26703 - Human biochemistry

Información del Plan Docente

Academic Year	2016/17
Academic center	104 - Facultad de Medicina 229 - Facultad de Ciencias de la Salud y del Deporte
Degree	304 - Degree in Medicine 305 - Degree in Medicine
ECTS	6.0
Course	1
Period	First semester
Subject Type	Basic Education
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

CHAPTER I

26703 - Human biochemistry

Amino Acids and Proteins

Lecture 1. Amino acids, Structure, properties and classification of proteinogenic amino acids. Stereochemistry. Acid-base properties of amino acids.

Lecture 2. Proteins. Composition of proteins. Classification. Functional diversity of proteins. Primary structure. Peptide bond. Acid-Base properties of peptides. Peptides of biological interest.

Lecture 3. Spatial conformation of proteins. Regular conformations of polypeptide chain: a-helix and b-sheet secondary structures. Collagen helix. Non covalent forces determining and stabilizing secondary structure.

Lecture 4. Conformation of globular proteins: tertiary and quaternary structures. Myoglobin: structure. Heme group binding to protein and oxygen. Quaternary structure: hemoglobin. Types of hemoglobin. Tertiary structure of globins. Oxygen saturation curves for myoglobin and hemoglobin. Regulation of hemoglobin oxygenation. Bohr effect. Fetal and S hemoglobin. Thalassemias.

Lecture 5. Enzymes. General properties of enzymes. Specificity. Classification and nomenclature. Distribution of enzymes. Isoenzymes. Enzymes in clinical diagnostics. Enzyme quantification.

Lecture 6. Enzyme kinetics. Catalysis and enzyme mechanism of action. Enzyme kinetics: Michaelis-Menten equation and its transformations. Effects of pH, temperature and enzyme concentration in enzymatic reaction speed. Enzyme inhibitors.

Lecture 7. Regulation of enzyme activity. Metabolic regulation. Induction, repression and derepression. Proenzymes. Antienzymes. Feedback and covalent modification.

Lecture 8. Vitamins. Hydrophilic vitamins and their roles as coenzymes. Structure and function. Lipophilic vitamins. Structure and function.

Laboratory sessions:

1.- Electrophoresis.

2.- Chromatography.

3.- Clinical case: Vitamin B12 deficiency and Vitamin D toxicity.

Learning activities:

Lectures: 10 hours

Laboratory sessions: 5 hours

Student autonomous work: 18.5 hours.

26703 - Human biochemistry

CHAPTER II

Storage and Use of Genetic Information

Lecture 9. Nucleic acids. Structure and properties of nucleosides and nucleotides. DNA structure: double helix. DNA supercoiling. Topoisomerases. Chromatin structure. RNA: structure and types. Degradation of nucleic acids.

Lecture 10. DNA replication. General characteristics of replication: semiconservative, bidirectional. Mechanisms for DNA replication in prokaryotes. Primosome and replisome. DNA reparation. Replication origin.

Lecture 11. DNA transcription: RNA synthesis. Prokaryote transcription. Post-transcriptional modifications of rRNAs and tRNAs. Ribozymes.

Lecture 12. Translation of genetic message: protein biosynthesis. The genetic code. Translation machinery: involved molecules. Activation and binding of amino acids to tRNA: aminoacil tRNA synthetases. Prokaryote protein synthesis. Post-translational modifications. Differential characteristics os eukaryote protein synthesis. Inhibitors of protein synthesis.

Lecture 13. Mitochondrial genetic system. Gene organization. Replication and transcription of mammal DNA. RNAs processing. Regulation of expression.

Laboratory Session:

1.- DNA purification.

Learning activities:

Lectures: 6 hours

Laboratory sessions: 2 hours

Student autonomous work: 10 hours.

CHAPTER III

Introduction to Intermediary Metabolism

Lecture 14. Intermediary metabolism. Concept. Catabolic, anabolic and amphibolic routes. Bioenergetics: exergonic and endergonic processes. Energetic coupling. Energy rich compounds: chemical characteristics. Transferred chemical groups. Types of energy rich bounds. Enzymes and coenzymes involved in biological oxydoreduction processes.

26703 - Human biochemistry

Learning activities:

Lectures: 3 hours

Student autonomous work: 4.5 hours.

CHAPTER IV

Metabolism of Carbohydrates

Lecture 15. Glycolysis. Glucose uptake by tissues. Stages of glycolysis. Pyruvate metabolic fates. Metabolic and hormonal regulation of glycolysis. Stoichiometry and energy balance. Cori's cycle. Other hexoses incorporation of glycolytic pathway. Pyruvate oxidation to acetyl-CoA.

Lecture 16. Cytric acid cycle. Cycle's role within intermediary metabolism. Cellular localization. Metabolic reactions and their regulation. Cycle's energy balance. Anaplerotic reactions.

Lecture 17. Biological oxidation and respiratory chain. Components of respiratory chain. Sequence of respiratory chain components. Oxidative phosphorylation. Structure and function of ATP synthetase. Chemiosmotic hypothesis. Specific transport systems in the mitochondria's inner membrane: translocases. System of mitochondrial shuttles. ATP balance in glucose total oxidation. Reactive oxygen species, antioxidant defenses and human disease.

Lecture 18. Gluconeogenesis. Specific reactions. Metabolic and hormonal reactions. Stoichiometry and energy balance. Enzymatic differences between glycolysis and gluconeogenesis. Alterations in gluconeogenesis in humans.

Lecture 19. Glycogen metabolism and its regulation. Glycogen stores and their physiological role. Glycogenolysis. Synthesis of Glycogen. Hormonal regulation of glycogen metabolism in muscle and liver. Glycogen phosphorylase system. Glycogen synthetase system. Dephosphorylation of enzymes: phosphatases. Glycogenosis.

Lecture 20. Pentose phosphate pathway. Reactions of oxidative phase. Reactions of non oxidative phase. Regulatory mechanisms. Enzymatic defects. Glucuronic acid pathway.

Lecture 21. Heteroside metabolism. General properties. Biosynthesis of glycoproteins: N-glycans and O-glycans. Control of glycoprotein biosynthesis. Glycoprotein catabolism. Biosynthesis and degradation of proteoglycans. Mucopolysaccharides.

Laboratory sessions

1.- Characterizing reducing sugars.

Learning activities:

Lectures: 9 hours

26703 - Human biochemistry

Laboratory sessions: 2 hours

Student autonomous work: 12 hours.

CHAPTER V

Lipid Metabolism

Lecture 22. Lipoprotein metabolism. Exogenous and endogenous lipid transport. Reverse cholesterol transport.

Lecture 23. Adipose tissue metabolism and fat mobilization. Lipolysis. Hormonal regulation of lipolysis. Lipolysis products fate: liver metabolic reactions. Fat liver degeneration.

Lecture 24. Fatty actid oxidation. Fatty acid activation in cytosol and transport inside mitochondria. Carnitine as shuttling molecule. Mitochondrial beta-oxidation of even- and odd-chain saturated fatty acids. Energy balance.

Lecture 25. Ketonic bodies metabolism. Ketogenesis. Use of ketonic bodies by extrahepatic tissues: cetolysis. Regulation of fatty acid beta-oxidation and ketogenesis.

Lecture 26. Biosynthesis of fatty acids: lipogenesis. Biosynthesis of even- and odd-chain saturated fatty acids. Sources of acetyl-CoA and NADPH for lipogenesis. Malonil-CoA formation. Enzymatic and co-enzymatic components of fatty acid synthase. Metabolic reactions. Regulation of synthesis of fatty acid. Fatty acid chain elongation. Biosynthesis of mono- and polyunsaturated fatty acids.

Lecture 27. Eicosanoid biosynthesis. Eicosanoid precursors. Metabolism of araquidonic acid. Biosynthesis of eicosanoids: cyclooxigenase pathway and lipoxigenase pathway. Catabolism of eicosanoids. Mechanism of action of eicosanoids and its clinical significance.

Lecture 28. Metabolism of complex lipids. Biosynthesis of triacylglicerides. Biosynthesis of phosphoacylglycerides: de novo pathway and saving pathway. Phosphoacylglycerides degradation. Biosynthesis and degradation of sphingolipids.

Lecture 29. Metabolism of cholesterol. Whole body cholesterol balance. Biosynthesis of cholesterol. Mevalonate formation. Mevalonate transformation into squalene. Squalene transformation into cholesterol. Control of cholesterol synthesis.: HMG-CoA reductase. Cholesterol transport. Diseased caused by alterations in cholesterol metabolism.

Lecture 30. Cholesterol derivatives with physiological significance in human body. Biliary acids. Biosynthesis of primary and secondary biliary acids. Regulation of biliary acid synthesis. Enterohepatic circulation. Cholesterol excretion. Steroid hormones from adrenal cortex and gonads: biosynthesis and degradation. Biosynthesis of 1,25-dihydroxycholecalciferol.

Laboratory Session:

1.- Automatization in the Biochemistry laboratory.

26703 - Human biochemistry

Learning activities:

Lectures: 7 hours

Laboratory sessions: 1 hours

Student autonomous work: 11 hours.

CHAPTER VI

Metabolism of Nitrogen Compounds

Lecture 31. General reaction in amino acid catabolism. Transamination reactions. Oxidative deamination. Decarboxylation. Ammonia fate. Glutamine formation and ammonium excretion. Urea cycle and its regulation. Enzymatic defects in urea cycle.

Lecture 32. Fate of carbon skeleton from amino acids. Routes for amino acid carbon skeleton incorporation into different metabolic intermediates. Glycogenic and ketogenic amino acids.

Lecture 33. Conversion of amino acids into specialized products. Creatine and creatinin formation. Creatinine excretion rate as muscle mass index. Triptophane: serotonin precursor. Malignant carcinoid syndrome (argentaffin cell tumors). Metabolism of g-aminobutyrate.

Lecture 34. Metabolism of purines and pyrimidines.

Lecture 35. Metabolism of Hemoglobin. Biosynthesis and regulation of porphyrins and heme group. Porphyrias: definition and classification. Biosynthesis of hemoglobin. Catabolism of hemoglobin: metabolism of bilirubin, and biliary pigment formation. Jaundice.

Learning activities:

Lectures: 6 hours

Student autonomous work: 9 hours.

5.4.Planning and scheduling

5.5.Bibliography and recomended resources