ANATOMY AND PHYSIOLOGY

YEAR/SEMESTER: first year/course over two semesters

ECTS: 8 (lectures) + 1 (practical exercises)

PROFESSORS	HOURS	MODULE
Bonanzinga Tommaso	21	Anatomy and physiology of the musculoskeletal system
Di Mitri Diletta	20	Histology
Rasile Marco	30+9	Neuroanatomy and introduction to the physiology of the nervous system
Cappato Riccardo	15	Cardiovascular system
Paiardi Silvia	34+9	Splanchnology and physiology of organ systems

LEARNING OBJECTIVES OF THE COURSE:

The course aims to provide the students with an understanding of the fundamentals of human anatomy and physiology. The acquired knowledge will be reflected in the student's ability to use specific terminology, which is an essential component of effective communication in the healthcare profession. The student will be able to recognise the main anatomical structures and thus contextualise their knowledge of physiology. By the end of the course, the student will be able to interpret and understand anatomical illustrations and will have acquired basic knowledge of the functioning of human organs and organ systems.

TEACHING METHODS: lectures, case studies, watching video clips, practical exercises

ASSESSMENT METHODS: written test (multiple choice questions) and oral test

PREREQUISITES: Passing the exam is a prerequisite for enrolment into the second year

SUGGESTED READING:
Martini, Nath – Fondamenti di Anatomia e Fisiologia – EdiSES
Rigutti – Atlante di Fisiologia – Giunti
Stevens, Lowe – Istologia Umana – CEA

Humanitas University
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info@hunimed.eu
hunimed.eu
CF 97692990159

MODULE: HISTOLOGY

Professor: Dr Diletta Di Mitri

PhD in Medical Biotechnology and Head of the Tumour Microenvironment Unit - Humanitas Clinical and Research Centre
E-mail: diletta.di_mitri@humanitasresearch.it

LESSON 1
Cytology: structure and function of the different components of the cell / Epithelial tissues

Objectives:

- identify and describe the functions of the plasma membrane, cytoplasm, and membranous and non-membranous cell organelles
- describe the vesicular transport mechanisms within the cell: exocytosis and endocytosis
- discuss how cells interact to maintain tissue stability
- list the functions of the epithelial tissue, the criteria used for its classification, the functions and typical location of each type of epithelial tissue
- describe the types, structural and functional characteristics of the lining epithelia
- describe the types, structural and functional characteristics of glandular epithelia

LESSON 2
Connective and cartilaginous tissue / Bone tissue

Objectives:

- list and describe the main functions of connective tissue
- describe the extracellular matrix: structural and functional characteristics
- describe the fibrillar component: collagen and elastic fibres
- describe the types of cells: resident and transient cells
- list and explain the types of connective tissue
- describe cartilaginous tissue: structure and functions
- identify and describe the general structure of the bone
- describe the histology of lamellar bone tissue
- list and describe bone cells
- describe the process of the histogenesis of bone and the processes of ossification
- describe bone remodelling

LESSON 3
Muscle tissue

Objectives:

- list and describe the general characteristics of muscle tissues
- list and describe the structural and functional characteristics of skeletal muscle
- describe the mechanisms of muscle contraction and relaxation
- describe the cardiac muscle
- describe smooth muscle tissue

LESSON 4
Adipose tissue / Lymphoid organs
Objectives:

- list the main regions of the brain, the primary brain vesicles and ventricles and describe their locati list and describe the general characteristics of adipose tissue
- describe white adipose tissue: structural and functional characteristics
- describe brown adipose tissue: structural and functional characteristics
- list and describe the structural and functional characteristics of lymphoid organs
- describe the lymphoid organs: spleen, thymus, lymph nodes and tonsils
- describe the structural and functional characteristics of mucosa-associated lymphoid tissue (MALT)

LESSON 5
Introduction to the nervous tissue

Objectives:

- describe the general organisation of the nervous system
- neurons: functional and structural characteristics
- describe synapses and signal transmission within the nervous system
- describe glial cells: characteristics and functions
- describe the structure and function of the blood-brain barrier

MODULE: NEUROANATOMY and INTRODUCTION TO THE PHYSIOLOGY OF THE NERVOUS SYSTEM

Professor and course coordinator: Dr Marco Rasile

PhD in Morphological Sciences, currently researcher at the Laboratory of Pharmacology and Pathology of the Nervous System - Humanitas Clinical and Research Centre.
E-mail: marco.rasile@humanitasresearch.it

LESSON 1
Spinal cord, spinal nerves and reflexes

Objectives:

- describe the structure and organisation of the nervous system
- discuss the structure and functions of the spinal cord: organisation, longitudinal and cross section subdivision, distribution of white and grey matter
- describe the meninges/coatings of the central nervous system
- describe the structure of a spinal nerve and how spinal nerves connect to different parts of the body
- understand the terms somatotopy, dermatome and myotome
- define neuronal pools and describe the interactions between neurons within the same pool and between different pools
- list and briefly describe the main nerve plexuses
- illustrate the mechanism of the nerve reflex and explain how it can be adapted to generate

more complex motor behaviours
- explain how the higher centres are able to control and modify motor responses

LESSON 2-3
The brain and cranial nerves

- on and function
- explain how the brain is protected and its activity sustained
- discuss the formation, circulation and functions of cerebrospinal fluid
- describe the anatomical differences between the brainstem and the spinal cord, identify the main structures of the brainstem and describe their function
- list the main structures of: pons, cerebellum, midbrain, diencephalon and specify their function
- identify the main structures of the limbic system and specify their location and function
- describe the most typical examples of cranial reflexes that produce somatic or visceral responses depending on the stimuli
- list the cranial nerves by classifying them into motor/sensitive or mixed, indicating the nerves' points of emergence and exit from the skull

LESSON 4-5
Sensory pathways and somatic nervous system

Objectives:
- describe the components of the afferent and efferent pathways of the nervous system and explain what is meant by somatic nervous system: lateral, medial and cortico-spinal systems, posterior cord, anterolateral and spinocerebellar pathway
- explain how receptors can respond to specific stimuli and how the structural organisation of a receptor affects its sensitivity
- identify sensory receptors and describe their function
- identify the main sensory pathways and explain how we can distinguish between sensations originating in different areas of the body
- describe the structures, processes and functions of the somatic motor pathways
- describe the role of reticular activating system in maintaining the state of consciousness

LESSON 6-7
Autonomic nervous system, higher order functions and the associated anatomy of pain

Objectives:
- compare the organisation of the autonomic nervous system with that of the somatic nervous system
- describe the function of neurotransmitters and their receptors within the sympathetic and parasympathetic nervous systems
- describe the structure of the sympathetic division in relation to the spinal cord
- discuss the mechanism of dual innervation and autonomic tone
- describe the hierarchy of control of the autonomic nervous system, define a visceral reflex and explain its meaning
- describe morphological bases of pain sensations

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LESSON 8-9
Sensory organs

Objectives:

- describe the organs of smell and taste and illustrate the nerve pathways that carry information to the brain
- explain what is meant by olfactory/taste discrimination and briefly describe its physiological aspects
- identify the internal structures and adnexa of the eye and explain their function
- explain how colour distinction and depth perception is possible, explain how light is able to stimulate the production of nerve impulses and describe the optical pathways describe the structures of the outer, middle and inner ear and explain their role in balance and hearing
- trace the balance and hearing pathways to the brain

MODULE: SPLANCHNOLOGY AND PHYSIOLOGY OF ORGAN SYSTEMS

Professor: Dr Silvia Paiardi

Internist and Emergency Physician at the Emergency Department of the Humanitas Clinical and Research Centre

E-mail: silvia.paiardi@humanitas.it

LESSON 1
Endocrine system

Objectives:

- describe the importance of communication between cells and the mechanisms involved
- be able to compare the mechanisms of intercellular communication between the endocrine and nervous systems
- discuss the main mechanisms of hormone action on target organs
- describe the anatomy, function and hormones produced by: pituitary gland, thyroid, parathyroid, adrenals and pancreas
- describe the anatomical location and functions of the pineal gland and the hormones produced by it
- depict the functions of the hormones produced by the kidney, heart, thymus, testicles, ovaries and adipose tissue
- explain how hormones interact to produce coordinated physiological responses and modify behaviour

LESSON 2
Respiratory system

Objectives:

- describe the main characteristics and subdivisions of the 5 features of breathing
- describe the upper airways (nose, pharynx, larynx) and the main

characteristics/differences between breathing and phonation
- describe the characteristics and anatomical relationships of the trachea and bronchi, bronchial tree and its main branches, alveolar gas exchange system, visceral and parietal pleurae
- define and compare the processes of external and internal respiration
- briefly explain the physics of the movement of air in the lungs and the diffusion of gases in the blood and body tissues
- describe the structure and function of haemoglobin in the transport of oxygen and carbon dioxide in the blood
- list the factors influencing respiratory rate, discuss respiratory reflexes and the areas of the brain involved in respiratory control

LESSON 3
Digestive system, metabolism and energy

Objectives:
- describe the structure and functions of: tongue, salivary glands, teeth, oesophagus, stomach, small and large intestines
- present the process of digestion and absorption of: carbohydrates, fats and proteins
- describe the metabolism of nutrients and identify the key aspects of proper nutrition to prevent deficiencies

LESSON 4
Urinary system and fluid, electrolyte and acid-base balance

Objectives:
- describe from an anatomical point of view the components of the urinary system: kidneys, ureters, bladder and urethra
- explain the mechanism of glomerular filtration: hydrostatic pressure and colloid osmotic pressure
- list factors influencing reabsorption and secretion
- describe the micturition reflex
- explain the mechanisms involved in fluid, electrolyte and acid-base balance
- describe the mechanisms involved in maintaining homeostasis
- explain the types of acid/base balance alterations

LESSON 5
Genital apparatus

Objectives:
- describe the macro- and microscopic characteristics of the male reproductive system. In particular, explain gamete development, fertilisation and the main functions of the testicles, penis and prostate.
- describe the macro- and microscopic characteristics of the female reproductive system. In particular, illustrate the menstrual cycle and the main characteristics of the ovary, fimbriae, uterus and vagina
- discuss the physiology of sexual intercourse for males and females

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MODULE: the CARDIOVASCULAR SYSTEM

Professor: Prof. Riccardo Cappato

Prof. Riccardo Cappato

Cardiologist Electrophysiologist and Arithmologist, currently in charge at the Centre of Arithmology and Electrophysiology - IRCCS - MultiMedica Group, via Milanese 300, 20099 Sesto San Giovanni (Mi)

E-mail: riccardo.cappato@hunimed.eu

Objectives:

- know the basic anatomy of the heart: its vascularisation and the structure of the pericardium, its cavities, the direction of blood flow within these cavities, the vessels they are connected to and the valves within them
- know the basic principles of cardiac electromechanical muscle activation: the cardiac conduction
- system and the electrical events in a normal electrocardiogram
- know the principles that regulate the heart muscle in terms of systole and diastole, both atrial and ventricular. Evaluate the cardiac sounds detected by auscultation with a stethoscope
- know the principles behind cardiac output and the factors that influence heart rate, systolic volume, diastolic volume and systolic output

- know the factors that influence cardiovascular parameters during physical activity
- know the basics of the anatomy of vessels and lymphatic system: their distribution in the body and the physiology of the lymphatic circulatory system

MODULE: ANATOMY AND PHYSIOLOGY OF THE MUSCULOSKELETAL SYSTEM

Professor: Dr Tommaso Bonanzinga

PhD in Orthopaedics, currently a researcher at the Orthocenter of Humanitas - Humanitas Clinical and Research Centre.
E-mail: t.bonanzinga@gmail.com

LESSON 1
Introduction: axial and appendicular skeleton, the skull

Objectives:

- Introduce the module on anatomy and physiology of the musculoskeletal system
- Define and differentiate the axial and appendicular skeleton
- Describe and classify bones

- Describe and classify joints
- Describe and classify the various topologies of movement
- Describe and classify muscles

LESSON 2
The skull

Objectives:
- List and describe the bones of the skull
- List and describe the muscles of the skull

LESSON 3
The axial skeleton

Objectives:
- Describe the trunk
- Clinical focus: scoliosis
- Describing the different types of vertebrae: cervical, thoracic, lumbar, sacrum
- Clinical focus: low back pain
- Clinical focus: herniated disk
- Describe the rib cage
- Clinical focus: thoracentesis

LESSON 4
The upper limb

Objectives:
- Describe the structure of the shoulder girdle
- Describe the bones of the upper limb: the clavicle, the scapula, the humerus, the ulna, the radius and the bones of the hand.
- Describe the shoulder joint
- Clinical focus: carpal tunnel syndrome
- Describe the elbow joint
- Describe the muscles of the arm with emphasis on function, innervation and vascularisation.

LESSON 5
Bone tissue

Objectives:
Describe the components of bone tissue
- The compact bone and the spongy bone
- Bone cells: osteoblasts and osteoclasts
- Describe the periosteum
- Describe the various types of ossification

LESSON 6
Muscle tissue

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Objectives:

- Describe in general terms the differences between the three types of muscle tissue: smooth, skeletal and cardiac.
- Describe the characteristics of skeletal muscle tissue
- Describe the characteristics of smooth muscle tissue
- Describe the characteristics of cardiac muscle tissue
- Describe the biomechanics of the main muscle groups
- Clinical focus: immobilisation and muscles

LESSON 7

Abdomen and lower limb

Objectives:

- Describe the function and structure of the diaphragm
- Describe the muscles of the abdomen
- Describe the structures of the pelvic girdle
- Describe the bones of the lower limb: femur, patella, tibia, fibula and the bones of the foot
- Describe the knee joint
- Clinical focus: rupture of the cruciate ligament
- Clinical focus: lower limb alignment
- Describe the structures of the outer, middle and inner ear and explain their role in balance AND hearing
- Trace the balance and hearing pathways to the brain

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