DEGREE CURRICULUM

BIOCHEMISTRY AND METABOLISM

Coordination: SANCHIS MORALES, DANIEL

Academic year 2023-24

BIOCHEMISTRY AND METABOLISM 2023-24

Subject's general information

<table>
<tr><td>Subject name</td><td>BIOCHEMISTRY AND METABOLISM</td></tr>
<tr><td>Code</td><td>100600</td></tr>
<tr><td>Semester</td><td>2nd Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Bachelor's Degree in Human Nutrition and Dietetics</td><td>1</td><td>COMMON/CORE</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>9</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
<table>
<tr><th>Activity type</th><td>PRALAB</td><td>PRAULA</td><td>TEORIA</td></tr>
<tr><th>Number of credits</th><td>1.5</td><td>3</td><td>4.5</td></tr>
<tr><th>Number of groups</th><td>3</td><td>2</td><td>1</td></tr>
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</td></tr>
<tr><td>Coordination</td><td>SANCHIS MORALES, DANIEL</td></tr>
<tr><td>Department</td><td>BASIC MEDICAL SCIENCES</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>All information in the program is in class attendance. The student has to prepare three presentations equipment (seminars metabolism disorders) for which attendance is also intended time (it is up to the student whether used or prepares independently). The autonomous student work focuses ideally in reviewing what is in class for their understanding and final maturation.</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>Catalan /Spanish
some material in English</td></tr>
<tr><td>Distribution of credits</td><td>Magisterial Classroom Activity 4.9
Practice 1.8
Seminar 2.3</td></tr>
</table>

BIOCHEMISTRY AND METABOLISM 2023-24

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
SANCHIS MORALES, DANIEL	daniel.sanchis@udl.cat	15	

Subject's extra information

Bibliography

1. Berg, J.M. Tymoczko, .L., Stryer, L. (2007) Bioquímica. 6ª ed. Editorial Reverté. (Versió en català i en castellà)
2. Biesalski, H.K., Grimm, P. (2007) Nutrición. Texto y atlas. Editorial Médica Panamericana. **
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6. Mathews, C.K., van Holde, K.E. Ahern, K.G (2002) Bioquímica. 3ª ed. Editorial Adisson-Wesley.
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8. Mckee, T., Mckee, J.R. (2003) Bioquímica. La base molecular de la vida. 3ª ed. Editorial McGraw Hill.
9. Voet, D., Voet, J.G., Pratt, C.W. (2007) Fundamentos de Bioquímica. 2ª ed. Editorial Médica Panamericana.

web resources:

BioRom: http://sebbm.bq.ub.es/BioROM/indices/index.html

MolviZ.org: http://www.umass.edu/microbio/chime/

Learning objectives

As for knowledge, the student must pass the subject:

1. Know the basic scientific terminology applied to biochemistry.

2. Recognize and classify the most important biomolecules that make up living things.

3. Know the basics of enzymology and regulation of enzyme activity and apply to human nutrition.

4. Recognize the mechanism of energy production from staple foods.

5. Know and differentiate the main routes of metabolism of carbohydrates, lipids, amino acids, nucleotides and its regulation.

6. Integrate different metabolic pathways using compounds and have an overview of metabolism.

7. Distinguish the role of the most important hormones in energy metabolism

8. Know the basic elements of a laboratory of biochemistry and basic to ensure reliability in the results and safety at work in the laboratory guidelines.

In terms of procedure, the student must pass the subject:

1. Understand and discuss basic scientific articles related to the biochemistry of human nutrition.

2. Knowing how to use the basic elements of a biochemistry laboratory.

3. Use spectrophotometric techniques to calculate parameters of metabolic importance

4. Know how to use electrophoretic techniques to separate macromolecules.

5. Analyze and compare the experimental results and assess their importance and limitations.

6. To collect basic information on a topic, prepare a summary and expose their peers.

7. Teamwork in solving problems.

Competences

Basic Training Block

CE1 To know the chemical, biochemical and biological fundamentals of application in human nutrition and dietetics.

General Competencies

CG4. Communicate effectively, both orally and in writing, with people, health professionals or industry and the media, knowing how to use information and communication technologies, especially those related to nutrition and lifestyle habits.

CG5. Know, critically evaluate and know how to use and apply the sources of information related to nutrition, food, lifestyles and health aspects.

Basic competences

CB2 The students have to know how to apply their knowledge to their work or vocation in a professional manner and possess the competencies and the skills that are usually demonstrated through the development and defense of arguments and problem solving within their field of study.

CB3 That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

CB4 The students have to be able to transmit information, ideas, problems and solutions to both specialized and non-specialized audiences.

CB5 The students have to developed those learning skills necessary to undertake further studies with a high degree of proficiency undertaking further studies with a high degree of autonomy.

Transversal Competences of the UdL

CT1 To have a correct oral and written expression

CT2 Mastering a foreign language

CT3 Mastering ICT

CT5. To acquire essential notions of scientific thinking.

BIOCHEMISTRY AND METABOLISM 2023-24

Subject contents

BIOCHEMISTRY AND METABOLISM

Structural Biochemistry and Enzymology

Item 1. Composition of the living matter. Water and buffer systems

• Constitution of living beings.
• Structure, characteristics and properties of water.
• Biological importance. Distribution in the human body.
• pH concept. Buffers of biological importance.

Item 2. I Biomolecules: Carbohydrates
• General characteristics and classification.
• monosaccharides: structure, properties, derivatives and biological interest.
• Disaccharides. The glycosidic bond. Maltose, cel.lobiosa, lactose and sucrose.
• Oligosaccharides. Structure, properties and biological interest.
• Polysaccharides booking. structure and function of starch and glycogen.
• structural polysaccharides. Cellulose, xylans, glucomannan, chitin.

Item 3. Biomolecules II: lipids
• General characteristics of lipids. Function and classification.
• Fatty acids. physicochemical properties and nomenclature.
• triacylglycerols.
• membrane lipids: glycerophospholipids, sphingolipids and cholesterol.
• Other lipids of biological interest: waxes, soaps, eicosanoids and isoprenoid

Item 4. Biomolecules III: proteins
• Structure, nomenclature and properties of amino acids.
• protein primary structure. The peptide bond.
• Secondary structure: helix and beta pleated sheet.
• Concept of tertiary structure. structural motifs and domains. native structure and denaturation.
• Quaternary structure: oligomeric proteins.
• Fibrous proteins: keratins and collagen.
• Globular proteins: myoglobin and hemoglobin.
• Technical study of proteins. Concept proteomic

Item 5. enzymes, enzyme kinetics and regulation
• Introduction to enzyme catalysis: activation energy.
• Nature, nomenclature and classification of enzymes. Concept isoenzyme.
• enzymatic reaction mechanisms: active center concept
• Prosthetic and coenzymes Groups.
• Effect of pH, temperature and ionic strength on the enzyme activity. Quantitative determination of enzyme activity
• Enzyme kinetics. Michaelis-Menten equation. Km and Vmax. Lineweawer-Burk representation.
• irreversible and reversible enzyme inhibition: competitive and noncompetitive.
• regulation of enzyme activity: covalent and al.lostérica.

Item 6. Vitamins and micronutrients
• Concept of vitamin and micronutrient.
• Fat-soluble vitamins.
• Water-soluble vitamins
• Micronutrients.

BIOCHEMISTRY AND METABOLISM 2023-24

Bioenergetics and Metabolism

Item 7. Introduction to bioenergetics
• concept of metabolism and metabolic pathway
• Free energy. Standard free energy change
• endergonic and exergonic reactions
Coupled reactions •
• Role of ATP
• oxidation-reduction concept
• Main mechanisms of metabolic regulation

Item 8. central routes of oxidative metabolism
• concept of metabolism and metabolic pathway
• Formation of acetyl-CoA: pyruvate dehydrogenase complex.
• citric acid cycle and regulation.
• Anaplerotic reactions
• Anabolic Role of the citric acid cycle

Item 9. Electronic transport and oxidative phosphorylation
• electron transport chain: stages and inhibitors.
• Hypothesis Chemiosmotic Mitchell
• The enzyme ATP synthase
• Launchers. ATP-ADP translocase.
• Energy efficiency
• Decoupling. thermogenesis
• generation of toxic oxygen radicals. physiological importance.

Item 10. glucose metabolism
• Glucolisis: stages, regulation and energy balance. physiological importance.
• Incorporation of other carbohydrates in the glycolytic pathway: galactose and fructose.
• metabolic fates of pyruvate
• anaerobic glycolysis: lactic fermentation.
• glycogen metabolism. Regulation.
• Gluconeogenesis: precursors, stages and regulation.
• Blood glucose monitoring: importance of different organs and tissues
• Via pentose phosphate: steps and regulation. physiological importance.

Item 11. Lipid metabolism
• Oxidation of (beta-oxidation) fatty acids. energy efficiency and regulation.
• Ketones. Origin and regulation. physiological importance.
• Biosynthesis of fatty acids and triglycerides.
• Cholesterol: biosynthesis and regulation.
• Degradation of cholesterol. Acids and bile salts.
• plasma lipoproteins: structure and function.

Item 12. Metabolism of amino acids and proteins
• protein catabolism. protein turnover.
• catabolism of amino acids: transamination and oxidative deamination.
• Urea cycle.
• Destination carbon skeleton of amino acids.
• ammonium metabolism.
• amino acid biosynthesis. Amino acids essential and nonessential.
• compounds Biosynthesis of amino acid derivatives.

Item 13. Metabolism of nucleotides
• Biosynthesis and pyrimidine nucleotides purínics. De novo synthesis and recovery mechanisms.
• Degradation and pyrimidine nucleotides purínics

• Biosynthesis deoxyribonucleotides

Methodology

KEYNOTE SESSIONS

49 Theoretical sessions of approximately 50 minutes where the teacher presents the theme, aided by computer equipment (presentations * * power- point, web pages, etc). These sessions aim to introduce the different topics in students, guide them in their assimilation, highlighting the most important points and facilitate integration globally. It is expected that during classes and encouraged by the teacher, the student contribution and contribute prior knowledge (prior to the completion of the course and prior agenda) and a dialogue to facilitate the teaching of the agenda is established. It is an important part of the course where teachers can go following the progress of the students individually, assessing interest, assistance and spontaneous moments of dialogue or intervention.

LAB PRACTICES

Practice 1. pH determination and measurement of buffered soultion efficiency
Determination of the pH of diverent combinations of phosphate buffer and their response to increasing HCl load.

Practice 2. Colorimetric determination of proteins
Determination of total serum protein concentration by colorimetric techniques. Biuret method. Performing a standard curve with bovine serum albumin.

Practice 3. Enzyme activity assay
Study of alcohol dehydrogenase activity. Catalyzes reaction and quantification strategies activity. Calculation of enzyme activity and specific activity. Determination of the constants Km and apparent Vmax.

Practice 4. Determination of ethanol in beverages
As the content of ethanol by spectrophotometric techniques in wine and beer. Test coupling of two reactions: alcohol dehydrogenase and acetaldehyde dehydrogenase. Determination of the concentration of ethanol from the measurement of NADH formed.

Practice 5. Study of iron metabolism.
Hematocrit determination
Determination of total iron from human serum
Comparison and discussion of results

Practice 6. Quantification of salivary amylase activity.

Measurement of salivary amylase activity on starch using spectrophotometric techniques.

Quantification of the students' salivary amylase activity on a starch sample, comparison with a free glucose pattern and calculation of the reducing carbohydrates released per unit of time.

Comparison and discussion of the results.

Practice 7. Measurement of cholesterolemia.

Determination of total cholesterol and HDL cholesterol in fasting plasma using spectrophotometric techniques.

Comparison and discussion of the results.

SEMINARS

Session about study techniques: how to handle information, organize and structure it to facilitate the learning process.

Structure of carbohydrates and lipids: Work in the computer room to assimilate various concepts of structure of carbohydrates and lipids seen in theory. (2h)

Protein Structure: Work in the computer room to assimilate various concepts of protein structure seen in a theory. (2h)

Troubleshooting enzymology: practical exercises to facilitate the assimilation of theoretical concepts of enzyme kinetics. (2h)

Pathologies arising from alterations in metabolism:

Students prepare in small groups (3-5 people) a presentation that integrates the knowledge acquired on aspects of metabolism and diseases resulting from alterations in metabolism, with the guidance and support of the teacher if they consider it. Then they expose their presentation in front of the class, in about 15-20 minutes. It gives time teaching hours of the subject and teacher support for the preparation and presentation of seminars.

Pathologies arising from alterations in the metabolism of micronutrients
Pathologies arising from alterations in carbohydrate metabolism

(There is available to students a guidance document for the preparation of proposals including seminars and advice to make this work)

Evaluation

- • Program of lectures: 55%. (5.5 points) Two exams about theoretical concepts made up of 24 (or 12) multiple choice questions and 4 (or 3) essay questions. It is necessary to obtain a 4 out of 10 in each theory test for it to average with the rest. It is necessary to pass each theory exam with a 4 or higher to pass the course.
  • Program of Seminars: 25%. Solving problems. Presentation of structural exercies performed during the class (2 sessions 0.25p/session). Exhibition of work produced and presented by groups (2 seminars 1p/seminar= 2 points). The note of the seminars presented by students will be progressively stricter since after each presentation strengths and points to be improved will be reviewed to improve the student / group.
  • Laboratory practices: 20%. (0-2 points). an examination with short questions regarding the practices carried out will be performed at the end of the course. To be eligible for consideration, you must have attended at least 70% of practices and always absences must be justified. participation and skill shown in the practice sessions will be assessed if the teacher deems it necessary.

- The student who takes advantage of the alternative evaluation modality must take a theory exam on the day and time that has been scheduled for the evaluation of the rest of the class. These exams account for 100% of the mark. Exam composition: the same content as the exam prepared for the rest of the class. The student will be exempt from the obligation to attend the seminars and practices of the subject.

Bibliography

Bibliography

1. Berg, J.M. Tymoczko, .L., Stryer, L. (2007) Bioquímica. 6ª ed. Editorial Reverté. (Versió en català i en castellà)
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MolviZ.org: http://www.umass.edu/microbio/chime/