



MEDICINE AND SURGERY

Course: Body at Work 1

Year : 2nd

Period : 1st semester

Credits: 14 (Anatomy 3, Physics 2, Biochemistry 2, Physiology 7)

Objectives

This course will lead the student to understand the basic mechanisms of life: how the cells and the organism gather energy from the environment and employ it to establish an “internal milieu”, to respond to stimuli, to adapt to (or anticipate) changes in the external environment and to actively behave.

The student will master the concepts of homeostasis and how cellular functions are achieved through the regulation of exchanges, biochemical functions and gene expression, via the activation of receptor and signal transduction pathways, by means of cell excitability, neuronal activity and the morpho-functional organization of the nervous system.

The student will know how the sensory and motor systems are organized and function, and this will help them understand the main neurological problems that originate from their dysfunction and introduce them to the principles of the neurological examination.

A number of key physical, biochemical and anatomical aspects will be addressed in joint lectures, in a functional and Pathophysiological perspective, to help the student to acquire a comprehensive, interdisciplinary perspective.

The course also includes PhysiLab experiences to practice with physiological measurements, and professionalizing activity aimed at introducing the neurological examination of the patient.

The student will be able to apply the learned notions to the qualitative and quantitative analysis of cellular as well as systemic processes. They will therefore be able to understand and illustrate the functioning of the sensory systems, and the causes and mechanisms of sensory defects and pathologies. They will also be able to describe the functioning of neurons, the processes of communication at synapses and the learning capabilities that arise from neuronal and synaptic plasticity.

The student will be asked - through specific assignment during the courses and in the oral interview at the exam - to explain the processes and mechanisms that they encounter during the classes. This will boost the student's capacity of communicating clearly and simply even complex topics, an indispensable skill of a medical doctor.

Prerequisites

The student must possess the bases of maths, physics and chemistry that are needed to grasp the conceptual aspects of the regulation of the biological processes and deal with the in quantitative terms: these are the topics faced in the PLM course (Principles of the Living Matter).

The student must possess the basic notions of macroscopic and microscopic anatomy, embryology and development, and cell biology that are needed to face the study of the functions of cells and organisms: these are the topics treated in the BA (Body Architecture), BB (Building Bodies) and CMP (Cells Molecules and Processes) courses.

Contents

P = Physics – A = Anatomy – B = Biochemistry – L = Physiology – G = Group work – J = Joint – C = Collaborative learning – F = flipped class – CL = Clinical links; numbers = hours

1 – Life: energy, homeostasis: 8L + 12B + 2J

- understand homeostasis, cell components and compartments, the ECM

CL: connective tissue syndromes, ER stress in type II diabetes

2 – Control: regulation and change: 10L + 4G

- classify transport mechanisms, receptors and signal transduction pathways

- understand cell Ca²⁺ regulation

CL: toxins and diarrhoea, channelopathies

3 – Bioelectricity: 6P + 6L + 2J G

- master the concepts of electric charge, force, potential, field, current; resistor and capacitor

- explain ion partition, Nernst's and Goldman's equations, the action potential and its propagation

4 – Intercellular communication: 12L + 5Bem + 4L G

- understand the structure and function of synapses, vesicle and neurotransmitter turnover

- classify transmitters and receptors, understand post-synaptic events: computation and plasticity

CL: myasthenias

5 – Sensory systems – Generalities, touch, pain, proprioception: 4J A-L + 2L + 4+4F A

- classify sensory modalities and describe sensory pathways, stations and cortical areas

- understand the concepts of receptive field, adaptation, nociception and pain, sensitization and pain control paths

- define proprioception and understand the muscle spindle

CL: sensory loss

6 - Optics, sight and visual elaboration: 6P + 6A + 6L + 4J G

- examine light, geometric optics, lenses

- describe the organization of the eyeball, extra-ocular muscles, retina, optic path and visual cortex

- explain photoelectric transduction, cones and rods, adaptation and image processing

- understand detection of movement, recognition and localization of objects: the sensory-motor function of the parietal cortex

CL: Daltonism – Hemianopsia – Emi-spatial neglect

7 – Acoustics – Hearing and sound processing – Vestibular function: 4P + 6A + 4L + 2L G + 4J G



- understand sound waves, harmonic motion, acoustics, ultrasounds
- describe the external, middle and inner ear and the acoustic and vestibular pathways
- understand sound transduction in hair cells, the band of audible sounds, sounds interpretation and localization

CL: deafness, vertigo.

8 - Chemoceptors, smell and taste: 4J A-L

- describe the anatomy of taste and olfaction, transduction in smell and taste, and the interaction between the two senses in perception

9 - Movement control: 2A + 2L + 8J A-L + 4L GL

- review the descending pathways: medial and lateral system, reticulo-spinal, vestibulo-spinal, rubro-spinal and pyramidal tracts
- predict the motor impairments brought about by lesions in each of these systems
- understand the hierarchical organization of the motor system: spinal reflexes and CPGs
- describe organization and functions of the cerebellum and the basal ganglia

CL: paralysis, spasticity, ataxia, extrapyramidal syndromes

10 – Brain perfusion and metabolism – Cortical circuitry: 4B + 4J A-L-Neurology + 4F A + 4J A-L + 4J C A-L

- describe brain vascularization and metabolism; the blood-brain barrier
- explain the impairments associated with localized cerebrovascular problems
- describe the microcircuits of the cortex and understand its elaboration modes and the excitation/inhibition balance

CL: functional imaging of the brain, stroke

11 – Muscle and motor units: 4B – 6L

- describe structure and function of muscle proteins and explain the different patterns of contraction, in skeletal, cardiac and smooth muscle
- explain tension build-up in skeletal muscles, isometric, isotonic and eccentric contraction

CL: Motor neuron diseases, Cramps

Teaching Methods

- Lectures
- Indication of readings
- Personal and group assignments – quizzes, research assignments, open questions, self-evaluation
- Interactive and multidisciplinary re-elaborations
- Flipped classrooms
- Formative revision tests, Question time
- Collaborative learning and use of conceptual maps (Cmaps)
- Practicals (Neurological examination)

The course is organized on three distinct levels:

1. knowledge transfer – Lectures (whether given in presence, in streaming or recorded) will remain accessible to students online; students will also be addressed to textbook chapters, scientific articles



and other studying material: through all this the students are expected to acquire the notions needed to master the topics at hand

All these activities will be programmed in the daily schedule; however, they can be performed by the students at the times most convenient for them, if they are residing in other Countries

2. active knowledge elaboration – self-assessment tests, small-group (either physical or digital) assignments and didactic material for flipped classrooms will help the students process and master the acquired notions

3. knowledge activation – interactive lectures, joint interdisciplinary seminars, question and answer sessions, discussions of group assignments and the actual flipped classrooms will help the student to fully understand, assimilate and frame the acquired notions in an organized general perspective, and to clearly and linearly explain the complex issues of the functioning of living systems.

Knowledge activation sessions will be held on Campus in the afternoon (Italian time) to make online synchronous attendance easier from most Countries in the world.

Verification of learning

Learning by the students will be monitored during the course through the assignments and interactive sessions and will be eventually assessed through a written and oral examination.

In order to access the exam the student must have completed the required PPP portfolio activities and the assignments given during the course.

The exam is comprised of three parts:

1. Evaluation of the skills on the neurological examination of the patient
2. Written examination: Multiple Choice Questions or similar tests
3. Oral examination
 1. Physical examination: this part of the exam consists in a passed or failed evaluation. Students will be asked to perform part of the checklist they have learned during the Practicals. This part of the exam must be passed to proceed to the written part.
 2. Written part: Multiple Choice Question or similar test. The test consists of 60 items (15 Anatomy, 10 Physics, 10 Biochemistry, 25 Physiology). Time allotted: 90 minutes. In order to pass the written test, 2/3 of the questions must be answered correctly (40/60); 60% of the correct answers must also be given for each discipline (9/15 Anatomy, 6/10 Physics, 12/20 Biochemistry, 15/25 Physiology). Occasionally, thresholds might be lowered, in case of anomalous average, best and worst performances. Only students who pass the written test will access the oral examination.

The mark obtained in the written test will be taken into consideration in the final evaluation; however, it will neither determine the final mark nor grant success.
 3. Students who passed the written test do not need to repeat it if they take the oral during the same exam session.

The oral interview will assess the competence of the student in explaining how the structural



aspects, the biophysical and biochemical mechanisms and the physiological processes contribute to the functions of cells, neurons, sensory systems, muscles and motor control.

Since failing this exam implies repeating the second year, on the last exam session only the students will be given the opportunity of an oral interview even if they failed the written test, to confirm the judgement and discuss their learning performance and possible problems for tutoring.

An extra-session in the first week of October will be set up to give a final opportunity to students who failed all previous sessions. Only students who did attend (and failed) the last session in September will be admitted to this extra session.

Texts

Physics, Anatomy, Biochemistry:

Refer to the text used during the first year

Physiology:

- Guyton and Hall – Textbook of Medical Physiology. By John E. Hall, 13th Edition. 2016. Elsevier Health Sciences. 1168 pp. ISBN: 978-1-4557-7005-2 / 978-1-4557-7016-8.
- Walter F. Boron & Emile L. Boulpaep. Medical Physiology, 3rd Edition. 2016. Elsevier Health Sciences. 1312 pp. ISBN: 978-1-4557-4377-3.

Neurosciences :

- Eric R. Kandel e James H. Schwartz. Principles of neural science. 5th Edition 2012. McGraw-Hill. ISBN 10: 9780071390118 / 13: 9780071390118.
- Michael S. Gazzaniga e George R. Mangun. The cognitive neurosciences. 5th Edition. 2014. Mit Press Ltd. 1128 pp. ISBN: 9780262027779