Universidad Zaragoza

Year : 2019/20

28401 - Biologics and Biochemistry

Syllabus Information

Academic Year: 2019/20
Subject: 28401 - Biologics and Biochemistry
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.Aims of the course

The ultimate aim of the subject Biology is to transfer to the students the knowledge and capacity of analysis related to this subject with the evolutionary process, the formation of populations and species, the implication of the plant world on production and the extent to which populations influenced by human performance change.

For its part, the general objective of the subject Biochemistry is to inculcate in the students the basic fundamentals of all the biological molecules that in later subjects will be applied for the study of pathologies and their treatment, nutrition, animal genetic improvement and breeding procedures applied to animal production, and breeding technologies, food preservation and processing.

1.2.Context and importance of this course in the degree

The subject of Biology constitutes the first part of the subject of Biology and Biochemistry framed within the basic subjects of the Veterinary Degree. It is the basis for the comprehension and comparison of all the aspects of living beings, with numerous practical applications of evolutionary biology in future working life of the Veterinarians.

The subject of Biochemistry forms part of the basic training module and is indispensable for the knowledge of the structure of biomolecules, metabolic reactions of their synthesis and transformation, obtaining energy as well as all regulatory mechanisms. Obtaining all of these basic principles is important for the knowledge of the growth and development of organisms. The degree is intended, among other things, to make available to the Administration and qualified technical companies for the direction of the departments of Health and Production Animal, Hygiene and Food Safety, as well as for clinical animal care.

1.3.Recommendations to take this course

Basic knowledge of Biology / Biochemistry / Chemistry

2.Learning goals

2.1.Competences

On successful completion of this course, students will be able to:

Transversal:

01. Realization of analysis and synthesis
02. Application of knowledge in practice
03. Time planning and management
04. Oral and written communication
05. Research skills
06. Ability to learn
07. Information management skills (ability to search for and analyse information from a variety of sources)
08. Critical and self-critical capacity
09. Ability to generate new ideas
10. Troubleshooting

11. Teamwork

12. Relationship capacity

14. Eagerness to overcome

Specific MATERIAL BIOLOGY:

01. Knowledge of the classification systems and nomenclature of organisms.

02. Knowledge of the evolutionary process and the origin of new species.

04. Knowledge of the basics of plant structure and physiology

05. Initiation of knowledge of the applications of plant biotechnology.

06. Ability to move in a Biology laboratory

07. Dexterity in the handling of basic biological techniques

Specific BIOCHEMICAL MATERIALS:

01. Knowledge of the structure of biomolecules

02.Identification of metabolic reactions of synthesis and transformation of biomolecules, as well as mechanisms of regulation.

03. Knowledge of the mechanisms for obtaining metabolic energy.

04. Initiation of the knowledge of the applications of Biochemistry.

05. Ability to move in a biochemical laboratory

06. Dexterity in the handling of basic biochemical techniques

2.2.Learning goals

If students complete the course successfully, they should be able to:

1. Identify and know the structure of biomolecules, metabolic transformation reactions and synthesis of these biomolecules, as well as regulatory mechanisms.
2. Describe the mechanisms for obtaining and transforming metabolic energy.
3. Able to explain how the set of inanimate molecules that make up living organisms influence each other to constitute, maintain and perpetuate life.
4. Manage himself in a Biology and Biochemistry laboratory and master basic tools and techniques for research as realization and staining of simple preparations for visualization by optical microscopy, obtaining samples of animal origin and quality analysis, calibration and use of automatic pipettes, spectrophotometry and calculations with biological repercussions.
5. Handle the most relevant sources of information.
6. Define and describe evolution as a process of genesis and change of living beings.
7. Analyze and enumerate the base of the mechanisms that allow to direct the animal and vegetal selection with application in the veterinary field.
8. Remember and understand the diversity of living beings, their classification and nomenclature.
9. Analyze and remember the relationships of organisms between them and with the environment.
10. Assess the contribution of the biology of plant systems to the veterinary agronomic environment.

2.3.Importance of learning goals

They allow the veterinary student to have an overview of the diversity of life and the metabolism of beings with the rest of the competences acquired in Chemistry and Physiology to the training of the students for its management in all the basic biological and biochemical aspects and that will have later application in the veterinarian profile.

They also contribute, along with the rest of the disciplinary modules, to the training of the students for the performance of the professional profiles of Teaching and Research in the fields related to Veterinary Science.

3.Assessment (1st and 2nd call)

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

1: Evaluation procedures and instruments in **BIOLOGY**

1. Evaluation of the knowledge acquired in relation to theoretical teaching, including that acquired in participative lectures, and seminars. It will be carried out by means of a multiple-choice written test with only one correct answer. Right answer is a positive point, wrong answer subtracts 0.2 points. The score of this test will be from 0 to 10, it will be necessary to get 50% of correct answers (5 out of 10) in each test and will represent 60% of the student's final grade in this subject. Passing these tests will accredit the achievement of learning outcomes 6 to 10.

2. The attendance to laboratory practices is compulsory. The evaluation of the knowledge acquired in relation to practice sessions will consist in the resolution of multiple choice test questions with a single right answer. Right answer is a positive point, wrong answer subtracts 0.2 points. The grade will be from 0 to 10, it will be necessary to obtain 50% of correct answers (5 out of 10) and will suppose 40% of the student's final grade in this course.

Passing this test will demonstrate achievement of the learning outcome 4.

2: Evaluation procedures and instruments in **BIOCHEMISTRY**

1. Partial and final written assessment test consisting of multiple choice questions with only one answer correct. Right answer is a positive point, wrong answer subtracts 0.2 points. The score of this test will be from 0 to 10, it will be necessary to obtain 50% of correct answers (5 out of 10) and will suppose 70% of the final grade of the student in this matter. Passing these tests will demonstrate the achievement of learning outcomes 1, 2 and 3.
2. Practical test of evaluation of the practices that have been carried out in the laboratory by means of the accomplishment of a laboratory practice. Passing this test will accredit the achievement of learning result 4. It will be passed when the required competence is carried out with the precision and accuracy proper to the procedure. The overall rating will involve 25% of the student's final grade in this subject. The attendance to laboratory practices is compulsory.
3. Assessment of information management capacity. Comprehension of selected scientific texts will be assessed. Written assessment test consisting of 10 multiple choice questions with only one correct answer. Right answer is a positive point, failure does not subtract points. Passing this test will accredit the achievement of learning outcome 5 and will be evaluated according to the following criteria and requirement levels. The score will be from 0 to 10, which will be added to the score of the theoretical exam once it has been passed, and will represent 5% of the final grade of the course.

Practice and/or theory may be approved independently (the grade may be saved for later season)

A part (practice or theory) will be compensated if the rating is 4.5 and if the other part is approved. In no case will grades lower than 5 be kept.

The final grade in this subject will be 66.6% of the grade of the subject "Biology and Biochemistry"

Marking system:

According to the national regulation Law 1025/2003, 5th of September which lays down the European system of credits and marking system for the university degree.

0-4,9: FAIL.

5,0-6,9: PASS

7,0-8,9: GOOD (NT).

9,0-10: EXCELLENT (SB).

As the article 158 of the Statutes of the University of Zaragoza lays down, provisional grades will be displayed at least for 7 days and students will be able to review them on the date, time and place provided for that purpose.

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning goals. 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.

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.

4.2.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:

- Lectures: 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:

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

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.

4.3.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 andevolutionary 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: ??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 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 and sphingolipids.

Unit 21. Unsaponifiables lipids. Structures, properties and biological functions of steroids (cholesterol, vitamin D, steroid hormones, bile acids).

Unit 22. Macromolecular structures of lipids. Composition. Bilayers (biological membranes) and monolayers (lipoproteins and lipid droplets) Formation. General properties and function of QM, VLDL, IDL, LDL and HDL.

Unit 23. Lipid metabolism. Oxidation of fatty acids. Types of adipose tissue. Neutral fat mobilization. Fatty acids activation and transport to the mitochondria. Saturated fatty acid ?-oxidation. Beta;-oxidation energy balance. Regulation of

fatty acid oxidation. Ketone body metabolism.

Unit 24. 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 25. Cholesterol biosynthesis. Cholesterol balance in the body. Intestinal absorption Cholesterol Biosynthesis. Regulation of cholesterol biosynthesis and uptake.

Unit 26. Eicosanoids biosynthesis. Arachidonic acid as a precursor of eicosanoids. Prostaglandins and thromboxanes biosynthesis via cyclo-oxygenase. Leukotrienes biosynthesis via lipoxygenase. Biological repercussions.

Unit 27. Metabolic coordination. Metabolic interactions between major metabolizing lipids organs. Fat digestion and absorption. Transport of endogenous and exogenous fat. Major hormones that control lipids metabolism in mammals.

PART IV. - AMINO ACIDS AND NITROGEN COMPOUNDS METABOLISM.

Unit 28. 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.

Unit 29. **Degradation of Amino Acids II**. 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.

Unit 30: **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 31: **Precursor functions of amino acids.** Amino acids as precursors of biomolecules. Biosynthesis and degradation of porphyrins: main stages and genetic defects.

Unit 32: **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 33: **Amino acid metabolism regulation**: overview of amino acids metabolism in the liver. Hormonal regulation of amino acids metabolism: Insulin and Glucagon.

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.

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.

4.4.Course planning and calendar

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

4.5.Bibliography and recommended resources

http://psfunizar7.unizar.es/br13/egAsignaturas.php?codigo=28401