# 1. OVERVIEW

| | |
|---|---|
| **Subject Area** | Physiology |
| **Degree** | Medicine |
| **School/Faculty** | Biomedical and Health Sciences |
| **Ac. Year** | 1º |
| **ECTS** | 12 |
| **Type** | Core |
| **Language(s)** | Spanish |
| **Delivery Mode** | On campus |
| **Semester** | Year (S1-S2) |

# 2. INTRODUCTION

Physiology is taught in the first year of the Degree in Medicine. It forms part of students' basic learning and together with the rest of the core subjects, it provides a sound base for academic and professional development. This learning continues in the second year, where the physiology of the different systems and apparatus are studied in the subjects Morphology, Structure and Function of Organs and Systems I and II.

Physiology will provide students with the knowledge required for understanding the make-up and functions of the human body. To achieve an understanding of the body as a whole, it is important to progress from the most basic knowledge to much more complex notions.

Physiology as a subject is divided into three main blocks. The first looks at the general concepts of physiology which will be constant throughout the whole course. The second deals with cellular function, with a particular focus on excitable tissues. Finally, the third block looks at the circulatory system and particularly the structure of erythrocytes, haemostasis and the immune system.

Just by understanding cellular physiology, it is possible to solidify further understanding of how the different systems and apparatus work in the second year of study. Physiology is essential in understanding things such as: how health and disease conditions can change, how to provide curative treatments, which treatments can lead to certain health conditions, and how to evaluate patient evolution.

# 3. SKILLS AND LEARNING OUTCOMES

**Key skills (CB, by the acronym in Spanish):**

- CB5: Students will develop the learning capacity required to undertake subsequent study with a high degree of autonomy.

**General skills (CG, by the acronym in Spanish):**

- CG7: Understand and recognise the normal structure and function of the human body. This includes studies of molecules, cells, tissue, organs and systems in the different stages of life.

**Cross-curricular skills (CT, by the acronym in Spanish):**

- CT4: Adaptability: ability to detect, interpret and respond to a changing environment. Ability to equip themselves and work effectively in different situations and/or with different groups or individuals. This means adapting to change depending on circumstances or needs. It involves the confidence to take on crucial challenges on a personal or group level, maintaining a good physical and mental health to allow work to be carried out effectively.
- CT10: Independent learning: the ability to govern your own development by choosing the most effective lines of action, strategies, tools and opportunities to independently learn and apply knowledge to practice.

**Specific skills (CE, by the acronym in Spanish):**

- CE 1.1.1: Recognising the structure and function of cells. Biomolecules. Metabolism. Metabolic regulation and integration.
- CE 1.1.2: Understanding the fundamentals of human nutrition. Cell communication. Excitable membranes. The Cell Cycle. Cellular differentiation and proliferation. Gene expression, information and regulation. Heredity. Embryo development and organogenesis.
- CE 1.2.1: Understanding the morphology, structure and function of the different systems and apparatus: cardiovascular, digestive, locomotor, reproductive, urinary, respiratory, endocrine, immune, integumentary, circulatory, and central and peripheral nervous systems. Growth, maturity and ageing of the different systems and apparatus. Homoeostasis. Adaptation to environment.
- CE 1.2.2: Using basic laboratory techniques and materials. Interpreting a normal analysis. Using macroscopic, microscopic and imaging techniques to recognise the morphology and structure of tissue, organs and systems. Performing functional tests and determining vital signs and how to interpret them. The basic physical examination.

**Learning outcomes (RA, by the acronym in Spanish):**

- Define and understand the principles of physiology as a science.
- Understand the physiology of nerve cells, their connections, and the principles of cellular excitability.
- Understand the main functional characteristics of the musculoskeletal system.
- Understand the molecular mechanism of contraction.
- Be aware of the organisation and composition of the fluid compartments in the body.
- Know the principles of homoeostasis.
- Understand the molecular and cellular composition of blood.
- Understand the general functions of each of the types of blood cells.
- Know how to interpret a normal blood analysis.
- Know the principles of haemostasis and coagulation.
- Know the differential characteristics of the innate and adaptive responses of the immune system.
- Understand how the cardiac muscle and the cardiac conduction system work.
- Understand the physiology of gas exchange and the transport of gases in the blood.
- Know how to interpret a blood gas test and the pH in the blood.

The following table shows how the skills developed in the course match up with the intended learning outcomes:

| Skills | Learning outcomes |
|---|---|
| CG7 | Define and understand the principles of physiology as a science. |
| CB5, CG7, CT4, CT10, CE1.1.1, CE1.1.2, CE1.2.1, CE1.2.2 | Understand the physiology of nerve cells, their connections, and the principles of cellular excitability. |
| CG7, CT4, CE1.1.1, CE1.1.2 | Understand the main functional characteristics of the musculoskeletal system and smooth muscle. |
| CG7, CE1.1.1, CE1.1.2, CE1.2.2 | Understand the molecular mechanism of contraction. |
| CG7, CT10, CE1.2.1, CE1.2.2 | Be aware of the organisation and composition of the fluid compartments in the body. |
| CB5, CG7, CE1.2.1, CE1.2.2 | Know the principles of homoeostasis. |
| CB5, CG7, CT4, CE1.1.1, CE1.2.1, CE1.2.2 | Understand the molecular and cellular composition of blood. |
| CB5, CG7, CT4, CE1.1.1, CE1.2.1, CE1.2.2 | Understand the general functions of each of the types of blood cells. |
| CB5, CG7, CT4, CE1.2.2 | Know how to interpret a normal blood analysis. |
| CB5, CG7, CE1.1.1, CE1.2.1 | Know the principles of haemostasis and coagulation. |
| CG7, CE1.1.1, CE1.1.2, CE1.2.1 | Know the differential characteristics of the innate and adaptive responses of the immune system. |
| CB5, CG7, CE1.1.1, CE1.1.2 | Understand how the cardiac muscle and the cardiac conduction system work. |
| CB5, CG7, CT4, CE1.1.1, CE1.2.1, CE1.2.2 | Understand the physiology of gas exchange and the transport of gases in the blood. |
| CB5, CT7, CE1.2.1, CE1.2.2 | Know how to interpret a blood gas test and the pH in the blood. |

*CB5: we consider to be applicable to the learning outcomes which will be covered in the second year of Medicine.*
*CT4: we consider to be applicable to the learning outcomes which students will work on actively based on the WSLA (Work Station Learning Activities) methodology. This involves clinical and integral scenarios in subjects on both a horizontal and vertical level within the Degree programme.*
*CT10: we consider to be applicable to the learning outcomes which require prior work to be undertaken by students.*

# 4. CONTENTS

**TOPIC 1: INTRODUCTION TO PHYSIOLOGY**

1.1. - Physiological systems
1.2. - Functions and processes
1.3. - Physiology: integrative science

**TOPIC 2: HOMOEOSTASIS AND REGULATION**

2.1. - Homoeostasis and the internal conditions
2.2. - Intercellular communication
2.3. - Control mechanisms: response and regulation

**TOPIC 3: BODY FLUIDS**

3.1. - Fluid compartments
3.2. - Composition of organic fluids
3.3. - Interchange of fluids between body compartments
3.4. - Oedemas

**TOPIC 4: COMMUNICATION PATHWAYS/INTRACELLULAR SIGNALLING**

4.1. - General aspects
4.2. - Signalling pathways or cascades
4.3. - Types of surface receptors
4.4. - Simple and direct pathways
4.5. - Physiological examples

**TOPIC 5: MEMBRANE TRANSPORT**

5.1. - Permeability of membranes
5.2. - Proteins involved in membrane transport
5.3. - Passive transport
5.4. - Importance of gradients in mammal cells
5.5. - Cell volume regulation
5.6. - Controlling cytoplasmic pH

**TOPIC 6: MEMBRANE POTENTIAL**

6.1. - Prior concepts
6.2. - Definition of resting potential membrane
6.3. - Equilibrium potential: Nernst equation
6.4. - Resting membrane potential of a neuron
6.5. - Electromotive force
6.6. - Role of the Na+/K+ ATPase pump

**TOPIC 7: EXCITABILITY AND ACTION POTENTIAL**

7.1. - Types of electrical signals: receptor potential, synaptic potential and action potential
7.2. - Ionic basis of action potential: threshold and action potential phases
7.3. - Voltage-dependent ionic channels (Na+ and K+)
7.4. - Refractory period
7.5. - Propagation of action potential

**TOPIC 8: SYNAPTIC TRANSMISSION**

8.1. - Chemical and electrical synapses
8.2. - Properties of electrical synapses
8.3. - Properties of chemical synapses: neuromuscular junction
8.4. - Presynaptic action potential and neurotransmitter release
8.5. - Molecular mechanisms involved in the neurotransmitter secretion
8.6. - Motor point potential

8.7. - Quantal release of neurotransmitter
8.8. - Local recycling of synaptic vesicles
8.9. - Postsynaptic potentials
8.10. - Neuronal integration and modulation

**TOPIC 9: NEUROTRANSMITTERS AND THEIR RECEPTORS**

9.1. - Basic concepts of neurotransmission
9.2. - Types of receptors
9.3. - Intracellular mechanisms of action
9.4. - Concept and types of neurotransmitters
9.5. - Classical neurotransmitters
9.6. - Non-classical neurotransmitters
9.7. - Medical implications: neuropharmacology Parkinson's, drug addiction and ischaemia.

**TOPIC 10: MUSCULOSKELETAL PHYSIOLOGY**

10.1. - Musculoskeletal functions
10.2.- Properties of muscle fibres
10.3.- Musculoskeletal organisation
10.4.- Neuromuscular junction
10.5. - Excitation-contraction coupling
10.6. - Role of calcium regulation in muscle contraction
10.7. - Muscle contraction: sliding filament theory
10.8.- Energy source for muscle contraction
10.9.- Types of muscle fibres

**TOPIC 11: MECHANICS OF MUSCLE CONTRACTION MUSCLE FATIGUE AND OTHER ISSUES**

11.1. - Motor unit and groups of motor neurons
11.2. - Muscle strength and factors which affect the production of force
11.3. - Types of contractions
11.4. - Muscle fatigue: central and peripheral fatigue

**TOPIC 12: INTRODUCTION TO MOTOR CONTROL**

12.1. - Information motor neurons receive
12.2. - Muscle spindles
12.3. - Golgi tendon organs
12.4. - Organisation of motor neurons in the spinal cord
12.5. - Introduction to the motor pathways

**TOPIC 13: PHYSIOLOGY OF THE CARDIAC MUSCLE**

13.1. - Properties of the cardiac muscle
13.2. - Electrical conduction of the heart
13.3. - Action potentials of the cardiac muscle
13.4. - Ion conductances during the action potentials
13.5. - Refractory period
13.6. - Excitation-contraction coupling
13.7. - Mechanical properties of the cardiac muscle
13.8. - Extrinsic heart regulation

**TOPIC 14: PHYSIOLOGY OF THE SMOOTH MUSCLE**

14.1. - Location and general aspects of the smooth muscle
14.2. - Types of smooth muscle
14.3. - Contractile apparatus of smooth muscle
14.4. - Types of action potentials in the smooth muscle
14.5. - Excitation-contraction coupling
14.6. - Regulation of smooth muscle contraction
14.7. - Characteristics of smooth muscle contraction
14.8. - Nervous system, humoral and mechanical control of muscle contraction

**TOPIC 15: BLOOD**

15.1. - Definition and functions of blood
15.2. - Composition of blood: cellular components and plasma
15.3. - Bone marrow
15.4. - Physiology of the erythrocyte

**TOPIC 16: HAEMOSTASIS AND COAGULATION**

16.1. - Primary haemostasis
16.2. - Secondary haemostasis - Blood clotting
16.3. - Fibrinolysis

**TOPIC 17: IMMUNE SYSTEM**

17.1. - Introduction to the immune system
17.2. - Antigen presentation and processing
17.3. - Lymphocyte activation and effector mechanisms

# 5. TEACHING/LEARNING METHODS

The types of teaching/learning methods are as follows:

- Lectures.
- Selection of cases and problems.
- Learning based on specific laboratory teaching.
- Problem-based learning.
- Specialised seminars.
- Learning in skills classes and simulation environments.

# 6. LEARNING ACTIVITIES

The types of learning activities, plus the amount of time spent on each activity, are as follows:

| LEARNING ACTIVITIES | HOURS |
|---|---|
| Theory/practical learning activities | 137 |
| Directed learning activities | 33 |
| Self-study | 90 |
| Tutorials | 36 |
| Knowledge tests | 4 |
| **TOTAL** | **300 h** |

# 7. ASSESSMENT

The assessment methods, plus their weighting in the final grade for the course, are as follows:

| Assessment system | Weighting |
|---|---|
| Objective tests | 70% |
| Practical content (activities and laboratory practice) | 30% |

The objective tests assessment includes the evaluation of the theory content (50%) and skills and knowledge acquired during the practical subject activities (20%).
Assessment of the practical section includes: integrated activities following the work station learning model (WSLA), problem solving, literature analysis, clinical case studies, and more. They also include an assessment of the student's attitude.

On the Virtual Campus, when you access the subject area, you can see all the details of your assessment activities and the deadlines and assessment procedures for each activity.

# 8. BIBLIOGRAPHY

The recommended bibliography is indicated below:


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