CELL BIOLOGY

Code:: ΝΠ18-13
Cycle/Level: 1st cycle / Undergraduate
Semester: 2nd
Type of Course

X	Background
	Scientific Area (Pharmacy)

ECTS: 7
Lectures (hours): 4
Tutorials (hours): 2
Laboratory Work (hours): -
Course Coordinator:
Christos Panagiotidis, Professor (http://users.auth.gr/pchristo/)
Faculty Instructors
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Teaching Assistants: -

Learning Outcomes: To help the students understand the basic principles of cell biology, the importance of the cell structure to its functions and the roles of both the subcellular organelles and the major biological macromolecules. To achieve these goals, the course presents various areas of cell biology, i.e. starting with the presentation of the chemistry of the cells and the biosynthesis of its macromolecules (DNA, RNA, proteins etc.) and continuing into the structure of the membranous cell organelles, the pathways of intracellular transport, energy production and cell communication. Special emphasis will be given in aspects that are useful to pharmacy students, e.g. the cellular and molecular basis of disease and drug effects on the cell structure and function.
General Competences: Familiarization with key concepts of cell biology.
Teaching methods: Course lectures and tutorials.

Course Content:
Introduction to the Cell: Life and its study. Introduction to the cell and its components. Cell theory. Observing cells under a microscope. Similarities and differences between cells.
The chemical composition of the cells: Chemical bonds. Characteristics and the role of water. The molecules of the cell. Structures of simple sugars, polysaccharides, fatty acids/fats/lipids, nucleic acids and proteins. Enzymes, enzymatic reactions, allosteric motor proteins and protein machines.
Biological membranes, Intracellular compartments and transport: The lipid bilayer, membrane proteins (categories of membrane proteins, modes of attachment to the membranes, functions, the role of the cell cortex). Membranes carbohydrates and the importance of glycocalyx. Membrane organelles-structure and biological roles. Mechanisms of protein sorting and import to organelles (co- & post-translational translocation, the role and significance of signal sequences). The role of molecular chaperones in the protein transport across membranes, as well as on protein quality control. Vesicular transport (cargo selection, vesicle budding, targeting and

docking of transport vesicles). Secretory pathway and the role of the Golgi apparatus. Endocytosis, phagocytosis and structure and functions of lysosomes.
Cytoskeleton: The role(s) of cytoskeleton. Intermediate filaments. Microtubules and biological importance of their dynamic instability. The microtubules as highways for the transport of vesicles and other cell components. Microtubule motor proteins and their importance. Structure and function of actin in cell structure and movement. Attachment to motor proteins and myosins.
Mitochondria and Chloroplasts, the energy centers of the eukaryotic cells: Biological oxidations and energy production. The mitochondrion and its morphology. Degradation and oxidation of macromolecules. Respiratory chain and chemiosmotic conversion of oxidation energy to ATP. Chloroplasts and plastid morphology. Biological significance of the chloroplasts-Photosynthesis. Mitochondrial and plastid biogenesis and genome.
Protein synthesis, folding, modifications and degradation: The genetic code; codons, anticodons & transport RNAs; Reading frames in translation; Ribosome, the place of mRNA decoding; The process of translation and its regulation; Post-translational protein modifications, protein folding and degradation. The roles of molecular chaperones in protein folding, transport and sorting. Protein degradation.
Organization, storage and reproduction of the genetic information: The genetic information resides in DNA; DNA and genetic code; DNA structure and organization. Eukaryotic chromatin structure: euchromatin, heterochromatin and their significance. Nucleosomes (structure and importance); Higher levels of chromatin organization- chromosomes; DNA replication: mechanism and enzymes involved in the process; The problem of replication at the ends and the role of telomerase. DNA damage, mutations and DNA repair mechanisms.

Transmission of the Genetic Information: The process of transcription, RNA polymerases and their functions; promoters and transcription initiation, general and regulatory transcription factors; the roles of chromatin and histone modifications on transcription; the role of DNA methylation and chromatin structure in heritable gene silencing; Post-transcriptional maturation of eukaryotic RNAs (cap addition, splicing and 3’ end maturation).
Cell cycle and Cell Death: The stages of the cell cycle; Cell cycle regulation (the importance of checkpoints, cyclins and cyclin-dependent kinases); Stages of mitosis; The role of cytoskeleton in mitosis; Meiosis and sexual reproduction; Programmed cell death and its biological significance; Structural and functional alterations of cells undergoing programmed cell death; death signals; the roles and regulation of caspase activity; the role of mitochondria; anti-apoptotic factors.
Multicellular Organization and Cancer: Extracellular matrix and connective tissue; epithelium and intercellular junctions; Tissue maintenance and renewal-Deregulation in Cancer; Molecular roles oncogenes anti-oncogenes.

Proposed literature:

1. Essential Cell Biology, Authors: Alberts B.,Bray D.,Hopkin K.,Johnson A.,Lewis J.,Raff M.,Roberts K.,Walter P., 2015, BROKEN HILL PUBLISHERS LTD, I SBN: 9789963274253
2. The Cell: A Molecular Approach, Authors: Geoffrey M. Cooper & Robert E. Hausman,Έκδοση: 7η/2017, ΑΚΑΔΗΜΑΪΚΕΣ ΕΚΔΟΣΕΙΣ Ι. ΜΠΑΣΔΡΑ & ΣΙΑ ΟΕ, ISBN: 978-618-5135-08-9
3. Milecular Cell Biology. Authors: Harvey Lodish, Arnold Berk, Chris Kaiser, Monty Krieger, Anthony Bretscher, Hidde Ploegh, Angelica Amon, Kelsey Martin, 2018, UTOPIA Publishing ISBN: 978-618-5173-39-5

Educational activities:

Attendance of course lectures and tutorials.

Evaluation process and methods:

Student performance is evaluated using Intermediate exams (A) or final exams at semester end (B).
The exam structure is similar both in A & B and it consists of 20 sentences where the students are asked to define whether each sentence is correct or wrong (0.1 point per correct answer, -0.1 points per mistaken answer) and to justify their answer (0.4 points per question). All questions are equivalent (0.5 points). Questions that have not been answered correctly by any

students are withdrawn and final grade is calculated based on the grades from the remaining questions. The examination time in 1 hour

Use of ICT (Information and communication technologies) / Electronic distribution of the course materials:

ICT is used in the lectures (Powerpoint presentations, interactive tutorials using ICT, videos etc.). Lecture material, course and exam announcements, exam results etc. are posted on Lecture material, course and exam announcements, exam results etc. are posted on the Aristotle University's e-learning platform (https://elearning.auth.gr), and on the webpages of the course coordinator and the course instructors.

Teaching

Teaching takes place with course lectures and tutorials.

A) Lectures. The lectures (2 hours each) take place twice a week in Lecture Hall Δ12 of the School of the Exact Sciences (For health safety reasons, during the COVID-19 pandemic web-based lectures are also being used). The lectures, together with related educational material, are freely accessed in the webpages of the two course instructors

Lectures	Title	Instructor
1	Introduction to the cell and its constituents	Panagiotidis
2	The chemical composition of the cells	Pampalakis
3	Protein structure and function(s)	Panagiotidis
4-6	Biological membranes, Intracellular compartments and protein sorting	Panagiotidis
7-8	Vesicular transport, secretion, endocytosis, lysosomes and autophagy	Panagiotidis
9- 10	Mitochondria and Chroloplasts – The energy centers of the eukaryotic cells	Panagiotidis
11-12	Protein synthesis, folding, modifications and degradation	Panagiotidis
13-14	Cytoskeleton	Panagiotidis
15	Structure and organization of the genetic material	Pampalakis
16	DNA replication and DNA repair	Pampalakis
17	The process of transcription and its regulation	Panagiotidis
18-20	Cell division and Programmed Cell Death	Pampalakis
21	Meiosis and sexual reproduction	Pampalakis
22-23	Multicellular organization and cancer	Panagiotidis
24-26	Review lectures	Panagiotidis Pampalakis

B) Tutorials. The students have to attend three mandatory tutorials (three hours each).

Tutorial	Title	Instructor
1	The chemistry of the cells – Properties and activities of enzymes – Enzyme inhibitors and pharmaceutical applications (Interactive).	Panagiotidis Pampalakis
2	The flow of genetic information and the enzymes involved in these processes (Interactive)	Panagiotidis Pampalakis
3	The cell in motion 1 – Cell division The cell in motion 2 – Chemotaxis, cell signalling, cell death and phagocytosis	Panagiotidis Pampalakis