



BIOCHEMISTRY COURSE SYLLABUS

Academic Year 2016-2017

1. COURSE DESCRIPTION

Degree:	Biotechnology
Double Degree:	No
Course:	Biochemistry: metabolism and its regulation
Module:	Molecular Biology
Department:	Molecular Biology and Biochemical Engineering
Academic Year:	2016-2017
Term:	Fall
Total Credits:	6
Year:	2016-2016
Type of Course:	Fundamental
Course Language:	English

Teaching model:	B1	
a. General/background:		60%
b. Theory-into-practice/developmental knowledge-building		40%
c. Guided Academic Activities:		



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2. COURSE COORDINATOR

Name:	Francisco J. Bedoya Bergua
School:	Experimental Sciences
Department:	Molecular Biology & Biochemical Engineering
Academic Field::	Biochemistry & Molecular Biology
Position	Professor
Office hours:	Tuesday, Wednesday & Thursday, 12- 14 pm Request of appointment by e-mail through the portal of the course at the Virtual Classroom
Office No.:	Building 22, room 3-08
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3. ACADEMIC CONTEXT

3.1. Course Description and Objectives

The course seeks to explore the molecular bases of life. Emphasis will be placed on chemical transformations underlying metabolic features in animal cells and tissues.

The aims of the course can be summarized as follows:

1. Description and integration of the metabolic pathways that play a role in the handling of energy processes in cells.
2. Description of the molecular bases of the major cellular processes.
3. Knowledge of the main signaling pathways that control cell metabolism
4. Application of knowledge to solve exercises related with metabolic pathways and its alterations.

3.2. Contribution to the Training Plan

The course addresses the knowledge of chemical changes occurring in cells from the perspective of its basic support of vital functions of growth, replication, maintenance of structure and integrity of the cell and its response to the environment. Achieving the objectives of the course will provide the student with tools to understand the close coordination in the functioning of metabolic pathways and for the study subjects such as Genetic Engineering, Microbial Physiology and Metabolism and Molecular Genetics in the module of Biochemistry and Molecular Biology .



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3.3. Recommendations or Prerequisites

It is recommended that students have background knowledge in cell biology, organic chemistry, structure of biomolecules, bioenergetics and enzymology. In addition, the students should be fluent in written and spoken English and have experience in text processing programs, scientific citation and in the handling of the Virtual Classroom Application.



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4. SKILLS

4.1 Degree Skills Developed during this Course

- 1) Based on the expertise of a level of secondary education, to know and understand completely the basic facts, concepts, principles and theories in connection with the study of living things and their interplay with human activities.
- 4) Develop methods of acquisition, interpretation and analysis of information together with a critical understanding of the appropriate contexts for its use, suitable for applying the knowledge in a professional way and to demonstrate the acquired skills through the development and sustaining of arguments and problem solving in the field of Biotechnology.
- 5) Develop learning skills needed to undertake later studies with a high level of autonomy.
- 6) Know and understand the general biological processes from a molecular, cellular and physiological perspective.
- 7) Know and understand the information obtained from the biological processes and its adjustment to the theoretical frame for the subjects taught.
- 8) Use rigorous terminology, nomenclature and systems classification in each of the subjects taught.
- 9) Acquire basic experimental skills appropriate to each of the subjects taught that enable the description, quantification, analysis, and critical evaluation of experimental results obtained autonomously.
- 12) Ability to generate responsible initiatives at work
- 13) Raise awareness of the relevance of team work and critical discussion of common objectives

Specific Skills of the Training Plan in Biotechnology

- 55) Describe, integrate and solve problems on the different metabolic pathways and their control mechanisms
- 57) Be able to measure metabolic activities, as well as to understand and interpret the results obtained in the assays of activities related with metabolic pathways, organisms and defined growth conditions, both in the nature and under experimental conditions, and finally
- 58) Be able to connect the findings with biotech applications such as remediation of pollutants or the generation of metabolites of interest.



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4.2. Module Skills Developed during this Course

3. Describe, integrate and solve problems on the different metabolic pathways and their control mechanisms
4. Describe the molecular mechanisms of key cellular processes
6. Work properly in biochemistry and biology laboratories molecular, including safety and waste handling

4.3. Course-specific Skills

Develop the concept of metabolic fluxes and metabolic networks

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5. COURSE CONTENT (COURSE TOPICS)

General Topics

1. General features of metabolism
 - 1.1. Structure and types of metabolic pathways
 - 1.2. Principles and types of metabolic regulation
2. Citric acid cycle, the respiratory chain and phosphorylative oxidation
 - 2.1. Role in cell metabolism
 - 2.2. Cycle description. Anaplerotic reactions
 - 2.3. Structure of the respiratory chain and energetics of electronic transport
 - 2.4. Oxidative phosphorylation. Structure of ATP synthase.
 - 2.5. Control of electronic transport and oxidative phosphorylation
3. Carbohydrate metabolism
 - 3.1. Glycolysis. Metabolic basis of Pasteur and Warburg effects
 - 3.2. Transformations of pyruvate: fermentations and oxidative decarboxylation
 - 3.3. Pentose phosphate pathway
 - 3.4. Neoglucogenesis
 - 3.5. Synthesis and degradation of glycogen
4. Lipid metabolism
 - 4.1. Plasmatic lipoproteins
 - 4.2. Fatty acid degradation
 - 4.3. Fatty acid synthesis
 - 4.4. Isoprenoid metabolism
 - 4.5. Metabolism of membrane lipids and icosanoids
5. Amino acid metabolism
 - 5.1. Degradation of the amino group
 - 5.2. Degradation of the carbon backbone
 - 5.3. Biosynthesis of amino acids
6. Metabolism of nucleotides
 - 6.1. Degradation of purine and pyrimidine nucleotides
 - 6.2. Recycling and biosynthesis of purines and pyrimidines

Theory-into-practice/developmental knowledge-building

There are two types of activities:

1. Laboratory sessions
Throughout sessions the student will learn to work in the laboratory of biochemistry. For that, the student will learn how to use the measuring equipment, will carry out experiments that show the metabolic transformations of selected biomolecules and above all, will develop the fundamentals of metabolic analysis
2. Problem sessions
The student will apply the acquired knowledge to solve problems in cell metabolism



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Laboratory Session 1

Cell Fractionation

- Separation Methods: Separation of nuclei, mitochondria and cytosol
- Markers for cell constituents

Laboratory Session 2

Quantification of Oxidative Damage

- Production of oxidative damage
- Determination of final end products
- Quantification of damage
- Quantification of protection

Laboratory Session 3

Lipid Metabolism

- Separation and determination of lipoproteins
- Determination of Triglycerides
- Identification of ketone bodies

Laboratory Session 4

Metabolism of Nitrogenated Biomolecules

- Analysis of urea
- Analysis of uric acid
- Analysis of transaminases

2. Problem Sessions

Problem Session 1

Metabolism and biological oxidations

- Bioenergetics
- Citric acid cycle
- Oxidative phosphorylation

Problem Session 2

Carbohydrate metabolism

- Glycolysis
- Glycogen metabolism
- Pentose phosphate pathway



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Problem Session 3

Lipid Metabolism

- Lipolysis
- Synthesis of ketone bodies
- Biosynthesis of cholesterol and fatty acids

Problem Session 4

Metabolism of nitrogenous biomolecules

- Oxidation of amino acids and urea cycle
- Inborn errors of amino acid metabolism
- Biosynthesis of amino acids and nucleotides

6. METHODOLOGY AND RESOURCES

Methodology

Lectures of 60 min. supported with slide presentations.

Problem solving sessions with individual and team work.

Laboratory sessions with individual work

Personal work

Writing exams

Resources

Teaching laboratory

Webpage at Virtual Classroom (Blackboard, former WebCT): supplementary teaching material, chats, links to web pages, discussion forum, plagiarism prevention tool.

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7. ASSESSMENT

The assessment of the subject will be based on the following items:

- **General Topics**

It will be worth 60%

- Participation at the class (up to 1 point)
- Final exam (up to 5 points)
 - Can be taken at the end of the term and in July
 - The contents to be explored will be made public in advance

- **Theory-into-practice/developmental knowledge-building**

It will be worth 40%

- **Problem Session**

4 sessions are scheduled. The problems will be uploaded on the web page and they will be dealt with in the classroom. Students will work in teams and they will present the results in the class. For the presentation, students will be selected randomly among the members of the team. If the students are unable to explain the answers or fail to attend the classes, they will be scored negatively. Every session will be worth 0.5 points.
- **Laboratory Session**

4 sessions are scheduled. Assessment will be carried out by the presentation of a Laboratory log book and by taking a practice exam.

The Laboratory log book will be worth up to 1 point and the practice exam will be worth up to 1 point.

8. BIBLIOGRAPHY

Introductory Reading

- **Biochemistry Illustrated : biochemistry and molecular biology in the post-genomic era**

PN. Campbell, AD. Smith , T.Peters

Elsevier Churchill Livingstone 5th ed. 2005.

This book aims to provide a survey of biochemistry in a easy assimilable form. It is addressed to students who appreciate a sketchy summary of the subjects before starting a more advanced study required in this course

Available at the library



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Core Books

- **Lehninger Principles of Biochemistry** DL Nelson, MM Cox
WH Freeman & Co. 2013, 6th edition
This book has been the reference book for biochemistry students for more than 40 years. Metabolism is reasonably well addressed and it will be the core manual of the course.
The sixth English edition is available at the library
- **Biochemistry**
JM Berg
Freeman & Co. 2002, 5th edition
An alternative to Lehniger's biochemistry that is also available at the library