

**Physiology**

Code: 102633  
ECTS Credits: 9

Degree	Type	Year	Semester
2502445 Veterinary Medicine	FB	2	A

**Contact**

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**Use of Languages**

Principal working language: catalan (cat)  
Some groups entirely in English: No  
Some groups entirely in Catalan: No  
Some groups entirely in Spanish: No

**Teachers**

Patri Vergara Esteras  
Maite Martín Ibáñez  
Jose Ramon Palacio Cornide  
Tomás Férez Roig  
Sergi Casabella Ramon  
Gloria Costa  
Sergio Berdun Marin

**Prerequisites**

It is assumed that the student has a baggage of physics and chemistry, necessary for the understanding of physiological functions.

It is essential to have completed the first year of the degree and have acquired the knowledge of Cell Biology, Biochemistry, Morphology I and Estrucutra and Function of the Nervous System.

It is important to attend simultaneous subjects such as Morphology II, some of which are complementary to those of the Physiology course.

**Objectives and Contextualisation**

The objective of the subject is that the student knows the functions of the different organs and systems and be able to understand and explain how they all work coordinately in the face of the challenges that animals are once exposed to. The specific objectives are that the student knows:

1 - The functions of blood, hemostasis, hemodynamics and regulation of the cardiovascular system.

2 - The functions of the respiratory system and the renal system and their relation to the regulation of pH of physiological fluids and hydroelectrolytic equilibrium.

3 - The functions of the endocrine system as a regulator of the energy and intermediate metabolism and of the adaptations of the organism in the medium and long term.

4 - The reproductive function in males and females and their regulation.

5 - Digestive function and adaptations of the digestive system to dietary conditions and the presence of microbial.

6 - The immune system, the tolerance of its own structures and the innate and adaptive defensive responses of the organism.

This subject should provide the basis for detecting, evaluating, understanding and treating the pathological situations that the clinical veterinarian faces in his/her professional activity. It should also be the basis for understanding concepts that will be explained later, such as those related to nutrition, nutrition and animal production.

## Competences

- Analyse, synthesise and resolve problems and make decisions.
- Apply scientific method to professional practice, including medicine
- Demonstrate knowledge and understanding of the physical, chemical and molecular bases of the main processes in the animal organism.
- Demonstrate knowledge and understanding of the structure and functions of healthy animals.
- Demonstrate knowledge of English to communicate both orally and in writing in academic and professional contexts.
- Demonstrate knowledge of the rights and duties of the veterinarian, with a special focus on ethical principles
- Draft and present satisfactory professional reports, always maintaining the required confidentiality.

## Learning Outcomes

1. Analyse the relation between the type of immune response that develops and the characteristics of the pathogen: the method and anatomical place of entry, the effector mechanisms of the response and the evasion mechanisms.
2. Analyse, synthesise and resolve problems and make decisions.
3. Apply scientific method to professional practice, including medicine
4. Define the properties of innate and adaptive immune response and defend clonal selection theory: a lymphocyte, an antigen receptor.
5. Demonstrate knowledge of English to communicate both orally and in writing in academic and professional contexts.
6. Draft and present satisfactory professional reports, always maintaining the required confidentiality.
7. Explain the basic concepts of the mechanisms of functional regulation in each system.
8. Explain the interrelation between the different organs and systems, and their hierarchical organisation.
9. Explain the main physical, chemical and molecular bases that ensure the correct functioning of the organism.
10. Explain the mechanisms for activating and regulating cellular and humoral immune response.
11. Foresee the qualitative and quantitative repercussions of disorder in a particular mechanism for the organism as a whole.
12. Identify the variables that enable evaluation of the functions of each system.
13. Recognise the magnitude and time dimension of the physiological changes that take place in the adaptation of an animal to its surroundings.
14. Recognise the mechanisms through which the environment induces changes in animals functions.
15. Use correct and suitable physiological terminology.
16. Use physiological concepts to solve problems related with clinical and experimental situations or related with the productive field.

## Content

Lectures (62h)

Presentation of the subject

### PHYSIOLOGY

1-Circulation and respiration (resp. M.T. Martín) 1.7 ECTS

1.1 Cardiac cycle (I). Phases of the heart cycle. Isovolummetric contraction and relaxation. Relationship between ECG, pressures and volumes of the different compartments.

1.2 Cardiac cycle (II). Cardiac sounds and murmurs. Systolic and diastolic sounds. Regulation of the heart cycle.

1.3 Blood functions. Cellular elements, proteins and other solutes. Hemostasis; adhesion and platelet aggregation. Coagulation and fibrinolysis. Tissue repair

1.4 Hemodynamics of the arterial, capillary, venous and lymphatic circulation.

1.5 Regulation of blood pressure (I). Nervous mechanisms. Concept of baroreceptor. Nervous centers and afferent pathways. Neurotransmitters involved.

1.6 Regulation of blood pressure (II). Endocrine regulation. Role of the kidney in the regulation of blood pressure. Integration of the different mechanisms: pharmacological approach.

1.7 Regulation of local blood flow. Mechanisms of hyperemia and self - regulation. Local control factors.

1.8 Capillary circulation: mechanisms for exchange and dissemination.

1.9 Mechanics of respiration. Respiratory cycle. Volumes and pressures. Functions of the diaphragm.

1.10 Gas exchange. Oxygen and carbon dioxide exchange at the alveolar and peripheral level. Gas transport

1.11 Regulation of breathing. Central and peripheral mechanisms of breathing regulation. Breathing in birds.

Endocrine system and metabolic regulation (resp. E. Fernández) 2.5 ECTS

2.1. Basic concepts on endocrinology. Hormone and target tissue concept. Hormone receptors Type of hormones and hormonal secretions. Factors modifying the response to hormones.

2.2. Mechanisms of action. Intracellular mediators: concept of second messenger. Types of hormones and hormonal secretions. Factors modifying the response to hormones.

2.3. General organization of the endocrine system. Hypothalamic control of the pituitary gland. Relationship of the hypothalamus with other higher structures. Hormones of the neurohypophysis. Hypothalamus-pituitary portal circulation.

2.4. Thyroid hormones. Synthesis, storage and secretion of thyroid hormones. Transport and metabolism. Effects. Thyroid function regulation.

2.5 The pancreatic islets. Insulin: secretion, transport and effects. Glucagon: Effects. Somatostatin. Effects Other pancreatic hormones. Regulation of pancreatic islet secretions.

2.6. Adrenomedullary hormones. Biosynthesis and metabolism. Fight or Flight responses. Stress and adrenal hormone secretions.

2.7. Glucocorticoids Effects on metabolism. Effects on the immune system. Other effects. Control of glucocorticoids secretion.

2.8 Growth hormone Direct and indirect effects Primary and secondary somatomedines. Regulation of the secretion of growth hormone

2.9. Energy metabolism. Energy balance. Metabolic rate. Endocrine functions of adipose tissue: Leptin and adipocytes. Actions on intermediate metabolism and metabolic rate and food intake.

2.10 Thermoregulation. Mechanisms of heat production and loss. Fever, hyperthermia, heat stroke, acclimatization, hibernation, lethargy.

2.11. Chronobiology. Rhythms in animal functions and their adaptive value. Circadian rhythms and their neural regulation. The Pineal gland and the regulation of infradian rhythms. Adaptation of the endocrine system to environmental changes.

3-Reproduction (P.Vergara P. resp.) 0.8 ECTS

3.1. Sex biology Sexual differentiation. Sexual steroids.

3.2. Testicular function. Testicular compartments. Regulation and organization of spermatogenesis.

3.3. Ovarian function and ovarian cycle. Phases of follicular development. Ovulation luteogenesis. Luteolysis

3.4. Regulation of the ovarian cycle. Regulation of gonadotrophin secretion. Types of cycles: Menstrual cycle; Estrous cycle; Polyestral and monoestral females.

3.5. Environmental influences on reproduction. Effects of the photoperiod: seasonal and non-seasonal animals. f Sexual intercourse-induced ovulation. Effects of social interaction.

3.6. Function of androgens in adults. Secretions of the male reproductive system. Function of estrogens and progestagens in the female reproductive system. Changes in the oviduct, uterus, cervix and vagina during the ovarian cycle. Genital reflexes: Erection, ejaculation.

3.7. Pregnancy. Endocrine recognition and support of pregnancy. Differences between different species of domestic mammals. Hormonal changes related to delivery. Functions of oxytocin. Restoration of cycles after delivery.

3.8. Development of the mammary gland. Mechanism of the secretion of milk. Start, maintain and suppress lactation. Execution of milk. Influence of lactation on ovarian function.

3.9. Reproduction in birds.

4-Renal system and water and salt balance (resp. E. Fernandez) 0.9 ECTS

4.1. Hormones regulating calcium and phosphorus metabolism. Physiology of the bone. Parathyroid hormone, vitamin D and calcitonin.

4.2. Renin-angiotensin-aldosterone system. Kallikrein-kinin system. Atrial natriuretic factor.

4.3. Vasopressin. Actions, control of its secretion. Relationship with other hormones involved in the regulation of water and salt balance.

4.4. Kidney function. Renal circulation, glomerular filtration and its regulation. Tubulo-glomerular feed back. Renal Clearance. Estimating glomerular filtration rate.

4.5. Tubular functions. Tubular reabsorption mechanisms. Tubular secretion. Mechanisms of urine concentration and dilution. Excretory function in birds. Micturition. Mechanisms and neural pathways involved.

4.6. Regulation of the acid-base balance. Blood and tissue tampon systems. Metabolic, respiratory and renal influences

5: Digestive system (P.Vergara resp.) 1.1 ECTS

- 5.1 Gastrointestinal functions. Enteric nervous system. Gastrointestinal hormones.
- 5.2. Gastrointestinal secretions: regulation of the composition of salivary, gastric, pancreatic and biliary secretion.
- 5.3. Swallowing. Gastric receptivity and emptying.
- 5.4. Fasting and Postprandial motility patterns: Migrating motor complexes. Segmentation and peristaltic movements.
- 5.5. Digestion of foodstuff and absorptive processes. Water and electrolyte secretion and absorption in the intestine.
- 5.6. Digestion by symbionts. Digestion and motility in the ruminant stomach.
- 5.7. Digestive function in birds

## BLOCK IMMUNOLOGY

### 6- Functions of the immune system (resp. J.R Palacio) 2 ECTS

- 6.1. Elements of the immune system. Innate immunity Cells and proteins. The complement system. / Theme of Self-Learning (AAP).
- 6.2. Structure of immunoglobulins (Igs) Antigen-antibody interaction. TCR and BCR
- 6.3. Organization of immunoglobulin genes: Recombination mechanisms. The T cell receptor (TCR). Complex CD3: TCR signaling complex. TCR / MHC / antigen trimolecular interaction.
- 6.4. Major Histocompatibility Complex (MHC) Class I and Class II. Structural characteristics and function. Restriction of T response by MHC. Polymorphism and peptide binding. MHC-peptide complex: interactions, conformational changes, recognition surface, molecular mimicry
- 6.5. Antigenic processing and recognition. Synthesis of molecules of MHC class I and class II. Processing paths. "Cross priming". Presentation of antigens: requirements, signals accessories. Recognition of the antigen by the T cells: immunological synapse.
- 6.6. T Lymphocytes . Ontogeny and maturation of T lymphocytes. Positive and negative clonal selection. Restriction for MHC and self tolerance. T cell populations : TCRab and TCRgd. Functional subpopulations: Helper (Th), cytotoxic (Tc) and regulatory (Treg) T cells. NKT cells. Memory T cells.
- 6.7. B Lymphocytes. Ontogeny and maturation of the B lymphocytes. Phenotypic and functional differences in B lymphocytes. Effector functions of B lymphocytes: antibody production and antigen presentation (APC). Subpopulations of lymphocytes B: B-1 and B-2 lymphocytes. T-dependent and T-independent antigens.
- 6.8. Professional Antigen Presentation Cells (APCs). Conventional and plasmacytoid dendritic cells: Function and anatomical location. Other cells: mast cells, eosinophils, basophils and NK cells..
- 6.9. Cytokines Properties. Functional redundancy. Families of cytokines. Receptors. Cytokines of innate and adaptive immunity. Chemokines, Chemotaxis and homing of leukocytes. Families of chemokines and their receptors. Specificity, properties and main effects.

Organization of the immune response.

6.10. Cellular immunity. From the innate to the adaptive response . Activation of T lymphocytes. TCR interaction, MHC and accessory molecules. Signal Transmission. Third activation signal: micro-environment of cytokines. Lymphocyte activation markers T: IL2R, Class II T cells and B memory. Phenotypic characteristics. Effector T cells. Th1 and Th2. T cytotoxic lymphocytes. Mechanisms of cytotoxicity.

6.11. Humoral immune response. Activation of B lymphocytes. Antigen recognition. Second signal transduction. Th follicular cells (Tfh). Lymphoid follicles and germinal center formation. Somatic hypermutation Maturation of affinity.

6.12. Isotope change and microenvironment in the lymph nodes. Humoral responses against T-independent and T-dependent antigens. Effector function of the antibodies. Anatomical distribution of antibodies.

6.13. Regulation of the immune response Self-regulation. Immune Tolerance: central (clonal deletion) and peripheral (ignorance, anergy, deletion, suppression) tolerance. Mechanisms and elements of regulation during and after the immune response. Apoptosis (AICD). T regulatory lymphocytes: natural regulators (nTr), induced regulators (Tr1).

6.14. Immune response towards bacteria, fungi, parasites and viruses. Mechanisms of evasion of the immune response. Immune memory. Autoimmunity in response to a viral infection. HIV infection.

Ineffective immune response

6.15. Hypersensitivity reactions Concept of hypersensitivity. Type I hypersensitivity. Type II hypersensitivity. Type III hypersensitivity. Hypersensitivity type IV. 6.16. Autoimmunity Tolerance and autoimmunity. Mechanisms of autoimmunity and examples: autoantibodies, immunocomplexes, CD8 cells, CD4 cells.

Practical works (10.5 h):

- Hematology: Blood cell counts, hematocrit and leukocyte formula
- Separation and functional evaluation of lymphocytes
- ECG in the dog
- Structure and function of the lymphoid organs
- Renal function tests in the dog.

Seminars (6 h):

- 1- Electrophysiological basis of the electrocardiogram.
- 2- Case studies on endocrine functions.
- 3- Testing renal function. Calculating renal function parameters, significance and interpretation.
- 4- Adaptations of the digestive system.
- 5- Case studies on reproductive physiology

## **Methodology**

The teaching methodology will involve theory classes as dynamic as possible. Some theory classes may be taught in English. In some cases, evaluation activities can be considered in a short format (quizzes, short questions ...)

The practical classes will be done in the laboratory and in the microscopy room. In some cases the practical classes will be carried out in small groups to make possible the student's contact with reality (manipulation of the instruments and the living animal) and to approach real clinical situations. In some sessions, English will be used as the vehicular language.

Seminars: will have as objective the discussion of cases and the resolution of problems through which physiological concepts and practical applications can be inferred. At the end of the seminars, evaluation activities will be carried out.

- Self-learning cases / topics should be prepared based on the contents established for each topic but taking into account the competences and skills indicated above.

a) Students should work the cases once the basic contents related to them have been studied.

b) The works can be done in groups (maximum 3 people), unless expressly indicated otherwise.

c) The cases will be delivered, corrected and evaluated in the terms indicated in the virtual campus. It will indicate a few hours of tutoring to comment, where appropriate, the most frequent errors and clarify the issues that may require it and review if necessary the score obtained for each job. After these tutorials (which may be done in virtual classrooms) the grades of the cases cannot be modified.

## Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	62	2.48	1, 4, 5, 7, 10, 8, 9, 12, 11, 14, 13, 15
Practical works	10.5	0.42	2, 5, 8, 12, 11, 13, 6, 16, 15
Seminars	6	0.24	2, 3, 5, 8, 12, 11, 14, 13, 16, 15
Type: Autonomous			
Autonomous work on Case Reports	33	1.32	1, 2, 3, 4, 5, 8, 12, 11, 14, 13, 6, 16, 15
Individual work and study	108	4.32	1, 4, 7, 10, 8, 9, 12, 11, 14, 13, 16, 15

## Assessment

A multifactorial evaluation system has been proposed in order to:

- Guarantee the achievement of a good level of knowledge and skills.
- Assess the continuous work throughout the course through various tests and tasks
- Stimulate a continuous work on the subject (many tasks, each with a small contribution to the final score).
- Provide students with useful tools to integrate the knowledge and opportunity to be aware of how good is their progress in learning.
- Make it possible to test all the skills that must be evaluated.

The most relevant aspects of the evaluation system set for the 2019-20 course are listed below:.

The weight of the Immunology block is 25% and that of the Physiology block is 75% of the final score. However, the blocks of Immunology and Physiology must be passed separately with a minimum mark of 5,00 / 10 in each one.

To pass the Immunology block it is essential:

- to have done passed the practical works and the quiz on practical works
- To pass the tes of Immunology: at least 70% of the questions in the test must be answered and a minimum score of 5/10 must be reached.
- Students getting lower scores should pass a second test at the end of the second semester and reach a score > 5,00 / 10.

To pass the Physiology it is required to:

- Obtain a score > 5/10 in the global test including all the physiology block lessons. The socire of this test will be worth 50% of the score of the subject
- Students not reaching a score of 5/10 in the global test should pass another exam at the end on the second semester.
- The marks obtained in the evaluable activities performed during the course (case resolution and classroom tests) will be worth 25% of the mark of the subject.

Students enrolled for a second or third time may opt to be evaluated through an exam which will include test questions and written questions and be worth of 75% of the total core of the subject. Adherence to this option must expressed and sent by email to [Ester.Fernandez@uab.cat](mailto:Ester.Fernandez@uab.cat) before October 15

Students who have obtained average qualifications below 5 in the continuous assessment tests may also choose to do a mixed examination with a 75% valuation at the end of the second semester.

Students may opt to improve their marks at the end of the semester.

## Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Case reports and classroom quizzes	25%	1.5	0.06	2, 5, 7, 8, 9, 12, 11, 14, 13, 6, 16, 15
Practical work on immunology report and self learning	1%	0	0	1, 3, 4, 10, 6, 16, 15
TEST IMMUNOLOGY BLOCK	24%	2	0.08	1, 4, 10, 9, 12, 14, 15
TEST PHYSIOLOGY BLOCKS	50	2	0.08	7, 8, 9, 12, 11, 14, 13, 16, 15

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