

Información del Plan Docente

Academic Year	2016/17
Academic center	100 - Facultad de Ciencias
Degree	452 - Degree in Chemistry
ECTS	7.0
Course	3
Period	Second semester
Subject Type	Compulsory
Module	---

1.Basic info**1.1.Recommendations to take this course****1.2.Activities and key dates for the course****2.Initiation****2.1.Learning outcomes that define the subject****2.2.Introduction****3.Context and competences****3.1.Goals****3.2.Context and meaning of the subject in the degree****3.3.Competences****3.4.Importance of learning outcomes****4.Evaluation****5.Activities and resources****5.1.General methodological presentation****5.2.Learning activities****5.3.Program**

0. Introduction to Biochemistry. Interdisciplinary character of Biochemistry. A historical view of its development. The impact of the discoveries in Biochemistry in the society. Biotechnology as a modern human activity.

THE CHEMICAL SUPPORT OF LIFE

1. Chemical composition of living matter. Principal characteristics of living matter. Elements and molecules present in living beings. The importance of water in Biology. Molecular interactions.

2. General characteristics of biomolecules: carbohydrates, lipids, proteins, nucleic acids: properties and structure.

ENZIMOLOGY

3. Enzymes: catalysis and kinetics. General properties of enzymes. Enzyme classification and nomenclature. Catalysis and activation energy. Enzymatic activity determination. Enzyme kinetics: K_m y V_{max} definition and experimental determination. Turnover number k_{cat} y k_{cat} / K_m definition. Influence of pH and temperature on the rate of enzymatic reactions. Zymogens and proteolytic activation of enzymes.

4. Enzyme regulation. Reversible and irreversible inhibition. Regulation of enzymatic activity: allosteric enzymes, reversible covalent modification.

METABOLISM

5. Introduction of the study of metabolism. The cycle of matter and flow of energy in the biosphere. Origin of biological energy. Organization of the metabolic pathways.

Oxidation of food compounds as the source of biological energy. ATP as the energy exchange molecule. Techniques for the study of metabolism.

Carbohydrate metabolism

27217 - Biochemistry

6. Glycolysis. The utilisation of glucose and other dietary carbohydrates. The two phases of glycolysis: reactions and enzymes involved. Regulation of glycolysis. The different fates of pyruvate: respiration or fermentation. Degradation of other monosaccharides by glycolysis.

7. The citric acid cycle. Cellular localization. Oxidation of pyruvate by the pyruvate dehydrogenase complex. Regulation. The reactions of the citric acid cycle. The intermediates of the cycle as substrates for biosynthetic reactions. Anaplerotic reactions.

Regulation of citric acid cycle. The glyoxylate cycle.

8. The pentose phosphate pathway of glucose oxidation. Biological role of the pathway in different tissues. Anabolic and catabolic role of the pathway: oxidative and non-oxidative phases. Interconnection between glycolysis and the pentose phosphate pathway.

9. Gluconeogenesis. Common and specific enzymes in glycolysis and gluconeogenesis. Thermodynamically irreversible reactions. Stoichiometry and energetic yield of the gluconeogenic pathway. Regulation of key enzymes. Origin of the substrates used for the synthesis of glucose.

10. Glycogen metabolism. The role of glycogen in animals. Glycogen degradation. Glycogen synthesis. Coordinated regulation of glycogen metabolism: the role of metabolic cascades. Diseases due to defects in the glycogen metabolism.

Energy transduction mechanisms

11. Electron transfer and oxidative phosphorylation. The mitochondria and the membrane systems. The electron transport chain: multiprotein complexes and electron carriers. The generation of a proton gradient as a form of conserving the energy. Electron transport inhibitors. Coupling of electron transport and proton transfer. Uncouplers. The chemiosmotic theory to explain the energy conservation: ATP synthesis. The ATP synthase complex.

12. Photosynthesis: transforming the light energy. The anatomy and organization of chloroplasts. Photosynthetic pigments in plants and algae. Light absorption and light-driven electron flow. The photochemical reaction centre. Photosynthetic electron transport chain: from water to NADP⁺. Photosystems I and II. Final balance of the photosynthetic reactions: ATP and NADPH synthesis. The dark phase of photosynthesis, the synthesis of glucose and the Calvin Cycle. Photorespiration and its meaning.

Fatty acids metabolism

27217 - Biochemistry

13. Fatty acids catabolism. Digestion, mobilization and transport of fatty acids. Absorption of dietary fats in the small intestine. Transport of lipids in animals: albumin and plasmatic lipoproteins. Activation and transport of fatty acids into the mitochondria. β -oxidation of fatty acids. Energy balance. Ketonic bodies, synthesis and degradation. The use of ketone bodies as a source of energy.

14. Biosynthesis of fatty acids. Similarities and differences between the biosynthetic and degradative pathways. Acetyl-Co and bicarbonate as precursors of fatty acid synthesis: the formation of malonyl-CoA. Synthesis of fatty acids: stoichiometry, and energy balance. Origin of cytosolic NADPH and Acetyl-CoA. Essential fatty acids. Desaturation and elongation of fatty acids. Hormone regulation of stored triglycerols mobilization.

15. Biosynthesis of cholesterol. Cholesterol as precursor of active biological molecules. Transport and cellular internalization of cholesterol: action mechanism of transport by lipoproteins. Regulation of cholesterol synthesis: Hydroxymethylglutaryl-CoA reductase and LDL receptors. Diseases of cholesterol metabolism.

Metabolism of nitrogen compounds

16. Degradation of nitrogen compounds. Digestion of proteins. Continuous replacement of proteins in living organisms. Amino acid degradation. General reactions. Transamination and oxidative degradation. The urea cycle and its relation with the citric acid cycle. Metabolic degradation of carbon skeletons from amino acids. Glycogenic and ketogenic amino acids. Genetic disorders in the amino acids metabolism.

17. The sources of biological nitrogen. The nitrogen cycle. Biological nitrogen fixation: the nitrogenase complex. Nitrification and denitrification processes. The incorporation of ammonia into carbon skeletons: glutamate dehydrogenase, glutamate synthase and glutamine synthetase. Regulation of nitrogen metabolism.

18. An overview of metabolism. Reciprocal relationships between different organs in animals. The main metabolic pathways in the different organs: liver, adipocyte, brain, muscle. Metabolic adaptations to different physiological and pathological situations: fasting, prolonged exercise, diabetes.

MOLECULAR GENETICS AND GENETIC ENGINEERING

27217 - Biochemistry

19. Principal processes of DNA and RNA metabolism. Replication and reparation of DNA. Mutations. RNA synthesis and post-transcriptional RNA modifications. RNA translation: protein synthesis.

20. Introduction to the DNA recombinant technology. Gene cloning: vectors, genomic libraries, cDNA construction. Characterization and expression of cloned genes. Applications of recombinant DNA technology: gene modification in bacteria, plants and animals. Transgenic animals. The polymerase chain reaction.

5.4.Planning and scheduling

5.5.Bibliography and recommended resources

BB Berg, Jeremy M.. Biochemistry / Jeremy M. Berg, John L. Tymoczko, Lubert Stryer ; with Gregory J. Gatto . Interantional 7th ed., 3rd. print. New York : W.H. Freeman and Co., cop. 2012

BB Berg, Jeremy M.. Bioquímica / Jeremy M. Berg, John L. Tymoczko, Lubert Stryer ; [versión española por José M^a Macarulla] . - 6^a ed. Barcelona [etc.] : Reverté, D.L. 2007, cop. 2008

BB Bioquímica : libro de texto con aplicaciones clínicas / coordinada por Thomas M. Devlin. . 4^a ed. Barcelona [etc.] : Reverté, D.L. 2004

BB Devlin, T. M. Textbook of Biochemistry with Clinical Correlations. 7th ed. Wiley and Sons, 2010

BB Mathews, Christopher K.. Bioquímica / Christopher K. Mathews, K. E. Van Holde, Kevin G. Ahern ; traducción, José Manuel González de Buitrago . - 3^a ed., reimpr. Madrid [etc.] : Pearson Addison Wesley, 2004

BB Nelson, David L.. Lehninger Principios de bioquímica / David L. Nelson, Michael M. Cox ; coordinador de la traducción, Claudi M. Cuchillo. 6^a ed. Barcelona : Omega, D.L. 2014

BB Nelson, David L.. Lehninger Principios de bioquímica / David L. Nelson, Michael M.

27217 - Biochemistry

Cox ; coordinador de la traducción, Claudi M. Cuchillo. 6ª ed. Barcelona : Omega, D.L. 2014

BB Problemas de Bioquímica / J. Cárdenas [et al.] Madrid : Alhambra, 1988

BB Voet, Donald. Bioquímica / Donald Voet, Judith G. Voet ; [traducido por Pablo Baldi ... (et al.)] . - 3ª ed. Barcelona : Médica Panamericana, cop. 2006

BC Biochemistry / Laurence A. Moran, J. David Rawn... [et al] . - 2nd ed. Englewood Cliffs, New Jersey : Prentice Hall, cop.1994

BC Fersht, A. Enzyme structure and mechanism. 2a Ed. 1985

BC Liras, Antonio. Cuestiones prácticas de enzimología básica / Antonio Liras Madrid : Universidad Autónoma de Madrid Ediciones, D.L.1996

BC Macarulla, José M.. Bioquímica cuantitativa. Volumen II, Cuestiones sobre metabolismo / José M. Macarulla, Aída Marino, Alberto Macarulla. - 2ª reimp. Barcelona [etc.] : Reverté, 2002

BC Preguntas y respuestas de bioquímica / J.A. Lozano Teruel ... [et al.] Madrid [etc.] : McGraw-Hill-Interamericana, D.L.1997

BC Serrano Salom, Ramón. Introducción a las aplicaciones de las enzimas / Ramón Serrano Salom . - 1ª ed. Madrid : Alhambra, 1985