MASTER IN NEUROSCIENCE: FROM BENCH TO BEDSIDE

ACADEMIC PROGRAM

(UMH 1337) Neuroscience today (4.5ECTS)
- Current topics in neuroscience a multidisciplinary view: scientific seminars and activities of the INA.

(UMH 1337) Advances in embryology and the genetic analysis of the nervous system (6 ECTS)
- Fundamental Concepts in Developmental Genetics.
- Zebrafish as a Model for Developmental Genetics.
- Mouse Genetics: Transgenesis and Gene Targeting.
- Gastrulation. Determination of the embryonic axes.
- Practicum: Chick gastrulation.
- Neural Induction.
- Practicum: zebrafish development.
- The neural crest.

(UMH 1336) New developments in the study of the organization and cellular components of the nervous system (6 ECTS)
- General introduction to the organization of the CNS.
- Morphogenesis of the vertebrate nervous system.
- Experimental Embryology -Practicum: Ectopic expression of morphogenetic signals.
- Early brain development.
- The Anatomy of the Spinal cord, Rombencephalon and Cerebellum.
- Practicum: Human Brain Dissection.
• Practicum: Microscopic Anatomy of the Mouse Brain.
• Axonal transport.

(UMH 1339) Cell communication (6 ECTS)
• Electrical Signaling in the Nervous System.
• Ionic Currents and the Action Potential.
• Voltage-dependent membrane permeability.
• Ionic channels and transporters.
• Intracellular Signaling: General principles of cell signaling.
• Nitric Oxide as a signaling molecule in the nervous system.
• Control of nucleo-cytoplasmic protein transport.
• Protein kinases and phosphatases modulation of neural function.
• Role of calcium in neuronal signaling.

(UMH 1340) Synaptic transmission and plasticity. Sensory processing (6 ECTS)
• Electrical synapses and gap junctions.
• Chemical synapses I: presynaptic mechanisms. Quantal release of neurotransmitter and the role of calcium in transmitter release.
• Chemical synapses II: Molecular mechanisms of transmitter release.
• Chemical synapses III: postsynaptic mechanisms and synaptic integration.
• Neurotransmitters and receptors I: Glutamate receptors.
• Neurotransmitters and receptors II: ACh, GABA and others.
• Common themes in sensory pathways.
• Visual system.
• Auditory and Somatosensory Systems.
• Systems Neurophysiology.
• Plasticity.
• Superior Cognitive Functions.

(UMH 2695) Neuropathology (3 ECTS)
• Neuropsychopharmacology of neurological and psychiatric diseases.
• Interneuron disfunction in psiquiatric disorders.
• Biochemistry and therapeutic targets in Alzheimer’s disease.
• Axonal myelination and neurological disorders
• Genetic, cellular, and molecular basis of mental retardation
• Neurochemical mechanisms involved in pain and analgesia
• Functional reorganization of brain networks supporting addiction and relapse.
• Role of molecular pharmacology in the study of cognitive disturbances.
• Transcriptional dysregulation in neuropathology.

(UMH 2697) New therapies (3ECTS)
• Advanced therapy (genetic and cellular) in the treatment of neurological diseases.
• Cell therapy for the treatment of ELA.
• Cellular and molecular alterations in dopaminergic neurodegeneration.
• Stereotaxic surgery (intracerebral stimulation and radiosurgery) for neurological disorders.
• Cell therapy in the treatment of Parkinson disease.

(UMH 2699) Animal facilities and tools in neuroscience (3 ECTS)
• Basic aspects of the use of shared Technologies.
• The use of animal models in neuroscience.
• Cell culture procedures.
• Tools for Bioinformatics Analysis of Gene Expression and Evolution.
• Statistical tools in neuroscience.
• Annotated brain atlas.

(UMH 2700) Functional imaging acquisition and image analysis (3 ECTS)
• Basic concepts in imaging technologies.
• Practical issues of in vivo imaging systems.
• Image analysis in the context of neuroscience.
• Functional magnetic resonance in small animals.
• Physics behind Nuclear Magnetic Resonance Imaging (NMR)
• Biological bases of NMR.
• Functional imaging based on NMR.
• Multimodal combination of NMR, electrophysiological and optogenetic techniques.
• Paramagnetic contrast agents.
• Experimental applications.

(UMH 2750) Master Research work (15 ECTS)

OPTATIVES:

(UMH 2703) Sensory transduction (4.5 ECTS)
• Biophysics and pharmacology of ion channels.
• Molecular mechanisms of transmitter release.
• Synaptic transmission in the cerebral cortex.
• Cellular mechanisms and functional role of synaptic short and long-term potentiation.
• Molecular and cellular basis of sensory transduction
• Bases of nociception.
• The cornea as a nociceptive model.
• Bases of chemotransduction.
• Bases of thermotransduction.
• Bases of mechanotransduction.
(UMH 2751) Information processing (4.5 ECTS)

- Visual information processing: Functional architecture of retinal, thalamic and cortical receptive fields.
- Finding a shape: the emergence of orientation selectivity in primary visual cortex as a model of cortical function.
- Parallel and serial information processing in the cerebral cortex.
- Visual objects in context: what the visual arts tell us about high order perception.
- Somatosensory information processing: Functional architecture of whisker receptive fields.
- The contribution of intrinsic and synaptic properties to information processing in the somatosensory system.
- Development and plasticity of whisker receptive fields in the barrel cortex.
- Efficient coding of tactile stimuli in the rodent barrel cortex.
- Anatomical, functional and effective connectivity in the brain.
- Synaptic plasticity and network reorganization.
- Deep brain microstimulation.

(UMH 2702) Developmental neurobiology: from neurogenesis to circuit formation (4.5 ECTS)

- Precursor determination and specification. Neurogenic genes: Lateral inhibition.
- Asymmetric Cell Division: Generating Neuronal Diversity.
- Control of neural proliferation and neuronal differentiation in CNS neurogenesis.
- Neural migration. General concepts.
- Neuronal Polarization. Role of the cytoskeleton in neuronal polarization.
- Neuronal Migration. Pyramidal neurons vs. GABA-ergic interneurons.
- The development of the visual system as a model to study axon guidance and target recognition.
- Directional navigation versus fasciculation.
- Synapse Formation.
- Synapse stabilization and refinement.
- Early neuronal populations in the developing cerebral cortex.
- Regionalization of the cerebral cortex: Intrinsic vs. extrinsic factors.
- Formation of cortical gyri.