Universitat Autònoma de Barcelona

2020/2021

Biochemistry

Code: 101967
ECTS Credits: 6

Degree	Type	Year	Semester
2500890 Genetics	FB	1	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

Name: Mohammed Moussaoui
Email: Mohammed.Moussaoui@uab.cat

Use of Languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Prerequisites

There are no official prerequisites, but it is assumed that the student has previously acquired enough solid knowledge on subjects like Chemistry or Celular Biology

Much of the literature is in the English language, which is also used in the figures used in theory classes.

Objectives and Contextualisation

In the Biochemistry course, the structural and functional characteristics of biomolecules from a basic and general point of view, focusing on proteins, and especially on enzymes, are studied in the first part. In a second part the concepts will be applied dynamically to understand the bioenergetics, the biosignalisation and the main routes of the metabolism. The general objective of the subject is to provide the basics of the molecular and metabolic aspects and concepts necessary for the monitoring of many subjects of the Degree of Genetics.

Specific objectives of the subject:

- Understand the fundamental structural features of biological molecules, knowing how to draw conclusions about their stability, their functionality and their capacity for replication of structures.
- Understand the kinetic concepts of enzymatic action in the context of the study of biological reactions and their regulation.
- Describe the general mechanisms through which living things get and transform the energy of the environment.
- To know the main molecular mechanisms of signal transduction.
- Describe the main routes of intermediate metabolism of glucids, lipids and nitrogen compounds, their regulation and coordination.
- Learn how to apply the knowledge studied to solve qualitative and quantitative problems.

Competences

- Be able to analyse and synthesise.
- Develop self-directed learning.

- Know and interpret the metabolic and physiological bases of organisms.
- Know and understand the underlying chemical basics of the molecular properties of genetic and biological processes in general.
- Recognise and structurally and functionally describe the different levels of biological organisation, from macromolecules to ecosystems.
- Understand and describe the structure, morphology and dynamics of the eukaryotic chromosome during the cell cycle and meiosis.
- Use and manage bibliographic information or computer or Internet resources in the field of study, in ones own languages and in English.

Learning Outcomes

1. Be able to analyse and synthesise.
2. Define the concepts of enzymatic catalysis and bioenergetics.
3. Describe the structure of DNA and its packaging levels.
4. Develop self-directed learning.
5. Explain and schematise the main metabolic pathways.
6. Identify the basic biological functions of biomolecules.
7. Recognise the chemical structure and the physical and chemical properties of biomolecules.
8. Resolve problems with the physical and chemical functions and properties of biomolecules.
9. Use and manage bibliographic information or computer or Internet resources in the field of study, in ones own languages and in English.

Content

THEORY

Topic 1. Basic concepts

General concept of biochemistry. Chemical elements present to living beings. Levels of structural organization of biomolecules. Types of links between molecules. Biological importance of water. Concept of pH and pK.

Topic 2. Proteins: functions and primary structure

Types of proteins and functions. Structure and properties of amino acids. Peptides and peptide link. Composition and sequence of amino acids of proteins.

Topic 3. Three-dimensional structure of proteins

Structuring levels of proteins. Description of alpha helix and beta pleated sheet. Fibrous and globular proteins. Folding of proteins. Quaternary structure.

Topic 4. Function and evolution of proteins: oxygen transport proteins.

Storage and transport of oxygen: myoglobin and hemoglobin as examples of protein evolution. Allosterism and cooperativity of hemoglobin. Different forms of hemoglobin: physiological adaptation and molecular pathology.

Topic 5. Enzymes, enzymatic kinetics and regulation.

Nature and function. Classification and nomenclature of enzymes. Effects of catalysts on chemical reactions. Enzymatic mechanisms. Enzymatic kinetics: Michaelis-Menten model. Enzymatic cofactors. Enzymatic inhibition. Regulation of enzymatic activity: allosterics, covalent modification and changes in enzyme concentration. Biomedical and biotechnological applications.

Topic 6. Glucids.

Types of glucose and functions. Monosaccharides, description and properties. Glycosidic link

Oligosaccharides. Polysaccharides Glycoproteins, proteoglycans and glycolipids.

Topic 7. Nucleic acids.

Nature and function. Nucleotides. Primary structure of nucleic acids. Secondary structure: Watson and Crick model and alternative structures. Tertiary structure: DNA transfer and super-proliferation RNA. Complex DNA-proteins: organization of chromosomes.

Topic 8. Lipids.

Types of lipids and functions. Storage pumps

Topic 9. Introduction to metabolism.

Concept of metabolism Biochemical and thermodynamic reactions: free energy in biological processes. Role of ATP and other phosphorylated compounds. Biological reactions of oxidation-reduction. Regulation of metabolic processes.

Topic 10. Biosignaling.

Extracellular chemical signals: hormones, neurotransmitters and growth factors. Properties of the signal transduction mechanisms. Signal transduction main systems: membrane and intracellular receptors.

Topic 11. Metabolism of glucose.

Degradation of glucose: glycolysis and pentoses phosphate pathway. Fermentation Gluconeogenesis. Synthesis and degradation of glycogen.

Topic 12. Central routes of oxidative metabolism.

Production of acetyl-CoA. Cycle of citric acid. Energy performance and regulation. Anaplerotic reactions.

Topic 13. Energy transitions: oxidative phosphorylation and photosynthesis.

Mitochondrial chain electron transport and oxidative phosphorylation. Respiratory control Chain of photosynthetic electron transport chain and photophosphorylation. Biosynthesis of glucides (Calvin cycle). Regulation of photosynthesis.

Topic 14. Lipid Metabolism.

Metabolism of fatty acids. Regulation of the metabolism of fatty acids. Ketogenesis. Cholesterol and lipoprotein metabolism.

Topic 15. Metabolism of nitrogen compounds.

Catabolism of amino acids. Excretion of nitrogen and urea cycle. Nitrogen fixation. Metabolism of nucleotides.

Topic 16. Integration of metabolism.

Specific tissue metabolism. Coordination between the metabolisms of the liver, muscle (skeletal and cardiac), adipose tissue and brain. Main regulatory hormones. Stress and adaptation of metabolism.

PROBLEMS

The problems refer to some aspects of the Theory program, such as chemical equilibrium and amortizing systems, enzymatic kinetics, Lambert-Beer law, free energy and constant equilibrium, reduction potential and

redox reactions. The collection of statements will be presented at the beginning of the semester through the Virtual Campus of the subject.

"*Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents."

Methodology

The training activities are divided into two sections: theory classes and problem classes. Each of them has its own specific methodology. These activities will be complemented by a series of tutoring sessions that will be programmed additionally.

Theory classes

The teacher will explain the contents of the syllabus with the support of graphic material (class presentations) that will be made available to students through the Virtual Campus of the subject.

These lectures will be the most important part of the theory section.

Problems classes

During the course, 10 hours will be devoted to class sessions of problems.

The group will be divided into two equitable subgroups in number, whose lists will be made public at the beginning of the course. Students will attend the sessions programmed by their group.

At the beginning of the semester, the dossier of statements of subject problems that will be solved during the course will be delivered through the Moodle classroom. The dossier will contain 5 blocks according to the problem agenda and each block will include 3-4 statements. The teacher will solve the problems of the dossier during the face-to-face sessions. If deemed necessary, the teacher will be able to impart supplementary theory material necessary to solve the problems corresponding to one of the blocks. It is advisable that students prepare the resolution of the problems as self-employed before the session, in order to optimize learning.

Tutorials

Individual tutorials will be carried out at the request of the students. In the event that the number of applications was extremely high, especially for partial examinations, up to 3 classroom tutorials that would be announced on a timely basis through the Virtual Campus could be carried out. The objective of these sessions will be to resolve doubts, review basic concepts. These sessions will not be exhibitable nor in them will be advanced matter of the official agenda, but will be sessions ofdebate and discussion.

Material available in the Moodle classroom of the subject

Teaching guide

Calendar of teaching activities (classroom, tutorials, assessments, deliveries ...)

Presentations used by teachers to theory classes

Dossier with statements of problems and complementary material

"*The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities."

Activities

Title	Hours	ECTS	Learning Outcomes

Type: Directed			
problems	10	0.4	2, 5, 7, 8, 1
theory	35	1.4	2, 3, 5, 6, 7, 8, 1, 9
Type: Supervised			
Delivery of questions proposed through the Virtual Campus	5	0.2	2, 3, 4, 5, 6, 7, 8, 1, 9
individual tutorials	5	0.2	2, 3, 5, 6, 7, 8, 1
Type: Autonomous			
problem resolution	25	1	2, 4, 5, 8, 1, 9
study	55	2.2	2, 3, 5, 6, 7, 8, 1, 9

Assessment

The evaluation of this subject will have the format of continued evaluation with a final test of recovery. To participate in the recovery, the students must have been previously evaluated in a set of activities whose weight equals to a minimum of two thirds of the total grade of the subject or module. Therefore, students will obtain the "Non-Valuable" qualification when the assessment activities carried out have a weighting of less than 67% in the final grade. The objective of the continuous evaluation is to encourage the student's effort throughout the semester, allowing to monitor their degree of follow-up and understanding of the subject. The final test of recovery is used to verify that the student has reached the necessary degree of integration of knowledge of the subject, in case of having suspended the continuous evaluation.

Theory

Individual assessment through:

Two partial tests with quiz questions and short answer questions.

A final test for recovering that will have the same format as the partial ones. This exam is aimed at students who have obtained a grade of less than 3.5 in partial tests.

The weight of the theory evaluation will be 75% of the total, 35% for each partial.

Problems

Individual assessment through:

Two partial tests where problems were solved in problem-solving blogs (2-3 problems for a partial test).

A final recovery test with problemscorresponding to the problem agenda. This exam is aimed at students who have not passed with grade of less than 3.5 in partial test.

The weight of the individual evaluation of problems will be 18% of the total.

Evaluation of synthesis problems:

Twice during the course, a summary problem will be given through the Moodle classroom that students willhave to solve in teams of 4 students and return to the teacher within the set period. Each of these synthesis problems will be corrected and evaluated. If a group does not deliver the problems or does it outside the set deadline, it will receive a score of 0. If a student delivers the problem individually and / or out of time, he will receive a rating of 0. It is the responsibility of the students checked that the computer file with the problem of synthesis resolved was delivered correctly in time and form. The qualification of this part will be calculated as the average of the qualifications of the two synthesis problems. The mark obtained will be the same for all the

team members, as long as all of them have participated in the resolution of the synthesis problem in an equivalent way. The involvement of the different members of the team will be checked by means of a small individual and confidential survey, where each member of the team will evaluate himself and the rest of the members. This note will modulate the note obtained in the synthesis problems. The weight of the evaluation of team problems will be 7% of the total.

Global evaluation

The two sections (Theory and Problems) are inseparable, so that the student must participate, and be evaluated, in both to overcome the matter. To be able to make the average of the marks between partial tests, without going to the final test of recovery, the student will have to obtain in each one of the partials a qualification equal or superior to 3,5. In addition, in the case of the problems, the global note of the problem module (ava individual + ava synthesis problems) must be equal to or greater than 3.5 to be able to ponder with the block of theoretical note.

If the global note of the problem module or the theory note is lower than the minimum marks required, it will not be possible to do the weighting and the subject will receive a maximum final grade of 3.5.

In the recovery examinations you must also obtain a qualification of 3.5 or more to be able to do the weighting.

Those students who have passed the partial proofs of theory and / or problems want to improve their qualification may choose to present themselves to the proof of recovery of the whole subject matter or one of the partial ones (theory and / or problems). The student who is present in the note will quit the note obtained above.

It is necessary to obtain a final grade equal to or greater than 5 to pass the subject, either through partial tests or through the final recovery test.

"*Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities."

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Delivery of answers to questions proposed through the Virtual Campus	5	3	0.12	4, 1, 9
Partial or final individual proofs of theory	70	6	0.24	2, 3, 4, 5, 6, 7, 1
answers to synthesis problems	7	3	0.12	4, 7, 8, 1
individual tests of problems partial or final	18	3	0.12	4, 7, 8, 1

Bibliography

THEORY (by alphabetical order)

- Mathews C.K., van Holde K.E and Ahern K. G. (2002) Biochemistry. 3rd ed. Ed. Addison / Wesley.

- McKee T. and McKee J.R. (2009) Biochemistry. The molecular bases of life. 4th ed. McGraw-Hill-Inter-American.

- Müller-Esterl W. (2008) Biochemistry: Foundations for Medicine and Life Sciences. 1st ed. Ed. I reverted

- Nelson D.L. and Cox M.M. (2016) Lehninger, Principles of Biochemistry. 7th ed. Ed. McMillan

- Stryer L., Berg J.M. i Tymoczko J.L. (2013) Biochemistry, with clinical applications. 7th. Spanish Ed. I reverted

- Stryer L., Berg J.M. i Tymoczko J.L. (2014). Biochemistry, Basic Course. Spanish Ed. I reverted

PROBLEMS

- Van Eikeren P. (1987) Lehninger Biochemistry Principles Guide. Ed. Omega ..

- Macarulla J.M., Marino A. and Macarulla A. (1992) Quantitative Biochemistry. Ed. I reverted

- Segel I.H. (1976) Biochemical Calculations. Ed. Wiley & Sons.

WEB LINKS

Check the updates in the Moodle space of the subject.