COURSE DATA

Data Subject	
Code	33938
Name	Biochemistry II
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1205 - Degree in Human Nutrition and Dietetics	Faculty of Pharmacy and Food Sciences	2	First term

Subject-matter

Degree	Subject-matter	Character
1205 - Degree in Human Nutrition and Dietetics	7 - Biochemistry	Basic Training

Coordination

Name	Department
ANIENTO COMPANY, FERNANDO	30 - Biochemistry and Molecular Biology
MARCOTE ZARAGOZA, M.JESUS	30 - Biochemistry and Molecular Biology

SUMMARY

Biochemistry II is a second-year (first semester) basic subject of the Degree in Human Nutrition and Dietetics (Faculty of 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, Organic Chemistry and General Biology. 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.

OUTCOMES

1205 - Degree in Human Nutrition and Dietetics

- Capacidad de obtener, procesar e interpretar datos e información relevantes en el ámbito de la alimentación y la nutrición humana, haciendo uso de las tecnologías de la información y la comunicación.
- Capacidad para transmitir ideas, analizar problemas y resolverlos con espíritu crítico, adquiriendo habilidades de trabajo en equipo y asumiendo el liderazgo cuando sea apropiado.
- Desarrollar habilidades para emprender estudios posteriores y actividades de formación continuada.
- Know how to apply the scientific method and acquire skills for managing the main bibliographic sources.
- Adquirir la formación básica para la actividad investigadora, siendo capaces de aplicar el método científico a la resolución de un problema, comprendiendo su importancia y sus limitaciones en materia sanitaria y nutricional.
- Capacidad de integrar los contenidos estudiados en las diferentes materias cursadas en un conocimiento interdisciplinar aplicable al ámbito académico y profesional.
- Conocer los nutrientes, estableciendo así la base del equilibrio nutricional e integrando nutrición y alimentación en situaciones fisiológicas y patológicas, siendo capaces de planificar y protocolizar dietas y evaluar el estado nutricional de individuos y colectividades.

- Know the biochemical and biological principles applicable to human nutrition and dietetics.
- Understand and use basic scientific terminology related to the subject area.
- Know the structure and properties of biological macromolecules and their relationship with the function that they perform.
- Understand the operation of enzymes and their regulation.
- Know the mechanisms of production and transformation of energy.
- Know about the major metabolic pathways and obtain an integrated view of metabolism and its regulation.
- Know and understand essential processes in the transmission of genetic information from DNA to protein.
- Understand the molecular origin of the basic functions of living beings and the main biotechnological and medical implications.

LEARNING OUTCOMES

- 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. 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
Seminars	2,00	100
Tutorials	2,00	100
Development of group work	2,00	0
Study and independent work	55,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	5,00	0
Resolution of online questionnaires	3,00	0
TOTAL	**147,00**	

TEACHING METHODOLOGY

Lectures. They 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, as well as questionnaires to be carried out online through the Virtual classroom. 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. All students should prepare and give a seminar, which should focus on issues raised by the teacher responsible for the subject within the overall objectives of the same, and must follow the guidelines on coordinated seminars available at the web page of the Degree. The development of the seminar will be monitored through tutorials, to be agreed upon between the teacher and the students.

EVALUATION

1. Theory. Written exam: short questions and multiple choice questions. **70 points**.

2. Practicals: 20 points.

- Written exam: problems and short questions or multiple choice questions. **15 points**.
- Assessment of laboratory work and Results Report. **5 points**.

3. Seminar. 10 points.

Concerning seminar evaluation, written work, presentation, defence and proposed activities will be taken into account, according to the guidelines on coordinated seminars available at the web page of the Degree. The level of understanding of the contents as well as the skills for its presentation and discussion will be assessed.

The questionnaires and activities proposed for the tutoring sessions will be valued over **5 points** and will serve to raise the final grade as long as the student reaches the minimum required in the theory and practical exams, as detailed below.

To pass the course a total score of **50 POINTS** is required, with a **MINIMUM** of **32 points in the theory written exam** and of **6 points in the written exam of practicals**. In addition, at least a 30 % of the total score of each part of the subject has to be achieved in the theory exam. In the case these minimal requirements are not met, the final qualification will be “Fail“, and the final score (which cannot reach 5 points out of 10) will be the addition of the scores of the theory and practicals written exams, without considering the remaining issues (results report, questionnaries or activities and seminar).

Students who fail to pass in the first call will keep for the **second call** the score obtained in the theory written exam if they reach 35 points or the score of the practicals written exam if they reach 7.5 points. In addition, they will keep the score of the seminar and the Practicals Results Report.

Attendance to group tutorials, seminars and practicals is compulsory the first year in order to pass the subject.

REFERENCES

Basic

- NELSON, D.L. y COX, M.M.: Lehninger. Principios de Bioquímica. 6ª ed. Ediciones Omega, Barcelona, 2014 (7ª ed. en inglés, 2017).
VOET, D.; VOET, JG. y PRATT, CW. Fundamentos de Bioquímica. La vida a nivel molecular. 4ª ed., Ed, Panamericana. Madrid, 2016 (5ª ed. en inglés, 2016).
- FEDUCHI, E., BLASCO I., ROMERO, C.S. y YAÑEZ E.: Bioquímica Conceptos esenciales. 2ª ed. Ed. Panamericana. Madrid, 2016.
- STRYER, L.; BERG, J.M.; TYMOCZKO, J.L. Bioquímica. 7ª ed., Ed. Reverté, Barcelona, 2013 (9ª ed. en inglés, 2019).
- VOET, D. and VOET, J.G.: Bioquímica. 3ª ed., Ed. Panamericana, Madrid, 2007 (4ª ed. en inglés, 2010).
- WATSON J.D.: Biología Molecular del Gen 7ª ed, Ed, Panamericana, Madrid, 2016.
- 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. 6ª ed. Ediciones Omega, Barcelona, 2016.
- HORTON, H.R., MORAN, L.A., SCRIMGEOUR, K.G. y RAWN, J.D.: Principles of biochemistry. 5th ed., Prentice-Hall, New Jersey, 2012.
- LODISH, BERK, KAISER; KRIEGER; BRETSCHER, PLOEGH, AMON, SCOTT; Biología Celular y Molecular. 7ª ed., Ed. Panamericana, 2016 (8a ed. en inglés, 2016).
- MATHEWS, C.K., VAN HOLDE, K.E., AHERN, K.G.: Bioquímica. 3ª ed., Pearson Education (Addison Wesley), Madrid, 2002 (4ª ed. en inglés, 2012).
- McKEE, T. y McKEE, J.R. Bioquímica. Las bases moleculares de la vida. 5ª ed. McGraw-Hill/Interamericana, Madrid, 2014 (7ª ed .en inglés, 2019).
- PERETÓ, J., SENDRA, R., PAMBLANCO, M. i BAÑÓ, C.: Fonaments de bioquímica. Servei de Publicacions de la Universitat de València, Valencia, 2005.