

COURSE OF MEDICINE AND SURGERY
Student Handbook a.y. 2014-2015

PHYSIOLOGY

II Year	Scientific Field	DISCIPLINE	TUTOR
Physiology	BIO/09	<i>Physiology</i>	Gianfranco Bosco
ECM 18 Coordinator Gianfranco Bosco			

PROGRAM

Cell Physiology. Overview of membrane transport. Unassisted and assisted membrane transport. Fick's law. Osmosis. Membrane potential. Equilibrium potential: Nernst's Equation. Passive electric properties of the plasma membrane. Membrane electric conduction. Ion channels. The action potential. Refractory period. Conduction of action potentials.

Neural communication. Electric and chemical synapses. Quantal theory of neurotransmitter release. Synaptic potentials and synaptic integration. Neuromuscular junction. Neurotransmitter types and functional mechanisms. Signal transduction: G proteins, cyclic nucleotides, calcium, IP3 pathway, phosphorylation. Synaptic plasticity.

Muscle Physiology. Structure of skeletal muscle. Molecular basis of skeletal muscle contraction. Cycles of cross-bridge binding. Electro-mechanical coupling. Muscle twitch and tetanus. Skeletal muscle mechanics. Isometric and isotonic contraction. Tension-length and speed-load relationships. Muscle power. Skeletal muscle metabolism and muscle fatigue. Motor units and muscle fiber types. Smooth muscle. Control and modulation of smooth muscle contraction. Cardiac muscle. Electro-mechanical coupling in the cardiac muscle.

Cardiovascular Physiology. Morphofunctional features of the heart. Electrical activity of the heart. Pacemaker activity of the sinoatrial node. Spread of cardiac excitation. Electrocardiogram (ECG). Mechanical events of the cardiac cycle. Heart sounds and murmurs. Cardiac output and its control. Morphofunctional characteristics of blood vessels: Arteries, arterioles, capillaries, veins. Patterns and physics of the blood flow. Microcirculation and capillary exchange. Diffusion and filtration. Venous return. Lymphatic system. Vasoactive substances. Special vascular districts: coronary, pulmonary, cutaneous, brain.

The respiratory system. Respiratory anatomo-functional characteristics. Respiratory mechanics. Respiratory muscles and movements. The pleural sac. Intrapleural pressure. Intra-alveolar and transmural pressure. Boyle's law and pressure-volume relationship. Pulmonary compliance. Airways resistance. Alveolar stability and pulmonary surfactant. Ventilation: lung volumes and capacities. Anatomic and functional dead space. Breathing work. Gas exchange. Diffusion and partial pressure gradients of O₂ and CO₂. Alveolar perfusion and ventilation / perfusion ratio. Gas transport. Hemoglobin and transport of oxygen. Transport of CO₂. Respiratory contribution to acid-base balance. Control of respiration: respiratory centers and respiratory muscles innervation. Reflex mechanisms. Peripheral and central chemoceptors. Baroreceptors. Physiological and pathological adaptation of respiratory function.

The urinary system. Fluid compartments: distribution and exchange of water and solutes. Functional anatomy of the kidneys. Homeostatic functions of the kidneys. Glomerular filtration. Extrinsic control and autoregulation of glomerular filtration. Tubular reabsorption and secretion. Urine excretion and plasma clearance. Concentration of the urine: medullary osmotic gradient and countercurrent multiplication. Countercurrent exchange and vasa recta. Water reabsorption and vasopressin. Actions of vasopressin, aldosterone and natriuretic peptides on kidneys' function. Endocrine functions of the kidneys: renin-angiotensin-

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The digestive system. General aspects of digestion. The mouth: chewing and salivary secretion. Pharynx and esophagus: control of swallowing. Functions of the stomach. Gastric secretion and its control. Pancreatic and biliary secretions: composition and control. Small intestine: digestion and absorption of nutrients. Functions of the large intestine. The enteric nervous system and the control of gastrointestinal motility. Overview of gastrointestinal endocrine and immune functions. Food intake and energy balance.

Systems neurophysiology. General organization of sensory systems. The somatosensory system: touch, proprioception, thermoception and nociception. Vision: Retinal functions. Central processing of visual information: analysis of shape, colour and motion. Hearing: functional properties of the external and middle ear. Functions of the cochlea. Central processing of auditory signals. Chemical senses: taste and smell. General principles of motor control. Spinal reflexes: stretch reflex and withdrawal reflex. Locomotion. The vestibular system and the control of balance. Oculomotor control. The cerebellum and the basal ganglia. Motor learning. Cortical control of action. Cognitive function: language and memory. Neurophysiology of sleep.

The endocrine system. The hypothalamus and the control of homeostatic functions. Circumventricular organs. The pineal gland: melatonin and circadian rhythms. The autonomic nervous system. Endocrine control of fluid balance. Endocrine control of calcium metabolism. Endocrine control of fuel metabolism: pancreatic hormones and glycemic / lipostatic control. The pituitary gland and the hypothalamus-pituitary axes. Endocrine control of growth: Growth hormone (GH) and insulin-like growth factors (IGF). The thyroid: hormones (T4, T3) and their functions. Thermogenesis and thermoregulation. The adrenal gland and the stress response. Pro-opiomelanocortin (POMC) e glucocorticoids: target organs and molecular mechanisms. Endocrine control of reproductive functions. Hormones during pregnancy and lactation. Hormones and the immune system; cytokines and their action on the nervous and endocrine system.

Textbooks

- 1) L. Sherwood: Human Physiology: From Cells to Systems
- 2) B. Koepfen, B. Stanton: Berne & Levy Physiology
- 3) Guyton and Hall: Textbook of Medical Physiology
- 4) Purves: Neuroscience

EXAM METHOD

Oral Exam. Exam dates: to be defined (it is a yearly course, thus the earliest dates available will be in June)

EXAM COMMISSION

Gianfranco Bosco (President)			
Virginia Tancredi			
Daprati Elena			



Tutor

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