

## 28408 - Animal Physiology

### Syllabus Information

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**Academic Year:** 2022/23

**Subject:** 28408 - Animal Physiology

**Faculty / School:** 105 - Facultad de Veterinaria

**Degree:** 451 - Degree in Veterinary Science

**ECTS:** 12.0

**Year:** 2

**Semester:** Annual

**Subject Type:** Basic Education

**Module:**

## 1. General information

### 1.1. Aims of the course

The general objective of this subject will be the learning of the functions of the organs and systems of the animal organism, their regulation and their application to animal medicine and production.

In order to achieve this general objective, the specific learning objectives of Animal Physiology will be:

- Knowing, understanding and describing the functioning of systems, devices and organs of healthy mammals and birds (especially those of veterinary interest), at their different levels of organisation.
- Knowing the mechanisms by which these living beings perform their functions.
- Understanding the interrelation, coordination and regulation of the various organic functions, as well as the processes of integration that give rise to homeostasis.
- Understanding and knowing how to use the scientific and technological terminology of Animal Physiology properly.
- Become familiar with the experimental techniques associated with a laboratory of Physiology and handling the basic scientific instrumentation, as well as acquiring the necessary skills for the realization of certain functional tests in animals.
- Analysing the different parameters obtained after the performance of functional or laboratory tests, knowing the normal results coming from healthy animals.
- Understanding the concept of Animal Physiology and its applications in Clinic and Health, Animal Production and other veterinary disciplines.
- Acquiring the physiological bases for the understanding of physiopathology and the mechanisms causing the disease, therapeutics and the means for the maintenance of health and the prevention of diseases.
- Knowing the fundamental bibliographic sources of this science and being able to manage them and search for references.
- Ability to understand physiological scientific works published in specialized journals.
- Knowing the methodologies from which physiological knowledge has been acquired.
- Knowing the possibilities of development of the personal work within the basic sciences in other aspects, in order to be able to orient the professional activity towards the teaching and the investigation.
- Knowing how to adapt to changing scientific and technological schemes in Physiology.

These approaches and objectives are aligned with the following Sustainable Development Goals (SDGs) of 2030 Agenda of the United Nations (<https://www.un.org/sustainabledevelopment/>), so that the acquisition of the learning outcomes of the subject provides training and competence to contribute to some extent to the achievement of Goal 2: Zero hunger; Goal 3: Health and well-being; Goal 4: Quality education; Goal 12: Responsible consumption and production; Goal 16: Peace, justice and strong institutions.

### 1.2. Context and importance of this course in the degree

Animal Physiology, as a basic subject, should allow students for the acquisition of the necessary skills to take the rest of the subjects of the Degree, especially those integrated into the modules of Clinical Sciences and Animal Health and Animal Production.

### 1.3. Recommendations to take this course

The student must have taken all first year subjects of the Degree and be enrolled in the subjects that, if applicable, have been pending in that course.

It is necessary to have a solid knowledge of animal anatomy and histology, as well as biology and biochemistry.

It is also important to understand the physicochemical bases applicable to the study of the function of the animal organism.

## 2. Learning goals

### 2.1. Competences

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

1. Know and interpret the physiological processes of the animal organism's apparatuses and systems.
2. Apply theoretical knowledge to the analysis of practical situations in real contexts.
3. Develop critical reasoning and capacities for analysis, synthesis and evaluation.
4. Effective and correct communication, using the appropriate scientific terminology.
5. Understand certain English language basic terminology related to the subject.
6. Skillful at computer applications used for the study of physiological processes.
7. Organise and plan work autonomously and manage information sources properly.
8. Integrating in team work to achieve common objectives, distributing and sharing responsibilities.

### 2.2. Learning goals

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

1. Know, understand and explain the physiological fundamentals of the different systems of the animal organism (nervous, endocrine, cardiovascular, respiratory, renal, digestive and reproductive), as well as the mechanisms for the maintenance of homeostasis and physiological adaptations.
2. Interrelate different concepts and knowledge to describe the overall functioning of the organism and its regulation.
3. Use properly the scientific terminology specific to this subject.
4. Handle the basic scientific instrumentation, obtain data through the performance of physiological techniques in the laboratory as well as analyze such data to explain certain physiological phenomena.
5. Acquire necessary skills to perform certain functional tests on animals and ability to interpret them.

### 2.3. Importance of learning goals

They allow understanding the fundamental principles of Animal Physiology, as a basic subject, with a view to its application to the study of other subjects of the Degree in the fields of Nutrition, Pharmacology and Therapeutics, Propedeutics, Medicine and Surgery, Obstetrics and Reproduction, Health and Production Animal, among others.

## 3. Assessment (1st and 2nd call)

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

Theoretical classes will be assessed by written tests consisting of 30 multiple-choice questions and 12 short answer questions. Passing these tests will demonstrate the achievement of learning outcomes 1, 2 and 3.

At the end of each practice, the teacher will verify that the student has passed the objectives of the practice. The evaluation will be complemented with a written examination of 10 short questions. Passing them will guarantee the achievement of learning outcomes 4 and 5.

**Test 1. First part.** It will include the thematic blocks I to VI of the theoretical program. It will represent 40% of the final grade.

**Test 2. Second part.** It will include the thematic blocks VII to X of the theoretical program. It will suppose 40% of the final grade.

**Test 3. Practical examination.** Acquisition of skills and abilities in the execution of the different practices of laboratory or computer room, as well as in the development of the realized clinical cases will be assessed. In addition, there will be a written examination of 10 short answer questions. It will be 20% of the final grade.

Assessments of tests 1 and 2 will take place on the dates indicated in the examination schedule drawn up by the centre.

Test 3 will be called additionally during the course of the school year, after the end of the practices, as well as in the official calls.

### Valuation criteria and requirement levels

In order to pass the theoretical part of the course, both written exams must be passed: Tests 1 and 2.

Each of the written examinations will consist of two parts:

1. 30 multiple choice questions (1 correct answer out of 4 possible options): The incorrect answers will not be penalized with negative points. This test will be evaluated on 10 final points and to obtain the score equivalent to 5, it will be necessary to reach 60% of the maximum score.
2. 12 short questions. This test will be evaluated on 10 final points and to obtain the score equivalent to 5, 50% of the maximum score must be reached.

The final grade of the written examination will be calculated by means of the weighted sum of the two parts, 40% of which correspond to the multiple-choice questions and 60% to the short questions.

A minimum score of 5 points is required to pass each midterm exam. However, from a score of 4.7 in one partial, you can make up what is missing up to 5 points if you overcome this difference in the other midterm exam.

In each of the official announcements the student may apply for one or both partial, according to his or her own criteria. In addition, the option of being able to take test 1 (first partial) at the end of the first four-month period will be given, without in this case involving the consumption of a summons.

Passed partial will be kept and counted only during the current academic year.

In order to pass the practical part of the course, it must first be demonstrated that the necessary skills and abilities have been acquired for the correct execution of the practices summoned throughout the different sessions. This will be done through direct observation of the student's work by the teacher, during the various face-to-face practice sessions. A student who demonstrates having acquired such skills will be given the grade of fit in this part. If it is not demonstrated in this way, a practical test will be carried out in the laboratory in each of the official announcements, consisting of the execution and oral explanation in the laboratory of any practice included in the program.

In addition, all students will take an exam consisting of 10 short questions about the contents of the practical program, each of which will be assessed with a maximum of 1 point. In order to pass this exam, a minimum of 5 out of 10 points must be obtained.

#### **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.

The passing of the practices and their qualification will be maintained for successive calls of the subject in subsequent courses, within the Grade.

## **4. Methodology, learning tasks, syllabus and resources**

### **4.1. Methodological overview**

The subject is structured in 10 thematic blocks and each of them includes the study of the Physiology of one organ system. There are 50 topics that are given in 78 hours of participatory lectures. The program is complemented with 34 hours of laboratory practices or in the computer classroom. There are 22 practices distributed in 11 practical sessions that they will be adjusted over time, where possible, to the developed concepts in the lectures. The 4 hours of programmed seminars will serve to reinforce and to discuss part of physiological concepts developed throughout the course.

Within the practical program, each student will also receive 2 sessions of clinical cases, with a duration of 2 hours per session, in order to reinforce, relate and integrate the knowledge acquired during the theoretical and practical sessions of the course.

### **4.2. Learning tasks**

The program offered to the student in helping to achieve the expected results includes the following activities:

- **Lectures:** 78 hours of theoretical classes will be given. They included a first class of introduction and presentation of the subject. They will be given in the classroom, with the students divided in two groups.
- **Seminars:** 4 hours of seminars will be given also in the classroom in the same groups of theoretical classes.
- **Practical classes:** A total of 34 hours of practical classes will be given in the Laboratory of Physiology or in the Computer classroom. They will be distributed in 11 sessions of 3 to 4 hours in the groups programmed by the Faculty. Each practical class will start with an explanation of the session and then students will perform the practice under continuous supervision by teachers. The obtained results will be analyzed at the end of the practical session. Guide notes and specific materials for its understanding and fulfilment will be available for the students.

Within the practical program, each student will receive two sessions of clinical cases, each one of a duration of 2 hours. These sessions will be held at the beginning and at the end of the second semester. In each session contents of the theoretical and practical program will be reviewed, with an applied pathophysiological approach. In this way, the students can integrate knowledge and apply it to the study of pathological processes in subsequent subjects of the degree.

### 4.3. Syllabus

## A) Lectures

Theoretical classes are distributed in 10 thematic blocks, with a chronology and assignment of hours that is described in detail below.

- I Introduction to Animal Physiology (1 h).
- II General Physiology (7 h).
- III Physiology of the Nervous System (10 h).
- IV Internal environment: Blood (3 h).
- V Cardiovascular Physiology (9 h).
- VI Gastrointestinal Physiology (12 h).
- VII Respiratory Physiology (6 h).
- VIII Renal Physiology (6 h).
- IX Endocrinology (12 h).
- X Reproduction (12 h).

Thematic blocks I to VI will be included in the first partial exam of the subject, whereas sections VII to X will constitute the second partial exam.

### I. Introduction to Animal Physiology (1 h)

**Topic 0.** Concept of Animal Physiology. Objectives. Relation to other sciences. The Physiology in the context of the Veterinary Degree. Bibliographical sources.

### II. General Physiology (7 h)

**Topic 1.** Homeostasis. Internal environment and biological fluids.

**Topic 2.** Physiology of excitable tissues. Resting membrane potential. Action potential. Propagation of the nerve impulse.

**Topic 3.** Synapse: Chemical synapse. Postsynaptic potentials. Electrical synapse. Neurotransmitters. Neuromuscular transmission.

**Topic 4.** Skeletal muscle, cardiac muscle and smooth muscle: Action potentials. Excitation-contraction coupling.

### III. Physiology of the Nervous System (10 h)

**Topic 5.** Sensory receptors. Transduction of sensory stimuli. Adaptation of receptors.

**Topic 6.** Somatovisceral sensitivity. Cutaneous mechanoreception, proprioception and kinesthesia. Thermal and pain sensitivity. Somatovisceral sensitivity transmission and cortical integration.

**Topic 7.** Chemical Senses. Taste. Smell.

**Topic 8.** Hearing. Range of hearing in several species. Phonoreceptors. Sense of Equilibrium: Functions of the vestibular system.

**Topic 9.** Vision. Ocular optics. Accommodation. Pupillary reflexes. Retina and photoreceptors. Chromatic vision. Field of vision. Binocular vision. Visual pathways.

**Topic 10.** Motor activity. Spinal reflexes. Motor functions of the brain stem, cerebellum, basal ganglia and cerebral cortex.

**Topic 11.** Autonomic nervous system. Sympathetic system. Parasympathetic system. Nervous centers regulating visceral function.

### IV. Internal environment: Blood (3 h)

**Topic 12.** General properties of blood. Components of blood. Hematopoiesis. Functions of erythrocytes and leukocytes.

**Topic 13.** Platelets. Hemostasis. Blood coagulation. Fibrinolysis.

### V. Cardiovascular Physiology (9 h)

**Topic 14.** Electrical activity of the heart. Pacemaker and conduction system of the cardiac impulse. Electrocardiography.

**Topic 15.** Mechanical activity of the heart. Cardiac cycle. Cardiac output and work of the heart.

**Topic 16.** Regulation of the cardiac activity. Intrinsic control: length-tension relationship. Extrinsic control: effects on rate and contraction force.

**Topic 17.** Systemic circulation. Blood pressure and vascular resistance. Circulation in arteries and arterioles. Venous circulation.

**Topic 18.** Capillary circulation. Capillary dynamics. Lymphatic circulation.

**Topic 19.** Mechanisms of neuroendocrine regulation of the peripheral blood circulation. Local control of tissue blood flow. Regulation of the arterial pressure.

## **VI. Gastrointestinal Physiology (12 h)**

**Topic 20.** Regulatory systems of the gastrointestinal functions. Regulation of food intake.

**Topic 21.** Salivary secretion. Mastication. Swallowing. Functions of the esophagus.

**Topic 22.** Functions of the stomach: Secretion, digestion and motility. Vomiting.

**Topic 23.** Physiology of the ruminant forestomach. Functional characteristics of the preruminant animals. Motility of the forestomach and abomasum. Rumination and eructation. Fermentative digestion.

**Topic 24.** Exocrine pancreatic secretion. Biliary secretion. Functions of the gallbladder.

**Topic 25.** Functions of the small intestine. Secretion, motility, enzymatic digestion and absorption.

**Topic 26.** Functions of the large intestine. Motility. Fermentative digestion. Secretion and absorption. Defecation.

**Topic 27.** Avian digestion. Functions of the crop, muscular stomach, small intestine and cecum.

## **VII. Respiratory Physiology (6 h)**

**Topic 28.** Pulmonary ventilation. Mechanics of pulmonary ventilation. Respiratory dead space. Ventilation and perfusion relationships.

**Topic 29.** Exchange of gases (O<sub>2</sub> and CO<sub>2</sub>) through the respiratory membrane. Gas transport in the blood. O<sub>2</sub> y CO<sub>2</sub> dissociation curves. Gas exchange between the blood and tissues.

**Topic 30.** Regulation of respiration. The respiratory center. Chemical and neural control of respiration. Other functions of the respiratory system.

**Topic 31.** Respiration in birds. Mechanics of breathing: lungs and air sacs. Gas exchange. Control of breathing.

## **VIII. Renal Physiology (6 h)**

**Topic 32.** Functions of the kidney. Glomerular function. Glomerular filtration rate. Renal clearance. Renal autoregulation.

**Topic 33.** Tubular functions: Tubular reabsorption and secretion.

**Topic 34.** Mechanisms of urinary concentration and dilution.

**Topic 35.** Regulation of acid-base balance. Renal mechanisms of pH control. Micturition reflex and its regulation.

## **IX. Endocrinology (12 h)**

**Topic 36.** General characteristics of the endocrine system. Concept of hormone. Chemical nature of hormones. General process of hormone synthesis, transport and degradation. Mechanisms of hormone action. Regulation.

**Topic 37.** Hypothalamic hormones. The hypothalamic-pituitary axis.

**Topic 38.** Hormones of the adenohypophysis. Prolactin-growth hormone family, corticotropin, gonadotropins, and thyrotropin. Biosynthesis. Function and regulation. Intermediate lobe of the hypophysis: melanocyte-stimulating hormone

**Topic 39.** Hormones of the neurohypophysis: vasopressin or antidiuretic hormone and oxytocin.

**Topic 40.** Thyroid hormones: synthesis, physiological effects and regulation.

**Topic 41.** Hormones involved in the metabolism of calcium and phosphate: Parathyroid hormone, calcitonin, and active metabolites of vitamin D. Synthesis, functions and regulation.

**Topic 42.** Pancreatic hormones: Insulin, glucagon, somatostatin and pancreatic polypeptide. Synthesis, functions and regulation.

**Topic 43.** The adrenal gland. Hormones from the adrenal cortex: Mineralocorticoids, glucocorticoids and other steroid hormones. Hormones from the adrenal medulla: Adrenaline and noradrenaline. Synthesis, functions and regulation.

**Topic 44.** The pineal gland. Melatonin. Synthesis, functions and regulation.

## **X. Reproduction (12 h)**

**Topic 45.** Physiology of the male reproductive system. Functions of testis: spermatogenesis and steroidogenesis. Sex glands. The hypothalamic-pituitary-gonadal axis. Actions of androgens. Erection and ejaculation.

**Topic 46.** Physiology of the female reproductive system. Ovarian functions: oogenesis, folliculogenesis and steroidogenesis. The hypothalamic-pituitary-gonadal axis. Estrogens and progesterone effects. Effects of other hormones from the ovarium. Ovulation. The estrous cycle. Functions of oviduct, uterus and vagina.

**Topic 47.** Physiology of the female reproductive system in domestic animals. Estrous cycles. Seasonal variations.

**Topic 48.** Physiological changes in pregnancy. Hormones of pregnancy. Function of placenta. Parturition. Maternal and fetal mechanisms. Physiological induction of the parturition.

**Topic 49.** Physiology of lactation. Mammogenesis. Lactogenesis. Milk ejection. Galactopoiesis. Mammary gland involution.

**Topic 50.** Avian reproduction. Female reproductive system. Ovarian hormones. Functions of oviduct. Ovulation and oviposition. Male reproductive system. Mating in birds.

## **B) Seminars**

Four hours of seminars will be programmed in the classroom, and they will consist in:

- Collaborating with external professionals in order to study more in depth some topics, with special interest in practical aspects and with application in Physiology.
- Studying more in depth some topics of the program.

## **C) Practical program**

It will consist in 34 hours of practical activities, distributed in 11 sessions.

### **Session 1. Study of the skeletal muscle contraction. (3 h)**

- **Practice 1.** Computer acquisition and analysis of the electrical and mechanical activity in the skeletal muscle.

### **Session 2. Study of the action potential. (3 h)**

- **Practice 2.** Study of the resting membrane potential and the action potential in a nervous fiber through a simulation computer program.

### **Session 3. Sensorial physiology. (3 h)**

- **Practice 3.** Analysis of the auditory function.
- **Practice 4.** Study of the eye movement.

### **Session 4. Blood analysis I: Red blood cells. (3 h)**

- **Practice 5.** Red blood cells count.
- **Practice 6.** Determination of hemoglobin concentration.
- **Practice 7.** Determination of hematocrit value.
- **Practice 8.** Determination of blood groups.

### **Session 5. Blood analysis II: White blood cells. Determination of proteins in plasma and serum (3 h)**

- **Practice 9.** White blood cells count.
- **Practice 10.** Blood smear evaluation.
- **Practice 11.** Serum and plasma preparation. Total proteins determination in serum and plasma. Determination of concentration of albumin, globulins and fibrinogen.

### **Session 6. Electrocardiogram, blood pressure and arterial pulse (3 h)**

- **Practice 12.** Electrocardiography and arterial pulse.

### **Session 7. Blood pressure and physiology of the blood vessels (3 h)**

- **Practice 13.** Study of the physiology of the blood vessels and the control of blood pressure using an interactive computer program.
- **Practice 14.** Measurement of blood pressure using a sphygmomanometer.

## **Session 8. Intestinal absorption of carbohydrates and the estrous cycle in the rat. (4 h)**

- **Practice 15.** Study of the intestinal absorption of glucose in anesthetized rat.
- **Practice 16.** Analysis of the estrous cycle in the rat. Vaginal cytology.

## **Session 9. Respiratory function. (3 h)**

- **Practice 17.** Spirometry. Study of respiratory cycle

## **Session 10. Analysis of the urine and biochemical determinations in plasma and serum. (3 h)**

- **Practice 18.** Qualitative analysis of the urine. Study of the urinary sediment.
- **Practice 19.** Biochemical assays: urea and creatinine.
- **Practice 20.** Biochemical assays: glycaemia.
- **Practice 21.** Biochemical assays: bilirubin and alanine aminotransferase (ALT).

## **Session 11. Exercise physiology. (3 h)**

- **Practice 22.** Study of the physiological adaptations to exercise using an interactive computer program.

## **D) Clinical cases:**

- Session 1 (2 h). It will be done at the beginning of the second semester.
- Session 2 (2 h). It will be held at the end of the second semester.

### **4.4. Course planning and calendar**

## **Calendar of attendance sessions and presentation of works**

The schedule and events of this subject are described in detail with the remaining subjects of the Degree of Veterinary Medicine, in the web page of the Faculty of Veterinary Medicine (link: <http://veterinaria.unizar.es/>). This link will be updated at the beginning of each academic course.

### **4.5. Bibliography and recommended resources**

<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=28408>