28401 - Biologics and Biochemistry

Información del Plan Docente

Academic Year	2017/18
Faculty / School	105 - Facultad de Veterinaria
Degree	451 - Degree in Veterinary Science
ECTS	9.0
Year	1
Semester	Annual
Subject Type	Basic Education
Module	---

1.General information

1.1.Introduction

1.2.Recommendations to take this course

1.3.Context and importance of this course in the degree

1.4.Activities and key dates

2.Learning goals

2.1.Learning goals

2.2.Importance of learning goals

3.Aims of the course and competences

3.1.Aims of the course

3.2.Competences

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as theory sessions, laboratory sessions, and seminars.

Students are expected to participate actively in the class throughout the semester.

28401 - Biologics and Biochemistry

Classroom materials will be available via Moodle. These include a repository of the lecture notes used in class, the course syllabus, as well as other course-specific learning materials.

Further information regarding the course will be provided on the first day of class.

5.2.Learning tasks

The course includes 9 ECTS organized according to:

- Biology teaching and learning activities (3 ECTS): 30 hours.

- Biochemistry teaching and learning activities (6 ECTS): 60 hours.

Biology teaching and learning activities:

- Theory sessions: 18 h.
- Animal handling sessions: 3 h
- Laboratory sessions: 7 h.
- Seminars: 2 h.
- Autonomous student work: 45 h study

Lecture notes will be available for the student (via Moodle) at least 1 week before their explanation in the classroom. At the beginning of each lecture, it is planned to spend 5 minutes reviewing the previous one in order to place students in the later explanation, and a 45 minutes exposure of the most important and/or difficult aspects. It will emphasize the need to interrupt the teacher when they see fit to solve problems as they arise during the lecture.

Animal handling session will take place on the premises of Support Service of Experimentation (SAE) and the sperm evaluation laboratories of the Department of Biochemistry and Molecular and Cellular Biology. In this practice session, the students will work in small groups (2 people from each classroom, to be announced in advance), and they will handle the rams during the semen collection by artificial vagina, and they will analyze the sperm quality in the laboratory in a 3-hour session.

Laboratory sessions will take place in a 3-hour session and two 2-hour sessions, in the laboratory of the Department of Biochemistry and Molecular and Cellular Biology.

Seminars will be organized in sessions of 1 hour and will consist of the visualization and discussion of a biology documental. They will be held on schedule of the lectures.

Biochemistry Teaching and learning activities:

- Theory sessions: 40 h.
- Seminars: 5 h.
- Laboratory practical sessions: 15 h.
- Autonomous student work: 65 h study

28401 - Biologics and Biochemistry

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Laboratory sessions will take place in 3-hour sessions in the laboratory of the Department of Biochemistry and Molecular and Cellular Biology.

Seminars will be organized in sessions of 1 hour and will consist on the resolution of biochemistry problems related to lecture sessions.

5.3.Syllabus

The course will address the following topics:

Biology

Block I: THE ORIGING OF LIFE AND THE BIOLOGICAL DIVERSITY

- **Unit 1.- Exploration and classification of life:** Definition of Biology. Introduction to the study of biological diversity. Classification of the diversity of life: classification and nomenclature systems. Unity in the diversity of life: the concept of evolution

- **Unit 2.- The origin and evolution of life** : Life and living beings: ideas about the generation of life. Conditions on early Earth made the origin of life possible. The hypothetical sequence of primitive cells formation. Different energy strategies: heterotrophic vs. autotrophic. The evolution of prokaryotes and the oxygen revolution. Origin of the eukaryotic cells. Multicellularity evolved several times in eukaryotes.

Block II: THE PROCESS OF EVOLUTION

- **Unit 3.- Evolution: History and evidences of Darwin's theory:** Historical overview: ideas against evolution and evolutionary ideas prior to Darwin. The construction of Darwin's theory: descent with modification and natural selection. Evidence of the evolutionary process: Biogeography, fossil record, homologies and direct observation. After Darwin: synthetic theory of evolution.

- **Unit 4.- The evolution of populations :** Key Concepts: gene, allele and gene pool. Variability in a population: quantification, origin and maintenance. The Hardy- Weinberg equilibrium. Causes of changes in the genetic composition of a population: gene flow, genetic drift, non-random mating and natural selection.

- **Unit 5.- Formation of new species and macroevolution:** The biological species concept: reproductive isolation. Exploration of the reproductive barriers. Modes of speciation: allopatric and sympatric speciation. Macroevolution: convergent and divergent evolution, adaptive radiations and extinctions. The pace of speciation: gradualism and punctuated equilibrium.

- **Unit 6.- Reconstructing and using phylogenies** : Definition of phylogeny, phylogenetic tree and clade. How

phylogenetic trees are constructed? Parsimony, information sources and molecular clocks. Phylogeny relationship with taxonomy.

- Unit 7.- Taxonomy and phylogeny of species of veterinary interest: The tree of life: Prokaryotes, and eukariotes. The Eukarya domain: Protist, plants, fungus and animals. The animal kingdom classification and phyla of veterinary interest: Invertebrates and vertebrates

Block III: PLANT BIOLOGY

- **Unit 8.- The origin of plants and plant diversity:** Origin of the land plants: biochemical and morphological evidences. Adaptations to life on land **.** Definition of the plant kingdom **.** Plant diversity: plant phylogeny **.** Vascular plants: general characteristics. Seed plants: the evolutionary advantage of seeds. Characteristics and diversity of angiosperms. Agricultural significance.

- **Unit 9.- Plant structure and form:** The plant organs: structure, types and function. The three tissue systems: Dermal, vascular and Ground. Plant cells: Fundamental differences with animal cells: cell wall, vacuoles and plastids. Some specific types of plant cells. Tissue organization in each organ.

- **Unit 10.- Transport in vascular plants:** Transport of water and minerals: The roots absorb water and minerals from the soil. The role of root hairs and mycorrhizae. Ascend of water and minerals from the roots through the xylem. Regulation of transpiration. Transport of organic nutrients: translocation. Symbiosis with nitrogen-fixing bacteria.

- **Unit 11.- Reproduction in angiosperms:** Sexual reproduction: Life cycle of angiosperms. Pollination and double fertilization. Asexual reproduction: mechanisms and application in agriculture.

- **Unit 12.- Plant growth and development :** Stopping the growth of the embryo within the seed: dormancy. Resumption of growth of the embryo: Seed germination. Plant growth. Primary growth, apical meristems. Secondary growth, lateral meristem.

- **Unit 13. - Plant hormones:** Definition of plant hormones. Major groups of plant hormones: auxins, cytokinins gibberellins, abscisic acid, ethylene, brassinosteroids and defense hormones. Plant hormones role in growth and development, responses to stimuli and defense against herbivores.

Practical lessons program
- Practice 1: Semen collection and evaluation of sperm quality
- Practice 2: Introduction to the optical microscope. Observation and comparison of animal and plant cells.
- Practice 3: Concentration and cell viability
- Practice 4: Observation of subcellular organelles: plastids. Study of osmotic phenomenon

BIOCHEMISTRY THEORICAL LESSONS PROGRAM:

BLOCK I.- PROTEINS AND ENZYMES.

Unit 1. **Proteins and peptides.** Composition, characteristics. Peptide bond structure. Protein functions.

Unit 2. **The structure of proteins** . Primary structure. Secondary structure: α−Helices. ß- sheet. Tertiary structure: Myoglobin. Quaternary structure: Hemoglobin. Oxygenation. Cooperative effects. Conformational

changes. Oxygenation regulation. Regulation by CO2. Bohr effect. 2,3- bisphosfoglicerate effect. Hemoglobinopathies.

Unit 3. **Enzymes** . Concept and characteristics. Classification and nomenclature. Enzymes as catalysts. Isoenzymes.

Unit 4. **Active site of an enzyme.** Concept and general characteristics. Chymotrypsin mechanism action.

Unit 5. **Kinetics of enzymatic reactions** . Initial velocity, maximum velocity. Michaelis-Menten equation. Enzymatic activity. Experimental determination of Km and Vmax.

Unit 6. **Regulation of enzymatic activity** . By changes in gene expression. Changes in environmental conditions. Mechanism of enzyme inhibition. Covalent modifification mechanism. Allosteric regulation.

Unit 7. **Oxidation-Reduction cofactors** . Nicotinamide cofactors. Structure, function and mechanism of action. Flavin cofactors. Structure, function and mechanism of action.

Unit 8. **Transfer cofactors** . Structure and function. Tetrahydrofolate. Coenzyme B12. Pyridoxal Phosphate. Coenzyme A.

Unit 9. **Carboxylation-Decarboxylation cofactors** . Structure and function. Biotin and Thiamine Pyrophosphate.

Unit 10. **Energy Metabolism.** Catabolism and Anabolism. Coupled reactions. ATP. Energy regulation. Cell energy level. The Phosphorylation Potential.

Unit 11. **Oxidative Phosphorylation** . Electron transport chain, oxidative phosphorylation. The Chemiosmotic Model. ATP Synthase.

PART II. - CARBOHYDRATE METABOLISM.

Unit 12. **Glycolysis** . Phases. Enzymatic steps. Regulation and energy balance. Incorporation of different monosaccharides

Unit 13. **Destinations for pyruvate** . Fermentations. Entry of pyruvate into the mitochondria. Pyruvate Dehydrogenase Complex. Recovery cytoplasmic NAD+ Shuttles.

Unit 14. **Krebs Cycle** . Enzymatic steps. Amphibolic Nature. Regulation. Glucose degradation energy efficiency.

Unit 15. **Pentose Phosphate Pathway** . Functions. Pathway phases. Enzymatic steps. Regulation as cellular needs. Glucose 6-phosphate Flow.

Unit 16. **Carbohydrate Biosynthesis.** Gluconeogenesis. Lactate to muscle glucose conversion. Cori Cycle. Gluconeogenesis from amino acids Krebs Cycle intermediates.

Unit 17. **Glycogen Metabolism.** Glycogen. Glycogen Synthesis. Glycogen Degradation. Glycogenolysis and

28401 - Biologics and Biochemistry

Glycogenesis metabolic and hormonal regulation. Glycogenolysis and Glycogenesis signaling cascade amplification.

PART III. - LIPID METABOLISM .

Unit 18. **Lipids.** General properties, biological functions, and classification. Fatty acids: nature and properties.

Unit 19. **Simple lipids.** Structures and physico-chemical properties of triacylglycerides and waxes.

Unit 20. **Complex lipids.** Structures and physico-chemical properties of glycerophospholipids (lecithin, cephalin, plasmalogens and cardiolipins) and sphingolipids (ceramides, sphingomyelins and glycosphingolipid).

Unit 21. **Biological membranes.** Composition. Bilayers Formation. The fluid mosaic theory. Membrane proteins. Fluidity and membrane asymmetry.

Unit 22. **Unsaponifiables lipids** . Structures, properties and biological functions of terpenes (vitamin A, vitamin E, vitamin K), steroids (cholesterol, vitamin D, steroid hormones, bile acids) and prostaglandins.

Unit 23. **Lipid transport** . Lipoproteins: General properties and function of QM, VLDL, IDL, LDL and HDL. Fat digestion and absorption. Transport of endogenous and exogenous fats. Dyslipidemias.

Unit 24. **Lipid metabolism** . Oxidation of fatty acids. Neutral fat mobilization. Fatty acids activation and transport to the mitochondria. Saturated fatty acid β-oxidation. β-oxidation energy balance. Regulation of fatty acid oxidation. Ketone body metabolism.

Unit 25. **Fatty Acid Biosynthesis** . Carbon sources and NADPH. Fatty acid synthase complex. Malonyl-ACP formation. Palmitate biosynthesis. Elongation and desaturation of fatty acid chains. Fatty acids biosynthesis regulation. Triacylglyceride biosynthesis.

Unit 26. **Complex lipids biosynthesis** . Overview of the routes of synthesis of glycerophospholipids and sphingolipids.

Unit 27. **Cholesterol biosynthesis** . Overview and regulation of cholesterol synthesis route.

Unit 28. **Metabolic coordination** . Metabolic interactions between major metabolizing lipids organs. Major hormones that control metabolism of lipids in mammals.

PART IV. - AMINO ACIDS AND NITROGEN COMPOUNDS METABOLISM.

Unit 29. **Degradation of Amino Acids I** . General characteristics. The loss of amino acids group: transamination and oxidative deamination. Fate of ammonium ion: ammonium ion toxicity and transport from peripheral tissues to the liver. Muscle amino acids. Glucose-alanine cycle. Ammonium excretion. Urea cycle: stages, cellular location, energy balance and genetic defects.

28401 - Biologics and Biochemistry

Unit 30: **Degradation of amino acids II** . Fate of the carbon skeleton in the degradation of the amino acids: Ketogenic and glucogenic amino acids. Phenylalanine degradation.

Unit 31: **The Biosynthesis of amino acids.** The Nitrogen cycle. Biological nitrogen fixation: organisms capable of performing it, enzymatic mechanisms and regulation. Essential and non-essential amino acids. Biosynthesis of nonessential amino acids.

Unit 32: **Precursor functions of amino acids.** Amino acids as precursors of biomolecules. Biosynthesis and degradation of porphyrins: main stages and genetic defects.

Unit 33: **Nucleotides Metabolism** . Nomenclature of nucleotides: purine and pyrimidine. Biosynthesis of purine nucleotides: main stages and regulation. Biosynthesis of pyrimidine nucleotides: main stages and regulation. Purine degradation: stages and genetic defects. Pyrimidine degradation.

Unit 34: **Amino acid metabolism regulation** : overview of amino acids metabolism in the liver. Hormonal regulation of amino acids metabolism: Insulin and Glucagon.

Unit 35: **Metabolic integration** : metabolic integration between tissues and organs. New integrationist molecules.

PRACTICAL LESSONS PROGRAM

1. Laboratory work introduction. Calibration of automatic pipettes.
2. Introduction to spectrophotometry. Quantitative determination of proteins.
3. Quantitative determination of plasma cholesterol.
4. Determination of Lactate Dehydrogenase (LDH) activity.
5. Skill verification of Competency: the student will individually carry out one of the four laboratory training topic and will present a detailed result report, using a scientific format.

5.4.Course planning and calendar

For further details concerning the timetable, classroom and further information regarding this course please refer to the "Facultad de Veterinaria" website (https://veterinaria.unizar.es/).

5.5.Bibliography and recommended resources

For reference bibliography please refer to http://psfunizar7.unizar.es/br13/eBuscar.php?tipo=a