



UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Biokemija
Subject Title:	Biochemistry

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Splošna medicina General medicine		1	2

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
60	30		30		90	7

Nosilec predmeta / Lecturer:

Prof. dr. Uroš Potočnik

Jeziki /

Predavanja / Lecture: Slovensko/ Slovenian

Languages:

Vaje / Tutorial: Slovensko/Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Vsebina:

- Uvod v biokemijo, molekulske osnove življenja, voda, biološko pomembni elementi, ioni in glavne skupine biomolekul:
 - Trigliceridi, monosaharidi in kompleksni ogljikohidrati, peptidi in aminokisline, nukleinske kisline in nukleotidi, večina biomolekul so polimeri.
- Uvod v strukturo beljakovin:
 - Aminokisline: struktura, povezava med strukturo in funkcijo, izoelektrična in izoiionska točka, analitika aminokislin.
 - Peptidi: biološko aktivni peptidi; biogeni amini; strukturne osnove delovanja peptidnih hormonov in biogenih aminov
 - Primarna, sekundarna, terciarna in kvartarna struktura beljakovin
 - Beljakovine: splošna zgradba in lastnosti, razdelitev po funkciji (encimi, transportne, skladiščne, kontraktilne, strukturne, obrambne in regulatorne beljakovine)
 - Fibrilarne in globularne beljakovine
 - Struktura in funkcija fibrilarnih beljakovin: keratin, kolagen, elastin
 - Monomerna in oligomerna struktura beljakovin: mioglobin in hemoglobin
- Kemijske reakcije
 - Encimi: splošne značilnosti in osnove encimske kinetike
 - Mehanizmi encimskih reakcij, regulacija encimske

Content (Syllabus outline):

- Introduction to the biochemistry, molecular bases of life, water, elements and ions of biological importance, classification of biomolecules: triglycerides, monosaccharides, amino acids and peptides, nucleic acids and nucleotides, polymers.
- Introduction to the protein structure: amino acids: structure, links between structure and function, isoelectric and isoionic point, analysis of amino acids.
 - Peptides: biologically active peptides, biogenic amines, structurally based function of peptide hormones and biogenic amines.
 - Primary, secondary and tertiary structure of proteins.
 - Proteins: general structure and characteristics, classification by the function (enzymes, transport, contractile, accumulative, defence and regulatory proteins).
 - Fibrillar and globular proteins.
 - Structure and function of fibrillary proteins: keratin, collagen, elastin.
 - Monomeric and oligomeric structure of proteins: myoglobin and haemoglobin.
- Chemical reactions:
 - Enzymes: general features and bases of enzymatic kinetics.
 - Mechanism of enzymatic reactions, regulation of enzymatic activity (allosteric modulation,

aktivnosti (alosterična modulacija, kovalentna modifikacija, regulacija prek proteolitičnih encimov), klasifikacija in nomenklatura encimov
d. Koencimi
• Sklopljene reakcije, vloga ATP pri sklopljenih procesih, aktivni transport • GTP, UTP in CTP tudi sodelujejo pri encimskih reakcijah; koencim A; kovinski ioni
e. Biokemijske komponente celic in tkiv
• Biološke membrane – struktura in funkcija • Primeri membranskih beljakovin: transporterji za ione in beljakovine, receptorji • Celična površina – membranske karakteristike; krvne skupine • Citoskelet, kontraktilne beljakovine in molekularni motorji: miozin, aktin, troponin, tropomiozin, kinezin in dinein • Enostavni in sestavljeni polisaharidi, glikoproteini, celična stena
f. Metabolizem
• Prebavni encimi, uvod v metabolne poti – regulacija metaboličnih poti, glavni eksperimentalni pristopi za študij metabolizma • Encimska razgradnja glikozidnih vezi • Oksidativni procesi v celici in pridobivanje energije • Metabolizem ogljikovih hidratov, uravnavanje sinteze in razgradnje ogljikovih hidratov • Metabolizem maščobnih kislin in trigliceridov • Metabolizem nukleotidov in nukleinskih kislin, uravnavanje metabolizma nukleotidov, bolezni povezane z metabolizmom nukleotidov • Metabolizem membranskih lipidov, celična razgradnja in biosinteza enostavnih in sestavljenih lipidov; biosinteza in razgradnja žolčnih kislin; metabolizem lipoproteinov; metabolizem prostaglandinov; uravnavanje metabolizma lipidov, bolezni povezane z metaboličnimi defekti v metabolizmu lipidov • Metabolizem aminokislin, prebava proteinov, razgradnja aminokislin, biosinteza neesencialnih aminokislin, uravnavanje hitrosti metabolizma aminokislin, bolezni povezane z metaboličnimi defekti v metabolizmu aminokislin; aminokisline kot izhodne snovi v biosintezah biološko pomembnih spojin • Metabolizem hema • Vitamin: klasifikacija vitaminov, vodotopni vitamini, koencimi in prostetične skupine; lipidotopni vitamini.
g. Pomen biokemije za razlago in zdravljenje bolezni
h. Biosinteza proteinov, usmerjanje, znotrajcelični transport, zvijanje, kontrola kvalitete, degradacija
i. Genetske bolezni
j. Membranske beljakovine, prenos snovi skozi biološke membrane, pasivni in aktivni transport, primeri pasivnega in aktivnega transporta pri človeku
k. Hormoni, sproščanje hormonov
l. Vloga hormonov v uravnavanju metaboličnih

covalent modification, regulation of proteolytic enzymes), classification and nomenclature of enzymes.
d) Coenzymes.
• ATP, active transport. • GTP, UTP and CTP and their role by the enzymatic reactions: coenzyme A, metal ions.
e) Biochemical components of cells and tissues.
• Biological membranes – structure and function. • Examples of membrane proteins: transporters, receptors. • Cell surface: membrane characteristics: blood groups. • Cytoskeleton: contractile proteins and molecular motors: myosin, actin, troponin, tropomyosin, kinesin and dinein. • Simple and complex polysaccharides, glycoproteins, cell wall.
f) Metabolism.
• Digestive enzymes; introduction to the metabolic pathways, major experimental approaches to the study of metabolism. • Enzymatic digestion of glycoside bonds. • Oxidative processes in the cell and energy generation. • Metabolism of carbohydrates, regulation of anabolism and catabolism of carbohydrates. • Metabolism of fatty acids and triglycerides. • Metabolism of nucleotides and nucleic acids, regulation of their metabolism, diseases. • Metabolism of membrane lipids, anabolism and catabolism of simple and complex triglycerides, bile acids, lipoproteins, prostaglandins, regulation of lipid metabolism. Diseases that arose from metabolism disorders. • Metabolism of amino acids and proteins, anabolism and catabolism of essential and non-essential amino acids, regulation of metabolism, diseases that arose from metabolic disorders. • Haem metabolism. • Vitamins: classification, water soluble vitamins and coenzymes and prosthetic groups, fat soluble vitamins.
g) Importance of biochemistry for disease explanation and treatment.
h) Biosynthesis of proteins, conformations, folding, quality control, intracellular transport.
i) Genetic disorders.
j) Membrane proteins: transport over the membrane, passive and active transport in human body. Hormones and their release.
l) Role of hormones in the regulation of metabolic processes.
m) Metabolism of minerals, intake, storage and secretion of minerals in the human body (calcium, magnesium, zinc, iodine, ...).
n) Metabolic characteristics of individual tissues and organs (skeletal muscle, heart muscle, liver, adipose tissue, kidneys, nervous

- procesov
- m. Metabolizem mineralov, vnos, zadrževanje in izločanje mineralnih snovi pri človeku (kalcij, magnezij, železo, cink, jod, itn.)
- n. Metabolične značilnosti posameznih tkiv in organov. Skeletna mišica, srčna mišica, jetra, maščevje, ledvica, živčevje, krvni elementi, koža, oko, pljuča, vezivno tkivo
- o. Medsebojna odvisnost in vloga organov v metaboličnih procesih pri človeku.

system, blood elements, skin, eye, lungs, connective tissue).

o) Interrelation and interactions of the organs in the metabolism of human body.

Temeljni literatura in viri / Textbooks:

1. Lehninger Principles of Biochemistry, 7th ed, W.H. Freeman and Company, New York, 2012.
2. Dewlin, Thomas M: Textbook of Biochemistry With Clinical Correlations , 8th Ed J. Wiley & sons, Hoboken (New Jersey), 2014 Nelson DL, Cox MM.;
3. Lee W. Janson, M. Tischler, Medical Biochemistry: The Big Picture (LANGE The Big Picture), McGraw-Hill, 2012, ISBN:9780071637923.
4. Rodney Boyer, Concepts in Biochemistry, 3rd Ed. Wiley, 2006, ISBN: 139780471661795.
5. Harper's Illustrated Biochemistry, 27th ed., McGraw-Hill, 2006. Robert Murray, Darryl Granner, Peter Mayes, Victor Rodwell. ISBN: 0071461973
6. Principles of medical biochemistry, 2nd ed., Mosby Elsevier, 2006. Gerhard Meisenberg, William H. Simmons, ISBN: 0323029426
7. Florian Horn. Biochemie des Menschen, 5., korrigierte Auflage 2012 664 S. , 1180 Abb. , Broschiert ISBN: 9783131308856

Cilji:

Študent se spozna z biomolekulami v človeškem telesu in s temeljnimi zakonitostmi ter mehanizmi biokemičnih dogajanj, ki predstavljajo osnovo za razumevanje življenjskih procesov v zdravem in bolezenskem stanju organizma.

Pridobi si osnovno znanje iz biokemičnih procesov, ki omogoča živim organizmom normalno delovanje in vzdrževanje optimalnih koncentracij celičnih sestavin in telesnih tekočin ter rast in razmnoževanje.

Objectives:

Students get acquainted with biomolecules in the human body with fundamental characteristics and mechanisms of biochemical reactions as a basis for understanding of life and processes in the healthy and ill state of the organism.

Students acquire the basic knowledge in biochemical processes to maintain the normal and optimal function of the human body.

Predvideni študijski rezultati:

Znanje in razumevanje:

Biokemija integrira molekularne osnove temeljnih življenjskih procesov in je nujna za razumevanje vzrokov bolezni ter molekularnih pristopov zdravljenja. Povezuje znanje o molekularnih mehanizmih delovanja zdravega organizma in okvar, ki privedejo do bolezni.

Prenesljive/ključne spretnosti in drugi atributi:

Spoznavanje delovanja organizma na molekularni ravni. Biokemija je povezana s predmeti Molekularna biologija in Biologija celice. Pomaga pri razumevanju Patofiziologije, Farmakologije in večine kliničnih predmetov.

Metode poučevanja in učenja:

Predavanja, skupinsko in individualno delo, seminarji, laboratorijske vaje. PBL.

Intended learning outcomes:

Knowledge and Understanding:

An integrative approach of fundamental living processes and understanding of disease incidence and molecular approaches of healing. Integrative knowledge of molecular mechanisms of functioning of the healthy organism and disorders that consequently lead to the disease.

Transferable/Key Skills and other attributes:

Biochemistry is correlated to the understanding of pathophysiology, pharmacology and most of the clinical subjects.

Learning and teaching methods:

Lectures, group and individual work, projects, laboratory practicals, PBL.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt) pisni izpit opravljene lab. vaje in kolokvij, opravljen seminar ŠTUDIJSKE OBVEZNOSTI ŠTUDENTOV Opravljene vaje – prisotnost na vajah Opravljene seminarji – prisotnost na seminarjih POGOJI ZA PRISTOP K POSAMEZNEMU PREVERJANJU ZNANJA Opravljene kolokvij iz vaj – pogoj za pristop k izpitu Opravljene vaje in dnevnik – pogoj za pristop h kolokviju iz vaj Opravljene seminarji – pogoj za pristop k izpitu	70 % 20 % 10 %	Type (examination, oral, coursework, project): written examination assessment of laboratory practicals, assessment of project work ACADEMIC OBLIGATIONS OF STUDENTS: Students should complete laboratory work and write reports. Presence at all laboratory work is mandatory. Students should write an essay on selected topic and give oral presentation (seminar). Presence at seminar presentations is mandatory. REQUIREMENTS FOR ACCESS TO INDIVIDUAL KNOWLEDGE CHECKING: Laboratory and seminary work project is condition for approaching to written exam Students can pass the exam with colloquia which is highly recommended. Colloquia are divided in three sets. For the recognition of written examination must all be positive.

Reference nosilca / Lecturer's references:

JOSTINS, Luke, MITROVIČ, Mitja, POTOČNIK, Uroš, et al. Host-microbe interactions have shaped the genetic architecture of inflammatory bowel disease. *Nature*, ISSN 0028-0836, 2012, vol. 491, no. 7422, str. 119-124, doi: 10.1038/nature11582. [COBISS.SI-ID 512230968], [JCR, SNIP, WoS do 22. 10. 2014: št. citatov (TC): 354, čistih citatov (CI): 353, čistih citatov na avtorja (CIAu): 17.40, normirano št. čistih citatov (NC): 140, Scopus do 22. 10. 2014: št. citatov (TC): 395, čistih citatov (CI): 392, čistih citatov na avtorja (CIAu): 19.32, normirano št. čistih citatov (NC): 624. SCI impact factor=36.28

RIVAS, Manuel A, MITROVIČ, Mitja, POTOČNIK, Uroš, et al. Deep resequencing of GWAS loci identifies independent rare variants associated with inflammatory bowel disease. *Nature genetics*, ISSN 1061-4036, 2011, vol. 43, no. 11, str. 1066-1073, doi: 10.1038/ng.952. [COBISS.SI-ID 15421974], [JCR, SNIP, WoS do 14. 10. 2014: št. citatov (TC): 180, čistih citatov (CI): 180, čistih citatov na avtorja (CIAu): 8.14, normirano št. čistih citatov (NC): 50, Scopus do 22. 10. 2014: št. citatov (TC): 192, čistih citatov (CI): 191, čistih citatov na avtorja (CIAu): 8.63, normirano št. čistih citatov (NC): 53. SCI impact factor=35.53

ŠIMENC, Janez, POTOČNIK, Uroš. Rapid differentiation of bacterial species by high resolution melting curve analysis. *Applied biochemistry and microbiology*, ISSN 0003-6838, 2011, vol. 47, no. 3, str. 256-263, doi: 10.1134/S0003683811030136. [COBISS.SI-ID 14937622], [JCR, SNIP, WoS do 28. 10. 2014: št. citatov (TC): 9, čistih citatov (CI): 9, čistih citatov na avtorja (CIAu): 4.50, normirano št. čistih citatov (NC): 3, Scopus do 6. 8. 2014: št. citatov (TC): 9, čistih citatov (CI): 9, čistih citatov na avtorja (CIAu): 4.50, normirano št. čistih citatov (NC): 3. SCI impact factor= 0.56

BERCE, Vojko, PINTO KOZMUS, Carina, POTOČNIK, Uroš. Association among ORMDL3 gene expression, 17q21 polymorphism and response to treatment with inhaled corticosteroids in children with asthma. *Pharmacogenomics journal*, ISSN 1470-269X, Dec. 2013, vol. 13, issue 6, 523-529. <http://www.nature.com/tpj/journal/vaop/ncurrent/full/tpj201236a.html>, doi: 10.1038/tpj.2012.36. [COBISS.SI-ID 4406079], [JCR, SNIP, WoS do 2. 4. 2014: št. citatov (TC): 1, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 25. 4. 2014: št. citatov (TC): 2, čistih citatov (CI): 1, čistih citatov na avtorja (CIAu): 0.33, normirano št. čistih citatov (NC): 0. SCI impact factor= 5.513

Cross-Disorder Group of the Psychiatric Genomics Consortium, et al., MITROVIČ, Mitja (sodelavec pri raziskavi), POTOČNIK, Uroš (sodelavec pri raziskavi), et al. Genetic relationship between five psychiatric disorders estimated from genome-wide SNPs. *Nature genetics*, ISSN 1061-4036, 2013, vol. 45, no. 9, str. 984-994, ilustr., doi:

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10.1038/ng.2711. [COBISS.SI-ID 512406840], [JCR, SNIP, WoS do 22. 10. 2014: št. citatov (TC): 57, čistih citatov (CI): 57, čistih citatov na avtorja (CIAu): 2.22, normirano št. čistih citatov (NC): 15, Scopus do 22. 10. 2014: št. citatov (TC): 98, čistih citatov (CI): 98, čistih citatov na avtorja (CIAu): 3.82, normirano št. čistih citatov (NC): 26
SCI impact factor=35.53