UNIVERSITÀ DI PISA

COMPARATIVE NEUROBIOLOGY

UGO BORELLO

Anno accademico	2022/23
CdS	NEUROSCIENCE
Codice	494EE
CFU	3

Moduli	Settore/i	Tipo	Ore	Docente/i
COMPARATIVE NEUROBIOLOGY	BIO/06	LEZIONI	24	UGO BORELLO

Learning outcomes

Knowledge
By the end of the course the students will have acquired knowledge on the molecular and cellular mechanisms of brain development and evolution.

Assessment criteria of knowledge
In itinere verifications with a group discussion of specific articles provided during the course.
Oral exam at the end of the course

Skills
By the end of the course the student will be able to recognize the anatomical structure of the brain of the major vertebrate groups. It will be able to query online databases containing data on gene expression and anatomical data of the vertebrate brain. It will be able to analyze and present data, obtained from the literature, on the molecular and cellular mechanisms of ontogenesis and phylogenesis of the vertebrate brain.

Assessment criteria of skills
In itinere verifications.
Oral exam at the end of the course

Behaviors
A scientific method based on molecular and cellular analysis will be acquired for the study of vertebrate brain development and anatomy. The students will be able to discuss and choose the most suitable experimental model, cellular animal in silico, for the study of neuro-psychiatric syndromes.

Assessment criteria of behaviors
In itinere verifications.
Oral exam at the end of the course

Prerequisites
Comparative anatomy
Cellular and molecular biology
Developmental biology

Teaching methods
The topics of the course will be presented with lectures, group discussions and exercises that include analysis of data and study of anatomical preparations. New learning methods will be used to engage students directly during the knowlegde acquisition process.
The E-learning website will be used to host teaching materials and teacher-student communications.
Interactions between student and teacher will be constant through lectures, meetings, tutoring and communication to students of the teacher's email address.

Syllabus
History of comparative neurobiology

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Study of vertebrate neurobiology from Aristotle to the present day: experimental approaches and schools of thought.

Development and structure of the vertebrate brain
Analysis of the molecular and cellular mechanisms of the central nervous system development. Proliferation and differentiation of neuronal precursor cells: parameters that modify the size and composition of the brain.
Signaling centers in the developing neural tube. Regionalization and ontogenesis of adult brain structures.
The brain bauplan in vertebrates: the neuromeric model. Overview of neuroanatomy.
Regulation of gene expression during brain development. Genes and genomic regions specific to Homo sapiens and brain development.
Molecular etiology of microcephaly as a paradigm of human cortex development.

Evolutionary changes in the size and structur of the brain
Methods of study of comparative neurobiology: molecular anatomy of the brain.
Online resources for the study of comparative neurobiology.
The dimensions of the vertebrate brain: absolute and relative dimensions.
Cellular composition of the mammalian brain: how many and which cells compose the vertebrate brain?
Correlation between brain size and neuronal connections.
Functional significance of the change in brain size and structure. Absolute and relative size of the individual brain regions
Definition and evolution of intelligence.
The brain as a complex system.

Evolution of the neocortex in mammals: what makes us human
Differences and homologies of the human brain compared to other species.
Ontogeny and cytoarchitecture of the neocortex. Lamination and girification of the cortex.
A special case: the prefrontal cortex in mammals.

Neuronal regeneration and adult neurogenesis under an evolutionary perspective
Regeneration mechanisms and adult neurogenesis in different species. The evolutionary significance of neuronal regeneration; applications to biomedicine.
Comparative neurobiology as an essential science in the use and choice of experimental systems for the study of neurobiology and neuro-psychiatric pathologies.

Bibliography
Principles of Brain Evolution, G.F. Striedter, Sinauer 2005
Building Brains, Price et al., Wiley 2017

Original papers indicated during the course

Non-attending students info
Course attendance is not mandatory but STRONGLY advised.

Assessment methods
Oral exam

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