



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

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|----------------------|---|
| Predmet: | Izbrane metode v biokemiji in molekularni biologiji |
| Course title: | Selected Methods in Biochemistry and Molecular Biology |

| Študijski program in stopnja Study programme and level | Študijska smer Study field | Letnik Academic year | Semester Semester |
|--|--------------------------------------|--------------------------------|-------------------------------------|
| Univerzitetni študijski program: Ekologija z naravovarstvom, 1. stopnja | | 2. ali 3. | 3. ali 4. ali 5. ali 6. |
| Undergraduate programme: Ecology with Nature Preservation, 1st level | | 2nd or 3rd | 3rd or 4th or 5th or 6th |

Vrsta predmeta / Course type

izbirni/elective

Univerzitetna koda predmeta / University course code:

| Predavanja Lectures | Seminar Seminar | Vaje Tutorial | Klinične vaje work | Druge oblike študija | Samost. delo Individ. work | ECTS |
|-------------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|---|-------------|
| 15 | | 30 | | | 135 | 6 |

Nosilec predmeta / Lecturer:

Janja TRČEK

**Jeziki /
Languages:**

**Predavanja /
Lectures:** Slovenski /Slovenian

Vaje / Tutorial: Slovenski /Slovenian

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

Jih ni.

Prerequisites:

No.

Vsebina:

Začetna predavanja so namenjena ponovitvi strukture genov in genomov. Sledile bodo predstavitve molekularno-bioloških tehnike za analizo proteinov, kromosomov in nukleinskih kislin. Za tem bodo predstavljene tehnike vzorčenja različnih vrst celic, metode izolacije, čiščenja in kvantifikacije nukleinskih kislin ter separacija DNA in RNA z elektroforezo na agaroznih in poliakrilamidnih gelih ter izolacija nukleinskih kislin iz gelov. Predstavljene bodo tudi metode encimske modifikacije DNA, kot so rezanje z restrikcijskimi encimi, lepljenje, fosforilacija in označevanje nukleinskih kislin. Razloženi bodo principi kloniranja, priprave DNA-knjižnic, izolacije pozitivnih klonov, izražanja rekombinantnih proteinov v različnih ekspresijskih sistemih kakor tudi uporaba različnih vektorjev za kloniranje in ekspresijo. Podane bodo metode hibridizacije nukleinskih kislin, pomembne za pregledovanje DNA-knjižnic, za metodi prenosa RNA po Northernu in DNA po Southernu in za kvantitativno ocenjevanje sorodnosti biotskih vrst na osnovi genomske DNA. Razloženi bodo tudi principi in možnosti uporabe tehnike verižne reakcije s polimerazo (PCR) in principi sekvenciranja DNA. Nazadnje bodo podane osnove analize nukleinskih kislin s pomočjo različnih bioinformatičnih orodij (npr. BLAST in CLUSTAL) ter različni pristopi in bioinformatična orodja za analizo filogenetskih odnosov med organizmi.

Content (Syllabus outline):

The introductory lectures will be dedicated to a review on genes and genome structures. Then the molecular-biological techniques on analyses of proteins, chromosomes and nucleic acids will be presented. Sampling techniques for different cell types will be presented and the methods for nucleic acids isolation, purification, separation and quantification using agarose and polyacrylamide electrophoresis will be given. Recovery of DNA and RNA fragments from gels will also be presented. Methods for enzymatic manipulation of DNA such as digestion of DNA with restriction enzymes, ligation, phosphorylation and nucleic acids labeling will be presented. The principles of cloning DNA, construction of DNA libraries, isolating positive clones, expression of recombinant proteins in different expression systems, the use of different cloning and expression vectors will be explained. Nucleic acid hybridization methods, important for screening DNA-libraries as well as for Northern and Southern blot methods and for quantitative assessment of relatedness of biotic species on the basis of genomic DNA will be given. The principles and possible applications of polymerase chain reaction (PCR) and the principles of different sequencing technology will also be explained. Finally, the fundamentals of nucleic acid analyses using different bioinformatics tools (such as BLAST and CLUSTAL) will be given and different approaches and bioinformatics tools for the analyses of phylogenetic relationships from molecular data.

Temeljni literatura in viri / Readings:

- Berg J, Tymoczko JL, Stryer L, Gatto G. 2019. Biochemistry, International Edition. 9. izdaja. 1296 str., Freeman W.H
- Krebs JE, Goldstein ES, Kilpatrick ST. 2017. Lewin's Genes XI. 12. izdaja. 838 str., Jones & Barlett Learning.
- Sambrook J, Russell DW. 2001: Molecular Cloning – a Laboratory Manual. 3. izdaja, Cold Spring Harbor Laboratory, 999 str.

Cilji in kompetence:

Namen predmeta je podati principe molekularno-bioloških tehnik, med katerimi so mnoge aplicirane tudi v klasičnih bioloških disciplinah. Velik poudarek je na praktičnem laboratorijskem delu. Študenti bodo seznanjeni z naslednjimi tehnikami:

- Izolacija RNA in DNA iz različnih vrst celic
- Čiščenje nukleinskih kislin
- Kvantifikacija nukleinskih kislin
- Separacija RNA in DNA na agaroznih gelih
- Separacija proteinov na poliakrilamidnih gelih
- Encimske modifikacije
- Kloniranje DNA in priprava DNA knjižnic
- Transformacija DNA v različne celične sisteme
- Hibridizacija RNA in DNA
- Selekcija pozitivnih klonov
- Hibridizacija po Northernu
- Hibridizacija po Southernu
- Verižna reakcija s polimerazo (PCR)
- Sekvenciranje DNA

Objectives and competences:

The aim of the subject is to give background information of the main molecular biology methods currently used, many of them applied also in systematics, evolution and ecology. A great emphasis is on practical laboratory work. Students will develop skills in using the following techniques:

- RNA and DNA isolation from various cell types
- Nucleic acid purification
- Nucleic acid quantification
- Separation of RNA and DNA on agarose gels
- Separation of proteins on polyacrylamide gels
- Enzyme modifications
- DNA cloning and DNA library construction
- Transformation of DNA in different cell systems
- Hybridization of RNA and DNA
- Screening of positive clones
- Northern blot
- Southern blot
- Polymerase chain reaction (PCR)
- DNA sequencing

Predvideni študijski rezultati:

Znanje in razumevanje:

- Študenti dobijo podroben vpogled v strukturo genov in genomov ter se znanijo z možnostmi in načini uporabe molekularno bioloških tehnik pri študiju biodiverzitete, filogenije, filogeografije, populacijske genetike in ekologije.
- Poleg poznavanja principov številnih molekularno bioloških metod in sposobnosti kritičnega ovrednotenja njihove uporabe v praksi dobro obvladajo laboratorijsko delo z različnimi aparaturami ter ravnanje z zdravju škodljivimi kemikalijami.

Prenosljive/ključne spretnosti in drugi atributi:

Intended learning outcomes:

Knowledge and understanding:

- Students get a detailed insight in gene and genomes structures, and about possibilities and ways of applications of molecular biology techniques in biodiversity, phylogenetic, phylogeography, population genetic and ecology studies.
- Besides the knowledge of principles of numerous molecular biology methods and the capacity of critical evaluations of their applications in practice, they are familiar with various laboratory instruments as well with handling with toxic materials.

Transferable/Key Skills and other attributes:

- Obvladovanje številnih sodobnih metod v molekularni biologiji.
- Poznavanje osnovnih pristopov in sposobnost uporabe bioinformatičnih orodij pri analizi nukleinskih kislin kakor tudi filogenetskih povezav s pomočjo molekularno bioloških podatkov.

- Capacity of understanding and handling numerous currently used methods in molecular biology.
- Knowledge of basic approaches and the ability to use current software applications for analyses of nucleic acids as well as phylogenetic relationships using molecular biology data.

Metode poučevanja in učenja:

- Predavanja
- Laboratorijske vaje
- Individualno delo s študenti

Learning and teaching methods:

- Lectures
- Laboratory excersises
- Individual work with students

| Načini ocenjevanja: | Delež (v %) / Weight (in %) | Assessment: |
|---|--------------------------------|--|
| <ul style="list-style-type: none"> • Kolokvij • Pisni izpit | 50 50 | <ul style="list-style-type: none"> • Practical examination • Written examination |

Reference nosilca / Lecturer's references:

1. Jelenko K., Cepec E., Nascimento F.X., **Trček J.** 2023. Comparative genomics and phenotypic characterization of *Gluconacetobacter entanii*, a highly acetic acid-tolerant bacterium from vinegars. *Foods* 12(1), 1-15.
2. Simonič M., Slapničar Š., **Trček J.**, Bogovič Matijašič B., Mohar Lorbeg P., Vesel A., Fras Zemljič L., Peršin Fratnik Z. 2023. Probiotic *Lactobacillus paragasseri* K7 nanofiber encapsulation using nozzle-free electrospinning. *Appl. Biochem. Biotechnol.* v tisku, 12 str.
3. Cepec E. in **Trček J.** 2022. Antimicrobial resistance of *Acetobacter* and *Komagataeibacter* species originating from vinegars. *Int. J. Environ. Res. Public Health* 19(1), str. 1-10.
4. Ajdnik U., Fras Zemljič L., Plohl, O., Pérez L., **Trček J.**, Bračič M., Mohan T. 2021. Bioactive functional nanolayers of chitosan-lysine surfactant with single- and mixed-protein-repellent and antibiofilm properties for medical implants. *ACS Appl. Mater. Interfaces* 13(20), 23352–23368.
5. **Trček J.**, Dogša I., Accetto T., Stopar D. 2021. Acetan and acetan-like polysaccharides: genetics, biosynthesis, structure, and viscoelasticity. *Polymers* 13(5), 1-16.