VNIVERSITAT DE VALÈNCIA

Course Guide
33937 Biochemistry I

COURSE DATA

Data Subject	
Code	33937
Name	Biochemistry I
Cycle	Grade
ECTS Credits	6.0
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
1205 - Degree in Human Nutrition and Dietetics	Faculty of Pharmacy and Food Sciences	1	Second 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
MIRALLES FERNANDEZ, VICENTE	30 - Biochemistry and Molecular Biology

SUMMARY

Biochemistry I is a first year (second semester) basic subject of the Degree in Human Nutrition and Dietetics (University of Valencia). This subject accounts for a total of 6 ECTS in the curriculum.

The aim of the course is to provide an overview of the fundamentals of biochemistry and the characteristics of living matter from a molecular point of view, including the structure and function of biomolecules, enzymology, basic concepts of bioenergetics and an overview of metabolism and its regulation.

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. Basic knowledge of general chemistry: basic thermodynamics, chemical equilibrium, acid-base and redox reactions, functional groups, major interactions in aqueous solution and structure of biomolecules. Basic knowledge of cell biology: main organelles of eukaryotic cells

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

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 (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. Introduction.

Concept and historical perspective. Biochemical research today

2. Amino acids and primary structure of proteins

Amino acids: structure, properties and classification. Peptide bond: characteristics and properties. Primary structure: sequence determination and evolutionary relationships

3. Three-dimensional structure of proteins

Secondary structure: helix and sheet. Supersecondary structures. Tertiary structure. Domains. Quaternary structure. Folding and stabilization of proteins. Denaturation and renaturation of proteins. Structural classification of proteins: fibrous proteins and globular proteins

4. Isolation, purification and characterization of proteins

Concept. Physicochemical properties of proteins. Chromatographic methods. Dialysis and ultrafiltration. Electrophoresis. Isoelectric focusing. Electrophoresis.

5. Enzymes: Basic Concepts and enzyme kinetics

Nomenclature and classification of enzymes. Enzyme Kinetics: Factors affecting the rate of an enzymatic reaction. Effect of substrate concentration. Concept of steady state. Michaelis-Menten equation. KM Concept. Turnover number. Catalytic efficiency. Transformations of the Michaelis-Menten equation. Effect of enzyme concentration, pH and temperature. Kinetics and mechanism of bisubstrate reactions

6. Enzymes: catalytic mechanisms

Active center: concept and general characteristics. Identification of functional groups essential for enzymatic catalysis. Factors contributing to the catalytic efficiency of enzymes. Factor proximity and orientation. Distortion and destabilization factor: Preferential transition state binding. Metal-ions catalysis. Covalent catalysis. General acid-base catalysis. Coenzymes: an overview

7. Regulation of enzyme activity

Reversible and irreversible enzyme inhibition. Different types of reversible inhibition: competitive, uncompetitive, and mixed inhibition. Enzymatic regulation by covalent modification. Activation of zymogens. Isoenzymes: concept, features and clinical applications. Allosteric enzymes. Concept of cooperativity. Hill equation. Models of cooperativity

8. Carbohydrates

General classification of carbohydrates and their function. Major monosaccharides and their derivatives. Disaccharides and homopolysaccharides. Complex carbohydrates

9. Lipids

Importance, functions and general characteristics. Classification. Storage Lipids. Membrane lipids

10. Nucleotides and Nucleic Acids

Chemical structures of the nucleotides. Chemical composition of nucleic acids

11. Introduction to metabolism

Basic concepts of metabolism. Thermodynamic principles applied to living systems. Potential transfer of phosphate groups. Reducing potential.

12. Organization and control of metabolic pathways

Characteristics of the metabolic pathways. Overview of the metabolic pathways. Intertissue relationships.

13. Hormonal regulation of metabolism: basic concepts

Role of hormones in metabolism. Hormone receptors. Hormonal Mechanisms of action

14. Glycolysis

Introduction to the metabolism of carbohydrates. Glucose transporters. React sequence: preparatory phase and phase of benefits. Some glycolytic enzyme reaction mechanisms. Key regulatory enzymes and their control. Metabolism of other hexoses: fructose, galactose and Mannose

15. Metabolic fates of Pyruvate

Lactic and alcoholic fermentations. Entry of pyruvate into aerobic metabolism: conversion to acetyl-CoA

16. The citric acid cycle

Overview. Reaction sequence and energy conservation. Control mechanisms of the citric acid cycle. Amphibolic nature and anaplerotic reactions

17. Electronic transport and oxidative phosphorylation

Overview. Mitochondrial electron transport chain. Chemiosmotic theory and mechanisms of electrochemical proton gradient generation. Oxidative phosphorylation. Inhibitors and uncouplers. Mitochondrial transport systems. Energy efficiency of oxidative phosphorylation. Integrated control of the ATP synthesis. Free radicals

18. Practicals

Isolation and purification of the enzyme invertase. Determination of enzymatic activity and protein concentration. Evaluation of the purification process. Enzyme kinetics

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. The 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. Each group must hand in a written report on the proposed topic, including references used for the preparation thereof and a copy of the artwork used in the presentation. The exhibition theme will be proposed in public session and it will

use any means of presentation that the group members see fit. After the presentation, open discussion among participants, moderated by the teacher.

EVALUATION

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

2. Practicals: 20 points.

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

3. Seminar. 10 points.

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 **30 points in the theory exam** and **6 points in the practicals 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 in the remaining calls.

Attendance to group tutorials, seminars and practicals is mandatory 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. and 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, 2006.
  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).
  -STRYER, L.; BERG, J.M.; TYMOCZKO, J.L. Bioquímica. 6ª ed., Ed. Reverté, Barcelona, 2013 (versión en catalán).
  -PERETÓ, J., SENDRA, R., PAMBLANCO, M. i BAÑÓ, C.: Fonaments de bioquímica. Servei de Publicacions de la Universitat de València, Valencia, 2005.

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. Content

There will be no change in the contents initially included in the teaching guide.

2. Workload and temporary education planning

The workload for the student, derived from the number of credits, remains unchanged as well. However, the methodology of the activities changes with respect to the conventional teaching guide as a result of the current situation, which made it necessary to adopt a hybrid model of teaching.

3. Teaching methodology

• Theoretical teaching: will be carried out through synchronous sessions (videoconferences synchronized on BBC, or other technology indicated by the Centre) and face-to-face teaching. The students will be distributed into two groups, 50% of the total number of students in each one. While one group learns in the classroom of the Faculty, the other will connect online, alternating their attendance every week. The classes will always be held following the schedule (date and time) approved by the Center Board.

• Tutoring: All sessions will be held face-to-face according to the dates set by the course calendar.

• Coordinated or uncoordinated seminars: All sessions will be held face-to-face according to the dates set by the course calendar.

• Practical classes: All sessions held face-to-face and according to the calendar of the course, but with the appropriate modifications to comply with the safety regulations against CoVid19. These regulations include:

- Limiting the capacity of laboratories to 50% by setting shifts for each group.

- Use of audiovisual descriptions that serve as a pre-practice introduction (virtual classroom).

- Reducing the time spent on sample processing times by showing the student the result that would be obtained if standard incubation times (24 hours) had elapsed, etc.

If a state of total confinement were to be reached, all face-to-face teaching would be done online.

4. Evaluation

If the evolution of the current pandemic allows it, it will be face-to-face and in the terms indicated in the teaching guide. Only in the event that this is not possible, the evaluation will be carried out through the virtual classroom with online tasks or questionnaires and/or through an oral examination by videoconference.

The relative weight of the theory, practicals and seminars is maintained as indicated in the teaching guide.