UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	FUNKCIJSKA GENOMIKA
Course Title:	FUNCTIONAL GENOMICS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Biokemija, 1. stopnja	**/**	**3.**	**6.**
USP Biochemistry, 1st Cycle	**/**	**3rd**	**6th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: BKSI7

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**15**	**30 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: izr. prof. dr. Uroš Petrovič / Dr. Uroš Petrovič, Associate Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	Content (Syllabus outline):
<u>Genom</u>: *Projekt Človeški genom* - zgodovinski pregled, kloniranje in kartiranje; drugi genomi. *Metode preiskave vloge posameznega gena* - tehnologija izničenja genov, utišanje genov z siRNA in protismiselno tehnologijo. *Celostne genomske analize z mikromrežami* - genotipiziranje in SNP čipi, re-sekvenciranje, CGH mikromreže, mutacijska analiza, iskanje promotorskih zaporedij. *Genomika* - primerjalna in evolucijska genomika, metagenomika. <u>*Transkriptom:*</u> Načini izražanja genov, tehnike za merjenje transkriptoma. <u>*Proteom:*</u> Interakcije protein-protein in protein-DNA; visoko zmogljivostne tehnike za karakterizacijo proteinov in njihovih interakcij.	<u>*Genome:*</u> Human Genome Project – historical overview, cloning and mapping; other genomes. Methods of analysing the role of genes – production of knockouts, siRNA silencing and antisense technology. Comprehensive genome analyses using microarrays - genotypisation and SNP chips, resequencing, CGH microarrays, mutation analysis, promoter sequencing. Genomics – comparative and evolutionary genomics, metagenomics. <u>*Transcriptome:*</u> ways of genomic expression, transcriptome measuring techniques. <u>*Proteome:*</u> protein-protein and protein-DNA interactions; high performance techniques for protein characterisation and their interactions.

Metabolom: sistemske študije kemičnih prstnih odtisov metaboličnih procesov v celici (metabolično profiliranje), separacijske in identifikacijske metode. *Fenom:* metode za določitev različnih vrst fenotipov na genomski ravni modelnih mikroorganizmov. *Osnove sistemske biologije:* teorija sistemov v biologiji, uporaba načela mrež (teorije grafov) v sistemski biologiji, osnove modeliranja bioloških mrež, orodja bioinformatike v funkcijski genomiki in sistemski biologiji. *Modelni organizmi v sistemski biologiji in funkcijski genomiki*: zgodovinski okvir razvoja sistemske biologije, kvasovka *S. cerevisiae*, nematoda *C. elegans*. *Funkcijska genomika in družba* - varstvo podatkov, pravni in etični vidiki, patentiranje. *Urejanje genoma* – uporaba novih metod za urejanje genoma (npr. CRISPR-Cas9) v funkcijski genomiki.	*Metabolome*: system studies of chemical fingerprints of metabolic processes in a cell (metabolic profiling), separation and identification methods. *Phenome*: methods for determining different phenotypes at the genome level of model microorganisms. *Fundamentals of systems biology*: theory of systems in biology, graph theory in systems biology, fundamentals of modelling biological networks, bioinformatics tools used in functional genomics and systems biology. *Model organisms in systems biology and functional genomics*: historical background of systems biology, S. cerevisiae yeast, C. elegans nematode. *Functional genomics and the society* – data protection, legal and ethical aspects, patenting. *Genome editing* – use of new methods for genome editing (e.g. CRISPR-Cas9) in functional genomics.

Temeljna literatura in viri / Readings:

Izbrana poglavja iz:

- Prevsner J. 2015 Bioinformatics And Functional Genomics, 3rd edition. Wiley Blackwell, 1160 strani (~15%)
- Klipp, E., Herwig, R., Kowald, A., Wierling, C., Lehrach, H. 2005 Systems Biology in Practice: Concepts, Implementation and Application. John Wiley & Sons.; 496 strani (~30%)
- Stagljar I. (Ed.) 2015 Yeast Functional Genomics and Proteomics. Humana Press, 304 strani (~25%).
- 3) Palsson B.O. 2015 Systems Biology: Constraint-based Reconstruction and Analysis. Cambridge University Press, 531 strani (~20 %)

Dodatna literatura:

- Debeljak, N., Horvat, S., Juvan, P., Košir, R., Kunej, T., Petrovič, U., Režen, T., Rozman, D., Ačimovič, J. 2016 Funkcijska genomika – praktikum. 2. izdaja
- Članki iz tekoče periodike.

Cilji in kompetence:

Cilji predmeta: pridobivanje osnovnih znanj o genomiki in študijah funkcije genov; spoznavanje (teoretično in praktično) eksperimentalnih in računskih tehnik, ki se uporabljajo v funkcijski genomiki; seznanjanje z modelnimi organizmi in njihovo uporabnostjo; pridobivanje osnovnih znanj o funkcijski genomiki in sistemski biologiji pri sesalcih in modelnih organizmih.

Objectives and Competences:

Learning outcomes: Acquiring basic knowledge on genomics and studies on gene functions; Acquiring (theoretical and practical) knowledge on experimental and computational techniques used in functional genomics; Learning about model organisms and their application; Acquiring basic knowledge on functional genomics and systems biology in mammals and model organisms.

Predmetno specifične kompetence:	**Competences:** subject specific competencies:
sposobnost načrtovanja eksperimentov s področja funkcijske genomike; sposobnost uporabe eksperimentalnih in bioinformatskih orodij, sposobnost razumevanja in interpretacije podatkov, sposobnost načrtovanja in izvedbe eksperimentov s področij transkriptomike, proteomike z interaktomiko, fenomike in eksperimentov z uporabo metod sekvenciranja nove generacije (NGS).	planning experiments in functional genomics, use of experimental bioinformatics tools, understanding and interpreting data, ability to design and perform experiments in the fields of transcriptomics, proteomics with interactomics, phenomics, and experiments using next generation sequencing (NGS) methods.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje - Poznavanje zgradbe in vloge človeškega genoma. - Poznavanje in razumevanja osnov transkriptomke, proteomike, metabolomike ion fenomike. - Poznavanje in razumevanja mrež in modelov bioloških sistemov. - Poznavanje modelnih organizmov v funkcijski genomiki in njihovih specifičnosti. - Poznavanje osnovnih načel modeliranja bioloških sistemov. - Poznavanje in razumevanje problematike pravnih in etičnih vidikov pogenomskega obdobja.	Knowledge and Comprehension - Know the structure and function of human genome - Know and understand the basics of transcriptomics, proteomics, metabolomics and phenomics - Know and understand the concept of biological networks and systems - Know model organisms in functional genomics and their specificities - Know the basics of modelling in biology - Know and understand the issues and importance of legal and ethical aspects of the post-genome era
Uporaba - Sposobnost uporabe specifičnih eksperimentalnih metod funkcijske genomike. - Sposobnost uporabe specifičnih bioinformatskih orodij.	Application - Ability to use specific experimental methods of functional genomics - Ability to use specific bioinformatics tools
Refleksija Študentje bodo razvili sposobnost kompleksnega vpogleda v biološke sisteme. Pridobili bodo sposobnost akstraktnejšega dojemanja organizacije in delovanje genoma ter celic in organizmov.	Analysis Students will be capable of a complex insight into biological systems. They will also obtain the capacity of abstract understanding of genome and cell/organism organization and functioning.
Prenosljive spretnosti - Sposobnost intepretacije eksperimentalnih podatkov.	Skill-transference Ability - Ability to interpret experimental data

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji, laboratorijsko delo.	Lecture, seminars, laboratory-based practical work

Delež (v %) /

Načini ocenjevanja:	Weight (in %)	**Assessment:**
Seminarska naloga Pisni izpit Ocene: 6-10 (pozitivno), 1-5 (negativno).		Seminar work Written exam Grades: 6-10 (positive), 1-5 (negative)

Reference nosilca / Lecturer's references:

- Mattiazzi Ušaj M, Kaferle P, Toplak A, Trebše P, **Petrovič U.** (2013) Determination of toxicity of neonicotinoids on the genome level using chemogenomics in yeast. Chemosphere. (v tisku; doi: 10.1016/j.chemosphere.2013.10.063)
- Mattiazzi M, Sun Y, Wolinski H, Bavdek A, Petan T, Anderluh G, Kohlwein SD, Drubin DG, Križaj I, **Petrovič U.** (2012) A neurotoxic phospholipase A2 impairs yeast amphiphysin activity and reduces endocytosis. PLoS One. 7(7):e40931
- Mattiazzi M, Curk T, Križaj I, Zupan B, **Petrovič U.** (2010) Inference of the molecular mechanism of action from genetic interaction and gene expression data. OMICS. 14(4):357-367