CORSO DI DOTTORATO IN NEUROSCIENZE
CURRICULUM: NEUROSCIENZE E NEUROTECNOLOGIE
Corsi 2018

Teaching course: **Molecular signaling and adhesion at the synapse** Cesca, Cingolani 6 hours + final exam = 3 credits			
Chemical synapses are asymmetric inter-cellular junctions that connect individual neurons into functional networks. A key property of synapses is the specificity with which they are formed and maintained. A growing number of trans-synaptic cell adhesion molecules, including cadherins, neurexins and neuroligins, have been shown to orchestrate synaptic specification and function by bridging directly pre- and postsynaptic specializations. In this course, we will discuss general principles and recent findings from the scientific literature illustrating how synaptic cell adhesion molecules co-ordinate: 1. Target recognition between an axon and a dendrite, 2. Synaptic differentiation and stabilization, 3. Structural and functional plasticity, thus highlighting the importance of these proteins as molecular code for synaptic specificity. Mutations in synaptic cell adhesion molecules that alter the formation and function of synapses in autism spectrum disorders will also be discussed.	Dr. Lorenzo Cingolani	03.12.2018 h. 09:00 – 12:00	CBA 4th floor
Molecular mechanisms of trophic signaling in health and disease. Trophic signals modulate every aspect of neuronal physiology, from neuronal development and differentiation to synaptic plasticity. This course aims at giving a comprehensive overview of the intracellular signaling pathways by which trophic factors orchestrate these phenomena. In addition, we will give few	Dr. Fabrizia Cesca	04.12.2018 h. 09:00 – 13:00	CBA 4th floor

examples of neuro-pathologies that have been associated to alterations of trophic pathways. Main points will include: - Nervous system development and the neurotrophic factor hypothesis - Neurotrophins (NTs): structure, evolution, processing and secretion (proNT, proBDNF), trafficking, local protein synthesis. NTs at the synapse. - NT receptors: signaling, transactivation, isoforms - Other trophic factors, i.e. the GDNF family - NT physiology: NTs in nervous system development (lessons from KO mice), NTs and cell death, NTs out of the nervous system. NTs and glia / microglia - NTs in pathology: Alzheimer's Disease, Huntington's Disease, Mood Disorders and Depression, Neuropathic Pain.			
Teaching course: **Material Neurobiology and Nanotechnology: a systematic Review of Bio-Nano Interactions within the central nervous system** Bramini, Cesca 6 hours + final exam = 3 credits			
Nanomaterials have unique physicochemical and biological properties, which make them leading contributors in the fields of biomolecule delivery, biomedical imaging and diagnostic biosensors. The main focus of the course will be to report on the use of nanomaterials within the CNS, specifically describing the peculiar role of nanotechnology in the diagnosis, treatment and prevention of various types of neuro-degenerative disorders and nervous system injuries. The course will cover both nanomedicine and nanotoxicology issues, and in detail, the main topics of the class will be: • Overview of the nanomaterial properties for biomedical applications. • Drug delivery and biocompatibility issues of nanomaterials used in neurology. • Functional interactions between nanomaterials, the blood-brain barrier, neuronal and glial cells.	Dr. Mattia Bramini Dr. Fabrizia cesca	12.12.2018 h. 10:00 – 13:00 13.12.2018 h. 10:00 – 13:00	CBA 4th floor CBA 4th floor

• Nanotechnology-based strategy for the diagnosis. • Nanotechnology for neuronal regeneration. • Latest application of graphene and 2D materials in recording and sensing.			
Teaching course: **Molecular structure and function of the synapse** Maragliano – Thalhammer 6 hours + final exam = 3 credits			
Molecular structure and function of the synapse. Neuronal signaling at the synapse is a process orchestrated by a complex molecular machinery, where a vast number of proteins control neurotransmitter release and binding. This module aims to provide the basic knowledge of the molecular determinants of synaptic function, and it will cover the following topics: - Elements of protein structure - Molecular basis of synaptic structure and communication - Mechanisms of neurotransmitter release: the vesicle cycle and the SNARE complex - The postsynaptic response: membrane receptors and signal transduction	Dr. Luca Maragliano	18.12.2018 h. 09:00 – 12:00	CBA 4th floor
Composition of the post-synaptic density: a more quantitative view The postsynaptic density (PSD) is an electron-dense structure located at neuronal contact sites. Proteomic approaches have revealed that the PSD protein complex is of considerable complexity, including cytoskeletal and scaffold proteins, receptors, ion channels and signaling molecules, in line with the role of PSDs in signal transduction and processing. This course will cover: - History of the race to identify the full PSD proteome - Mass-spectrometry in proteomics - Post-translational modification of the PSD	Dr. Agnes Thalhammer	18.12.2018 h. 13:00 – 16:00	CBA 4th floor

- Activity-dependent changes of the PSD proteome - The PSD proteome and disease			
Teaching course: **Molecular and cellular determinants of neocortical development** De Pietri Tonelli 4 hours + final exam = 2 credits Preliminary to Dr. Cancedda's and Dr. Maya-Ventencourt's courses.			
Neocortical development is a complex process that, at the cellular level, involves tight control of stem cells self- renewal, cell fate commitment, survival, differentiation and delamination/migration thus resulting in a precise temporal, spatial control of cortical neurons accumulation. These processes require the precise regulation of intrinsic signaling pathways and extrinsic factors with coordinated action in a spatially and temporally specific manner. In the course, I will discuss cellular (e.g. cell polarity, stem cells subtypes, etc.) and Molecular determinants (e.g. transcriptional and post-transcriptional regulations, such as microRNAs (miRNAs)) of brain development in rodents and during evolution. The course style is very informal and centered on theoretical and practical examples of techniques and approaches that can be used to investigate these aspects in vivo.	Dr. Davide De Pietri Tonelli	14.12.2018 h. 14:00 – 18:00 Final exam: 17.12.2018 h. 9:30 – 11:30	IIT Morego, Sala Montalcini IIT Morego, Sala Dulbecco
Teaching course: **Development and plasticity of Cortical Circuits** Cancedda 8 hours + final exam = 4 credits			

All students shall attend Dr. De Pietri Tonelli's course before enrolling. Preliminary to Dr. Maya-Ventencourt's course.			
The course will highlight the organizing principles of the development and plasticity of cortical circuits. The most fascinating aspects of the process of migration, differentiation of the neuronal subtypes composing cortical circuits will be explained. A special emphasis will be on how GABAergic transmission shapes neuronal circuits during development. Finally, we will show the synaptic and cellular mechanisms by which cortical circuits are sensitive to manipulations of the sensory experience during postnatal development. The course will have an interactive character, and active discussion of the most recent and provoking works in the field will play a central role.	Dr. Laura Cancedda	07.01.2019 h. 10:00 – 12:00 09.01.2019 h. 10:00 – 12:00 11.01.2019 h. 10:00 – 12:00 Final exam: 17.01.2019 h. 14:00 – 16:00	IIT Morego, Sala Dulbecco IIT Morego, Sala Dulbecco IIT Morego, Sala Dulbecco IIT Morego, Sala Dulbecco
Teaching course: **Cortical plasticity in adult life: structural and functional mechanisms.** Maya-Vetencourt 6 hours + final exam = 3 credits All students are strongly recommended to attend Dr. De Pietri Tonelli's and Cancedda's preliminary courses before enrolling.			
The capacity of the nervous system to change in response to environmental stimuli, referred to as plasticity, underlies experience-dependent modifications of brain functions. This feature is fundamental for neural circuitries to be	Dr. José Fernando Maya-Vetencourt	12.02.2019 h. 10:00 – 12:00	CBA 4th floor

sculpted by external signals. The nervous system translates information from the external world through signals generated by the electrical activity associated to sensory inputs, and orchestrates adaptive responses to changing environmental conditions. A failure to be exposed to normal experience during early life permanently impairs sensory functions and/or behavior. Sensory experience modulates brain structure and function via the activation of different cellular and molecular players, such as: inhibitory/excitatory synaptic transmission, neurotrophins, and extracellular matrix molecules. Signal transduction cascades driving the modulation of gene expression patterns ultimately result in long-lasting alterations of synaptic transmission. In this course, we shall review recent findings in the field of cortical plasticity while focusing on how physiological mechanisms associated with experience in adult life promote structural changes that determine functional modifications of neural circuitries in the brain.		18.02.2019 h. 10:00 – 12:00 22.02.2019 h. 10:00 – 12:00 Final exam: 28.02.2019 h. 14:00 – 16:00	CBA 4th floor CBA 4th floor CBA 4th floor
Teaching course: **Basic Concepts of Epigenetics in Neuroscience** Cesca**,** Maya-Vetencourt 4 hours + final exam = 2 credits			
The course will cover the basic concepts of epigenetics, focusing on neuronal physiology and pathology. More in detail, subjects covered will include: - Basic concepts of epigenetics - Epigenetics and transcription (including NPAS4) - Epigenetics and neuronal activity - The epigenetics of the BDNF gene - Epigenetics and the inhibitory transcription factor REST/NRSF - Epigenetics and diseases (neuropsychiatric and mood disorders, epilepsy)	Dr. Fabrizia Cesca Dr. José Fernando Maya-Vetencourt	26.02.2019 h. 10:00 – 12:00 26.02.2019 h. 13:00 – 15:00	CBA 4th floor CBA 4th floor