# Fundamentals of neurobiology and genetics

## Prof. Sara Missaglia; Prof. Daniela Tavian

***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

The course aims to guide students towards a general understanding of the properties of living material, the biological structure and meaning of the macro-molecules of life, of metabolism and cellular organisation, while placing particular emphasis on the structure and workings of neuronal cells. Students will discuss the laws of transmission of hereditary characters and connected molecular mechanisms, as well as the neurobiological basis of some human diseases and normal and pathological behaviour.

At the end of the course students will be able to:

* Identify and understand the biochemical bases of biological systems and processes;
* Understand and describe the relationship between structure and function within informational macro-molecules (nucleic acids, proteins);
* Identify and describe the main laws of transmission of hereditary characters in man;
* Learn the ability to solve biological problems inherent to the analysis of the metabolism and genetic heritage;
* Identify and describe the workings of neurons;
* Correctly contextualise notions of biology and human genetics and critically assess neuro-cognitive and genetic studies;
* Implement and update personal knowledge by independently referring to scientific texts, articles and online platforms;
* Describe/communicate neuro-biological and genetic knowledge accurately, also to non-experts using scientifically correct language and terminology.

***COURSE CONTENT***

Module 1

Unit 1: The study of living nature

- The experimental method: development, needs and limits

- Living organisms: the life cycle, reproduction, homeostasis, and

interaction with the environment

Unit 2: The molecular bases of life

- The principal elements and classes of compounds found in living matter

- The informational macromolecules: DNA, RNA and protein, the structure-function relationship

- Molecular genetics: from the structure of nucleic acids to maps of the human genome

Unit 3: The cell

- The cell: the basic unit of living organisms

- The principal cellular organelles of eukaryotic cell: structure and function

Unit 4: Cell cycle and division

- Mitosis: somatic cell division

- Meiosis: sexual reproduction and gamete formation

- Mitosis vs meiosis: key differences

Unit 5: Transmission of hereditary characteristics

- Mendel's laws and modern genetics

- Gender determination, heterosomal inheritance

- Mutations and genetic variability

- Regulation of gene activity

Module 2

Unit 1: Syndromes from chromosomal aberrations, neurocognitive and genetic aspects

- The normal and pathological human karyotype

- Autosomal aneuploidies: Down syndrome, Edwards syndrome and Patau syndrome

- Heterosomal aneuploidies: Turner syndrome, Klinefelter syndrome

- Deletions of chromosomal tracts: Cri-du-chat syndrome

- Fragile X syndrome, an example of an "expansion"-related mutation

Unit 2: The autistic spectrum

- Neurobiological and genetic bases

- The new "broken mirror" theory

- Classic autism, Asperger syndrome and Rett syndrome.

Unit 3: Genes and behaviour

- Single genes and basic behavioural traits

- Mutations in single genes: motor and cognitive deficits (example: Huntington's Chorea)

- Complex behavioural traits: polygenic model (examples: schizophrenia, bipolar disorders and borderline personality disorder)

Unit 4: Nature and transmission of nerve impulses

- The cells of the nervous system: neurons and glial cells

- Electrical transmission: membrane potentials, ionic channels

- Synaptic potential and action potential

- Synaptic transmission: synapses, neurotransmitters and neuromodulators

- Neurotransmitters and drugs

***READING LIST***

D. Sadava-D.M Hillis-H.C. Heller-M.R. Berenbaum-S. Hacker, *Life: the science of Biology, volume 1,* Sinaurer Associates Inc, 2020, 12th edition.

***TEACHING METHOD***

The course consists of lectures that will outline the approach to the subjects and indicate a method of study. The course includes 10 hours of practical activities designed to complement the traditional lecture format. During these activities examples of solutions to certain biological problems will also be illustrated, allowing the student to assess their own level of understanding of the material. Tutorials will provide integrated sessions of in-depth study and verification.

***ASSESSMENT METHOD AND CRITERIA***

There will be a written test composed of questions on the entire course program. The test will contain 32 closed questions and they will carry 1 mark. Students can obtain marks ranging from 0 to 32 for the written test (zero: no correct answers; 32: all correct answers). Marks 31 and 32 will receive honours. The outcomes of the practical activities will be evaluated and factored into the final grade. The assessment criteria and methods will be explained in detail during class.

***NOTES AND PREREQUISITES***

No prerequisites are required for this course in terms of content knowledge. However, students are expected to have a genuine interest and intellectual curiosity in the topics covered in the course

 *Students’ reception*

MODULE 1: Prof. Sara Missaglia will receive the students on Wednesday from 12.30 to 14.30, by appointment via email (*sara.missaglia@unicatt.it*)

MODULE 2: Prof. Daniela Tavian will receive the students on Tuesday from 12.30 to 14.30, by appointment via email (*daniela.tavian@unicatt.it*)

Further information can be found on the lecturer's webpage at *http://docenti.unicatt.it/web/searchByName.do?language=ENG*, or on the Faculty notice board.