COURSE DATA

Data Subject	
Code	34068
Name	Biochemistry I
Cycle	Grade
ECTS Credits	6.0
Academic year	2017 - 2018

Study (s)

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

Subject-matter

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

Coordination

Name	Department
TORRES ASENSI, LUIS	30 - Biochemistry and Molecular Biology

SUMMARY

Biochemistry I is a second year (first 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 provide an overview of the fundamentals of biochemistry. The course is focused on provide a basic knowledge about the fundamental characteristics of living matter from a molecular point of view.

The course is organized in a total of 6 blocks, which are summarized below:

- Part I. Introduction to Biochemistry
- Part II. Structure and function of proteins.
- Part III. Enzymology.
- Part IV. Structure of important biomolecules.
- Part V. Introduction to metabolism and bioenergetics.
- Part VI. Intermediary metabolism.

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. 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.

OUTCOMES

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

- 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 role 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
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.

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.

To pass the course a total score of **50 POINTS** is required, with a **MINIMUM** of **30 points in the written exam** and of **10 points in practicals**.

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.

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).