

1. COURSE DESCRIPTION – GENERAL INFORMATION			
1.1. Course teacher	Assoc. Prof. Ana-Marija Domijan, PhD	1.6. Year of study	1
1.2. Name of the course	<b>Cell biology with genetics</b>	1.7. Credit value (ECTS)	7.5
1.3. Associate teachers	-	1.8. Type of instruction (number of hours L+E+S+e-learning)	30+30+15
1.4. Study programme (undergraduate, graduate, integrated)	Pharmacy integrated study programme	1.9. Expected enrolment in the course	130
1.5. Status of the course	Compulsory	1.10. Level of use of e-learning (1, 2, 3 level), percentage of instruction in the course on line (20% maximum)	2
2. COURSE DESCRIPTION			
2.1. Course objectives	The objectives of the course are to teach students structure and processes in the cell, as basic biological unit of living organisms as well as basic hereditary principles. Acquired knowledge will able students to follow courses on higher years of Study programme as Biological Chemistry, Physiology with Human Anatomy, Biochemistry, and Microbiology and Parasitology. For that courses basic knowledge of cell biology and genetic is necessary.		
2.2. Enrolment requirements and required entry competences for the course	None.		
2.3. Learning outcomes at the level of the study programme to which the course contributes	<ul style="list-style-type: none"> <li>• Apply of fundamental knowledge of cell biology and genetics to define, analyse and propose procedures related to research and development of pharmaceuticals.</li> </ul>		
2.4. Expected learning outcomes at the level of the course (4-10 learning outcomes)	<p>After passing exam students will be able to:</p> <ol style="list-style-type: none"> <li>1. List and describe basic characteristics of prokaryotic and eukaryotic cells and recognise type of organisation of an organism;</li> <li>2. Describe structure and functions of basic cells' macromolecules, importance of DNA macromolecule and principle of transcription, DNA packing into the chromosome, importance of cell cycle and mechanism of cell cycle control as well as distinguish difference between mitosis and meiosis;</li> <li>3. Explain cells' membrane structure and basic principles of transport through cell membrane, list and describe organelles within the eukaryotic cell, synthesis of protein on ribosome, and importance of organelles included in protein trafficking;</li> </ol>		

	<ol style="list-style-type: none"> <li>4. Define metabolism, importance of ATP molecule, basic characteristic of cellular respiration and photosynthesis;</li> <li>5. Name advantages of sexual reproduction;</li> <li>6. Define basic genetic terms as homolog chromosome, allele, loci, homozygote, heterozygote, genotype, phenotype and Mendel's laws of inheritance;</li> <li>7. Identify human disorders connected with changes on genome;</li> <li>8. Recognise cell compartments, cell functions and cell division under the microscope.</li> </ol>
<p>2.5. Course content broken down in detail by weekly class schedule (syllabus)</p>	<p>LECTURES:</p> <ul style="list-style-type: none"> <li>• Cell biology with genetics, introduction: introductory information to students about subjects that will be taught, their duties and tasks in order to gain knowledge described by learning objectives; grading of their activities.</li> <li>• Cell evolution: basic cell macromolecules, their components and functions within the cell, from macromolecules to cell, from prokaryotic cell to eukaryotic cell; organisation of multicellular organisms.</li> <li>• Cell nucleus: morphology of cell nucleus, packing of DNA helix, chromosome structure, DNA replication and transcription.</li> <li>• Cell membrane: components of cell membrane, phospholipids, proteins, carbohydrates and cholesterol in cell membrane, transport through cell membrane (passive and active), ion channels and pumps.</li> <li>• Cell organelles and protein trafficking: organelles of eukaryotic cell, their structure and functions, protein synthesis on ribosome, trafficking of proteins within eukaryotic cell.</li> <li>• Vesicular transport: importance of vesicular transport, cell compartments included in vesicular transport, exocytosis (constitutive secretory pathway and regulatory secretory pathway), endocytosis (phagocytosis, pinocytosis, endocytosis controlled by receptors).</li> <li>• Metabolism and mitochondrion: basic principles of metabolism, ATP molecule, structure of mitochondria, cellular respiration (glycolysis, citric cycle, oxidative phosphorylation).</li> <li>• Cell energy and chloroplasts: type of plastids, chloroplast structure, photosynthesis.</li> <li>• Cytoskeleton: importance and functions of cytoskeleton, actin filaments, microtubules and intermediate filaments, their structure and functions in the cell, structures of flagellum and cilia in the eukaryotic and prokaryotic cell.</li> <li>• Cell cycle: phases of cell cycle, control system of cell cycle, cell signal transduction, apoptosis.</li> <li>• Cell division - mitosis and meiosis: phases of mitosis, control system of mitosis, cytokines, phases of meiosis, importance of meiosis, fertilisation, advantage of sexual reproduction.</li> <li>• Genetics – laws of inheritance: basic terms in genetics, Mendel and genes, Mendel's laws of inheritance (classical genetics), incomplete dominance, co-dominance, epistasis.</li> <li>• Genetics and chromosome: Morgan and <i>Drosophilla</i>, sex-linked inheritance, genetic linkage, X-inactivation, types of chromosome abnormalities.</li> <li>• Human genetics: hereditary diseases, their division and examples.</li> </ul> <p>SEMINARS:</p> <ul style="list-style-type: none"> <li>• Introductory seminar on methods in cell biology and distribution of seminars' tasks: Methods in cell biology – monitoring of cell structures by use of microscope, organisms as experimental models, cells in culture, cells</li> </ul>

	<p>fractioning, analysis of macromolecules, following of macromolecules in the cell.</p> <ul style="list-style-type: none"> <li>• Cell nucleus and cell membrane: Morphology of cell nucleus; Packing of DNA helix; Chromosome structure; Components of cell membrane; Passive transport through cell membrane; Active transport through cell membrane.</li> <li>• Cell compartments and trafficking of proteins: Endoplasmic Reticulum; Golgi apparatus; Peroxisome, Lysosome; Protein trafficking within the eukaryotic cells; Exocytosis; Endocytosis.</li> <li>• Cell metabolism and cytoskeleton: Mitochondria and cellular respiration; Chloroplast and photosynthesis; Actin filaments, Microtubules; Intermediate filaments; Flagella and cilia.</li> <li>• Cell cycle and cell division: Cell cycle; Apoptosis; Mitosis and cytokinesis; Meiosis and fertilisation; Advantage of sexual reproduction.</li> <li>• Genetics: Mendel's law of inheritance; Advance in Mendel's laws; Morgan's discoveries; X-linked inheritance; Chromosome abnormalities; Human genetics.</li> </ul> <p><b>EXERCISES:</b></p> <ul style="list-style-type: none"> <li>• Basic in microscopy: parts of a light microscope and basic rules in microscopy. Students learn how to use microscope and prepare microscopic slides.</li> <li>• Different type of cells – prokaryotic and eukaryotic cells: students prepare slides of prokaryotic cells (<i>Agrobacterium tumerofaciens</i> and <i>Oscillatoria</i> sp.) and eukaryotic cells (protozoa, yeast, buccal epithelial cells, pig kidney epithelial cells, various tumour cell lines grown <i>in vitro</i>, human blood cells, plant cells) to learn the difference in size and shape of various cells type.</li> <li>• Cell membrane – plasmolysis: the experiment of plasmolysis and deplasmolysis is conducted on <i>Rhoeo discolor</i> by exchanging water and salt solution – transport of water could be observed.</li> <li>• Compartments of eukaryotic cell: cells' compartments that can be observed under light microscope (<i>Allium cepa</i>), and cell compartment observed under electron microscope.</li> <li>• Cell energetics: students perform experiment in order to confirm that starch is product of photosynthesis (in reaction with Lugol solution); under light microscope they observe various plastides involved in plant cell energetics (from production to stores) as chloroplasts, chromoplasts, leucoplasts and amyloplasts (<i>Helodea canadensis</i>, <i>Rhoeo discolor</i>, <i>Solanium tuberosum</i>). By paper chromatography they separate leaf pigments.</li> <li>• Cell cycle - mitosis: students prepare slide of <i>Allium cepa</i> roots and observe various stages of cell cycle.</li> <li>• Meiosis: students observe and try to recognise various stages of meiosis on slide of gland of <i>Caelifera</i>. Solving problems.</li> <li>• Nucleus in interphase-polytene chromosome: students observe <i>Drosophilla melanogaster</i> life cycle and prepare slide of <i>Drosophilla</i> salivary gland to observe polytene chromosome.</li> <li>• Human karyotype: under the microscope students observe human karyotype. From given karyotype students prepare karyogram.</li> <li>• DNA isolation: students perform simple process of DNA isolation.</li> </ul>		
2.6. Type of instruction	<p><b>lectures</b> <b>seminars</b> and workshops <b>exercises</b> online in entirety</p>	<p><b>independent study</b> multimedia and the internet <b>laboratory</b> work with the mentor</p>	2.7. Comments:

2.6. Type of instruction	mixed e-learning field work		(other)		2.7. Comments:	
2.8. Student responsibilities	Regular attendance of lectures, independent preparation of seminar (by use of various literature sources), active discussion after seminar, active participation in laboratory/experimental work					
2.9. Screening of student's work (specify the proportion of ECTS credits for each activity so that the total number of CTS credits is equal to the credit value of the course)	Class attendance	1	Research		Practical training	
	Experimental work	1	Report	0.5		
	Essay		Seminar essay	1.5	(Other--describe)	
	Tests		Oral exam	3	(Other—describe)	
	Written exam	0.5	Project		(Other—describe)	
2.10. Grading and evaluation of student work over the course of instruction and at a final exam	Filled report form during experimental work (left after experimental work and graded), exercise (experimental work) knowledge is graded by final written exam. Seminar report and activity during seminars. Oral exam.					
2.11. Required literature (available at the library and via other media)	<b>Title</b>					
	Cooper, G.M., Hausman, R.E. The cell, third edition, Medicinska naklada, Zagreb, 2004 (in Croatian) Cell biology – exercises (experimental work). Script for experimental work available through e-learning Domijan A-M. Cell biology and genetics. Presentation of lectures are available through e-learning					
2.12. Optional literature	Pavlica M. Online book on genetics; <a href="http://www.gnetics.biol.pmf.unizg.hr">www.gnetics.biol.pmf.unizg.hr</a>					
2.13. Methods of monitoring quality that ensure acquisition of exit competences	Learning outcomes 1-7 (informations that are learned on exercise, seminars and lectures) are checked by oral exam. Regular attendance of seminars, interest and autonomy in preparation of seminar add to learning outcomes 1-7. Learning outcome 8 is checked by written exam after exercises.					