

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Programirana celična smrt
Course title:	Programmed Cell Death

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Nanoznanosti in nanotehnologije, 3. stopnja Nanosciences and Nanotechnologies, 3 rd cycle	Bioznanosti Biosciences	1	1

Vrsta predmeta / Course type Izbirni / Elective

Univerzitetna koda predmeta / University course code: NANO3-823

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30	30			30	210	10

**Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transferred to individual work.*

Nosilec predmeta / Lecturer: Prof. ddr. Boris Turk

Jeziki / Languages: **Predavanja / Lectures:** slovenščina, angleščina / Slovenian, English
Vaje / Tutorial:

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

Končan študij druge stopnje biokemije, biologije, medicine ali katerekoli druge naravoslovne smeri.

Poznavanje osnov biokemije, molekularne in celične biologije ter poznavanje osnov analitskih metod s področja.

Prerequisites:

Second cycle degree degree in biochemistry, biology, medicine or any other natural sciences discipline.

Basic knowledge of biochemistry and molecular and cell biology, as well as basic knowledge of analytical methods from the field.

Vsebina:

Uvod v področje: oblike celične smrti: nekroza in programirana nekroza, apoptoza, avtofagija
Apoptoza: osnovne značilnosti apoptoze, molekularni mehanizmi regulacije, biološki pomen apoptoze
Avtofagija: molekularni mehanizmi, regulacija, biološki pomen,
Nekroza/nekroptoza: molekularni mehanizmi, biološki pomen
Vnetje in piroptoza: splošni mehanizmi, nastanek inflammasoma, medvrstne razlike, ...
Povezave med različnimi oblikami celične smrti: molekularni mehanizmi, pomen in vloga organelov

Content (Syllabus outline):

Introduction to the field: cell death types; apoptosis, necrosis and programmed necrosis, autophagy
Apoptosis: basic characteristics of apoptosis, molecular mechanism of regulation, biological relevance
Autophagy: molecular mechanisms, regulation, biological relevance
Necrosis/necroptosis: molecular mechanisms, biological relevance
Inflammation and pyroptosis: basic mechanisms, inflammasome formation, species difference, ...
Links between different types of cell death:

Vloga proteaz pri regulaciji celične smrti: pomen proteaz za celično smrt oziroma preživetje celic
Programirana celična smrt pri boleznih: nevrodegenerativna obolenja, rak, HIV, ishemija, virusne okužbe, parazitska obolenja, infektivne bolezni
Analitske metode spremljanja celične smrti: encimatske metode, mikroskopija, imunološke metode, pretočna citometrija, itd.
Klinični razvoj: rak (IAP, Bcl-2 antagonisti, regulatorji autofagije, kemoterapija,...), neurodegenerativne bolezni

molecular mechanisms, organelle crosstalk
Role of proteases in cell death regulation: importance of proteases for cell death or cell survival
Programmed cell death in disease: neurodegeneration, cancer, HIV, ischemia, viral infections, parasitic diseases, infectious diseases
Analytical methods for monitoring cell death: enzymatic methods, microscopy, immunological methods, flow cytometry, ...
Clinical development: cancer (IAP, Bcl-2 antagonists, autophagy regulators, chemotherapy,...), neurodegenerative disorders,

Temeljni literatura in viri / Readings:

Klionsky DJ et al. (2016) Guidelines for the use and interpretation of assays for monitoring autophagy (3rd edition). *Autophagy* 12, 1-222.

Galluzzi L et al. (2018) Molecular mechanisms of cell death: recommendations of the Nomenclature Committee on Cell Death 2018. *Cell Death Differ.* doi: 10.1038/s41418-017-0012-4.

Kepp O et al. (2011) Cell death assays for drug discovery. *Nat Rev Drug Discov.* 10, 221-237.

Cell Death Techniques: A Laboratory Manual; Editors: Ricky W. Johnstone and John Silke (August 2015), CSH Laboratory Press. ISBN 978-1-621820-12-3 (<http://www.cshlpress.com/default.tpl?action=full&--eqskudatarq=1056>)

Tekoča relevantna literatura iz problematike / Relevant current articles from the field (Nature, Science, Cell, Nature Reviews, Autophagy...)

Cilji in kompetence:

Seznanim študenta s pojmom celične smrti, z različnimi vrstami celične smrti, z mehanizmi delovanja in regulacije celične smrti, z vlogo celične smrti v normalnih in patoloških procesih ter z razvojem kliničnih raziskav na področju. Študenta pripraviti na pripravo projektov s tega področja biomedicine.

Splošne kompetence:

- obvladanje raziskovalnih metod in postopkov, razvoj kritične in samokritične presoje,
- sposobnost uporabe znanja v praksi,
- razvoj komunikacijskih sposobnosti in spretnosti, posebej komunikacije v mednarodnem okolju,
- kooperativnost, delo v skupini in tudi v mednarodnem okolju.

Objectives and competences:

To inform student with the basics of cell death, including types of cell death, mechanisms of action and regulation, with the role of cell death in normal and pathological conditions, as well as with the development of clinical studies. To prepare student for future design of projects from this area of biomedicine.

General Competences:

- the student will master research methods and procedures and develop skills for critical assessment of his activities,
- the student will be able to put his knowledge into practice,
- the student will develop communications skills to present research achievement in the international environment,
- training for team work including the work in international environment.

Predmetnospecifične kompetence:
 Študent se bo seznanil s teoretičnimi osnovami problematike programirane celične smrti in z njenim pomenom in aplikacijami v biomedicinskih raziskavah. Pri svojem delu bo uporabljal najnovejšo tujo strokovno literaturo, kar bo izboljšalo njegove sposobnosti uporabe tujega jezika in kritičnega pogleda na objavljeno raziskovalno delo. Priprava na pripravo projektov s področja celične smrti.

Course Specific Competences:
 Student will learn theoretical background of programmed cell death and its relevance and application in biomedical research. During his study he will use the newest scientific literature, which will improve his foreign language skills and his ability to critically view the published research. Preparation for implementation into project preparation from the cell death field.

Predvideni študijski rezultati:
 Poznavanje in razumevanje pojmov iz celične in molekularne biologije, predvsem celične smrti. Poznavanje in razumevanje osnov nekaterih bolezni s poudarkom na raku in nevrodegenerativnih obolenjih. Razumevanje in pregled različnih analitskih metod ter njihovih zmožnosti in omejitev. Pregled različnih pristopov k reševanju relevantnih biomedicinskih problemov.

Intended learning outcomes:
 Knowledge and understanding of the basic phenomena in cell and molecular biology with the emphasis on cell death. Knowledge and understanding of the basics of selected diseases with the emphasis on cancer and neurodegeneration. Understanding and overview of analytical methods, their capabilities and limitations. Overview of different approaches to solving relevant biomedical problems.

Metode poučevanja in učenja:

- Predavanja (v primeru več od 5 študentov)
- Individualne konzultacije
- Seminarji (pregled literature)
- Laboratorijsko delo (samo v primeru mentorstva)

Learning and teaching methods:

- Lectures (for 5 students or more)
- Individual consultations
- Seminar work (overview of the literature)
- Laboratory work (if supervising the student)

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
<ul style="list-style-type: none"> • seminar • ustni izpit 	50 % 50 %	<ul style="list-style-type: none"> • seminar • oral exam

Reference nosilca / Lecturer's references:

Hafner Cesen M, Repnik U, Turk V, Turk B. (2013) Siramesine triggers cell death through destabilisation of mitochondria, but not lysosomes. *Cell Death Dis.* 4:e818. doi: 10.1038/cddis.2013.361.

Mikhaylov G, Klimpel D, Schaschke N, Mikac U, Vizovisek M, Fonovic M, Turk V, Turk B*, Vasiljeva O* (2014) Selective targeting of tumor and stromal cells by lipidated cathepsin B inhibitor-based drug delivery system. *Angew. Chem. Intl. Ed.* 53, 10077-10081

Repnik U, Hafner Cesen M, Turk B. (2014) Lysosomal membrane permeabilization in cell death: Concepts and challenges. *Mitochondrion*, 19 Pt A:49-57. doi: 10.1016/j.mito.2014.06.006.

Taggart C, TURK B, et al. Protean proteases : at the cutting edge of lung diseases. *European respiratory journal*, ISSN 0903-1936, 2107, vol. 49, no. 2, 1501200-1-1501200-12, doi: 10.1183/13993003.01200-2015

KRAMER, Lovro, RENKO, Miha, ZAVRŠNIK, Janja, TURK, Dušan, SEEGER, Markus A., VASILJEVA, Olga, GRÜTTER, Markus G., TURK, Vito, TURK, Boris. Non-invasive in vivo imaging of tumour-associated cathepsin B by a highly selective inhibitory DARPIn. *Theranostics*, ISSN 1838-7640, 2017, vol. 7, no. 11, str. 2806-2821, doi: 10.7150/thno.19081