Universitat Autònoma de Barcelona

2023/2024

Biochemistry

Code: 102522
ECTS Credits: 6

Degree	Type	Year	Semester
2502444 Chemistry	OB	3	2

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject.
Please note that this information is provisional until 30 November 2023.

Prerequisites

There are no official prerequisites. However, it is assumed that the student has acquired the knowledge given in the first year subject of Fundamentals of Molecular and Cell Biology, especially those referring to enzymology and the structure and function of glucides, lipids, proteins and nucleic acids .

Objectives and Contextualisation

Context and objectives

The subject Biochemistry continues and complements a part of the contents given in the subject "Fundamentals of Molecular and Cell Biology". In the Biochemistry subject, the basic aspects of the metabolic pathways, the associated energy changes, their physiological significance, their interconnections and their response to biological signals are studied from a basic and general point of view.

The general objective of the subject is to provide an overview of the metabolism in living beings, as well as their regulation

Specific objectives of the subject are:

- To describe the general mechanisms through which living organisms obtain and transform the energy of the environment.

- To know the main molecular mechanisms for the transduction of biological signals.

- To describe the central pathways of the metabolism of glucides, lipids, amino acids and nucleotides.

- To know the components of the electronic transport chains, oxidative phosphorylation or photophosphorylation, and obtention of metabolic energy.

- To give an overview of the interconnections between the metabolic pathways, as well as the mechanisms that regulate them in a coordinated way and the changes in various physiopathological situations.

- To know how to apply the knowledge studied to solve qualitative and quantitative problems.

Competences

- Adapt to new situations.
- Communicate orally and in writing in one's own language.
- Evaluate the health risks and environmental and socioeconomic impact associated to chemical substances and the chemistry industry.
- Handle chemical products safely.
- Handle standard instruments and material in analytic and synthetic chemical laboratories.
- Learn autonomously.
- Manage the organisation and planning of tasks.
- Manage, analyse and synthesise information.
- Obtain information, including by digital means.
- Propose creative ideas and solutions.
- Reason in a critical manner
- Recognise and analyse chemical problems and propose suitable answers or studies to resolve them.
- Resolve problems and make decisions.
- Show an understanding of the basic concepts, principles, theories and facts of the different areas of chemistry.
- Show initiative and an enterprising spirit.
- Show sensitivity for environmental issues.
- Use IT to treat and present information.
- Work in a team and show concern for interpersonal relations at work.

Learning Outcomes

1. Adapt to new situations.
2. Apply the basic methods of recombinant DNA technology.
3. Communicate orally and in writing in one's own language.
4. Describe the basic methodologies of recombinant DNA technology for application to the expression of recombinant proteins.
5. Describe the processes and reactions that occur in biological systems.
6. Evaluate how dangerous biological samples and reagents are in a specific framework.
7. Explain the molecular bases of the organisation of living beings.
8. Identify the mechanisms that regulate the vital functions of living beings.
9. Identify the risks associated with the handling of biological samples and reagents.
10. Identify the risks involved in the handling of chemical compounds used in biological chemistry, and apply suitable protocols for the storage or elimination of the waste generated.
11. Learn autonomously.
12. Manage the organisation and planning of tasks.
13. Manage, analyse and synthesise information.
14. Obtain information, including by digital means.
15. Propose creative ideas and solutions.
16. Reason in a critical manner
17. Resolve problems and make decisions.
18. Show initiative and an enterprising spirit.
19. Show sensitivity for environmental issues.
20. Study enzymatic catalysis by means of modelling methods.
21. Use IT to treat and present information.
22. Use suitable strategies to handle and eliminate certain biological materials.

23. Work in a team and show concern for interpersonal relations at work.

Content

THEORY

Topic 1. Basics of metabolism.

Concept of metabolism and metabolic pathway. Experimental methods for the study of metabolism. Phases of metabolism. Free energy of biological processes. Coupled reactions. Role of ATP and other phosphorylated compounds in metabolism. Oxido-reductions in biochemical processes. Paper of the electron transporters in the metabolism.

Topic 2. Basic concepts of metabolic regulation.

Regulation of enzymatic activity. Allosteric enzymes. Regulation by covalent modification. General aspects of the regulation of gene expression. Control and compartmentalisation of metabolic pathways.

Topic 3. Biosignaling.

Hormones, neurotransmitters and other primary messengers. Membrane and intracellular receptors. Molecular mechanisms of signal transduction. Integration of effects at the cytoplasmic and nuclear level.

Topic 4. Glucid metabolism.

Degradation of glucose: glycolysis and pentose phosphate pathway. Fermentation. Gluconeogenesis. Synthesis and degradation of glycogen. Use of other glucides. Coordination in the control of the metabolism of glucose and glycogen: importance of the metabolic specialization of tissues.

Topic 5. Central routes of oxidative metabolism.

Metabolic pathways leading to the formation of acetyl-CoA. The complex of the pyruvate dehydrogenase. Cycle of the citric acid. Energy performance and regulation. Anaplerotic reactions. Amphibolic nature of the cycle: connections with biosynthetic pathways. Glioxylate cycle.

Topic 6. Electronic transport and oxidative phosphorylation.

Mitochondrial electronic transport chain. Origin and use of reduced substrates. Chemiosmotic coupling: ATP synthase and oxidative phosphorylation. Mitochondrial transport systems. Regulation of oxidative phosphorylation. Energy balance of oxidativemetabolism (example of glucose). Decoupling proteins and thermogenesis.

Topic 7. Photosynthesis.

Basic process of photosynthesis. Photosynthetic pigments. Absorption of the energy of light. Electronic transport and photophosphorylation. Assimilation of CO_2 and photosynthesis. Biosynthesis of glucides (Calvin cycle). Regulation of photosynthesis. Photorespiration and C4 cycle.

Unit 8. Metabolism of lipids.

Use of triacylglycerols in animals. Metabolism of lipoproteins. Description and regulation of the oxidative pathway of fatty acids. Ketogenesis. Description and regulation of the biosynthetic pathway of fatty acids. Biosynthesis of triacylglycerols and phospholipids. Cholesterol metabolism and its derivatives.

Unit 9. Metabolism of nitrogen compounds: Metabolism of amino acids and nucleotides.

Nitrogen cycle. General characteristics of the synthesis and degradation of amino acids. Destination of carbon atoms of amino acids. Elimination of ammonia and urea cycle. Synthesis of amines of biological interest. Formation of creatine and phosphocreatine. General characteristics of the metabolism of purine and pyrimidine nucleotides. Synthesis of deoxyribonucleotides: regulation of ribonucleotide reductase. Biomedical applications of nucleotide analogues: AIDS, cancer.

Topic 10. Integration of metabolism.

Metabolic specialization of tissues. Metabolic characteristics of liver, muscle and adipose tissue. Metabolic adaptations to various physiopathological situations: Changes associated with the various nutritional states, the exercise and the effects of stress. Metabolic Alterations to Diabetes. Obesity Metabolic abnormalities in cancer. Biotransformation and drug detoxification.

PROBLEMS

The problems refer to some aspects of the Theory program. The own characteristics of the various parts of the Theory's agenda make the statements of the problems concentrate on certain aspects, such as the enzymatic reactions (oxidation-reduction, transfer of chemical group, etc.) that constitute the various stages of metabolism , Its regulation in response to the activation of different signaling pathways and the importance in various physiopathological conditions.

LABORATORY PRACTICES

There will be two laboratory sessions of four hours each:

1) Process of expression of a heterologous protein.
2) Process of expression of a heterologous protein (analysis of results). Determination of an enzymatic activity by monitoring a spectrophotometric signal. Determination of kinetic parameters under steady state conditions.

Methodology

Methodology
The training activities are divided into three sections: theory classes, problem classes and laboratory practices, each one with its specific methodology. These activities will be complemented by a series of tutoring sessions that will be programmed additionally. The following describes the organization and the teaching methodology that will be followed in these types of training activities.

Theory classes:
The content of the theory program will be taught mainly by the teacher in the form of master classes with audiovisual support. The presentations used in class by the teacher, will be available to the students in the Virtual Campus of the subject in advance at the beginning of each of the subjects of the course. It is recommended that students have the material published on the Virtual Campus in printed form in order to be able to follow the classes more comfortably. It is recommended that students regularly consult the books recommended in the Bibliography section of this teaching guide in order to consolidate and clarify, if necessary, the contents explained in class. It is also advisable that students use the links indicated on the Virtual Campus, which contain videos and animations related to the one explained in class.

Problem classes
During the course, 7 hours will be devoted to problem class sessions.

The statements of the problems will be delivered through the Virtual Campus in advance of the class of problems that must be addressed. It is intended that these classes serve to consolidate the contents previously worked in the theory classes and also so that the student becomes familiar with some of the experimental strategies used in biochemistry, with the interpretation of scientific data and the resolution of problems based on experimental situations real

Laboratory sessions
Each group in the morning and afternoon will be subdivided into subgroups, whose lists will be announced in advance. In order to ensure the smooth running of the practical sessions, only changes (in groups) that are clearly justified and accepted by the practice practitioners will be accepted. As a general rule, they will not be accepted other than those that involve the change of a student by another from a different group.
It is necessary to appear in the practices with a lab coat, splash protection goggles, the protocol of practices (available on the Virtual Campus) printed and previously read and a notebook to write down the observations made and the data obtained.
The practices, as well as their evaluation, will be carried out in groups of two people. After each session, a questionnaire will be delivered with the results of the experiment and the answers to the questions posed. The attendance to the practices is obligatory, except in cases where there is a documented just cause.

SECURITY WARNING IN THE LABORATORY
The student who is involved in an incident that may have serious consequences of security may be expelled from the laboratory and suspended the subject.

Tutorials
The purpose of these sessions is to resolve doubts, review basic concepts not explained in class and guide the sources of information consulted. These sessions will not be exhibited nor in them will be advanced matter of the official agenda, but will be sessions of debate and discussion. A class tutoring session will take place before the partial tests 1i2 and, at the request of the students, individual tutorials. In the event that the number of applications is high, they will be made. In addition, classroom tutorials that would be announced on time through the Virtual Campus.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Classes of problem resolution	7	0.28	2, 11, 3, 18, 5, 4, 20, 12, 13, 14, 16, 17, 21
Theoric classes	36	1.44	2, 11, 3, 5, 4, 12, 13, 8, 14, 16
practice sessions in the laboratory	8	0.32	1, 11, 18, 20, 12, 13, 9, 10, 14, 15, 16, 17, 21, 22, 6
Type: Supervised			
Tutor sessions	2	0.08	3, 5, 12, 13, 15, 16
Type: Autonomous			
resolution of the proposed questionnaire	10	0.4	11, 3, 20, 12, 13, 14, 15, 16, 17, 21
Problem solving	17	0.68	11, 3, 5, 20, 12, 13, 8, 14, 16, 17, 21

Study	46	1.84	11, 3, 5, 4, 20, 7, 12, 13, 8, 14, 16

Assessment

Theory

Individual evaluation through:

• Two partial tests with multiple choice questions and short answer questions. There are no conditions to take any of the scheduled tests. The total weight of the partial tests will be 70% of the final grade. The weight of each partial test will be proportional to the number of classes that enter the test.

Issues

Individual evaluation through:

• A test in which problems corresponding to the entire subject will be proposed and which will take place on the same day as the second partial exam. The weight of the evaluation of problems will be 15% of the final mark.

Practices

Group evaluation through:

• Presentation of the results obtained during the practices and the resolution of the proposed questionnaire. The attitude and behavior during the laboratory will also be taken into account.

Attendance at laboratory practices is mandatory. In case of justified absence in any of the practice sessions and not having the option of doing it in a group other than the one assigned, this session will not be considered in the calculation of the practice grade.

The weight of the evaluation of practices will be 15% of the total.

To pass the subject it is necessary to obtain an overall score equal to or greater than 5 points out of 10 and a minimum score of 3.5 in each of the partial tests and in the problem-solving test. If the grade is less than 3.5 in any of these tests, the maximum final grade will be 3.5 points out of 10.

single evaluation

The students who take advantage of the single evaluation system will take the test corresponding to the entire theory on the same day corresponding to the exam of the second part of continuous evaluation. The exam will have the same format as for continuous assessment and the grade obtained will account for 70% of the final grade for the subject. On the same day, the problems exam will be carried out, which will correspond to 15% of the grade. If in any of these tests you do not pass a grade of 3.5 or the sum of the different grades (theory, problems and practices) does not reach 5, you must go to recovery, to achieve at least these two minimum criteria to pass the subject .

Recovery test.

To participate in the recovery, students must have been previously evaluated in a set of activities whose weight is equivalent to a minimum of two thirds of the total grade for the subject or module. Therefore, the student body will obtain the qualification of "Not Evaluable" when the evaluation activities carried out have a weighting of less than 67% in the final qualification.

On the day of the recovery test, there will be a recovery test for the first set, another for the second set and another for problems. Students can apply to any of them. In the case of wanting to improve the grade, the student body may also take any of the tests: taking this new test (or tests) means giving up the first grade.

In the calculation of the course mark made from the recovery exam, each of the partials will have a weight proportional to the number of classes that the test trains. For the tests that have not been recovered, the grade obtained in the first instance will be used. If the grade is less than 3.5 in any of these tests, the maximum final grade will be 3.5 points out of 10.

Other considerations

Students who cannot attend an individual evaluation test for justified reasons (such as illness, death of a first-degree relative or accident) and provide the corresponding official documentation to the Degree Coordinator, will have the right to take the test in question at another date.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Presence in laboratory sessions and report elaboration	15%	18	0.72	1, 2, 11, 3, 18, 20, 12, 13, 9, 10, 19, 14, 15, 16, 17, 23, 21, 22, 6
Test problems	15%	2	0.08	3, 5, 7, 8, 15, 16, 17
Two partial test	70%	4	0.16	3, 5, 4, 20, 7, 12, 13, 8, 16, 17

Bibliography

Basic bibliografy (alphabetic order):

- Berg, J.M.,Tymoczko, J.L, Gatto, Jr., Stryer, L "Biochemistry" (2015). 8ª ed. Freeman, New York.

- Mathews,C.K., van Holde, K.E., Appling, D.R. and Anthony-Cahill, S.J., J.R. "Biochemistry" (2013) 4ª ed. PearsonEducation. Upper Saddle River.

- Nelson, D.L. and Cox, M.M. "Lehninger Principles of Biochemistry" (2017). 7ª ed. Freeman, New York.

- Voet D.and Voet J.G. "Biochemistry" (2011) 4ª ed. John Wiley and sons.

Web links
An up-to-date list is found in the Campus Virtual

Software

1. Microsoft Office
2. OpenOffice
3. LibreOffice
4. WPS Office
5. Calligra Office
6. Softmaker FreeOffice