



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Molekularna celična signalizacija
Course title:	Molecular cell signaling

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Doktorski študij Ekološke znanosti, 3. stopnja		1. ali 2.; 1st or 2nd	1.- 4.; 1st-4th
Doctoral Study Ecological Sciences, 3rd degree			

Vrsta predmeta / Course type: Izbirni/Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Lab. vaje Laboratory work	Terenske vaje Field work	Samost. delo Individ. work	ECTS
10	15	/	5	/	150	6

Nosilec predmeta / Lecturer: Doc. dr. Andraž Stožer

Jeziki / Predavanja / Lectures: slovenski / Slovene
Languages: Vaje / Tutorial: slovenski / Slovene

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

Pogoji za vključitev v delo: Pogojev ni.

Pogoji za opravljanje študijskih obveznosti:

Vsaka izmed definiranih obveznosti mora biti zaključena s pozitivno oceno. Ocena enaka ali višja minimalni (6/10) na testu iz predavanj, seminarjev in vaj, ki vsebuje problemske naloge, je predpogoj za pristop k ustnemu izpitu.

Prerequisites:

Prerequisites for attending the course: None.

Prerequisites for completing the course:

Each of the defined commitments must be completed with a passing grade. A grade equal to or higher than the passing minimum (6/10) of the problem-based test based on lectures, seminars, and practicals is required for taking the oral examination.

Vsebina:

Content (Syllabus outline):

1. Molekularna narava zunajceličnih signalnih molekul
2. Molekularna farmakologija in toksikologija iono- in metabotropne sinapse
3. Elektrofiziologija ionotropnih receptorjev
4. Biokemija metabotropnih receptorjev
5. ATP, cAMP in kalcijevi ioni kot znotrajcelične celične signalne molekule iz zunaj- in znotrajceličnih virov
6. Kinetika znotrajceličnih signalnih molekul, oscilacije membranskega potenciala, presnove, kalcijevih ionov
7. Kontraktilni proteini, vezikli in druge tarčne molekule v znotrajcelični signalizaciji.
8. Kontraktacija in eksocitoza kot končna dogodka v sklopitvi med stimulacijo in kontrakcijo in med stimulacijo in sekrecijo
9. Kinetika kontrakcije in sekrecije
10. Funkcionalna sklopitev signalov med homo- in heterotipičnimi celicami v istem tkivu in sklopitev z drugimi, predvsem nadzornimi in tarčnimi tkivi.
11. Napredni fizikalni pristopi k analizi, interpretaciji in predstavitvi fizioloških podatkov
12. Komparativna fiziologija celične signalizacije, evolucijski, embriološki in ontogenetski vidiki celične signalizacije
13. Kratka zgodovina razvoja področja in pregled Nobelovih nagrad na področju
14. Eksperimentalni vidiki in smeri razvoja – integracija znanja z metodologijo

1. Molecular nature of extracellular signaling molecules
2. Molecular pharmacology and toxicology of the iono- and metabotropic synapse
3. Electrophysiology of ionotropic receptors
4. Biochemistry of metabotropic receptors
5. ATP, cAMP, and calcium ions as intracellular signaling molecules coming from extra- and intracellular sources
6. Kinetics of intracellular signaling molecules, oscillations of membrane potential, metabolism, and calcium ions
7. Contractile proteins, vesicles, and other target molecules in intracellular signaling.
8. Contraction and exocytosis as terminal events in stimulus-contraction and stimulus-secretion coupling
9. Kinetics of contraction and secretion
10. Functional coupling of signals between homo- and heterotypic cells within the same tissue and coupling with other regulatory and target tissues.
11. Advanced physical approaches to analysis, interpretation, and presentation of physiological data
12. Comparative physiology of cell signaling, evolutionary, embryological, and ontogenetic aspects of cell signaling
13. A short history of field development and an overview of Nobel prizes awarded in the field
14. Experimental aspects and developments – integration with the methodology

Temeljni literatura in viri / Readings:

Boron WF, Boulpaep EL. **Medical Physiology**. 2e Updated Edition. Saunders, Philadelphia: 2012.
 Rang HP, Ritter JM, Flower RJ, Henderson G. **Rang & Dale's Pharmacology**, 8e 8th Edition. Elsevier Churchill Livingstone, Edinburgh: 2015.
 Kandel ER, Schwartz JH, Jessel TM, Siegelbaum SA, Hudspeth AJ. **Principles of Neural Science**. Fifth Edition. McGraw-Hill, New York: 2013.
 Rodwell VW, Bender DA, Botham KM, Kennely PJ, Weil PA. **Harper's Illustrated Biochemistry**. 30th Edition. McGraw Hill Education, New York: 2015.
 Alberts BA, Johnson A, Lewis J, Morgan D, Raff M, Roberts K, Walter P. **Molecular Biology of the Cell**. 6e. Garland Science, New York: 2014.

Cilji in kompetence:

Poglavitni cilj predmeta je pridobitev znanj o strukturi in funkciji hormonov, nevrotansmitorjev in drugih ekstracelularnih signalnih molekul, o njihovi vezavi na receptorje, postreptorskih znotrajceličnih signalnih poteh in celičnem odzivu. Prav tako bo študent dobil poglobljen vpogled v komunikacijo med celicami določenega tkiva in s celicami drugih nadzornih in tarčnih tkiv. Na osnovi znanja o normalni strukturi in funkciji bo študent dobil vpogled tudi v genetiko, toksikologijo in patofiziologijo najpogostejših bolezni sodobnega časa.

Objectives and competences:

The major aim of the course is to gain knowledge on structure and function of hormones, neurotransmitters and other extracellular signaling molecules, their receptor binding, postreceptor intracellular signaling pathways and the cellular response. In addition, students will gain a deep insight into intercellular communication between cells of a given tissue, as well as with cells of other control and target tissues. On the basis of the knowledge about normal structure and function, students will gain insight into genetics, toxicology, and pathophysiology of most common diseases.

Predvideni študijski rezultati:

Znanje in razumevanje:

- Struktura in funkcija zunajceličnih signalnih molekul
- Odgovor električno vzdražnih in nevzdražnih celic
- Celični odgovor
- Medcelična komunikacija
- Zdravila, motilci in toksini
- Metode za preučevanje signalizacije

Prenesljive/ključne spretnosti in drugi atributi:

- Komunikacija
- Vodenje in upravljanje
- Raziskovanje
- Timsko delo
- Samoupravljanje

Intended learning outcomes:

Knowledge and understanding:

- Structure and function of extracellular signaling molecules
- Responses of electrically excitable and non-excitable cells
- Cellular response
- Intercellular communication
- Drugs, disruptors, and toxins
- Methods for studying signaling

Transferable/Key Skills and other attributes:

- Communication
- Leadership and management
- Research
- Teamwork
- Self-management

Metode poučevanja in učenja:

Learning and teaching methods:

Interaktivna predavanja E-učenje Problem-based seminarji	Interactive frontal method E-learning Problem-based seminars
--	--

Delež (v %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

Pisne naloge	70 %	Coursework
Ustni izpit	30 %	Oral examination

Reference nosilca / Lecturer's references:

GOSAK, Marko, DOLENŠEK, Jurij, MARKOVIČ, Rene, RUPNIK, Marjan, MARHL, Marko, **STOŽER, Andraž**. Multilayer network representation of membrane potential and cytosolic calcium concentration dynamics in beta cells. *Chaos, solitons and fractals*. [Print ed.], 2015, vol. 80, str. 76-82

MARQUARD, Jan, SKELIN, Maša, **STOŽER, Andraž**, RUPNIK, Marjan, et al. Characterization of pancreatic NMDA receptors as possible drug targets for diabetes treatment. *Nature medicine*, ISSN 1078-8956, Apr. 2015, vol. 21, no. 4, str. 363-372

MARKOVIČ, Rene, **STOŽER, Andraž**, GOSAK, Marko, DOLENŠEK, Jurij, MARHL, Marko, RUPNIK, Marjan. Progressive glucose stimulation of islet beta cells reveals a transition from segregated to integrated modular functional connectivity patterns. *Scientific reports*, ISSN 2045-2322, vol. 5, 2015, 10 str

GOSAK, Marko, **STOŽER, Andraž**, MARKOVIČ, Rene, DOLENŠEK, Jurij, MARHL, Marko, RUPNIK, Marjan, PERC, Matjaž. The relationship between node degree and dissipation rate in networks of diffusively coupled oscillators and its significance for pancreatic beta cells. *Chaos*, ISSN 1054-1500, July 2015, vol. 25, iss. 7, 073115-1-073115-8

STOŽER, Andraž, GOSAK, Marko, DOLENŠEK, Jurij, PERC, Matjaž, MARHL, Marko, RUPNIK, Marjan, KOROŠAK, Dean. Functional connectivity in islets of Langerhans from mouse pancreas tissue slices. *PLoS computational biology*, ISSN 1553-734X. [Print ed.], Feb. 2013, vol. 9, iss. 2, str. e100292312-1-e1002923-12

STOŽER, Andraž, DOLENŠEK, Jurij, RUPNIK, Marjan. Glucose-stimulated calcium dynamics in Islets of Langerhans in acute mouse pancreas tissue slices. *PloS one*, ISSN 1932-6203, 2013, vol. 8, iss. 1, str. 1-13

DOLENŠEK, Jurij, **STOŽER, Andraž**, SKELIN, Maša, MILLER, Evan, RUPNIK, Marjan. The relationship between membrane potential and calcium dynamics in glucose-stimulated beta cell syncytium in acute mouse pancreas tissue slices. *PloS one*, ISSN 1932-6203, 2013, vol. 8, iss. 12, str. 1-16

DOLENŠEK, Jurij, RUPNIK, Marjan, **STOŽER, Andraž**. Structural similarities and differences

between the human and the mouse pancreas. *Islets*, ISSN 1938-2022, 2015, vol. 7, iss. 1, 16 str

DOLENŠEK, Jurij, ŠPELIČ, Denis, SKELIN, Maša, ŽALIK, Borut, GOSAK, Marko, RUPNIK, Marjan, **STOŽER, Andraž**. Membrane potential and calcium dynamics in beta cells from mouse pancreas tissue slices : theory, experimentation, and analysis. *Sensors*, ISSN 1424-8220, 2015, vol. 15, iss. 11, str. 27393-27419

SKELIN, Maša, DOLENŠEK, Jurij, **STOŽER, Andraž**, RUPNIK, Marjan. Measuring exocytosis in endocrine tissue slices. V: THORN, Peter (ur.). *Exocytosis methods*, (Neuromethods, ISSN 0893-2336, Vol. 83). New York [etc.]: Springer, 2014, str. 127-146