### TEACHING GUIDE

#### HUMAN AND CELL PHYSIOLOGY I

**MODULE CONTENT** | **YEAR** | **TERM** | **CREDITS** | **TYPE**
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MEDICINE AND PHARMACOLOGY | HUMAN AND CELL PHYSIOLOGY | 2nd | 1st | 6 ECTS | Obligatory

### LECTURERS
- Pilar Aranda Ramírez
- Javier Díaz Castro
- Naroa Kajarabille García
- Francisco Lisbona Delgado
- Mª Inmaculada López Aliaga
- María López-Jurado Romero de la Cruz
- Juan Llopis González
- Mª José Muñoz Alférez
- Mª Teresa Nestares Pleguezuelo
- Julio José Ochoa Herrera
- Jesús Mª Porres Foulquie
- Cristina Sánchez González

### CONTACT INFORMATION
- Department of Physiology, 1st Floor, Faculty of Pharmacy. Phone 958243879
- paranda@ugr.es, javierdc@ugr.es, naroakg@correo.ugr.es, flisbona@ugr.es, milopez@ugr.es, mlopez@ugr.es, jllopis@ugr.es, malferez@ugr.es, nestares@ugr.es, jjoh@ugr.es, jmporres@ugr.es, criissg@ugr.es

### DEGREE WITHIN THE SUBJECT IS TAUGHT

**Pharmacy**

**Pilar Aranda Ramirez**
- First semester: M, T and F, 11.30-14.30 (PHARMACY)
- Second semester: M, 11.30-14.30 (PHARMACY), T, 10.00-11.00 (FCAFYD), 11.30-14.30 (PHARMACY), F, 08.00-09.00 (FCAFYD), 11.30-14.30 (PHARMACY)

**Javier Díaz Castro**
- First semester: M, W and F 16.00-18.00
- Second semester: T 15.00-16.00, W 16.00-17.00 and 18.00-19.00, Th 17.00-18.00 and F 16.00-17.00 and 18.00-19.00

**Naroa Kajarabille Garcia**
- First semester: T 08.00-10.00, Th 09.00-10.00
- Second semester: T 09.30-10.30, Th 10.30-11.30

**Francisco Lisbona Delgado**
- First semester: T and Th 09.30-11.30 and F 10.30-12.30
- Second semester: T and Th 09.30-11.30 and F 10.30-12.30

**Mª Inmaculada López Aliaga**
First semester: M, W and F 10.30-12.30
Second semester: M, W and F 11.30-13.30
  • María López-Jurado Romero de la Cruz
    First semester: M, T and F, 11.30-14.30
      (PHARMACY)
    Second semester: M, 11.30-14.30 (PHARMACY),
    T, 10.00-11.00 (FCAFYD), 11.30-14.30
      (PHARMACY), F, 08.00-09.00 (FCAFYD), 11.30-
      14.30 (PHARMACY)
  • Juan Llopis González
    First semester: T and Th 11.30-13.30
  • Mª José Muñoz Alférez
    First semester: M and W 10.30-13.30
    Second semester: W and F 10.30-13.30
  • Mª Teresa Nestares Pleguezuelo
    First semester: M, W and F 11.30-13.30
  • Julio José Ochoa Herrera
    First semester: M, W and F 16.00-18.00
    Second semester: T 10.00-11.00 and 12.00-13.00,
    Th 09.00-11.00, F 11.00-13.00
  • Jesús Mª Porres Foulquie
    First semester: M, W, F 09.30-11.30
    Second semester: M, W, F 09.30-11.30
  • Cristina Sánchez González
    First semester: M, 09.00-15.00

PREREQUISITES and/or RECOMMENDATIONS

Prerequisites: those necessary to access to the degree, related with the level of formation that the student must acquire to accede to the University.

Recommendations: to have previous basic knowledge (background knowledge of Chemistry, Anatomy and Histology, Biochemistry, Metabolism.
A good standard of English and informatics skills are also required.

BRIEF ACCOUNT OF THE SUBJECT PROGRAMME

The programme has a high degree of coherence and integration and cover a diverse range of topics, while reflecting particular strengths within the biological and life sciences and there is a clear coherence between the different modules. Physiology is a study of the normal functions of cells, organs and systems of the living body, the mechanisms by which they are achieved and the regulation of functional activities to maintain the homeostasis, therefore the programme has been divided into thematic units just for didactic purposes, but during the course we will integrate all the body systems defining their links to maintain the homeostasis.

GENERAL AND PARTICULAR ABILITIES

Physiology is a study of the normal functions of cells, organs and systems of the living body, the mechanisms by which they are achieved and the regulation of functional activities. A firm grasp of its principles is essential not only for the study of successive courses, but also for students’ future professional career after graduation. Selection of the teaching material will be in accordance with the necessity of professional education and will be laid emphasis on basic theories and knowledge of physiology as well as on the training of basic techniques. Attention will also be paid to promote the ability of scientific thinking of the students. In order to foster the students’ ability of studying physiology, we conduct our teaching with several methods, such as self-study, exhibition in small groups and tutoring instead of to be given only by lecturer in the classroom. The lifelong learning to obtain more and better competences requires new pedagogical practices and the emergence of new scenarios for the students in where multimedia shall play a predominant role in our programme. Therefore, multimedia resources will be using our methodological teaching-learning process in the
Cooperative learning networks will be built and innovative teaching-learning strategies will be used to complement the traditional classes.

OBJECTIVES (EXPRESSED IN TERMS OF EXPECTED RESULTS OF THE TEACHING PROGRAMME)

Cognitive objectives:
- Understand and analyze the interactions between nervous system, cellular communication and its relation to human homeostasis.
- Study, understand and analyze the physiological roles of all the body systems and its integration to maintain homeostasis.

Procedural aims:
- Know properly use terms and concepts of matter and expressed in a correct and accurate.
- Deduct, identify and describe the physiological effects of body systems to maintain a stable, constant condition in the human body.
- Deduct, interpret and evaluate critically experimental results.
- Know the main documentary sources of the discipline of developing the ability to complete and update knowledge in the future.

Attitudinal objectives:
- Determine the complex interactions to maintain balance or return systems to functioning within a normal range.
- A scientific approach to the study and explanation of physiological phenomena in the domain of scientific knowledge.

DETAILED SUBJECT TOPICS

We will use several multimedia instruments during the course to enhance the teaching-learning process of the student. This programme has been designed taking into account the integration concept and cover a diverse range of physiological topics, with a clear coherence between the different issues. Physiology is a study of the normal functions of cells, organs and systems of the living body, the mechanisms by which they are achieved and the regulation of functional activities to maintain the homeostasis, therefore the program has been divided into thematic unit just for didactic purposes, although during the course we will integrate all the body systems, to understand better how they maintain a stable, constant condition.

Program theory (with aims and time schedule)

Subject 1. - Introduction to Physiology (1h)
Define the concepts of physiology, internal medium and homeostasis
Knowing the interest for a pharmacist involves the study of cell physiology and human

Subject 2. - Functional organization of the cell. Plasma membrane (1h)
Understanding the functional organization of the cell
Describe the functions of the plasma membrane
Knowing the ionic composition of the intracellular and extracellular fluids

Subject 3. - Transport across the plasma membrane (1h)
Differentiate processes of endocytosis (pinocytosis, phagocytosis) and exocytosis
Understanding the mechanisms of passive transport: simple diffusion and facilitated diffusion
Knowing the characteristics and regulation of the various kinds of ion channels.
Differentiate primary and secondary active transport
Know the characteristics and properties of the ion pumps
Knowing paracellular transport

Subject 4. - Excitability (2h)
Describe and explain the resting membrane potential and ionic bases
Describe the local potential and ion channels involved
Describe and explain the phases, properties and ionic basis of the action potential.
Knowing the excitability changes along the action potential
Describe the action potential conduction and the effect of myelin
Subject 5. - Nerve cells (1h)
To study the functions of the neuron.
Describe the process of myelogenesis.
Knowing the properties of the neuron
Describe the events involved in the damage and peripheral nerve repair

Subject 6. - Synaptic transmission (2h)
Describe the main morphological characteristics of the synapse
Distinguish between electrical synapses and chemical synapses
List the steps used in the transmission of impulses across the synapse
Distinguish between excitatory and inhibitory postsynaptic potentials
Define presynaptic inhibition
Identify the various types of neural circuits in the nervous system
Differences between spatial and temporal summation
Describe the properties of the synapse
List the criteria for identifying a substance as a neurotransmitter
Describe the classification and functions of neurotransmitters
Define and classify the neuromodulators

Subject 7. - The muscle fiber (4h)
Describe the motor neuron-muscle ratio
Enumerate the sequence of events and ionic power ranging from the production of an action potential in the motor nerve
to the contraction of a skeletal muscle
Describe how you conducted the cross-bridge cycle and shortening the sarcomere
Knowing the function of the calcium ion in the contraction-relaxation
Explain the sum of contractions and length-tension relationships and force-velocity

Subject 8. - General structure of the nervous system (2h)
Learn the basic functions of the nervous system
Knowing the functional characteristics of the cranial and spinal nerves
Know the elements of the central nervous system protection
Explain the formation, movement and function of cerebrospinal fluid
Know the meaning of the blood brain barrier

Subject 9. - General physiology of receptors (1h)
Differentiate the concepts of sensation and perception
List the types of sensory modalities
Define and classify sensory receptors
Describe the sensory transduction process and differentiate between potential and receptor potential generator
Adapting receptors. Differentiate between fast and slow
Define the concept of receptive field
Describe the process of sensory coding

Subject 10. Somato-visceral sensitivity (1h)
Describe the location and function of receptors of tactile, thermal and pain sensations
Describe the different types of pain
Identify proprioceptive receptors (muscle spindles and Golgi tendon organ) and describe their functions.
Describe the modes of transmission and integration somatovisceral cortical sensitivity

Subject 11. Physiology of vision (2h)
Know the functions of the structural components of the eyeball
Explain the role of the refraction, accommodation and constriction in imaging
Describe the functions of the photoreceptors and photopigments in vision
Adapting known vision receptors to changes in light intensity
Describe binocular vision and the ability to perceive the depth and three-dimensional nature of the objects
Understand the concept of visual acuity
Describe the processing of visual impulses in the retina and the visual pathways and centers of integration

Subject 12. Physiology of hearing and balance (2h)
Describe the functions of the structures that make up the three main parts of the ear
Describe the characteristics of a sound wave
Describe the process of capture and conveyance of a sound wave
Knowing sensory transduction in fonorreceptores
Describe the coding of frequency, intensity and sound localization
Identify pathways and nuclei involved in the neural processing of auditory information
Describe the function of the macula in the static and dynamic balance (linear acceleration and deceleration)
Describe the function of the ampullary crests in rotational acceleration or deceleration
Identify vestibular pathways and integration centers

**Subject 13. Physiology of taste and smell (1h)**
Knowing the structure of gustatory and olfactory receptors
Describe the physiology of taste and smell
Describe the pathways and centers for gustatory and olfactory sensitivity

**Subject 14. Control of motor activity I. Motor function in the spinal cord and brainstem (1h)**
Describe the function of the neural structures responsible for movement
Explaining spinal circuits and motor control
Describing the topographic relations
Describe the function of the brainstem motor: vestibular nucleus and reticular formation in the maintenance of balance and posture

**Subject 15. - Control of motor activity II. Motor function in the cerebellum, basal ganglia and cortex (1h)**
List the motor areas of the cerebral cortex and its relative contribution to the organization of the motor act.
Point out the differences between pyramidal and extrapyramidal motor system
Explaining the role of the cerebellum in voluntary movements
Describe the afferent and efferent projections of the cerebellum
Describe the role of the basal ganglia
Describe the afferent and efferent projections of the basal ganglia
Make a diagram integrating the functions of the various structures involved in the regulation and control of motor action

**Subject 16. - Higher functions of the nervous system (1h)**
Explain the cellular basis of sleep-wake rhythms and their possible role
Explain the cellular basis of learning and memory

**Subject 17. General organization of the endocrine system (1,5h)**
Define the terms endocrine gland and hormone
Identify various endocrine glands and the hormones they secrete
List a number of criteria that identify a substance as a hormone
Know the classification of various hormones
Know the processes of synthesis, secretion and hormone transport and metabolism
Describe the types of signals that can regulate the secretion of hormones
Describe the general mechanisms of hormone action

**Subject 18. Neuroendocrine integration (1,5h)**
Explain the functional relationship between the hypophysis and hypothalamus
Describe the functional implications of hypothalamic-pituitary portal system
List the hormones of the adenohypophysis and neurohypophysis and explain how its secretion is regulated by the hypothalamus

**Subject 19. Thyroid physiology (1,5h)**
Knowing thyroid hormones
Describe the biological actions and mechanisms of regulation of thyroid hormone secretion

**Subject 20. Hormonal regulation of metabolism calcium/phosphorus (2h)**
Know the different types of bone cells
Describe the interaction between the plasma levels of calcium and parathyroid hormone and calcitonin
Describe the biological actions and mechanisms of regulating the secretion of parathyroid hormone, vitamin D hormone and calcitonin
Subject 21. Hormonal regulation of growth (1h)
Describe the metabolic effects and mechanisms of regulation of GH secretion
Meet other factors and hormones involved in growth

Subject 22. Physiology of the endocrine pancreas (1,5h)
Describe the major metabolic actions of insulin and glucagon and explain the regulation of its secretion

Subject 23. Physiology of the adrenal gland (1,5h)
Describe the main biological actions of cortisol
Describe the hypothalamic-pituitary-adrenocortical in controlling the secretion of glucocorticoids
Describe the actions of catecholamines and explain how they are regulated secretions of the adrenal medulla

Subject 24. Hormonal regulation of water-salt balance (1h)
Knowing the role of mineralocorticoids in the regulation of water and electrolyte homeostasis
Describe some of the major biological actions of aldosterone
Describe the biological actions of ADH and how its secretion is regulated
Describe the renin-angiotensin-aldosterone activation mechanisms and functions

SYSTEM FOR ASSESSING THE ACQUISITION OF THE COMPETENCES AND KNOWLEDGE

To evaluate the course content, theory examination will be performed on dates determined by the faculty in coordination with the other subjects in the 2nd year. Prior to the date of each control the teacher will expose the type of examination.

There will also be an evaluation of the work performed and presented by the students in class and also of the regular attendance to classroom (focusing on class activities scheduled throughout the course).

In order to pass the course will be must have passed laboratory practices and theory examinations.

The allocation of points in the evaluation system will be based on percentages:
  - Theory examinations: 70%
  - Exhibition of topics by students, papers and participation in seminars: 10%
  - Attendance to class and class activities: 10%
  - Laboratory Practices: 10%

BIBLIOGRAPHY
Print Books on Physiology

- Anatomy & Physiology/ Gary A. Thibodeau, Kevin T. Patton. REF QP34.5 .S4 2003
- Appleton & Lange review of Physiology/ David G. Penney. QP40 .P44 2004
- Color atlas of Physiology / Agamemnon Despopoulos. REF QP34.5 .S5313 2003
- Human Physiology / Stuart Ira Fox. REF QP34.5 .F68 2004
- Human Physiology: from cells to systems / Lauralee Sherwood. REF QP34.5 .S48 2004
- Physiology/ [edited by] Robert M. Berne [et al.]. REF QP34.5 .P496 2004
- Principles of anatomy and physiology/ Gerard J. Tortora, Sandra Reynolds Grabowski. REF QP34.5 .T67 2003

Print Journals

- American Journal of Physiology.
- Canadian Journal of Applied Physiology.
- European Journal of Applied Physiology.
- Annual Review of Physiology.
- Handbook of Physiology.
- News in Physiological Reviews.

RECOMMENDED INTERNET LINKS

Electronic Books

- Origination of Organismal Form: Beyond the Gene in Developmental and Evolutionary Biology/ Vienna Series in Theoretical Biology, 2003. (netLibrary)

Electronic Journals

- Advances in Physiology Education (DOAJ)
- American Journal of Physiology (EBSCO Open Access)
- BMC Physiology (DOAJ)
- Experimental Physiology (Cambridge) (EBSCO Open Access)
- Journal of Applied Physiology (Free Medical Journals)
- Nephron – Physiology (Academic Search Premier)
- Journal of Physiology (Free Medical Journals)
- The Journal of General Physiology (Free Medical Journal)

PRACTICAL LABORATORY CLASSES

Group work sessions in the laboratory supervised by the lecturer. Meaningful construction of knowledge through interaction and student activity.

PRACTICAL LABORATORY CLASSES

Practice 1.- Detailed functional study of different organs and body systems models
| Practice 2. | Transport mechanisms and cell permeability (computer simulation) |
| Practice 3. | Neurophysiology of nerve impulses (computer simulation) |
| Practice 4. | Gustatory and olfactory receptors. |
| Practice 5. | Skeletal Muscle Physiology (simulated). Neuromuscular junction in vivo study |
| Practice 6. | Effect of thyroxine on the basal metabolism (computer simulation) |
| Practice 7. | Control of blood glucose. Determining the blood glucose curve |

Theoretical and practical exam

For each academic year, a selection of the above list will be performed at the physiology laboratory.

**TUTORING**

Personalized and small group attention. **Continuous instruction and/or orientation carried out by the lecturer** for the purpose of reviewing and discussing the materials and topics presented in lectures, seminars, readings, writing papers and of course to answer questions related with the subject.

**ADDITIONAL COMMENTS**

Context in the Degree:
The aim of the teachings of the Degree of Pharmacy is to train experts in the drug and its impact on health, as referred to in the European Directive 85/432 by regulating its teachings. With the study of Cell and Human Physiology is intended that the future pharmacist acquire knowledge about the functioning of the human organism. This course is supplemented by courses on Cell and Human Physiology II, Pathophysiology, Clinical Physiology and Biochemistry, Human Body Alterations: Functional Testing, which are discussed in later courses and provides a basis for understanding other basic materials for the pharmaceutical, such as "Pharmacology" and "Pharmacognosy and Phytotherapy", "Clinical Pharmacy and Pharmacotherapy", "Biopharmaceutics and Pharmacokinetics", "Pharmaceutical Technology" and "Nutrition and Food Science." If one of the main objectives of the Degree of Pharmacy is the knowledge of medicine, from research and preparation, dispensing, knowing meaningless actions without prior knowledge of the drugs keep the body where they will act.

All the lectures will be taught in Spanish, however the lecturers have a good standard of English and all the comments/questions and meetings with the lecturers can be made and answered in English. The exams also can be made in English. For additional information, please contact directly with the lecturer.

In addition, the Department of Physiology offers a at the postgraduate level (Master and Doctorate), a suite of leading programmes in Human & Applied Physiology and Human Nutrition (all of them with quality/excellence mentions).