VNIVERSITAT DE VALÈNCIA

Course Guide
34077 Biochemistry II

COURSE DATA

Data Subject	
Code	34077
Name	Biochemistry II
Cycle	Grade
ECTS Credits	6.0
Academic year	2019 - 2020

Study (s)

Degree	Center	Acad. year	Period
1201 - Degree in Pharmacy	Faculty of Pharmacy and Food Sciences	2	Second term
1211 - Double Degree in Pharmacy and Human Nutrition and Dietetics	Faculty of Pharmacy and Food Sciences	2	Second term

Subject-matter

Degree	Subject-matter	Character
1201 - Degree in Pharmacy	11 - Biochemistry	Basic Training
1211 - Double Degree in Pharmacy and Human Nutrition and Dietetics	1 - Asignaturas obligatorias del PDG Farmacia-Nutrición Humana y Dietética	Obligatory

Coordination

Name	Department
MONTERO PAU, JAVIER	30 - Biochemistry and Molecular Biology

SUMMARY

Biochemistry II is a second-year (second semester) basic subject of the Degree in Pharmacy (University of Valencia). This subject accounts for a total of 6 ECTS in the curriculum.

The aim of the course is to deepen the knowledge of Biochemistry and Molecular Biology. The course is focused on providing a deeper and integrated insight of the intermediary metabolism and the fundamental characteristics of the molecular mechanisms involved in the transmission of genetic information.

Part I. Intermediary metabolism. Pentose phosphate pathway. Gluconeogenesis. Glycogen metabolism. Metabolism of lípids, amino acids and nucleotides. Coordinate regulation of intermediate metabolism. Interdependence of the major organs in fuel metabolism. Main processes of fuel storage, mobilization and use during different physiological situations.

Part II. Structure and function of nucleic acids. Structure of nucleic acids. Genes and chromosomes. Denaturation and renaturation of nucleic acids. Replication, repair and recombination of DNA. Transcription and RNA maturation. Translation, protein maturation and posttranslational protein transport. Regulation of gene expression. Methods in molecular biology.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

It is recommended to have studied the subjects of General Chemistry, General Biology and Physical Chemistry. To study Biochemistry II must have completed Biochemistry I.
Basic knowledge of general chemistry and cell biology. Basic concepts of metabolism and bioenergetics. Hormonal regulation of metabolism. Metabolism of carbohydrates and their regulation. Metabolic fates of pyruvate. Citric acid cycle. Electron transport and oxidative phosphorylation.

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

1201 - Degree in Pharmacy

- To possess and to understand the knowledge in the different areas of study included in the formation of the pharmacist.
- To know how interpret, value and communicate relevant data in the different aspects of pharmaceutical activity, making use of information and communication technologies.
- Skill to communicate ideas, analyze problems and solve them with a critical mind, achieving team-working abilities and assuming leadership whenever required.
- Development of skills to update their knowledge and undertake further studies, including pharmaceutical specialization, scientific research and technological development, and teaching.
- Ability to collect and transmit information in English with a level of competence similar to the B1 of the Council of Europe.

- Develop know-hows for their professional career.
- Know how to apply the scientific method and acquire skills for managing the main bibliographic sources.
- Recognize the limitations and the need to maintain and update the professional competence, giving special importance to the self-learning of new knowledge based on scientific evidence.
- Understand and manage basic scientific terminology in the area of Biochemistry and Molecular Biology.
- Learn about the structure and properties of biomolecules and their relationship with the role, as well as their transformations in the cell.
- Understand the functioning of enzymes and their regulation.
- Learn about the mechanisms of production and transformation of energy.
- Know the major metabolic pathways and obtain an integrated view of the metabolism and its regulation.
- Know and understand the processes essential for the transmission of genetic information from DNA to protein.
- To carry out works of collection, preparation and conservation of plants, fungi and algae samples in order to study and identify these organisms by keys.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

- To understand the structure and properties of biological macromolecules and structure-function relationships.
- To know the basic mechanisms for energy generation and transformation.
- To know the main metabolic pathways and to have an integrated view of metabolism and its regulation.
- To understand the molecular mechanisms involved in the transmission, maintenance and regulation of genetic information.
- To develop the scientific method in the resolution of experimental work.
- To become familiar with literature and information sources of Biochemistry.
- To understand the multidisciplinary nature of biochemistry and its relationship to other sciences as well as its applications in health sciences.

DESCRIPTION OF CONTENTS

1. Gluconeogenesis

General features of gluconeogenesis. Precursors for the synthesis of glucose. Specific reactions of gluconeogenesis. Regulation of gluconeogenesis. Intertissue relationships in the hepatic synthesis of glucose.

2. Pentose phosphate pathway

Functions, tissue and subcellular localization. Reaction sequence. Regulation of pentose phosphate pathway.

3. Glicogen metabolism

General features of glycogen metabolism. Digestion of glycogen. Glycogen breakdown. Glycogen synthesis. Control of glycogen metabolism.

4. Lipid catabolism

Digestion, absorption and transport of dietary lipids. Mobilization of triacylglycerols stores. Fatty acid oxidation. Metabolism of ketone bodies.

5. Lipid biosynthesis

Lipogenesis: biosynthesis of fatty acids and triacylglycerols. Regulation of fatty acid metabolism. Coordinated regulation of synthesis and degradation of fatty acids. Cholesterol biosynthesis.

6. Metabolism of plasma lipoproteins

Definition, classification and characteristics of major lipoproteins. Transport of lipoproteins. Endocytosis of LDL. Regulation of synthesis and transport of cholesterol.

7. Amino acid metabolism

Introduction to amino acid catabolism. Origin and fate of amino acids in mammals. Catabolism of amino acids. Nitrogen excretion and the urea cycle. Fate of amino acid carbon skeletons. Biosynthesis of nonessential amino acids in mammals.

8. Nucleotide metabolism

De novo synthesis of purine ribonucleotides and salvage pathways. De novo synthesis of pyrimidine ribonucleotides. Formation of deoxyribonucleotides. Degradation of nucleotides.

9. Integration of metabolism and tissue and organ specialization

Introduction. Interdependence of the major organs in fuel metabolism. Main processes of fuel storage, mobilization and use during the well-fed state, starvation, exercise, excessive alcohol consumption and in diabetes mellitus.

10. Genes and chromosomes

The Human Genome. Conformation of DNA: conformational variations and unusual structures. Tertiary structure: supercoiling of DNA. Structure of RNA. Forces stabilizing nucleic acid structures: denaturation and renaturation. Eukaryotic chromosome structure: chromatin.

11. DNA replication

General features of DNA replication. Enzymology of replication: DNA polymerases. Other proteins involved in replication. General scheme of the replication complex in the replicative fork of prokaryotes: the replisome. Bacterial chromosome replication. Replication in eukaryotes. The cell cycle. Replication initiation. Completion of replication: telomeres and telomerase. Compounds that inhibit replication.

12. Mutation, repair and recombination

Concept and classification of mutations. Biological effects. Causes and mechanisms of mutations. DNA repair. Direct reversal of damage. Mismatch repair. Excision repair. The SOS response. Double-strand break repair. Recombination. Homologous and site-specific recombination. Mobile genetic elements. Retrotransposition.

13. Transcription and RNA maturation

Transcription definition. RNA polymerases. Transcription in prokaryotes. Initiation, elongation and termination of transcription. Promoters and general transcription factors in eukaryotes. Elongation and termination in eukaryotes. Transcription in mitochondria. Transcription inhibitors. Posttranscriptional processing of mRNA. Capping, polyadenylation and splicing. Ribosomal and transfer RNA processing.

14. Translation

The genetic code. The transfer RNA. Ribosomes: structure and general characteristics. Translation: generalities and direction. Stages of translation. Translation in eukaryotes. Inhibitors of protein synthesis. Protein maturation and posttranslational protein transport. Transport of proteins, the signal peptide. Glycosylation of proteins. Other posttranslational modifications. Degradation of proteins, the lysosomal system, the proteasome.

15. Regulation of gene expression in eukaryotes

Introduction: levels of regulation of gene expression. Promoter elements and enhancer sequences. Eukaryotic regulatory proteins. Binding and activation motifs. Regulation of expression at the level of chromatin: molecular mechanisms of transcriptional control in eukaryotes. RNA interference. Other levels of regulation.

16. Methods in Molecular biology

Purification of nucleic acids. Enzymes used in molecular biology. Electrophoresis of nucleic acids. Hybridization. PCR and RT-PCR. Sequencing of nucleic acids. Cloning of DNA: cloning and expression vectors, transformation methods, search and selection of genes. cDNA and genomic libraries. Directed mutagenesis. Genomics and proteomics. Transgenic animals.

17. Practicals

Determination of metabolites in blood from well-fed or fasted rats. Digestion of plasmidic DNA with restriction endonucleases. Visualization of the fragments generated by electrophoresis. Determination of the size of the fragments. Elaboration of the restriction map.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	38,00	100
Laboratory practices	15,00	100
Tutorials	3,00	100
Seminars	2,00	100
Development of group work	2,00	0
Study and independent work	58,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	5,00	0
TOTAL	**148,00**	

TEACHING METHODOLOGY

Lectures. The teacher will develop the essential concepts of the subject.

Group tutorials. They will be held in groups of 16 students, according to the established time-table. These sessions should reinforce the concepts presented in the lectures and should encourage the active participation of students. To do this, the teacher will propose questions to be discussed during the session. Also, it is the ideal means for students to raise questions or issues that may arise during the course. This will reveal how students assimilate concepts, identify any gaps or failures in the learning system and directly assesses the student's work.

Practicals. They will be held in groups of 16 students. They should allow students to become familiar with some basic techniques of biochemistry and molecular biology, to acquire some skills in lab work and to critically analyze the results, as well as to complement the concepts learned during the lectures. Attendance will be compulsory. There will be 3 laboratory sessions in groups of 2 students. Once finished, each working group should elaborate and present a written results report.

Seminars. They will consist in the realization of complementary activities about specific topics proposed by the responsible teacher within the general objectives of the subject. These activities can consist in the realization of exhibitions, case studies, work analysis, problem solving or discussion of current issues among others.

EVALUATION

1. **Theory** (70 points). Written final exam that will consist of short questions and multiple choice questions.

2. **Practice** (20 points):

- **Written test** (15 points). Final exam written on a practical case and short or test questions about the procedures performed during the practice sessions.

- **Laboratory work** (5 points). The attitude and the correct execution of the practical procedures will be valued, as well as a memory of the results.

3. **Seminars** (10 points). The evaluation method will be in accordance with the nature of the proposed activities, which may include the resolution of short exams, the delivery of reports, the evaluation of class participation or the quality of oral presentations, among others.

To pass the subject a score equal to or greater than 50 points out of 100 is needed, taking into account the following limitations:

a) For written tests, theory or practice, a minimum of 30 points will be accepted in the theory exam or a minimum of 6 points in the practical exam as compensable, provided that the total sum of both tests is 42 points.

b) In the case of laboratory work and seminars there is no minimum score, but they will only taken into account if the sum of the two exams (theory and practice) reaches the minimum of 42 points.

The student who does not pass the subject in the first call may keep for the second call of the same academic year the mark of the theoretical exam when it is equal or superior to 35 points, or the mark of the practical exam, when it is equal or superior to 7.5 points. In any case, the note obtained in the seminar and the laboratory work note will be kept.

In case of failling the subject, the realization of the laboratory practices will be optional in the following courses, as long as they have been done at least onece. Likewise, the qualification of laboratory work will be maintained from one course to another, but not the scores of the written tests or seminars.

REFERENCES

Basic

- STRYER, L.; BERG, J.M.; TYMOCZKO, J.L. Bioquímica. 7ª ed., Ed. Reverté, Barcelona, 2013.
- STRYER, L.; BERG, J.M.; TYMOCZKO, J.L. Bioquímica: Curso Básico. Ed. Reverté, Barcelona, 2014.
- VOET, D.; VOET, JG. and PRATT, CW. Fundamentos de Bioquímica. La vida a nivel molecular. 2ª ed., Ed. Panamericana. Madrid, 2007 (4ª ed. en inglés, 2011).
- FEDUCHI, E., ROMERO, C., BLASCO I., S. y GARCIA-HOZ, C.: Bioquímica Conceptos esenciales. 2ª ed., Ed. Panamericana. Madrid, 2015.
- NELSON, D.L. y COX, M.M.: Lehninger. Principios de Bioquímica. 5ª ed. Ediciones Omega, Barcelona, 2009 (6ª ed. en inglés, 2013).
- VOET, D. and VOET, J.G.: Bioquímica. 3ª ed., Ed. Panamericana, Madrid, 2006.
- WATSON J.D.: Biología Molecular del Gen 5ª ed, Ed. Panamericana, Madrid, 2006.
- DEVLIN, T.M.: Bioquímica: libro de texto con aplicaciones clínicas. 4ª ed., Ed. Reverté, Barcelona, 2004. (7ª ed. en inglés, 2010).

Additional

- ALBERTS, B. Biología Molecular de la célula. 5ª ed. Ediciones Omega, Barcelona, 2010.
- HORTON, H.R., MORAN, L.A., SCRIMGEOUR, K.G. y RAWN, J.D.: Principles of biochemistry. 4th ed., Prentice-Hall, New Jersey, 2006.
- LODISH, BERK, MATSUDAIRA, KAISER; KRIEGER; SCOTT; ZIPURSKY, DARNELL. Biología Celular y Molecular. 5ª ed., Ed. Panamericana, 2005
- MATHEWS, C.K., VAN HOLDE, K.E., AHERN, K.G.: Bioquímica. 3ª ed., Pearson Education (Addison Wesley), Madrid, 2002.
- McKEE, T. y McKEE, J.R. Bioquímica. Las bases moleculares de la vida. 4ª ed. McGraw-Hill/Interamericana, Madrid, 2009.

- PERETÓ, J., SENDRA, R., PAMBLANCO, M. i BAÑÓ, C.: Fonaments de bioquímica. Servei de Publicacions de la Universitat de València, Valencia, 2005.
- STRYER, L.; BERG, J.M.; TYMOCZKO, J.L. Bioquímica. 6ª ed., Ed. Reverté, Barcelona, 2013 (versión en catalán).

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

1. Contents

The contents initially included in the teaching guide are maintained

2. Volume of work and temporary planning of teaching

Maintenance of the weight of the different activities that add up to the hours of dedication in ECTS credits marked in the original teaching guide. The number of sessions programmed for theory, tutorials, seminars and practices is respected. When using synchronous methodology, the date and duration originally assigned will be respected. In the case of asynchronous methodologies, the volume of work will correspond to that of a face-to-face session but the student will be free to carry them out according to his/her own schedule.

3. Teaching methodology

Tools for adaptation to theoretical teaching may include materials with voice recordings, synchronous and asynchronous videoconferences via BBC, videos with explanations, uploading of problems and solved exercises. In the case of practices, simulators or videos demonstrating laboratory techniques may also be used. For the tutorials it will be possible to use the assistance by e-mail, discussion forums in the Virtual Classroom and videoconferences.

4. Evaluation

The evaluation is modified and the weight of the final exam is reduced from 70% to 60% to give more weight to the continuous evaluation (20% of the grade). The evaluation of the practice part (20% of the grade) is kept as it was in the original guide. The evaluation is therefore configured as follows.

- Theory (60 points): a single final exam that will be taken online via Virtual Classroom and will consist of multiple choice questions, true/false, matching, gap-filling, etc. and with a limited completion time.

- Continuous evaluation (20 points): questionnaires with multiple choice questions, true/false, matching, gap-filling, etc. for each topic. This will be done on-line through the Virtual Classroom with no time limit and to be submitted before the exam date. They are implemented as a self-evaluation method that accompanies autonomous study.

- Practices (20 points distributed in 5 points for the work in the laboratory + 15 points for the exam): the work in the laboratory (5 points) will be evaluated on the attitude and the correct execution of the practical procedures, as well as a report of the results in the case of having done the practices in person, in the case of having done them virtually in this section the work and virtual participation and the delivery of problem solving or questions will be valued. The practice test (15 points) corresponds to a practice test that will consist of problems and questions implemented online through the Virtual Classroom and with a limited time of completion.

In order to pass the course, a score of 50 points or more out of 100 must be obtained, taking into account the following limitations:

a) For the written tests, theory or practice, a minimum of 24 points in the theory test or a minimum of 6 points in the practice test will be accepted as compensable provided that the total of both tests is 37.5 points.

(b) In the case of laboratory work and continuous assessment, there is no minimum cut-off score, but they shall be counted only if the sum of the two tests (theory and practice) reaches the minimum of 37,5 points.

The student who does not pass the subject in the first call may keep for the second call of the same academic year the mark of the theoretical exam when this is equal or superior to 30 points or the mark of the practice exam, when this is equal or superior to 7.5 points.

5. Bibliography

The recommended reference manuals are maintained and will be complemented with additional material from the teaching staff when deemed necessary.