COURSE DATA

DATA SUBJECT

Code: 33134
Name: Metabolism and regulation
Cycle: Undergraduate Studies
ECTS Credits: 7.5
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1109 - Degree in Biochemistry and Biomedical Sciences	Facultat de Ciències Biològiques	3	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1109 - Degree in Biochemistry and Biomedical Sciences	Bioquímica	COMPULSORY

COORDINATION

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SUMMARY

Metabolism and Regulation is an obligatory course, which is taught in the third degree courses in second semestre in Biochemistry and Biomedical Sciences, University of Valencia. The course consists of 7.5 ECTS. As taught in 3rd degree course, students have some knowledge of Chemistry, Macromolecular Structure and Enzymology, Genetics, Cell Biology Bioenergetics topics necessary for this course. The course has a theoretical-experimental mixed, so the theoretical training is complemented by conducting experiments in the laboratory.

A living cell carries out thousands of reactions simultaneously, and each sequence of reaction is controlled so as not to accumulate or missing intermediates or products. Reactions occur by very complex mechanisms and stereochemical selectivity, in a gentle and non-extreme conditions. The main objective will be to understand how cells and higher organisms carry out and regulate these complex reactions. Any small failure of the system will be capable of producing a metabolic disease.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

COMPETENCES / LEARNING OUTCOMES

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Comprender e interpretar trabajos científicos relacionados con el metabolismo.

Comprender los mecanismos de control y regulación del metabolismo.

Conocer la naturaleza del metabolismo celular y sus rutas metabólicas.

DESCRIPTION OF CONTENTS

1. ITEM1. Overview of Intermediary Metabolism

General aspects of metabolism. Primary metabolism and secondary metabolism. Major pathways of primary metabolism. Architecture of metabolic networks and systems biology. Study of the mechanisms of regulation. Metabolic control theory.

2. ITEM 2. The acetyl-CoA and the citric acid cycle.

Origin and destination of acetyl-CoA. Destinations of pyruvate. Fermentations. Ethanol metabolism. Enzymatic steps and regulation of the citric acid cycle. Reactions related to the citric acid cycle.

3. ITEM 3. Carbohydrate metabolism in different cell types.

Glycolysis. Gluconeogenesis. Coordinated regulation in different cell types. Glyoxylate cycle. Glycogen synthesis and degradation. Route of the pentose phosphate.

4. ITEM 4. Extracellular and intracellular movement of lipids.

Lipoprotein metabolism and its regulation. Cholesterol metabolism and its regulation

5. ITEM 5. Lipid metabolism.

Fatty acid oxidation. Lipogenesis. Regulation of metabolism of fatty acids and triglycerides. Training and utilization of ketone bodies. Synthesis of other lipids.

6. ITEM 6. Amino acid metabolism.

Amino acid biosynthesis and degradation. Regulation of metabolism of amino acids. Toxicity of ammonium ion, and excretion of nitrogen in the urea cycle.

7. ITEM 7. Nucleotide metabolism.

Synthesis, catabolism and regulation of purine metabolism. Synthesis, catabolism and regulation of pyrimidine metabolism.

8. ITEM 8. Integration of metabolism.

Specialization of organs and hormonal control of metabolism.Regulatory elements of metabolism: AMPK, transcription factors, hormones, sirtuins. Examples of metabolic adaptations: periods of fasting, sports metabolism, diabetes. Cancer cell metabolism.

9. Class program laboratory practice

PRACTICE 1. Isocitrate dehydrogenase from yeast. Kinetic study of the activity-dependent isocitrate

dehydrogenase NAD + yeast in the absence and presence of an allosteric effector, AMP.
PRACTICE 2. Glucose catabolite repression of the gene of fructose-1 ,6-bisphosphatase yeast. Study of the specific activity of the gluconeogenic enzyme extracts from yeasts grown on medium with glucose or with gluconeogenic precursors.
PRACTICE 3. Glycogen biosynthesis in prokaryotes. Quantification of glycogen in cells of E. Coli cultured in poor or rich in nitrogen containing glucose or acetate as a carbon source.
PRACTICE 4. Metabolic adaptations to fasting. Redox state of cytosol and mitochondria. Quantitative analysis of metabolites in liver and rat serum in fasting and feeding conditions.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	3,00
Theory	50,00
Laboratory	20,00
Computer classroom practice	2,00
Total hours	**75,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	20,00
Independent study and work	42,50
Preparation of lessons	40,00
Preparation for assessment activities	0,00
Resolution of case studies	10,00
Total hours	**112,50**

TEACHING METHODOLOGY

The development of the course is divided into:

Classes of theory: Basically, we use the lecture model, offering the possibility to the professor to highlight the key concepts for understanding the issue and indicate the most suitable resources for further preparation of the subject in depth. We use PowerPoint presentations and videos that are available to students in the Virtual Classroom. On some issues, we will use the participatory model, focussing on communication between students and between them and the teacher. These classes will be complemented with the kinds of issues in which they proceed to propose questions and individual cases and their resolution, actively involving students in it.

Laboratory classes attendance are mandatory. These classes will carry out the specific application of the

knowledge that students have acquired in the lectures. With the objective that every student knows the goals and conduct is own experiments, in practical classes the student will be asked to fill a previous questionnaire. Also we will dedicated some time at the end of practical class to discuss issues and share all the results.

Practical classes in computer lab. Are compulsory. There will be a session of two hours. It will introduce students to the use of databases that contain information about enzymes and metabolic pathways and programs for stoichiometric analysis of metabolic networks. It will be a deadline to deliver written questions resolved.

Tutorials. It will be a session of three hours to discuss the results obtained in the laboratory experiments.

Seminars and other activities. Used to develop activities that allow students to expand their knowledge about the subject and relate them to other disciplines and to promote the acquisition of skills other than those acquired in the theoretical and practical classes. One of these activities will be critical analysis of scientific papers selected by the professors of the subject. This activity aims training the student in reading scientific papers (which necessarily involves technical reading in English) about the original literature from which we obtain new knowledge that allows the development and advancement of biomedical sciences. This activity is mandatory, will be organized jointly with the other courses in their third year, corresponding to each course between 3 to 6 papers, by number of credits. The preparation, presentation and discussion (30 minutes) of the items are held in groups of 2 students and will be supervised by the professor through tutoring.

It also considers the possibility of seminars given by experts in some field of research of the classes.

EVALUATION

Lectures: the knowledge will be evaluated with a theoretical test consisting of Test and questions to be developed. This test represents 75% of the grade and it is necessary to obtain a minimum score of 3 points.

Journal Club: an interdisciplinary activity will be carried out, consisting of the analysis and presentation of a research article. Their valuation represents up to 5% of the final grade.

Practical classes:

Laboratory sessions: the practices will be intensive and will be carried out over a week. The presentation of the results report and an exam that will be carried out in the tutorial sessions will be assesed.

Informatic Sessions: a computer classroom session will be held and a question will be given.

The assessment of practical classes: laboratory and Informatic Session will be 20% of the final grade.

Other considerations: In order to pass the subject it will be necessary to have obtained an overall grade equal to or greater than 5 out of 10 with the requirements mentioned above. In the case of suspension of the course, if the practices are passed (grade of 1 or higher), the grade for the following course will be maintained.

REFERENCES

- Reference b1: B. Alberts et al. Molecular Biology of the Cell 7 ed. (2022) W. W. Norton.
- Reference b2: L. Angius and H.S.A. Sherrat. Channelling in Intermediary Metabolism (1997) Portland Press Research Monograph
- Reference b3: T.H. Devlin, Bioquímica Libro de Texto con Aplicaciones Clínicas 4 ed (2004) Ed. Reverté, S.A
- Reference b4: K.N. Frayn and R.Evans. Human Metabolism. A Regulatory Perspective 4 ed. (2019) Wiley Blackwell Publishing
- Reference b5: C.K. Mathews, K.E. van Holde ,DR Appling y SJ Anthony-Cahill Bioquímica 4 ed. (2013) Ed. Pearson
- Reference b6: D.L. Nelson y M.M. Cox Lehninger Principles of Biochemistry 8 ed. Macmillan (2021)
- Reference b7: J. Peretó, R. Sendra, M. Pamblanco i C. Bañó. Fonaments de Bioquímica 5ed (2005) Universitat de Valencia
- Reference b8: JM Teijon, MD Blanco, RM Olmo, P Posada, C Teijon y A Villarino. Fundamentos de Bioquímica Metabólica Ed. Tébar Flores 4ª ed (2017)
- Reference b9: D. Voet, J.G. Voet y Ch.W. Pratt Fundamentos de bioquímica: La vida a nivel molecular. Ed. Panamericana, 4 ed., (2016)
- Review articles in specialized journals.