

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	MOLEKULARNE OSNOVE VED O ŽIVLJENJU
<b>Course Title:</b>	MOLECULAR FUNDAMENTALS OF LIFE SCIENCES

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemijsko inženirstvo, 1. stopnja, UŠP Kemija, 1. stopnja	/	1.	1.
USP Chemical Engineering, 1 <sup>st</sup> Cycle, USP Chemistry, 1 <sup>st</sup> Cycle	/	1 <sup>st</sup>	1 <sup>st</sup>

**Vrsta predmeta / Course Type:** obvezni / Mandatory

**Univerzitetna koda predmeta / University Course Code:** KE105

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
45	15	15 LV	/	/	75	5

**Nosilec predmeta / Lecturer:** izr. prof. dr. Marko Novinec / Dr. Marko Novinec, Associate Professor

**Jeziki / Languages:**

**Predavanja / Lectures:** slovenski / Slovenian

**Vaje / Tutorial:** slovenski / Slovenian

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

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.

**Prerequisites:**

The course has to be assigned to the student.

**Vsebina:**

### Življenje

1. Življenje in vede o življenju.
2. Značilnosti celic: prokarioti in evkarionti. Celična komunikacija.
3. Organi in fiziologija večceličnih organizmov (rastline, živali).
4. Evolucija in filogenija.
5. Organizmi in okolje.

### Biološke makromolekule

6. Aminokisliline, peptidi in proteini.
7. 3D zgradba proteinov in njihova biološka vloga.
8. Encimi: reakcije, kinetika, inhibicija,

**Content (Syllabus outline):**

### Life

1. Life and life sciences.
2. Cells: prokaryotes and eukaryotes. Cellular communication.
3. Organs and physiology of multicellular organisms (plants, animals).
4. Evolution and phylogeny.
5. Organisms and the environment.

### Biological macromolecules

6. Amino acids, peptides and proteins.
7. Proteins – three-dimensional structure and biological function.

koencimi.

9. Ogljikovi hidrati: zgradba in biološka vloga.

10. Lipidi, biološke membrane in transport.

11. DNA in RNA: zgradba in vloga.

**Molekularne osnove celičnih procesov**

12. Ohranjanje in prenos biološke informacije.

13. Rekombinantna DNA in biotehnologija.

14. Celični ciklus in celična smrt. Oksidativni stres. Rak.

15. Osnove bioenergetike in celičnega metabolizma.

16. Molekularni motorji.

17. Protitelesa in imunski odgovor.

18. Biokemija čutil.

8. Enzymes – reactions, kinetics, inhibition, coenzymes.

9. Carbohydrates – structure and biological function.

10. Lipids, biomembranes and membrane transport.

11. DNA and RNA – structure and function.

**Molecular basis of cellular processes**

12. Transmission of biological information.

13. Recombinant DNA and biotechnology.

14. Cell cycle and cell death. Oxidative stress. Cancer.

15. Bioenergetics and cellular metabolism.

16. Molecular motors.

17. Antibodies and the immune response.

18. Biochemistry of sensory organs.

**Temeljna literatura in viri / Readings:**

- Rodney Boyer: Temelji biokemije (Študentska založba, 2005): izbrana poglavja v skupnem obsegu 260 strani.

Za biološka poglavja načrtujemo pripravo spletnih vsebin ali skript v obsegu približno 60 strani.

**Cilji in kompetence:**

**Cilji:** Študenti bodo razumeli tiste biološke osnove, ki jim omogočajo razumevanje delovanja molekul v celici in na živo celico ter osnove fizioloških procesov. Razumeli bodo tudi najosnovnejše filogenetske odnose med organizmi in interakcije z okoljem.

Zgradbo bioloških makromolekul bodo študenti poznali dovolj natančno, da bodo razumeli metabolične poti in molekularno-biološke procese pri predavanjih, ki nadgrajujejo znanja tega predmeta (npr. pri predmetu Biološka kemija v programu Kemija). Dobro bodo razumeli tudi bioenergetske in metabolične osnove delovanja organizma ter temeljne procese prenosa genetskih informacij. Ob nekaterih zanimivih primerih biokemijskih procesov in tipov bioloških makromolekul bodo bolje razumeli delovanje živega sveta.

**Kompetence:** Predmet temelji na povezovanju teoretičnih osnov z laboratorijskim in seminarskim seznanjanjem predvsem z lastnostmi in primeri funkcije makromolekul.

**Objectives and Competences:**

**Objectives:** Students will understand basic biological principles required to follow molecular mechanisms in cells, as well as the fundamentals of physiological processes. They will recognize basic phylogenetic relations among organisms and their interactions with the environment. By knowing the structure of biological macro-molecules students will understand metabolic pathways and molecular biology processes in advanced courses (e.g. Biological Chemistry). Students will also obtain knowledge of the basics of cellular bioenergetics and metabolism as well as the transmission of genetic information. Several interesting examples of biochemical processes will be introduced to provide students with a better understanding of the functional characteristics of living organisms.

**Competences:** Theoretical topics will be intertwined with laboratory and seminar work to highlight the properties and examples of macromolecular function. During practical course the precision of laboratory

Študenti se bodo pri vajah urili v natančnosti laboratorijskih meritev in pri iskanju možnih vzrokov za odstopanja od pričakovanih rezultatov. Ob pisanju laboratorijskega dnevnika se bodo naučili pisnega posredovanja meritev in interpretacije rezultatov.

measurements will be trained and discussed. By writing a laboratory logbook, students will learn how to report experimental results and interpret them.

### **Predvideni študijski rezultati:**

#### Znanje in razumevanje

Znanje: osnovno poznavanje zgradbe in delovanja celice in organizma, filogenetskih odnosov med organizmi. Lastnosti bioloških makromolekul ter njihova biološka vloga. Energetske molekule in njihove pretvorbe.

Razumevanje: razlike med evkarionti, prokarionti in arhejami, osnovne evlucijske poti, interakcije organizma z okoljem, Delovanje encimov in inhibitorjev, pomen kinetičnih konstant. Osnove skladnosti metaboličnih procesov v celici in organizmu. Princip ohranjanja in prenosa genetske informacije. Celično rojstvo in smrt.

#### Uporaba

Občutek za dimenzije v biokemiji in molekularni biologiji. Sposobnost razlikovanja med tipi celic in organizmov. Stopnje v izolaciji makromolekul iz bioloških vzorcev in nekatere ključne metode (liziranje celic, določanje vsebnosti makromolekul, elektroforezna analiza). Povezava eksperimentalnih podatkov s teoretičnimi osnovami procesov. Praktična uporaba metod, ki so vključene v zaključne procese biotehnoških postopkov.

#### Refleksija

Usklajenost delovanja biokemijskih procesov v celici in organizmu. Mutacije kot gonilo razvoja – primerjava z genskim spreminjanjem in vitro. Kinetika encimskih reakcij – primerjava z drugimi kemijskimi reakcijami. Celična smrt kot kontroliran proces. Eksperiment kot osnova za preverjanje hipotez.

### **Intended Learning Outcomes:**

#### Knowledge and Comprehension

Knowledge: basic knowledge of the structure and function of cells and organisms and the phylogenetic relationships between organisms. Properties of biological macromolecules and their biological functions. High-energy molecules and the conversion.

Comprehension: difference between eukaryotes, prokaryotes and archaea, basic evolutionary pathways, interaction of organisms with their environment, function of enzymes and their inhibitors, the meaning of kinetic constants. Basic principles of metabolism in the cell and in the organism. Principles of storage and transmission of biological information. Cell birth and death.

#### Application

An understanding of dimensions used in biochemistry and molecular biology. The ability to differentiate between different types of cells and organisms. Basic methods for the purification of macromolecules from biological samples (cell lysis, macromolecular content determination, electrophoretic analysis). Linking experimental data with theoretical principles. Practical application of methods involved in final steps of biotechnological processes.

#### Analysis

Equilibrium of biochemical processes in the cell and in the organism. Mutations as the driving force of evolution – comparison with genetic alteration in vitro. Kinetics of enzyme-catalysed reactions – comparison with other chemical reactions. Cell death as a regulated process. Experiment as the basic tool for proof of hypothesis.

**Prenosljive spretnosti**

Pisanje poročil z vaj, samostojno in skupinsko delo za pripravo seminarjev in kratko poročanje pred občinstvom. Delo s spletnimi študijskimi viri.

**Skill-transference Ability**

Writing reports, individual and team work in the preparation of seminars, short presentation in front of an audience. Work with online study sources.

**Metode poučevanja in učenja:**

Predavanja, laboratorijske vaje, individualno in skupinsko delo pri pripravi seminarjev. Spletna gradiva za določena poglavja.

**Learning and Teaching Methods:**

Lectures, practical laboratory course, individual and team seminar work. Online resources for selected chapters.

**Načini ocenjevanja:**

- pisni izpit  
- seminarska naloga  
- kolokvij iz laboratorijskih vaj

Delež (v %) /

Weight (in %) **Assessment:**

- written exam  
- seminar  
- test

**Reference nosilca / Lecturer's references:**

- **NOVINEC, Marko**, KORENČ, Matevž, CAFLISCH, Amedeo, RANGANATHAN, Rama, LENARČIČ, Brigita, BAICI, Antonio. A novel allosteric mechanism in the cysteine peptidase cathepsin K discovered by computational methods. Nature communications, ISSN 2041-1723, feb. 2014, vol. 5, art. no. 3287

- **NOVINEC, Marko**, KOVAČIČ, Lidija, LENARČIČ, Brigita, BAICI, Antonio. Conformational flexibility and allosteric regulation of cathepsin K. Biochemical journal, ISSN 0264-6021, 2010, vol. 429, no. 2, p. 379-389

- **NOVINEC, Marko**, GRASS, Robert N., STARK, Wendelin J., TURK, Vito, BAICI, Antonio, LENARČIČ, Brigita. Interaction between human cathepsins K, L, and S, Mechanism of elastinolysis and inhibition by macromolecular inhibitors. The Journal of biological chemistry, ISSN 0021-9258, 2007, vol. 282, no. 11, str. 7893-78902