics of the cytoskeleton
- Cell communication and signal transduction (inner cell systems of signal transduction)
- Creating membrane potential of inactivity and creating, and spreading of the action potential (preparation and work of nervous muscle apparatus)

Seminars

The seminars include oral and written presentation given by every student on part of the theoretical lessons from different methodological units.

12.	Teaching methods: Interactive theoretical lessons, practical lessons and seminars	
13.	Total classes:	150

14.	Organization	30+30+15 75 lessons learning at home		
15.	Types of teaching activities	15.1	Lessons: theoretical classes	30
		15.2	Practical lessons Seminars	30 15
16.	Other types of activities	16.1	Practice	
		16.2	Self-supporting practice	
		16.3	Learning at home	
17.	Knowledge assesment	Points		
	17.1	Test	Morphology of the cell	21 – 35 points
	17.2	Final exam	Physiology of the cell	21 – 35 points
	17.3	Paper/project (oral and written presentation)	Paper	1 – 2 points
	17.3	Active participation	Min. – Max. Points	
			Theoretical lessons	1 - 2
			Practical lessons: total points	16 - 26
			Practical lessons: cell morphology	8 - 14
			Practical lessons: cell physiology	8 - 12
18.	Grading criterion (points/grades)	Up to 59 points	5 (five) F	
		From 60 to 68 points	6 (six) E	
		From 69 to 76 points	7 (seven) D	
		From 77 to 84 points	8 (eight) C	
		From 85 to 92 points	9 (nine) B	
		From 93 to 100 points	10 (ten) A	
19.	Requirements for obtaining a signature and attending the final examination	To obtain a signature, the student must gain minimum points from visiting the theoretical lessons and practical lessons.		
		To attend the final exam, the student must gain minimum points (30%) and pass the mid-term exams. In the exam session, the student first attends the mid-term exams (that he did not pass) and then the final exam.		
		The grade is based on the sum of the points of all the activities, mid-term exams and final exam.		
20.	Language	Macedonian		
21.	Method of evaluating the quality of the lessons	Anonymous student evaluation of the subject, the professors and the collaborators who hold the lessons.		
22.	Literature			
	22.1	Mandatory literature		
		1.	L. Milenkova, N. Kostovska, Structural Characteristics of the Eukaryotic Cells, UKIM Medical Faculty, 2011	
		2.	M. Ros, V. Pavlina, Histology – text and atlas (cell and molecular biology), Tabernakul, 2010	
		3.	L. K. Zunveira, H. Karneiro, Foundations of Histology (text and atlas), Prosvetno Delo, 2009	

		4.	E.Mitevaska, Cell morphology practical lessons handbook, UKIM Medical Faculty, 2011
		5.	Eric P. Weidmier, Hershel Raff, Kevin T. Strang, Wander Human Physiology: Mechanisms of the body's function, Ars Lamina, publications, Skopje, 2014
		6.	Thomas D. Pollard, William C. Earnshaw, Jennifer Lippincott Schwartz, Cell Biology, Elsevier, 2007
		7.	V. Maleska – Ivanovska et al., Physiology of the cell practicum, UKIM Medical Faculty, Skopje, 2011
	22.2	Additional literature	
		1.	Goeffrey M. Cooper, Robert E. Hausman, Station – Molecular Approach, Medicinska naknada, Zagreb, 2004
		2.	Artur K. Gaiton, John E. Holl, Textbook of Medical Physiology, Akademski pecat, 2012