ZNANOSTI O CELICI – TEORETIČNI PREDMETI

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Analiza bioloških signalov
Course title:	Biological signal analysis

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Bioznanosti, tretja stopnja, doktorski	Znanosti o celici		Celoletni

Univerzitetna koda predmeta/University course code: 3856

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
10	20	10	0	0	85	5

Nosilec predmeta/Lecturer:	Marko Kreft

Izvajalci predavanj:	Gregor Belušič, Marko Kreft
Izvajalci seminarjev:	
Izvajalci vaj:	
Izvajalci kliničnih vaj:	
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	

Vrsta predmeta/Course type:	teoretični/theoretical

Jeziki/Languages:	Predavanja/Lectures:	Angleščina, Slovenščina
	Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Splošni pogoji za vpis na doktorski študij	General prerequisites for enrolment in doctoral studies.

Vsebina:	Content (Syllabus outline):
Signali, ki jih posnamemo na živih organizmih nosijo informacijo o procesih na molekulski ali celični ravni, ravni organov ali sistemski ravni. Različni biološki signali so na primer posnetki govora, elektrokardiogram (EKG), elektroencefalogram (EEG), elektroretinogram (ERG), elektrofiziološki posnetki na posameznih celicah, itd. Pogosto snemamo kombinacijo signalov, npr. signal fluorescence kot kazalca vsebnost kalcija v celicah, sočasno s signalom toka na plazmalemi. Podobno	Signal transduced from living organisms are reporting processes at the molecular, cell, organ, or systemic level of organisation. Biological signals range from recordings of speech, the electrocardiogram (ECG), the electroencephalogram (EEG), electroretinogram (ERG), electrophysiological recordings on single cells, etc. In many cases we record a combination of signals, e.g. fluorescence signal as a reporter of calcium level in the cell, together with the signal of the plasma membrane

beležimo signale na poligrafu (detektor laži) ali polisomnografu za študije spanja. Biološki signali so sestavljeni iz signala in šuma. Pri predmetu bomo obravnavali osnove obdelave signalov v programskem jeziku Octave ali Matlab. Pri predmetu bomo uporabili realne signale za praktično uporabo analize časovnih sprememb bioloških spremenljivk. Uporabili bomo filtriranje, prileganje funkcij, povprečenje. Uporabili bomo primer študija profila fluorescenčne intenzitete. Šum pogosto povzroči močno variabilne profile. Filtriranje teh signalov zmanjšuje prostorsko ločljivost. Da bi se temu izognili, bomo uporabili povprečenje vrednosti sosednjih točk. V tem praktičnem primeru bomo uporabili diskretno Fourierjevo transformacijo (DFT) računano z algoritmom (FFT).	current. Similarly, we record signals of a polygraph (lie detector) or polysomnograph for sleep studies. Biological signals are and additive combination of signal and noise. A brief introduction to signal processing in Octave or Matlab will be given. Practical application of the signal processing will be studied. We will use analysis approaches of time dependent changes of biological measurements. We will use filtering, fitting of functions, averaging. An example of study of a line profile of fluorescent intensities will be presented. The image noise often results in scattered line profiles. Filtering of the signal results in reduced spatial resolution of the processed data. To avoid reducing the spatial resolution we will apply averaging of neighbouring pixel values. In this practical example the discrete Fourier transform (DFT) will be computed with a fast Fourier transform (FFT) algorithm.

Temeljna literatura in viri/Readings:

R.B. Northrop: Signals and Systems Analysis In Biomedical Engineering, 2. ed., CRC press (2009) Izbrani članki iz revije Biomedical Signal Processing and Control, Elsevier

Cilji in kompetence:	**Objectives and competences:**
Pridobivanje osnovnih znanj za zajem podatkov, analogno-digitalno pretvorbo, obdelavo, analizo in interpretacijo rezultatov. - zajem podatkov, - vrednotenje in analiza šuma - povprečenje, filtriranje, korelacija, - meritve pojavov sprememb v signalu - realni in kompleksni del analize Fourier, FFT, Bodejev diagram	Acquiring of basic skills on data acquisition, analogue to digital conversion, processing, analysis and interpretation of results. - Data acquisition, - Noise evaluation and analysis - Signal averaging, filtering, correlation, - Measurements of features in the signal - Real and Complex Fourier Series, Fast Fourier transform, Bode plot

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: - Praktična znanja za obdelavo signalov s pomočjo računalniških orodij. - razumevanje temeljev bioloških signalov - izbira ustrezne metodologije za obdelavo in analizo signalov.	Knowledge and understanding: - practical knowledge to solve signal processing tasks using computer tools. - understanding basics of biological signals - choosing of appropriate methodology to process and analyse signals.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, konzultacije, praktične demonstracije, seminarji in individualno projektno delo.	Lectures, consultations, practical demonstrations, seminars, individual project.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Predstavitev individualnega projekta in odgovori na vprašanja	100,00 %	Project presentation and answers to question

Reference nosilca/Lecturer's references:

prof. dr. Marko Kreft

MILOŠEVIĆ, Milena, STENOVEC, Matjaž, KREFT, Marko, PETRUŠIĆ, Vladimir, STEVIĆ, Zorica, TRKOV, Saša, ANDJUS, Pavle, ZOREC, Robert. Immunoglobulins G from patients with sporadic amyotrophic lateral sclerosis affects cytosolic Ca2+ homeostasis in cultured rat astrocytes. Cell calcium, ISSN 0143-4160, Jul. 2013, vol. 54, iss. 1, str. 17-25,

KABASO, Doron, JORGAČEVSKI, Jernej, COSTA CALEJO, Ana-Isabel, FLAŠKER, Ajda, GUČEK, Alenka, KREFT, Marko, ZOREC, Robert. Comparison of unitary exocytic events in pituitary lactotrophs and in astrocytes : modeling the discrete open fusion-pore states. Frontiers in cellular neuroscience, ISSN 1662-5102, Apr. 2013, vol. 7.

KABASO, Doron, GONGADZE, Ekaterina, JORGAČEVSKI, Jernej, KREFT, Marko, VAN RIENEN, Ursula, ZOREC, Robert, IGLIČ, Aleš. Exploring the binding dynamics of bar proteins. Cellular & molecular biology letters, ISSN 1425-8153, 2011, vol. 16, no. 3, str. 398-411 in S1-S8, ilustr.

KREFT, Marko, ZOREC, Robert, JANEŠ, Damjan, KREFT, Samo. Histolocalisation of the oil and pigments in the pumpkin seed. Annals of Applied Biology, ISSN 0003-4746, 2009, vol. 154, no. 3, str. 413-418. http://www3.interscience.wiley.com/journal/122376617/issue.

POTOKAR, Maja, KREFT, Marko, LEE, So-Young, TAKANO, Hajime, HAYDON, Philip G., ZOREC, Robert. Trafficking of astrocytic vesicles in hippocampal slices. Biochemical and biophysical research communications, ISSN 0006-291X, 2009, letn. 390, str. 1192-1196, doi: 10.1016/j.bbrc.2009.10.119.

KREFT, Samo, KREFT, Marko. Quantification of dichromatism : a characteristic of color in transparent materials. Journal of the Optical Society of America. A, Optics, image science, and vision, ISSN 1084-7529, 2009, letn. 26, št. 7, str. 1576-1551, doi: 10.1364/JOSAA.26.001576.

doc. dr. Gregor Belušič

BELUŠIČ, Gregor, PIRIH, Primož, STAVENGA, Doekele Gerben. A cute and highly contrast-sensitive superposition eye - the diurnal owlfly *Libelloides macaronius*. Journal of Experimental Biology, ISSN 0022-0949, 2013, vol. 216, str. 2081-2088.

RICHTER, David, KATZ, Ben, OBERACKER, Tina, TZARFATY, Vered, BELUŠIČ, Gregor, MINKE, Baruch, HUBER, Armin. Translocation of the *Drosophila* transient receptor potential-like (TRPL) channel requires both the N- and C-terminal regions together with sustained Ca2+ entry. The Journal of biological chemistry, ISSN 0021-9258, 2011, vol. 286, str. 34234-34243.

BELUŠIČ, Gregor, ZUPANČIČ, Gregor. Singing greeting card beeper as a finger pulse sensor. Advances in physiology education, ISSN 1043-4046, 2010, vol. 34, no. 2, str. 90-92.

BELUŠIČ, Gregor, PIRIH, Primož, STAVENGA, Doekele Gerben. Photoreceptor responses of fruitflies with normal and reduced arrestin content studied by simultaneous measurements of visual pigment fluorescence and ERG. Journal of comparative physiology. A, Sensory, neural, and behavioral physiology, ISSN 0340-7594, 2010, vol. 196, no. 1, str. 23-35.

BELUŠIČ, Gregor. ERG in *Drosophila*. V: BELUŠIČ, Gregor. Electroretinograms. Rijeka: InTech, 2011, str. 221-238, ilustr.

RUDOLF, Jerneja, MEGLIČ, Andrej, ZUPANČIČ, Gregor, BELUŠIČ, Gregor. Development and plasticity of mitochondria and electrical properties of the cell membrane in blowfly photoreceptors. Journal of comparative physiology. A, Sensory, neural, and behavioral physiology, 2014

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Dinamičnost celične arhitekture
Course title:	Dynamics of cell architecture
Članica nosilka/UL Member:	

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Bioznanosti, tretja stopnja, doktorski	Ni členitve (študijski program)		Celoletni

Univerzitetna koda predmeta/University course code:	0037354
Koda učne enote na članici/UL Member course code:	3857

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	30	20	0	55	125	10

Nosilec predmeta/Lecturer:	Nada Žnidaršič

Izvajalci predavanj:	Mateja Erdani Kreft, Rok Romih, Jasna Štrus, Miloš Vittori, Nada Žnidaršič
Izvajalci seminarjev:	
Izvajalci vaj:	Polona Mrak
Izvajalci kliničnih vaj:	
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	

Vrsta predmeta/Course type:	teoretični/theoretical

Jeziki/Languages:	Predavanja/Lectures:	Angleščina, Slovenščina
	Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Splošni pogoji za vpis na doktorski študij, zaključen študijski program s področja bioloških, biomedicinskih, biokemijskih, biotehniških smeri ali s širšega področja naravoslovno matematičnih smeri.	General prerequisites for enrolment in doctoral studies, completed studies in the biological, biomedical, biochemical, biotechnical or natural sciences - mathematics study programmes.

Vsebina:	**Content (Syllabus outline):**
1. Organizacija celic, morfogeneza in funkcija tkiv; posebnosti v zgradbi in delovanju evkariontskih celic; interpretacija celične ultrastrukture v povezavi s funkcijo; kopičenje in dinamika rezervnih snovi in kovin; sekrecija hitinskih struktur in mehanizmi biomineralizacije v nevretenčarskih epitelijih; interakcije med	1. Cellular organization, morphogenesis and tissue function; structural and functional characteristics of eukaryotic cell; interpretation of cell ultrastructure and fuction; accumulation and dynamics of reserve substances and metals; secretion of chitinous matrices and mechanisms of biomineralization in invertebrate epithelial tissues; interactions of bacteria and eucaryotic

bakterijami in evkariontskimi celicami; koevolucija mikroorganizmov in gostitelja 2. Celično-molekulski procesi in mehanizmi spreminjanja celične zgradbe ter funkcije med delitvijo, diferenciacijo in celično smrtjo. Poudarek na prerazporeditvi endomembranskega sistema, citoskeleta in medceličnih povezav med fiziološko obnovo tkiv.	cells; coevolution of miocroorganisms and their hosts 2. Cell and molecular processes and mechanisms of altered cellular structure and function during cell division, differentiation and cell death. Focus on reorganization of endomembranes, cytoskeleton and intercellular junctions during tissue regeneration.

Temeljna literatura in viri/Readings:

Pavelka Margit, Roth Jurgen 2005. Functional Ultrastructure An Atlas of Tissue Biology and Pathology Springer Verlag, Wien, ISBN 3-211-83564-4

Paracer S., Ahmadijan V.: Symbiosis: An introduction to biological associations. 291 pages. Oxford University Press (2000). ISBN 0195118073 – Poglavje 1 (str. 3-13), poglavje 3 (str. 33-50), poglavje 4 (str. 51-62), poglavje 6 (str. 79-88)

Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. (2008) Molecular biology of the cell, 5th edition.

Karp, B. Cell and Molecular Biology, 5th Edition, (2008) ISBN-13 978-0-470-04217-5. Poglavja 7,8,9, 15 in 18; strani 239-42,616-662, 727-774

Tekoča znanstvena periodika, pregledni članki iz znanstvenih revij Nature, The Cell in specifičnih znanstvenih publikacij.

Cilji in kompetence:	**Objectives and competences:**
• pridobivanje specialnih znanj s področja zgradbe in delovanja celice; • poznavanje in obvladovanje metod dela v celični biologiji; • poznavanje odnosov med pro- in evkarionti • zmožnost interpretacije celične funkcije v povezavi z višjimi organizacijskimi ravnmi • razumevanje dinamike endomembran in procesov regeneracije • poznavanje celičnih mehanizmov dinamike ionov kovin	• special knowledge on cell function and structure • understanding and mastering the methdos in cell biology • understanding the interactions between pro- and eucaryotes • ability to interprete the cell function in relation with higher levels of organization • understanding of endomembrane dynamics in cell regeneration • understanding metal ions dynamics

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • zmožnost interpretacije celične ultrastrukture pro- in evkariontov • razumevanje dinamike endomembranskih sistemov in citoskeleta • poznavanje celičnih mehanizmov regeneracije • uporaba tehnik za analizo celične zgradbe in delovanja • zmožnost iskanja in citiranja sodobnih virov s področja biologije celice	Knowledge and understanding: • interpretation of cell ultrastructure of pro- and eucaryotes • understanding of endomembrane and cytoskeleton dynamics • understanding cell mechanisms of regeneration • mastering techniques for analysis of cell structure and function • ability to follow and cite contemporary work in cell biology

Metode poučevanja in učenja:	**Learning and teaching methods:**
• Teoretična znanja v obliki diskusij in predavanj s poudarkom na specifičnih vsebinah, praktično delo v laboratoriju, priprava bioloških preparatov za mikroskopiranje, analiziranje	• Teoretical knowledge based on discussions and lectures focused to special topics in cell biology, laboratory work, preparation of biological samples for microscopy, analysis of

mikrografij, predstavitev seminarjev, razprave in projektno delo.	micrographs, seminars, consultations and project work

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt): - izpit iz teoretičnih poglavij celične biologije	50,00 %	Type (examination, oral, coursework, project): - exam based on theoretical knowledge in cell biology
- seminar ali predstavitev dela na konferenci	40,00 %	- seminar or presentation at the conference
- laboratorijsko delo	10,00 %	- laboratory work

Reference nosilca/Lecturer's references:

Nada Žnidaršič

- ŠOLN, Katarina, **ŽNIDARŠIČ, Nada**, DOLENC KOCE, Jasna. Root growth inhibition and ultrastructural changes in radish root tips after treatment with aqueous extracts of Fallopia japonica and F. xbohemica rhizomes. *Protoplasma*, ISSN 0033-183X, 2021, str. 1-13, [in press], ilustr., doi: 10.1007/s00709-021-01668-4. [COBISS.SI-ID 66701827]
- BOGATAJ, Urban, MRAK, Polona, ŠTRUS, Jasna, **ŽNIDARŠIČ, Nada**. Ultrastructural differentiation of plasma membrane and cell junctions in the hindgut cells is synchronized with key developmental transitions in Porcellio scaber. *Arthropod structure & development*, ISSN 1467-8039, 2019, vol. 50, str. 78-93, ilustr., doi: 10.1016/j.asd.2019.04.004. [COBISS.SI-ID 5071439
- PRISLAN, Peter, MRAK, Polona, **ŽNIDARŠIČ, Nada**, ŠTRUS, Jasna, HUMAR, Miha, THALER, Nejc, MRAK, Tanja, GRIČAR, Jožica. Intra-annual dynamics of phloem formation and ultrastructural changes in sieve tubes in Fagus sylvatica. *Tree physiology*, ISSN 0829-318X, 2019, vol. 39, iss. 2, str. 262-274, ilustr. https://doi.org/10.1093/treephys/tpy102, doi: 10.1093/treephys/tpy102. [COBISS.SI-ID 5187750]
- OTA, Ajda, ISTENIČ, Katja, SKRT, Mihaela, ŠEGATIN, Nataša, **ŽNIDARŠIČ, Nada**, KOGEJ, Ksenija, POKLAR ULRIH, Nataša. Encapsulation of pantothenic acid into liposomes and into alginate or alginate-pectin microparticles loaded with liposomes. *Journal of food engineering*, ISSN 0260-8774. [Print ed.], 2018, vol. 229, str. 21-31, ilustr., doi: 10.1016/j.jfoodeng.2017.06.036. [COBISS.SI-ID 4795000]
- ADEN, Saša, KOZOROG, Mirijam, ŠVIGELJ, Tomaž, POKLAR ULRIH, Nataša, **ŽNIDARŠIČ, Nada**, PODOBNIK, Marjetka, ANDERLUH, Gregor. Cholesterol enriched archaeosomes as a molecular system for studying interactions of cholesterol-dependent cytolysins with membranes. *The journal of membrane biology*, ISSN 0022-2631, 2018, vol. 251, iss. 3, str. 491-505, ilustr., doi: 10.1007/s00232-018-0018-y. [COBISS.SI-ID 4885880]
- **ŽNIDARŠIČ, Nada**, MRAK, Polona, RAJH, Eva, ŽAGAR, Kristina, ČEH, Miran, ŠTRUS, Jasna. Cuticle matrix imaging by histochemistry, fluorescence, and electron microscopy. *Resolution & discovery : new beacon for the microscopy community*, ISSN 2498-8707, 2018, vol. 3, iss. 1, str. 5-12, doi: 10.1556/2051.2018.00052. [COBISS.SI-ID 4679503]
- BOGATAJ, Urban, PRAZNIK, Monika, MRAK, Polona, ŠTRUS, Jasna, TUŠEK-ŽNIDARIČ, Magda, **ŽNIDARŠIČ, Nada**. Comparative ultrastructure of cells and cuticle in the anterior chamber and papillate region of Porcellio scaber (Crustacea, Isopoda) hindgut. *ZooKeys*, ISSN 1313-2989, 2018, vol. 801, str. 427-458. https://doi.org/10.3897/zookeys.801.22395, doi: 10.3897/zookeys.801.22395. [COBISS.SI-ID 4911695]
- KISOVEC, Matic, ADEN, Saša, KNAP, Primož, CAJNKO, Miša Mojca, CASERMAN, Simon, FLAŠKER, Ajda, **ŽNIDARŠIČ, Nada**, REPIČ, Matej, MAVRI, Janez, RUAN, Yi, SCHEURING, Simon, PODOBNIK, Marjetka, ANDERLUH, Gregor. Engineering a pH responsive pore forming protein. *Scientific reports*, ISSN 2045-2322, Feb. 2017, vol. 7, str. 42231-1-42231-13. http://www.nature.com/articles/srep42231.pdf, doi: 10.1038/srep42231. [COBISS.SI-ID 6088986]
- ŠTRUS, Jasna, **ŽNIDARŠIČ, Nada**, MRAK, Polona, BOGATAJ, Urban, VOGT, Günter. Structure, function and development of the digestive system in malacostracan crustaceans and adaptation to different lifestyles. *Cell and tissue research*, ISSN 0302-766X, 2019, vol. 377, no. 3, str. 415-443, ilustr., doi: 10.1007/s00441-019-03056-0. [COBISS.SI-ID 5117263]
- MRAK, Polona, BOGATAJ, Urban, ŠTRUS, Jasna, **ŽNIDARŠIČ, Nada**. Cuticle morphogenesis in crustacean embryonic and postembryonic stages. *Arthropod structure & development*, ISSN 1467-8039, 2017, vol. 46, str. 77-95, ilustr., doi: 10.1016/j.asd.2016.11.001. [COBISS.SI-ID 4232271]

Štrus Jasna

- VITTORI, Miloš, ROZMAN, Alenka, GRDADOLNIK, Jože, NOVAK, Urban**, ŠTRUS, Jasna**. Mineral deposition in bacteria-filled and bacteria-free calcium bodies in the crustacean Hyloniscus riparius (Isopoda: Oniscidea). PloS one, ISSN 1932-6203, 2013, vol. 8, no. 3, str. 1-14, e58968. http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0058968, doi: 10.1371/journal.pone.0058968. [COBISS.SI-ID 2756943],
- VITTORI, Miloš, ŽNIDARŠIČ, Nada, KOSTANJŠEK, Rok, **ŠTRUS, Jasna**. Microscopic anatomy of male tegumental glands and associated cuticular structures in Titanethes albus (Crustacea: Isopoda). Arthropod structure & development, ISSN 1467-8039, 2012, vol. 41, issue 2, str. 133-144. http://dx.doi.org/10.1016/j.asd.2011.08.004, doi: 10.1016/j.asd.2011.08.004. [COBISS.SI-ID 2468943]
- VITTORI, Miloš, KOSTANJŠEK, Rok, ŽNIDARŠIČ, Nada, ŽAGAR, Kristina, ČEH, Miran, **ŠTRUS, Jasna.** Calcium bodies of Titanethes albus (Crustacea: Isopoda) : molt-related structural dynamics and calcified matrix-associated bacteria. Journal of structural biology, ISSN 1047-8477, 2012, vol. 180, issue 1, str. 216-225.
- PIPAN TKALEC, Živa, DROBNE, Damjana, VOGEL-MIKUŠ, Katarina, PONGRAC, Paula, REGVAR, Marjana, **ŠTRUS, Jasna**, PELICON, Primož, VAVPETIČ, Primož, GRLJ, Nataša, REMŠKAR, Maja. Micro-PIXE study of Ag in digestive glands of a nano-Ag fed arthropod (Porcellio scaber, Isopoda, Crustacea). V: *Proceedings of the 12th International Conference on Nuclear Microprobe Technology, July 26-30, 2010, Leipzig, Germany*, (Nuclear instruments and methods in physics research, ISSN 0168-583X, B, Beam interactions with materials and atoms, vol. 269, no. 20, 2011). Amsterdam: North-Holland, 2011, vol. 269, no. 20, str. 2286-2291, doi: 10.1016/j.nimb.2011.02.068. [COBISS.SI-ID 24535591]
- MATSKO, Nadejda B., ŽNIDARŠIČ, Nada, LETOFSKY-PAPST, Ilse, DITTRICH, Maria, GROGGER, Werner, **ŠTRUS, Jasna**, HOFER, Ferdinand. Silicon : the key element in early stages of biocalcification. Journal of structural biology, ISSN 1047-8477, 2011, vol. 174, no. 1, str. 180-186. http://dx.doi.org/10.1016/j.jsb.2010.09.025, doi: 10.1016/j.jsb.2010.09.025. [COBISS.SI-ID 2278991],
- KOSTANJŠEK, Rok, MILATOVIČ, Maša, **ŠTRUS, Jasna**. Endogenous origin of endo-ß-1,4-glucanase in common woodlouse Porcellio scaber (Crustacea, Isopoda). *Journal of comparative physiology. B, Biochemical, systemic, and environmental physiology. B*, ISSN 0174-1578, 2010, vol. 180, no. 8, str. 1143-1153. http://dx.doi.org/10.1007/s00360-010-0485-7, doi: 10.1007/s00360-010-0485-7. [COBISS.SI-ID 2242127],
- DUH, Darja, AVŠIČ-ŽUPANC, Tatjana, JELOVŠEK, Mateja, GRAČNER, Maja, TRILAR, Tomi**, ŠTRUS, Jasna.** Rickettsia hoogstraalii sp. nov., isolated from hard- and soft-bodied ticks. International journal of systematic and evolutionary microbiology, ISSN 1466-5026, 2010, letn. 60, št. 4, str. 977-984, doi: 10.1099/ijs.0.011049-0. [COBISS.SI-ID 27117017],
- MILATOVIČ, Maša, KOSTANJŠEK, Rok**, ŠTRUS, Jasna**. Ontogenetic development of Porcellio scaber : staging based on microscopic anatomy. Journal of crustacean biology, ISSN 0278-0372, 2010, vol. 30, no. 2, str. 225-234. [COBISS.SI-ID 2163535]
- HILD, Sabine, NEUES, Frank, ŽNIDARŠIČ, Nada, **ŠTRUS, Jasna**, EPPLE, Matthias, MARTI, Othmar, ZIEGLER, Andreas. Ultrastructure and mineral distribution in the tergal cuticle of the terrestrial isopod Titanethes albus. Adaptations to a karst cave biotope. Journal of structural biology, ISSN 1047-8477, 2009, vol. 168, no. 3, str. 426-436. http://dx.doi.org/10.1016/j.jsb.2009.07.017, doi: 10.1016/j.jsb.2009.07.017. [COBISS.SI-ID 2060367]
- **ŠTRUS, Jasna**, KLEPAL, Waltraud, REPINA, Janja, TUŠEK-ŽNIDARIČ, Magda, MILATOVIČ, Maša, PIPAN TKALEC, Živa. Ultrastructure of the digestive system and the fate of midgut during embryonic development in Porcellio scaber (Crusteceana: Isopoda). *Arthropod structure & development*, ISSN 1467-8039, 2008, vol. 37, no. 4, str. 287-298.http://dx.doi.org/10.1016/j.asd.2007.11.004, doi: doi: 10.1016/j.asd.2007.11.004. [COBISS.SI-ID 1853775]

Mateja Erdani Kreft

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Rok Romih

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Miloš Vittori

- VITTORI, Miloš, KHURSHED, Mohammed, PICAVET, Daisy I., NOORDEN, Cornelis J. F. van, ŠTRUS, Jasna. Development of calcium bodies in Hylonsicus riparius (Crustacea: Isopoda). *Arthropod structure &*

development, ISSN 1467-8039, 2018, vol. 47, iss. 2, str. 199-213, ilustr., doi: 10.1016/j.asd.2018.02.002. [COBISS.SI-ID 4638031], [JCR, SNIP, WoS do 27. 4. 2018: št. citatov (TC): 0, čistih citatov (CI): 0, Scopus do 10. 3. 2018: št. citatov (TC): 0, čistih citatov (CI): 0]

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Polona Mrak

- MOHORIČ, Aleš, BOŽIČ, Janko, **MRAK, Polona**, TUŠAR, Kaja, CHENYUN, Lin, SEPE, Ana, MIKAC, Urška, MIKHAYLOV, Georgy, SERŠA, Igor. In vivo continuous three-dimensional magnetic resonance microscopy : a study of metamorphosis in Carniolan worker honey bees (Apis mellifera carnica). *Journal of Experimental Biology*, ISSN 0022-0949, Nov. 2020, vol. 223, iss. 21, 6 str., ilustr., doi: 10.1242/jeb.225250. [COBISS.SI-ID 32334339]
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- BOGATAJ, Urban, PRAZNIK, Monika, **MRAK, Polona**, ŠTRUS, Jasna, TUŠEK-ŽNIDARIČ, Magda, ŽNIDARŠIČ, Nada. Comparative ultrastructure of cells and cuticle in the anterior chamber and papillate region of Porcellio scaber (Crustacea, Isopoda) hindgut. *ZooKeys*, ISSN 1313-2989, 2018, vol. 801, str. 427-458. https://doi.org/10.3897/zookeys.801.22395, doi: 10.3897/zookeys.801.22395. [COBISS.SI-ID 4911695]
- ŠTORGEL, Nick, KRAJNC, Matej, **MRAK, Polona**, ŠTRUS, Jasna, ZIHERL, Primož. Quantitative morphology of epithelial folds. *Biophysical journal*, ISSN 0006-3495, Jan. 2016, vol. 110, str. 269-277, ilustr., doi: 10.1016/j.bpj.2015.11.024. [COBISS.SI-ID 3700815]
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UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Korelativna mikroskopija
Course title:	Correlative microscopy

Študijski programi in stopnja	**Študijska smer**	**Letnik**	**Semestri**
Bioznanosti, tretja stopnja, doktorski	Znanosti o celici		Celoletni

Univerzitetna koda predmeta/University course code: 3859

Predavanja	**Seminar**	**Vaje**	**Klinične vaje**	**Druge oblike študija**	**Samostojno delo**	**ECTS**
10	20	0	0	15	80	5

Nosilec predmeta/Lecturer: Mateja Erdani Kreft

Izvajalci predavanj:	Mateja Erdani Kreft
Izvajalci seminarjev:	
Izvajalci vaj:	
Izvajalci kliničnih vaj:	
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	

Vrsta predmeta/Course type: teoretični/theoretical

Jeziki/Languages:	Predavanja/Lectures:	Angleščina, Slovenščina
	Vaje/Tutorial:	

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Splošni pogoji za vpis na doktorski študij	General prerequisites for doctoral studies

Vsebina:	**Content (Syllabus outline):**
• Korelativna mikroskopija in podroben vpogled v zgradbo in delovanje iste celice. • Spremljanje istih celičnih procesov v času in prostoru z ločljivostjo svetlobne fluorescenčne mikroskopije ter elektronske mikroskopije. • Označevalci v korelativni mikroskopiji. • Predstavitev in uporaba različnih tehnik v korelativni mikroskopiji (od celic do mikroskopiranja in končne analize slike). • Pravilna izbira posameznih tehnik v korelativni mikroskopiji: prednosti in slabosti. • Praktični prikaz metod korelativne mikroskopije za opazovanje in analizo istih področij znotraj celice.	- Correlative microscopy with detailed insight into the structure and function of the same cells. - Simultaneous observation of a given subcellular structure and cellular processes from the micron to the nanometer scale while maintaining spatial orientation. - Labelling markers in correlative microscopy. - Introduction to the different correlative microscopy approaches and their applications. - The correct selection of the particular correlative microscopy approaches: their advantages and disadvantages. Demonstration of the correlative microscopy from the methods of culturing the cells, methods in light

	and electron microscopy to the semi/fully automated sample analyses.

Temeljna literatura in viri/Readings:

- Correlative Light and Electron MIcroscopy, 2012, Volume 111 (Methods in Cell Biology), Thomas Mueller-Reichert (Editor), Paul Verkade (Editor).
- Najnovejši pregledni in raziskovalni članki s področja korelativne mikroskopije /The latest review and research articles from the field of correlative microscopy.

Cilji in kompetence:	**Objectives and competences:**
• Pridobivanje specialnih znanj s področja korelativne mikroskopije. • Poznavanje in razumevanje metod svetlobne in elektronske mikroskopije za opazovanje in analizo istih področij znotraj celice.	• Acquiring of special knowledge on correlative microscopy. • To learn and understand the correlative microscopy for observation and analysis of the same areas within the cell.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • Praktična znanja za analizo ultrastrukture in delovanja celic s pomočjo korelativne mikroskopije. • Izbira ustreznih metod v korelativni mikroskopiji za raziskave v celični biologiji.	Knowledge and understanding: • Practical knowledge to analyse cell ultrastructure and function using correlative microscopy. • Choosing of appropriate methodology of correlative microscopy for applications in cell biology studies.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, konzultacije, praktične demonstracije, seminarji in individualno projektno delo.	Lectures, consultations, practical demonstrations, seminars and individual project.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Projektno/seminarsko delo in ustno izpraševanje	100,00 %	Project/essay work and oral answers to questions.

Reference nosilca/Lecturer's references:

prof. dr. Mateja Erdani Kreft

ZUPANČIČ, Daša, ERDANI-KREFT, Mateja, ROMIH, Rok. Selective binding of lectins to normal and neoplastic urothelium in rat and mouse bladder carcinogenesis models. Protoplasma, ISSN 0033-183X, Jan. 2014, vol. 251, iss. 1, str. 49-59, [COBISS.SI-ID 30779353]

KRISTL, Julijana, TESKAČ, Karmen, ERDANI-KREFT, Mateja, JANKOVIĆ, Biljana, KOCBEK, Petra, et al. Intracellular trafficking of solid lipid nanoparticles and their distribution between cells through tunneling nanotubes. European Journal of Pharmaceutical Sciences, ISSN 0928-0987, Vol. 50, iss. 1, 2013). Amsterdam: Elsevier, 2013, vol. 50, issue 1, str. 139-148, [COBISS.SI-ID 3439729]

VIŠNJAR, Tanja, ERDANI-KREFT, Mateja. Air-liquid and liquid-liquid interfaces influence the formation of the urothelial permeability barrier in vitro. In vitro cellular & developmental biology, Animal, ISSN 1071-2690, 2013, vol. 49, iss. 3, str. 169-204, [COBISS.SI-ID 30545881]

HUDOKLIN, Samo, ZUPANČIČ, Daša, MAKOVEC, Darko, ERDANI-KREFT, Mateja, ROMIH, Rok. Gold nanoparticles as physiological markers of urine internalization into urothelial cells in vivo. International

journal of nanomedicine, ISSN 1178-2013. [Online ed.], 2013, vol. 8, no. 1, str. 3945-3953, [COBISS.SI-ID 30967257]

ERDANI-KREFT, Mateja, GIANDOMENICO, Daniele, BEZNOUSSENKO, Galina V, RESNIK, Nataša, MIRONOV, Alexander A., JEZERNIK, Kristijan. Golgi apparatus fragmentation as a mechanism responsible for uniform delivery of uroplakins to the apical plasma membrane of uroepithelial cells. Biology of the Cell, ISSN 0248-4900. [Print ed.], 2010, letn. 102, št. 11, str. 593-607. [COBISS.SI-ID 27453657]

ERDANI-KREFT, Mateja, ROMIH, Rok, KREFT, Marko, JEZERNIK, Kristijan. Endocytotic activity of bladder superficial urothelial cells is inversely related to their differentiation stage. Differentiation, ISSN 0301-4681, 2009, letn. 77, št. 1, str. 48-59, doi: 10.1016/j.diff.2008.09.011. [COBISS.SI-ID 25479641]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Metode za študij živih celic
Course title:	Methods in Live Cell Imaging

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Bioznanosti, tretja stopnja, doktorski	Znanosti o celici		Celoletni

Univerzitetna koda predmeta/University course code: 3860

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
10	10	0	0	15	90	5

Nosilec predmeta/Lecturer: Peter Veranič

Izvajalci predavanj:	Peter Veranič
Izvajalci seminarjev:	
Izvajalci vaj:	
Izvajalci kliničnih vaj:	
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	

Vrsta predmeta/Course type: teoretični/theoretical

Jeziki/Languages:		
	Predavanja/Lectures:	Angleščina, Slovenščina
	Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent potrebuje osnovno znanje celične biologije, biokemije in molekularne genetike. Študent je moral opraviti izpit iz celične biologije v dodiplomskemštudiju.	The applicant student should have the basic knowledge in cell biology, biochemistry and molecular genetics. The student must have passed the examine of the course of Cell biology at the under graduate level.

Vsebina:	Content (Syllabus outline):
Uvod v sodobne metode, ki omogočajo morfološko analizo živih celic. Poudarek je na svetlobnomikroskopskih metodah, ki omogočajo dolgotrajno vzdrževanje in opazovanje celic pod mikroskopom (pomen temperature pH, vlažnosti, slikanje v časovnem zaporedju, analiza gibanja). Mehanizem in uporaba fluorescenčne označbe (GFP, DiI, Koleratoksin...) pri študiju celičnega gibanja, preraščanja in vitro poškodovanega področja, vpostavljanja medceličnih stikov, celične	Introduction of current methods, which enable observation and analysis of events appearing in live cells. The emphasis is on methods of light microscopy, which enable long-term maintaining and observation of cells in a microscope (temperature, pH and humidity controlled environment, time laps imaging, relocation of cells with collocate grids…). The mechanisms and the use of fluorescence labels (GFP, DiI, choleratoxin…), will be introduced to follow cell migration,

diferenciacije, dinamiki molekul membran, medcelične komunikacije, odzivanja na toksine...). Vzpodbujanje fluorescence povzroča tvorbo prostih radikalov, kar povzroča bledenje fluorokromov. Pregled metod, ki zmanjšajo fototoksičnost med opazovanjem fluorescenčno označenih celic (mikroskop z vrtečim se diskom, CLEM, antioksidanti). Razlaga artefaktov kot posledica fototoksičnosti.	transformation during regrowth of in vitro injuries, intercellular contact formation, rearrangement of molecules during cell differentiation, molecular dynamics in membranes, intercellular communication, cell response to drugs and toxins…) During excitation of fluorochromes the free radicals are produced, which can damage cells and cause fading of labelled structures. A survey of methods for decreased phototoxicity will be given (spinning disc microscopy, CLEM, antioxidative agents) and of possible artefacts as a result of phototoxicity.

Temeljna literatura in viri/Readings:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. (2008) Molecular biology of the cell, 5th edition.
2. revijalni članki s področja, tekoča periodika, druga učna gradiva

Cilji in kompetence:	**Objectives and competences:**
- poznavanje metod celične biologije (fluorescenčno označevanje, sekvenčno slikanje, ...) - sposobnost interpretacije procesov v živi celici (spreminjanje arhitekture citoskeleta, vezikularnega transporta, dinamike membranskih molekul) - razumevanje celične dinamike in vitro (epitelijsko mezenhimska transformacija, vzpostavljanje medceličnih stikov...) - razumevanje razlogov za artefakte zaradi fototoksičnosti...)	• acquaintance to methods of cell biology (time lapse imaging, fluorescence labelling of molecules in live cells) • ability of interpretation of processes in live cells (reorganisation of cytoskeleton in migrating cells, vesicular transport and molecular dynamics in membranes) • understanding of the cell dynamics in *in vitro* conditions (epithelio – mesenchymal transition, intercellular contact formation…) • understanding the reasons for the artefacts caused by fototoxisity as a result of illumination of photochromes

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: študent: - razume dinamika celičnih struktur - pozna mehanizme delovanje celice - pozna metode označevanja celic - pozna razloge fototoksičnosti	Knowledge and understanding: The student - understands the dinamics of cell structures - is familiar with basic mechanisms of cell functioning - is familiar with methods of live cell labelling - is familiar with reasons of photodamage and resulted artefacts

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja teoretičnih principov in praktičnega dela v laboratoriju, priprava bioloških vzorcev, analiza mikrografij, seminarsko delo, konzultacije	Lectures on theoretical principles, practical work in laboratory, preparation of biological specimens, microscopy, analysis of micrographs, seminar work, consultations

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
izpit	50,00 %	Examination
predstavitve seminarja	50,00 %	seminar presentation

Reference nosilca/Lecturer's references:

1.BREGAR, Vladimir Boštjan, LOJK, Jasna, ŠUŠTAR, Vid, VERANIČ, Peter, PAVLIN, Mojca. Visualization of internalization of functionalized cobalt ferrite nanoparticles and their intracellular fate. *International journal of nanomedicine*, ISSN 1178-2013. [Online ed.], 2013, vol. 8, str. 919-931, ilustr. [COBISS.SI-ID 30476761], kategorija: 1A1 (Z1, A', A1/2);

2. OGOREVC, Eva, HUDOKLIN, Samo, VERANIČ, Peter, KRALJ-IGLIČ, Veronika. Extracellular vesicle-mediated transfer of membranous components from the highly malignant T24 urinary carcinoma cell line to the non-malignant RT4 urinary papilloma cell line. *Protoplasma*, ISSN 0033-183X, 2013, vol. , no. , str. 1-4, ilustr. http://link.springer.com/article/10.1007/s00709-013-0544-5/fulltext.html, doi: 10.1007/s00709-013-0544-5. kategorija: 1A1 (Z1, A', A1/2);

3. ČERNE, Katarina, ERMAN, Andreja, VERANIČ, Peter. Analysis of cytotoxicity of melittin on adherent culture of human endothelial cells reveals advantage of fluorescence microscopy over flow cytometry and haemocytometer assay. *Protoplasma*, ISSN 0033-183X, 2013, vol. , iss. , str., ilustr., doi: 10.1007/s00709-013-0489-8. [COBISS.SI-ID 30477017], kategorija: 1A1 (Z1, A', A1/2);

4. LOKAR, Maruša, KABASO, Doron, RESNIK, Nataša, SEPČIĆ, Kristina, KRALJ-IGLIČ, Veronika, VERANIČ, Peter, ZOREC, Robert, IGLIČ, Aleš. The role of cholesterol-sphingomyelin membrane nanodomains in the stability of intercellular membrane nanotubes. *International journal of nanomedicine*, ISSN 1178-2013. [Online ed.], 2012, vol. 7, str. 1891-1902, ilustr. http://dx.doi.org/10.2147/IJN.S28723, doi: 10.2147/IJN.S28723 kategorija: 1A1 (Z1, A', A1/2);

5. KABASO, Doron, BOBROVSKA, Nataliya, GÓŹDŹ, Wojciech, GOV, Nir S., KRALJ-IGLIČ, Veronika, VERANIČ, Peter, IGLIČ, Aleš. On the role of membrane anisotropy and BAR proteins in the stability of tubular membrane structures. *Journal of biomechanics*, ISSN 0021-9290. [Print ed.], 2012, vol. 45, issue 2, str. 231-238, ilustr. [COBISS.SI-ID 29065945], kategorija: 1A1 (Z1, A', A1/2);

6. KABASO, Doron, LOKAR, Maruša, KRALJ-IGLIČ, Veronika, VERANIČ, Peter, IGLIČ, Aleš. Temperature and cholera toxin B are factors that influence formation of membrane nanotubes in RT4 and T24 urothelial cancer cell lines. *International journal of nanomedicine*, ISSN 1178-2013. [Online ed.], 2011, vol. 6, str. 495-509, ilustr. [COBISS.SI-ID 28077017], kategorija: 1A2 (Z1, A1/2);

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Mikroskopija in analiza slike bioloških vzorcev
Course title:	Microscopy and image analysis of biological samples

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Bioznanosti, tretja stopnja, doktorski	Znanosti o celici		Celoletni

Univerzitetna koda predmeta/University course code: 3861

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
10	20	0	0	15	80	5

Nosilec predmeta/Lecturer:	Rok Kostanjšek
Izvajalci predavanj:	Rok Kostanjšek, Marko Kreft, Nada Žnidaršič
Izvajalci seminarjev:	
Izvajalci vaj:	
Izvajalci kliničnih vaj:	
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	
Vrsta predmeta/Course type:	teoretični/theoretical

Jeziki/Languages:	Predavanja/Lectures:	Angleščina, Slovenščina
	Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Splošni pogoji za vpis na doktorski študij	General conditions for enrolment in doctoral studies

Vsebina:	Content (Syllabus outline):
- nadgradnja osnovnih svetlobno-mikroskopskih tehnik (mikroskopija v temnem polju, fazno-kontrastna mikroskopija, interferenčno kontrastna-DIC mikroskopija in fluorescenčna mikroskopija) s predstavitvijo njihovih prednosti in uporabe pri opazovanju bioloških vzorcev - predstavitev postopkov zajemanja mikroskopske slike, obdelovanja in kvantitativne analize slike bioloških vzorcev - predstavitev naprednih svetlobno-mikroskopskih tehnik za izdelavo optičnih rezin ter osnovami 3D-rekonstrukcije slik bioloških vzorcev - predstavitev presevne elektronske mikroskopije (TEM) za strukturno analizo različnih bioloških	- Upgrading of student's basic knowledge on light microscopy techniques (e.g. microscopy in a dark field, phase-contrast microscopy, interference contrast-DIC microscopy and fluorescent microscopy), their advantages and applications on biological samples - Procedures for image acquisition, processing, and quantitative analysis of micrographs - advanced light microscopic techniques with demonstration of optical sectioning and 3D reconstruction on biological samples - Principles and techniques of transmission electronic microscopy (TEM) for structural analysis of biological samples (tissues, cells, bacterial, viral

vzorcev (tkiva in celice, bakterije, virusi, liposomi...) s poudarkom na razumevanju in praktični izvedbi postopkov za pripravo bioloških vzorcev ter interpretaciji mikrografij - spoznavanje tehnik vrstične elektronske mikroskopije (SEM), praktično seznanjanje s postopki priprave bioloških vzorcev in interpretacijo SEM mikrografij - predstavitev naprednih elektronsko-mikroskopskih tehnik (HRTEM, EELS) in spektroskopskih metod (EDXS, EELS) bioloških vzorcev - seznanjanje s sodobnimi tehnikami in pristopi za vizualizacijo bioloških vzorcev	particles, liposomes...) with special emphasis on understanding of methodology, interpretation of micrographs and practical preparation of biological samples - Principles and demonstration of scanning electron microscopy (SEM), its application on biological samples, interpretation of micrographs and practical approaches in sample preparation. - Principles and examples of high resolution transmission electron microscopy (HRTEM) and spectroscopic methods (EDXS, EELS) of biological samples - Principles of advanced microscopic techniques and approaches for visualization of biological samples

Temeljna literatura in viri/Readings:

- Hayat M. A. (2000) Principles and techniques of electron microscopy – Biological applications. 4th Edition. Cambridge University Press, cambridge, UK, 543 str., ISBN 0-521-63287-0 (izbrana poglavja str. 367-388, 400-436)
- Bozzola J.J., Russell L.D. (1999): Electron microscopy – Principles and Techniques for Biologists. 2nd Edition. Jones and Bartlett Publishers, Subdury, Masachusetts, USA, 670 str., ISBN 0-7637-0192-0 (str. 16-46, 120-146, 148-201, 262-278, 368-394, 442- 475, 480-608).
- Beatty B., Mai S., Squire J. (2002) Fluorescence in situ hibridization – Practical approach. Oxford University Press, New York, USA, 255 str.,ISBN 0-19-963884-5 (poglavje 2, str. 5-27)
- Allen T.D. (ur.) (2008) Introduction to Electron Microscopy for Biologists, Methods in Cell Biology 88, izbrana poglavja D.B. Williams, C.B. Carter, Transmission Electron Microscopy, Plenum Press, 1996, izbrana poglavja
- Russ J.C. (2011) The Image Processing Handbook, 6th Edition. CRC Press, USA, 885 str., ISBN 978-1-4398-4045-0, izbrana poglavja
- Izbrani članki iz strokovnih revij:
- Microscopy and microanalysis online journal; Wiley and Sons
- Journal of Microscopy, Blackwell publishing

Cilji in kompetence:	**Objectives and competences:**
- nadgradnja znanja o mikroskopskih metodah in analizi slike - poznavanje z lastnostmi (prednostmi in morebitnimi omejitvami) različnih mikroskopskih tehnik - poznavanje postopkov priprave bioloških vzorcev za opazovanje z različnimi mikroskopskimi tehnikami - poznavanje procesov zajema, obdelave, analize in interpretacije mikrografij - razvijanje lastne iniciativnosti pri zasnovi poskusov, ki vključujejo vizualizacijske pristope	- upgrade of basic knowledge on microscopic methods - acquaintance with properties (benefits and potential drawbacks) of various microscopic techniques - acquaintance with preparation procedures of biological samples o with various microscopic techniques - acquiring of basic skills on acquisition, processing, analysis and interpretation of images of biological samples - development of self-initiative approach in designing of experiment, which include visualization approaches

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: - razumevanje fizikalnih osnov mikroskopskih tehnik - sposobnost izbire ustreznih mikroskopskih tehnik pri zasnovi poizkusov	Knowledge and understanding: - understanding of physical background of microscopic techniques

- poznavanje osnovnih postopkov priprave bioloških vzorcev za svetlobno in elektronsko mikroskopijo - pridobitev znanj za zajemanje, obdelavo in analizo slike - sposobnost interpretacije mikrografij bioloških vzorcev pridobljenih z različnimi mikroskopskimi tehnikami in prepoznavanje artefaktov kot posledice priprave vzorcev	- choosing of appropriate microscopic approach in experiment design - knowledge on basic procedures of biological sample preparation for light and electron microscopy - basic knowledge on image acquisition, processing and analysis - ability of interpretation of micrographs depicting biological samples

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, konzultacije in seminarji	Lectures, consultations and seminars

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni izpit iz tem predavanj	50,00 %	Examiation
Seminar	50,00 %	Seminar

Reference nosilca/Lecturer's references:

Kostanjšek Rok

KOSTANJŠEK, Rok, PAŠIĆ, Lejla, DAIMS, Holger, SKET, Boris. Structure and community composition of sprout-like bacterial aggregates in a Dinaric Karst subterranean stream. *Microbial ecology*, ISSN 0095-3628, 2013, vol. 66, issue 1, str. 5-18, ilustr. http://link.springer.com/content/pdf/10.1007%2Fs00248-012-0172-1, doi: 10.1007/s00248-012-0172-1. [COBISS.SI-ID 2711375]

BAVDEK, Andrej, **KOSTANJŠEK, Rok**, ANTONINI, Valeria, LAKEY, Jeremy H., DALLA SERRA, Mauro, GILBERT, Robert J., ANDERLUH, Gregor. pH dependence of listeriolysin O aggregation and pore-forming ability. *FEBS journal*, ISSN 1742-464X, 2012, vol. 279, iss. 1, str. 126-141. http://onlinelibrary.wiley.com/doi/10.1111/j.1742-4658.2011.08405.x/pdf, doi: 10.1111/j.1742-4658.2011.08405.x. [COBISS.SI-ID 4881690]

VODOVNIK, Maša, **KOSTANJŠEK, Rok**, ZOREC, Maša, MARINŠEK-LOGAR, Romana. Exposure to Al[sub]2O[sub]3 nanoparticles changes the fatty acid profile of the anaerobe Ruminococcus flavefaciens. *Folia microbiologica*, ISSN 0015-5632. [Print ed.], 2012, vol. 57, no. 4, str. 363-365.http://www.springerlink.com/content/n44j862418163777/fulltext.pdf, doi: 10.1007/s12223-012-0143-4. [COBISS.SI-ID 3037576]

KNEŽEVIĆ, Petar, OBREHT, Dragana, CURCIN, S., PETRUŠIĆ, Milivoje, ALEKSIĆ, Verica, **KOSTANJŠEK, Rok**, PETROVIC, O., et al. Phages of Pseudomonas aeruginosa: response to environmental factors and in vitro ability to inhibit bacterial growth and biofilm formation. *Journal of applied microbiology*, ISSN 1364-5072, 2011, issue 1, vol. 111, str. 245-254, doi: 10.1111/j.1365-2672.2011.05043.x. [COBISS.SI-ID 2392399]

VITTORI, Miloš, ŽNIDARŠIČ, Nada, **KOSTANJŠEK, Rok**, ŠTRUS, Jasna. Microscopic anatomy of male tegumental glands and associated cuticular structures in Titanethes albus (Crustacea: Isopoda). *Arthropod structure & development*, ISSN 1467-8039, 2012, vol. 41, issue 2, str. 133-144. http://dx.doi.org/10.1016/j.asd.2011.08.004, doi: 10.1016/j.asd.2011.08.004. [COBISS.SI-ID 2468943]

AMBROŽIČ, Jerneja, ŽGUR-BERTOK, Darja, **KOSTANJŠEK, Rok**, AVGUŠTIN, Gorazd. Isolation and characterization of a novel violacein-like pigment producing psychrotrophic bacterial species *Janthinobacterium svalbardensis* sp. nov. *Antonie van Leeuwenhoek*, ISSN 0003-6072, 2013, vol. 103, issue 4, str. 763-769. http://download.springer.com/static/pdf/897/art%253A10.1007%252Fs10482-012-9858-0.pdf?auth66=1354969235_038af70ca72300adad29e7303bd340f3&ext=.pdf, doi: 10.1007/s10482-012-9858-0. [COBISS.SI-ID 3147912]

VITTORI, Miloš, **KOSTANJŠEK, Rok**, ŽNIDARŠIČ, Nada, ŠTRUS, Jasna. Molting and cuticle deposition in the subterranean trichoniscid *Titanethes albus* (Crustacea, Isopoda). V: ŠTRUS, Jasna (ur.), TAITI, Stefano (ur.), SFENTHOURAKIS, Spyros (ur.). Advances in Terrestrial Isopod Biology, (Zookeys, Vol. 176, special issue). Sofia: Pensoft Publishers, 2012, vol. 176, special issue, str. 23-38. http://www.pensoft.net/J_FILES/1/articles/2285/2285-G-3-layout.pdf, doi: 10.3897/zookeys.176.2285. [COBISS.SI-ID 2550351]

MILATOVIČ, Maša, **KOSTANJŠEK, Rok**, ŠTRUS, Jasna. Ontogenetic development of *Porcellio scaber* : staging based on microscopic anatomy. *Journal of crustacean biology*, ISSN 0278-0372, 2010, vol. 30, no. 2, str. 225-234. [COBISS.SI-ID 2163535]

VALANT, Janez, DROBNE, Damjana, SEPČIĆ, Kristina, JEMEC, Anita, KOGEJ, Ksenija, **KOSTANJŠEK, Rok**. Hazardous potential of manufactured nanoparticles identified by in vivo assay. *Journal of hazardous materials*, ISSN 0304-3894. [Print ed.], 2009, issues 1-3, vol. 171, str. 160-165, ilustr. http://dx.doi.org/10.1016/j.jhazmat.2009.05.115, doi: 10.1016/j.jhazmat.2009.05.115. [COBISS.SI-ID 6013049]

KNEŽEVIĆ, Petar, **KOSTANJŠEK, Rok**, OBREHT, Dragana, PETROVIC, Olga. Isolation of *Pseudomonas aeruginosa* specific phages with broad activity spectra. *Current microbiology*, ISSN 0343-8651, 2009, vol. 59, str. 173-180. [COBISS.SI-ID 2009679]

Žnidaršič Nada

MATSKO, Nadejda B**., ŽNIDARŠIČ, Nada**, LETOFSKY-PAPST, Ilse, DITTRICH, Maria, GROGGER, Werner, ŠTRUS, Jasna, HOFER, Ferdinand. Silicon : the key element in early stages of biocalcification.*Journal of structural biology*, ISSN 1047-8477, 2011, vol. 174, no. 1, str. 180-186. http://dx.doi.org/10.1016/j.jsb.2010.09.025, doi: 10.1016/j.jsb.2010.09.025. [COBISS.SI-ID 2278991

HILD, Sabine, NEUES, Frank**, ŽNIDARŠIČ, Nada**, ŠTRUS, Jasna, EPPLE, Matthias, MARTI, Othmar, ZIEGLER, Andreas. Ultrastructure and mineral distribution in the tergal cuticle of the terrestrial isopod Titanethes albus. Adaptations to a karst cave biotope. *Journal of structural biology*, ISSN 1047-8477, 2009, vol. 168, no. 3, str. 426-436. http://dx.doi.org/10.1016/j.jsb.2009.07.017, doi:10.1016/j.jsb.2009.07.017. [COBISS.SI-ID 2060367],

ŽNIDARŠIČ, Nada, MRAK, Polona, TUŠEK-ŽNIDARIČ, Magda, ŠTRUS, Jasna. Exoskeleton anchoring to tendon cells and muscles in molting isopod crustaceans. V: ŠTRUS, Jasna (ur.), TAITI, Stefano (ur.), SFENTHOURAKIS, Spyros (ur.). *Advances in Terrestrial Isopod Biology*, (Zookeys, Vol. 176, special issue). Sofia: Pensoft Publishers, 2012, vol. 176, special issue, str. 39-53.http://www.pensoft.net/J_FILES/1/articles/2445/2445-G-3-layout.pdf, doi: 10.3897/zookeys.176.2445. [COBISS.SI-ID 2550863]

MRAK, Polona, **ŽNIDARŠIČ, Nada**, TUŠEK-ŽNIDARIČ, Magda, KLEPAL, Waltraud, GRUBER, Daniela, ŠTRUS, Jasna. Egg envelopes and cuticle renewal in Porcellio embryos and marsupial mancas. V: ŠTRUS, Jasna (ur.), TAITI, Stefano (ur.), SFENTHOURAKIS, Spyros (ur.). *Advances in Terrestrial Isopod Biology*, (Zookeys, Vol. 176, special issue). Sofia: Pensoft Publishers, 2012, vol. 176, special issue, str. 55-72. http://www.pensoft.net/J_FILES/1/articles/2418/2418-G-3-layout.pdf, doi: 10.3897/zookeys.176.2418. [COBISS.SI-ID 2551631]

MRAK, Polona, **ŽNIDARŠIČ, Nada**, ŠTRUS, Jasna. Alizarin red S staining of the crustacean cuticle : implementation in the study of Porcellio scaber larvae = Histokemijska analiza kutikule rakov z barvilom alizarin rdeče S : uporaba v proučevanju ličink raka enakonožca vrste Porcellio scaber. *Acta biologica slovenica*, ISSN 1408-3671. [Tiskana izd.], 2013, vol. 56, no. 2, str. 51-62, [1-6]. http://bijh-s.zrc-sazu.si/ABS/SI/ABS/Cont/56_2/ABS_56-2_2013_51-62_Mrak%20et%20al.pdf. [COBISS.SI-ID 3008335]

Kreft Marko

KREFT, Marko, LUKŠIČ, Miha, ZOREC, Tomaž M., PREBIL, Mateja, ZOREC, Robert. Diffusion of D-glucose measured in the cytosol of a single astrocyte. *Cellular and molecular life sciences*, ISSN 1420-682X, 2013, vol. 70, no. 8, str. 1483-1492. [COBISS.SI-ID 36617477]

JANÁČEK, Jiří, **KREFT, Marko**, ČEBAŠEK, Vita, ERŽEN, Ida. Correcting the axial shrinkage of skeletal muscle thick sections visualized by confocal microscopy.*Journal of Microscopy*, ISSN 0022-2720, 2012, vol. 246, iss. 2, str. 107-112, doi: 10.1111/j.1365-2818.2011.03594.x. [COBISS.SI-ID 29556953]

PREBIL, Mateja, VARDJAN, Nina, JENSEN, Jørgen, ZOREC, Robert, **KREFT, Marko**. Dynamic monitoring of cytosolic glucose in single astrocytes. *Glia*, ISSN 0894-1491, 2011, vol. 59, issue 6, str. 903-913, graf. prikazi, doi: 10.1002/glia.21161. [COBISS.SI-ID 28273625]

POTOKAR, Maja, STENOVEC, Matjaž, GABRIJEL, Mateja, LI, Lizhen, **KREFT, Marko**, GRILC, Sonja, PENKY, Miloš, ZOREC, Robert. Intermediate filaments attenuate stimulation-dependent mobility of endosomes/lysosomes in astrocytes. *Glia*, ISSN 0894-1491, 2010, letn. 58, št. 10, str. 1208-1219. [COBISS.SI-ID 27046873]

KREFT, Marko, PREBIL, Mateja, CHOWDHURY HAQUE, Helena, GRILC, Sonja, JENSEN, Jørgen, ZOREC, Robert. Analysis of confocal images using variable-width line profiles. *Protoplasma*, ISSN 0033-183X, 2010, letn. 246, št. 1/4, str. 73-80, doi: 10.1007/s00709-010-0127-7. [COBISS.SI-ID 27426009]

MUCK, Tadeja, JAVORŠEK, Dejana, **KREFT, Marko**. Use of confocal microscopy as a nondestructive method in the study of ink jet dot formation. Journal of imaging science and technology, ISSN 1062-3701, July/Aug. 2009, vol. 53, no. 4, str. 040201/1-040201/6, ilustr.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Molekulska fiziologija
Course title:	Molecular physiology

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Bioznanosti, tretja stopnja, doktorski	Znanosti o celici		Celoletni

Univerzitetna koda predmeta/University course code: 3863

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	30	10	0	0	190	10

Nosilec predmeta/Lecturer: Robert Zorec

Izvajalci predavanj:	Marko Kreft, Robert Zorec
Izvajalci seminarjev:	
Izvajalci vaj:	
Izvajalci kliničnih vaj:	
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	

Vrsta predmeta/Course type: teoretični/theoretical

Jeziki/Languages:	Predavanja/Lectures:	Angleščina, Slovenščina
	Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Splošni pogoji za vpis na doktorski študij.	General prerequisites for enrolment in doctoral studies.

Vsebina:	Content (Syllabus outline):
Predmet obravnava molekulsko fiziologijo na ravni interakcije celičnih predelkov, na ravni medcelične in sistemske komunikacije v zdravju in bolezni. Predmet poda biološke in biofizikalne temelje organiziranosti celic. Hkrati poda tudi temelje za raziskovalne metode v molekulski fiziologiji, kot so optofiziološke in elektrofiziološke metode. Predstavljene optofiziološke metode so konfokalna mikroskopija za snemanje v petih dimenzijah: tri prostorske dimenzije, čas in zajemanje spektrov emitirane svetlobe iz živih celic. Predstavljene bodo tudi razmerjemerne metode za spremljanje znotrajcelične aktivnosti kalcija in pH, ki sta	Subject covers the molecular physiology of subcellular organelle interactions, interactions between cells and interactions at the systems level, all in health and disease. The course brings forward the biological and biophysical foundations for cell organisation. At the same time methods employed in molecular physiology are presented, such as optophysiology and electrophysiology. Among optophysiological techniques confocal microscopy for recording in five dimensions is presented: three space dimensions, time and spectral recording of light emission from living cells. Furthermore, methods for recording cytosolic calcium activity, pH,

pomembna parametra za celično signalizacijo in uravnavanje volumna celic. Z naprednimi optofiziološkimi tehnikami je mogoče spremljati koncentracijo znotrajcelične glukoze, ki je pomemben kazalnik celičnega metabolizma. Elektrofiziološke metode, ki so močno prispevale k znanju na področju molekulske fiziologije, so klasične meritve transmembranske napetosti, metoda »patch-clamp« z meritvami kapacitivnosti, ki omogočajo spremljanje eksocitoze in endocitoze, ter amperometrija za zaznavanje izločanja posameznih kvantov hormonov, nevro- ali glio-transmiterjev. S temi metodami je omogočeno določanje molekulske fiziologije posameznih proteinov, kot so na primer ionski kanali, transporterji, proteini pomembni za eksocitozo in sicer pri normalni fiziologiji ali pri bolezenskih stanjih. Ob tem študent spozna tudi metode izolacije posameznih evkariontskih celic in metode gojenja primarnih in klonalnih kultur za posebne fiziološke meritve in metode za označevanje subceličnih organelov v živih celicah.	both physiological parameters are crucial in cell signalling and volume regulation. With advanced optical methods cytosolic glucose concentration, an important indicator of cell metabolism can be monitored. Key electrophysiological techniques which have contributed greatly to the field of molecular physiology are classical measurements of transmembrane potential, »patch-clamp« methods of membrane capacitance, which permit the monitoring of exocytosis and endocytosis, amperometric detection of chemical messengers and hormones. These techniques are used to determine molecular physiology of selected proteins, such as ion channels, transporters, proteins required for vesicular traffic and exocytosis, under normal and pathological conditions. Students are acquainted with methods of isolation and culturing of primary and clonal eukaryotic cells and methods for labelling subcellular organelles in vivo.

Temeljna literatura in viri/Readings:

N. Sperelakis (2001). Cell Physiology Source Book: A Molecular Approach. Academic Press; 3rd edition, 1235 strani. ISBN: 0126569770

J. Phillips, P. Murray, P. Kirk (2001). Biology of Disease, 2nd edition, 336 strani. ISBN: 0632054042

Tekoča periodika in zlasti pregledni članki s področij: molekulske fiziologije in raziskovalne tehnologije

Cilji in kompetence:	**Objectives and competences:**
Temeljni izobraževalni cilj je razumevanje funkcije celice v normalnih in patoloških procesih. Pri tem se obravnava raven celičnih predelkov (morfološko določeni organeli in drugi funkcionalni predmeti), raven medcelične in sistemske komunikacije. Študent pridobi kompetence pri obravnavi strategij za preoblikovanje delovanja celic z inženirskimi pristopi in biotehnološkimi metodami.	The educational aim of the course is to understand cell function under normal and pathological conditions. In this the following levels of organisation will be considered: subcellular organelles (morphologically defined structures as well as other functional modules) and the level of cell-to-cell as well as systems communication. Students gain competences in strategies for the biotech engineering and manipulation of cells.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Predviden študijski rezultat je nadgraditi znanje s področja molekulske in celične fiziologije in uporaba novega znanja za preoblikovanje delovanja celic.	Knowledge and understanding: The course is aiming to upgrade the competences and knowledge from the fields of molecular physiology, cell physiology and new advanced methods for cell engineering and manipulation.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, diskusijske delavnice predstavljenih seminarjev, predstavitve v laboratorijih. Pri izvajanju sodelujejo vabljeni predavatelji.	Lectures, workshops with seminars, lab presentations in cooperation with invited lecturers.

Načini ocenjevanja:	Delež/Weight	Assessment:
Pisni izpit iz tem predavanj	50,00 %	Written examination
Predstavitev individualnega projekta	50,00 %	Project presentation

Reference nosilca/Lecturer's references:

akad. prof. dr. Robert Zorec

RITUPER, Boštjan, CHOWDHURY HAQUE, Helena, JORGAČEVSKI, Jernej, COORSSEN, Jens R., KREFT, Marko, ZOREC, Robert. Cholesterol-mediated membrane surface area dynamics in neuroendocrine cells. Biochimica et biophysica acta. Molecular and cell biology of lipids, ISSN 1388-1981, Jul. 2013, vol. 1831, iss. 7, str. 1228-1238

MILOŠEVIĆ, Milena, STENOVEC, Matjaž, KREFT, Marko, PETRUŠIĆ, Vladimir, STEVIĆ, Zorica, TRKOV, Saša, ANDJUS, Pavle, ZOREC, Robert. Immunoglobulins G from patients with sporadic amyotrophic lateral sclerosis affects cytosolic Ca2+ homeostasis in cultured rat astrocytes. Cell calcium, ISSN 0143-4160, Jul. 2013, vol. 54, iss. 1, str. 17-25.

POTOKAR, Maja, STENOVEC, Matjaž, JORGAČEVSKI, Jernej, HOLEN, Torgeir, KREFT, Marko, OTTERSEN, Ole Petter, ZOREC, Robert. Regulation of AQP4 surface expression via vesicle mobility in astrocytes. Glia, ISSN 0894-1491, Jun. 2013, vol. 61, iss. 6, str. 917-928, ilustr., doi: 10.1002/glia.22485.

COSTA CALEJO, Ana-Isabel, JORGAČEVSKI, Jernej, KUCKA, Marek, KREFT, Marko, GONÇALVES, Paula P., STOJILKOVIĆ, Stanko, ZOREC, Robert. cAMP-mediated stabilization of fusion pores in cultured rat pituitary lactotrophs. The Journal of neuroscience, ISSN 0270-6474, May 2013, vol. 33, iss. 18, str. 8068-8078, ilustr., doi:10.1523/JNEUROSCI.5351-12.2013.

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RITUPER, Boštjan, GUČEK, Alenka, JORGAČEVSKI, Jernej, FLAŠKER, Ajda, KREFT, Marko, ZOREC, Robert. High-resolution membrane capacitance measurements for the study of exocytosis and endocytosis. Nature protocols, ISSN 1754-2189, 2013, vol. 8, no. 6, str. 1169-1183, ilustr., doi: 10.1038/nprot.2013.069.

JORGAČEVSKI, Jernej, KREFT, Marko, VARDJAN, Nina, ZOREC, Robert. Fusion pore regulation in peptidergic vesicles. Cell calcium, ISSN 0143-4160, 2012, vol. 52, iss. 3/4, str. 270-276, doi: 10.1016/j.ceca.2012.04.008.

JORGAČEVSKI, Jernej, POTOKAR, Maja, GRILC, Sonja, KREFT, Marko, ZOREC, Robert, et al. Munc 18-1 tuning of vesicle merger and fusion pore properties. The Journal of neuroscience, ISSN 0270-6474, 2011, vol. 31, issue 24, str. 9055-9066, doi: 10.1523/JNEUROSCI.0185-11.2011.

VELEBIT MARKOVIĆ, Jelena, CHOWDHURY HAQUE, Helena, KREFT, Marko, ZOREC, Robert. Rosiglitazone balances insulin-induced exo- and endocytosis in single 3T3-L1 adipocytes. Molecular and cellular endocrinology, ISSN 0303-7207. [Print ed.], 2011, vol. 333, issue 1, str. 70-77, doi: 10.1016/j.mce.2010.12.014.

JORGAČEVSKI, Jernej, FOŠNARIČ, Miha, VARDJAN, Nina, STENOVEC, Matjaž, POTOKAR, Maja, KREFT, Marko, KRALJ-IGLIČ, Veronika, IGLIČ, Aleš, ZOREC, Robert. Fusion pore stability of peptidergic vesicles. Molecular membrane biology, ISSN 0968-7688, 2010, letn. 27, št. 2/3, str. 65-80, doi: 10.3109/09687681003597104.

prof. dr. Marko Kreft

POTOKAR, Maja, STENOVEC, Matjaž, JORGAČEVSKI, Jernej, HOLEN, Torgeir, KREFT, Marko, OTTERSEN, Ole Petter, ZOREC, Robert. Regulation of AQP4 surface expression via vesicle mobility in astrocytes. Glia, ISSN 0894-1491, Jun. 2013, vol. 61, iss. 6, str. 917-928, ilustr., doi: 10.1002/glia.22485.

POTOKAR, Maja, LACOVICH, Valentina, CHOWDHURY HAQUE, Helena, KREFT, Marko, ZOREC, Robert. Rab4 and Rab5 GTPase are required for directional mobility of endocytic vesicles in astrocytes. Glia, ISSN 0894-1491, 2012, vol. 60, issue 4, str. 594-604, ilustr., doi: 10.1002/glia.22293.

VARDJAN, Nina, GABRIJEL, Mateja, POTOKAR, Maja, ŠVAJGER, Urban, KREFT, Marko, JERAS, Matjaž, DE PABLO, Yolanda, FAIZ, Maryam, PEKNY, Milos, ZOREC, Robert. IFN-gamma-induced increase in the mobility of MHC class II compartments in astrocytes depends on intermediate filaments. Journal of neuroinflammation, ISSN 1742-2094, 2012, vol. 9, art. no. 144, 13 str

COSTA CALEJO, Ana-Isabel, JORGAČEVSKI, Jernej, SILVA, V.S., STENOVEC, Matjaž, KREFT, Marko, GONÇALVES, Paula P., ZOREC, Robert. Aluminium-induced changes of fusion pore properties attenuate

prolactin secretion in rat pituitary lactotrophs. Neuroscience, ISSN 0306-4522. [Print ed.], 2012, vol. 201, str. 57-66, ilustr., doi:10.1016/j.neuroscience.2011.11.015.
STENOVEC, Matjaž, MILOŠEVIĆ, M., PETRUŠIĆ, V., POTOKAR, Maja, STEVIĆ, Zorica, PREBIL, Mateja, KREFT, Marko, TRKOV, Saša, ANDJUS, Pavle, ZOREC, Robert. Amyotrophic lateral sclerosis immunoglobulins G enhance the mobility of Lysotracker-labelled vesicles in cultured rat astrocytes. Acta physiologica, ISSN 1748-1708, 2011, vol. 203, issue 4, str. 457-471, ilustr., doi: 10.1111/j.1748-1716.2011.02337.x. [COBISS.SI-ID 28725465],
KOVAČIČ, Petra Brina, CHOWDHURY HAQUE, Helena, VELEBIT MARKOVIĆ, Jelena, KREFT, Marko, JENSEN, Jørgen, ZOREC, Robert. New insights into cytosolic glucose levels during differentiation of 3T3-L1 fibroblasts into adipocytes. The Journal of biological chemistry, ISSN 0021-9258, 2011, vol. 286, no. 15, str. 13370-13381, ilustr., doi:10.1074/jbc.M110.200980.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Toksini in biomembrane
Course title:	Toxins and biomembranes

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Bioznanosti, tretja stopnja, doktorski	Znanosti o celici		Celoletni

Univerzitetna koda predmeta/University course code: 3866

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	0	0	0	40	190	10

Nosilec predmeta/Lecturer: Tom Turk

Izvajalci predavanj:	Gregor Anderluh, Igor Križaj, Kristina Sepčić, Tom Turk
Izvajalci seminarjev:	
Izvajalci vaj:	
Izvajalci kliničnih vaj:	
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	

Vrsta predmeta/Course type: teoretični/theoretical

Jeziki/Languages:	Predavanja/Lectures:	Angleščina, Slovenščina
	Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Končan univerzitetni ali 2. stopenjski bolonjski študij iz širšega področja Naravoslovje, matematika in računalništvo oziroma ožjega področja Vede o živi naravi (klasifikacija po Klasius-u).	Completed university studies or bologna masters in natural sciences, mathematics and computer studies or the narrower field of life sciences (Klasius classification).

Vsebina:	Content (Syllabus outline):
Predmet bo obravnaval delovanje izbranih toksinov na biokemijske in regulatorne procese v celicah. Poudarek bo na razvozlavanju mehanizma delovanja teh toksinov zlasti glede vezave, vrinjanja v membrane ter na odkrivanju specifičnih membranskih domen in strukturnih motivov toksinov, ki so odgovorni za poškodbo celic. Drug poudarek pa bo na preučevanju vpliva nekaterih toksinov na celične signalne poti in posledično na delovanje prizadetih celic (eksocitoza, apoptoza itd.). Na izbranih primerih bo prikazana tudi	The subject will cover the activity of selected toxins in biochemical and regulatory processes in cells. Emphasis will be on unravelling mechanisms of these toxins, especially in relation to binding and insertion into the membranes, and on discovering specific membrane domains and structural motifs of toxins responsible for cell damage. Another stress will be on studying the impact of certain toxins on cell signalling pathways and, consequently, on the functioning of affected cells (exocytosis, apoptosis etc.). The use of membrane-active toxins in

uporabnost membransko aktivnih proteinov ali njihovih derivatov v biomedicini, biotehnologiji in farmakologiji. Predmet bo ponudil vsebine, ki obravnavajo: (i) delovanje izbranih citolitičnih toksinov na membrane (aktinoporini iz morskih vetrnic, ostreolizin in podobni proteini iz gliv, bakterijski CDC citolizini, perforinu podobni proteini z MACPF domenami, alkilpiridinijevi polimeri iz spužev in njihovi sintetični analogi), njihove mehanizme delovanja in posledice za celico; (ii) toksične fosfolipaze iz kačjih strupov, njihov mehanizem delovanja, načini internalizacije, vezava na celične proteine ter vpliv na signalne poti v celici in eksocitozo.	biomedicine, biotechnology and pharmacology will be demonstrated on chosen examples. The subject will provide contents covering: (i) mechanisms of action of selected citolytic toxins on membranes i.e. (actinoporins from sea anemones, fungal proteins ostreolysins, bacterial CDC cytolysins, perforin and other MACPF proteins, alkylpyridiium polymers from marine sponges and their synthetic analogues), their mode of action and their impact on cell; (ii) toxic phospholipases from snake venoms, their mode of action, methods of internalisation, binding to cell proteins and influence on cell signalling pathways and exocitosis.

Temeljna literatura in viri/Readings:

Pregledni članki in novejši znanstveni članki s področja/Review papers and recent scientific papers

Cilji in kompetence:	**Objectives and competences:**
Študent se bo poglobil v ožjo raziskovalno problematiko, ki jo bo nadgrajeval v svoji doktorski disertaciji. Predmet ni namenjen ekstenzivnemu širjenju teoretičnega znanja, pač pa je cilj predstavitev določenih problemov in obladovanje specifičnih metod in tehnik, ki lahko pripomorejo k rešitvi problemom. Namenjen je tudi poznavanju pregleda predhodnih raziskav s področja bodoče doktorske disertacije študenta.	Students will get deeper insight into research problems which he or she will upgrade in her/his doctoral thesis. The contents are not intended to broaden theoretical knowledge but should introduce specific problems, indicate methods and techniques with which the problem can be addressed. Student should get familiar with previous research in the field of their doctoral thesis.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Zgoraj opisan pristop se mora odraziti v pravilnem načrtovanju raziskav in poskusov, ki vodijo k preiskusu hipotez zastavljenih v temi doktorske disertacije.	Such an approach should result in the proper planning of research experiments which can test the hypotheses raised in the doctoral thesis.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Neposredna predavanja naštetih nosilcev (vsak pet ur), priprava in vodenje Journal clubov; priprava problemskih nalog, diskusije in konzultacije glede njihovega reševanja. Pregled in poprava rešitev problemskih nalog.	Frontal ex-cathedra teaching (5 hr per lecturer); preparation and supervision of Journal clubs; preparation of problem tasks, discussion and consultation. Asesement and correction of problem solutions.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Oddaja rešene problemske naloge	50,00 %	Presentation of problem solution
sodelovanje na journal club-ih	50,00 %	participation at journal clubs

Reference nosilca/Lecturer's references:

Tom Turk

1. MIKELJ, Miha, PRAPER, Tilen, DEMIČ, Rok, HODNIK, Vesna, TURK, Tom, ANDERLUH, Gregor. Electroformation of giant unilamellar vesicles from erythrocyte membranes under low-salt conditions. Analytical biochemistry, ISSN 0003-2697, Apr. 2013, vol. 435, iss. 2, str. 174-180. http://www.sciencedirect.com/science/article/pii/S0003269713000031, doi: 10.1016/j.ab.2013.01.001. [COBISS.SI-ID 36978693]
2. ZOVKO, Ana, VIKTORSSON, Kristina, LEWENSOHN, Rolf, KOLOŠA, Katja, FILIPIČ, Metka, XING, Hong, KEM, William R., PALEARI, Laura, TURK, Tom. APS8, a polymeric alkylpyridinium salt blocks [alpha]7 nAChR and induces apoptosis in non-small cell lung carcinoma. Marine drugs, ISSN 1660-3397, 2013, vol. 11, no. 7, str. 2574-2594. http://www.mdpi.com/1660-3397/11/7/2574, doi: 10.3390/md11072574. [COBISS.SI-ID 2854223]
3. GRANDIČ, Marjana, ARÁOZ, Romulo, MOLGÓ, Jordi, TURK, Tom, SEPČIĆ, Kristina, BENOIT, Evelyne, FRANGEŽ, Robert. Toxicity of the synthetic polymeric 3-alkylpyridinium salt (APS3) is due to specific block of nicotinic acetylcholine receptors. Toxicology, ISSN 0300-483X. [Print ed.], 2013, vol. 303, no. 1, str. 25-33. http://www.sciencedirect.com/science/article/pii/S0300483X12003654, doi: 10.1016/j.tox.2012.10.013. [COBISS.SI-ID 3598970]
4. GRANDIČ, Marjana, ZOVKO, Ana, FRANGEŽ, Robert, TURK, Tom, SEPČIĆ, Kristina. Binding and permeabilization of lipid bilayers by natural and synthetic 3-alkylpyridinium polymers. Bioorganic & Medicinal Chemistry, ISSN 0968-0896. [Print ed.], 2012, vol. 20, issue 5, str. 1659-1664, doi: 10.1016/j.bmc.2012.01.027. [COBISS.SI-ID 2500687]
5. ZOVKO, Ana, VAUKNER, Maja, SEPČIĆ, Kristina, POHLEVEN, Franc, JAKLIČ, Domen, GUNDE-CIMERMAN, Nina, TURK, Tom, et al. Antifungal and antibacterial activity of 3-alkylpyridinium polymeric analogs of marine toxins. International biodeterioration & biodegradation, ISSN 0964-8305. [Print ed.], 2012, vol. 68, str. 71-77. http://dx.doi.org/10.1016/j.ibiod.2011.10.014, doi: 10.1016/j.ibiod.2011.10.014. [COBISS.SI-ID 2500943]
6. GRANDIČ, Marjana, ARAOZ, Romulo, MOLGÓ, Jordi, TURK, Tom, SEPČIĆ, Kristina, BENOIT, Evelyne, FRANGEŽ, Robert. The non-competitive acetylcholinesterase inhibitor APS 12-2 is a potent antagonist of skeletal muscle nicotinic acetylcholine receptors. Toxicology and applied pharmacology, ISSN 0041-008X, 2012, vol. 265, no. 2, str. 221-228, doi: 10.1016/10.1016/j.taap.2012.09.024. [COBISS.SI-ID 3587706]
7. REGALADO, Erik L., TURK, Tom, TASDEMIR, Deniz, GORJANC, Manca, KAISER, Marcel, THOMAS, Olivier, FERNÁNDEZ, Rogelio, AMADE, Philippe. Cytotoxic and haemolytic steroidal glycosides from the Caribbean sponge Pandaros acanthifolium. Steroids, ISSN 0039-128X begin_of_the_skype_highlighting 0039-128X FREE end_of_the_skype_highlighting. [Print ed.], 2011, vol. 76, iss. 12, str. 1389-1396, doi: 10.1016/j.steroids.2011.07.010. [COBISS.SI-ID 2610511]
8. GRANDIČ, Marjana, SEPČIĆ, Kristina, TURK, Tom, JUNTES, Polona, FRANGEŽ, Robert. In vivo toxic and lethal cardiovascular effects of a synthetic polymeric 1,3-dodecylpyridinium salt in rodents. Toxicology and applied pharmacology, ISSN 0041-008X, 2011, vol. 255, no. 1, str. 86-93, doi: 10.1016/j.taap.2011.06.003. [COBISS.SI-ID 3364218]
9. RAZPOTNIK, Andrej, KRIŽAJ, Igor, ŠRIBAR, Jernej, KORDIŠ, Dušan, MAČEK, Peter, FRANGEŽ, Robert, KEM, William R., TURK, Tom. A new phospholipase A[sub]2 isolated from the sea anemone Urticina crassicornis - its primary structure and phylogenetic classification. FEBS journal, ISSN 1742-464X, 2010, vol. 277, no. 12, str. 2641-2653, doi: 10.1111/j.1742-4658.2010.07674.x. [COBISS.SI-ID 23636263]
10. RAZPOTNIK, Andrej, KRIŽAJ, Igor, KEM, William R., MAČEK, Peter, TURK, Tom. A new cytolytic protein from the sea anemone Urticina crassicornis that binds to cholesterol- and sphingomyelin-rich membranes. Toxicon, ISSN 0041-0101. [Print ed.], 2009, vol. 53, no. 7/8, str. 762-769. http://dx.doi.org/10.1016/j.toxicon.2009.02.007, doi: 10.1016/j.toxicon.2009.02.007. [COBISS.SI-ID 1956175]

Igor Križaj

1. OTA, Katja, MIKELJ, Miha, PAPLER, Tadeja, LEONARDI, Adrijana, KRIŽAJ, Igor, MAČEK, Peter. Ostreopexin : a hemopexin fold protein from the oyster mushroom, Pleurotus ostreatus. Biochimica et biophysica acta, Proteins and proteomics, ISSN 1570-9639, 2013, vol. 1834, no. 8, str. 1468-1473, doi: 10.1016/j.bbapap.2013.03.027. [COBISS.SI-ID 26658599]
2. SAJEVIC, Tamara, LEONARDI, Adrijana, KOVAČIČ, Lidija, LANG BALIJA, Maja, KURTOVIĆ, Tihana, PUNGERČAR, Jože, HALASSY, Beata, TRAMPUŠ-BAKIJA, Alenka, KRIŽAJ, Igor. VaH3, one of the principal hemorrhagins in Vipera ammodytes ammodytes venom, is a homodimeric P-IIIc metalloproteinase. Biochimie, ISSN 0300-9084, 2013, vol. 95, issue 6, str. 1158-1170, doi: 10.1016/j.biochi.2013.01.003. [COBISS.SI-ID 26474535]

3. OTA, Katja, LEONARDI, Adrijana, MIKELJ, Miha, SKOČAJ, Matej, WOHLSCHLAGER, Therese, KÜNZLER, Markus, AEBI, Markus, NARAT, Mojca, KRIŽAJ, Igor, ANDERLUH, Gregor, SEPČIĆ, Kristina, MAČEK, Peter. Membrane cholesterol and sphingomyelin, and ostreolysin A are obligatory for pore-formation by a MACPF/CDC-like pore-forming protein, pleurotolysin B. Biochimie, ISSN 0300-9084, 2013, vol. 95, iss. 10, str. 1855-1864, doi: 10.1016/j.biochi.2013.06.012. [COBISS.SI-ID 26868007]
4. VARDJAN, Nina, MATTIAZZI, Mojca, ROWAN, Edward G., KRIŽAJ, Igor, PETROVIČ, Uroš, PETAN, Toni. Neurotoxic phospholipase A[sub]2 toxicity model : an insight from mammalian cells. Communicative & integrative biology, ISSN 1942-0889. [Online ed.], 2013, vol. 6, no. 3, str. 23600-1-23600-3, doi: 10.4161/cib.23600. [COBISS.SI-ID 26545959]
5. HALASSY, Beata, BRGLES, Marija, HABJANEC, Lidija, LANG BALIJA, Maja, KURTOVIĆ, Tihana, MARCHETTI DESCHMANN, Martina, KRIŽAJ, Igor, ALLMAIER, Günter. Intraspecies variability in Vipera ammodytes ammodytes venom related to its toxicity and immunogenic potential. Comparative biochemistry and physiology. CBP, ISSN 1532-0456, 2011, vol. 153, no. 2, str. 223-230, doi: 10.1016/j.cbpc.2010.10.007. [COBISS.SI-ID 24083495]
6. SAUL, Friderick A., PRIJATELJ, Petra, NORMAND, Brigitte V. de, VILLETTE, Benoit, RAYNAL, Bertrand, PUNGERČAR, Jože, KRIŽAJ, Igor, FAURE, Grazyna. Comparative structural studies of two natural isoforms of Ammodytoxin, phospholipases A[sub]2 from Vipera ammodytes ammodytes which differ in neurotoxicity and anticoagulant activity. *Journal of structural biology*, ISSN 1047-8477, 2010, vol. 169, no. 3, str. 360-369, doi: 10.1016/j.jsb.2009.10.010. [COBISS.SI-ID 23047975]

Kristina Sepčić

1. SCHLUMBERGER, Sébastien, KRISTAN, Katarina, OTA, Katja, FRANGEŽ, Robert, MOLGÓ, Jordi, SEPČIĆ, Kristina, BENOIT, Evelyne, MAČEK, Peter. Permeability characteristics of cell-membrane pores induced by ostreolysin A/pleurotolysin B, binary pore-forming proteins from the oyster mushroom. FEBS letters, ISSN 0014-5793. [Print ed.], 2014, vol. 588, no. 1, str. 35-40, doi: 10.1016/j.febslet.2013.10.038. [COBISS.SI-ID 2958415]
2. OTA, Katja, LEONARDI, Adrijana, MIKELJ, Miha, SKOČAJ, Matej, WOHLSCHLAGER, Therese, KÜNZLER, Markus, AEBI, Markus, NARAT, Mojca, KRIŽAJ, Igor, ANDERLUH, Gregor, SEPČIĆ, Kristina, MAČEK, Peter. Membrane cholesterol and sphingomyelin, and ostreolysin A are obligatory for pore-formation by a MACPF/CDC-like pore-forming protein, pleurotolysin B. Biochimie, ISSN 0300-9084, 2013, vol. 95, iss. 10, str. 1855-1864, doi: 10.1016/j.biochi.2013.06.012. [COBISS.SI-ID 26868007]
3. BOTIĆ, Tanja, KRALJ KUNČIČ, Marjetka, SEPČIĆ, Kristina, KNEZ, Željko, GUNDE-CIMERMAN, Nina. Salt induces biosynthesis of hemolytically active compounds in the xerotolerant food-borne fungus Wallemia sebi. FEMS microbiology letters, ISSN 0378-1097. [Print ed.], 2012, vol. 326, issue 1, str. 40-46. http://dx.doi.org/10.1111/j.1574-6968.2011.02428.x, doi: 10.1111/j.1574-6968.2011.02428.x. [COBISS.SI-ID 2446671]
4. LUNDER, Mojca, DREVENŠEK, Gorazd, HAWLINA, Simon, SEPČIĆ, Kristina, ŽIBERNA, Lovro. Cardiovascular effects induced by polymeric 3-alkylpyridinium salts from the marine sponge Reniera sarai. Toxicon, ISSN 0041-0101. [Print ed.], 2012, vol. 60, issue 6, str. 1041-1048, doi: 10.1016/j.toxicon.2012.07.007. [COBISS.SI-ID 2612559]
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