Module BIO 628
Spring term 2015

MD/PhD Neuroscience course

This block course on Neuroscience is organized for students of the MD-PhD program and of the Master of Science in Medical Biology. It takes place after the spring term 2015 and last 3.5 weeks (June 1 – June 19, 2015).

Aims:
The MD/PhD neuroscience course sets a major accent on practical work at the bench to acquire basic skills in cellular and systems neurobiology, with focus on in vivo work. The main goal of the course is to familiarize students with state-of-the-art methods and technologies used in current neuroscience research.

Structure and content:
The course is methods-oriented and provides ample opportunity to learn key techniques by performing a small research project using state-of-the-art technologies, selected in the fields of imaging, electrophysiology, cellular neurobiology, or behavior. Students are expected to prepare and present a short report of their practical work.
Eight lectures and three seminars cover the theoretical background of the course; the students are also trained to read original research papers and have to orally present one article in the context of a lab meeting/journal club.

Learning goals:
Upon successful completion of the module, students should be able to:

- explain fundamental principles underlying brain imaging techniques, microscopy, electrophysiological recordings, and manipulation of neuronal gene expression.
- generate basic tools for neuroscience research using molecular/cell biological approaches.
- employ the tools for functional investigations in vivo using advanced imaging techniques, electrophysiology, or behavior.
- design research projects that provide mechanistic insights into neurobiological problems using multidisciplinary approaches and analytic tools.
- grasp the working hypothesis, main results and conclusions of an original research article related to their research project

Key skills:
Upon successful completion of the module, students should be able to:

- collect their own data and prepare a well-structured project report.
- present their findings effectively and appropriately.

Minimal requirements for obtaining credit points:
The final grade will be based on a written report and a public presentation of its content, which will be graded by the course supervisors. In order to qualify for the grades, a minimum of 80% attendance is required.

Practical Organisation

- Maximum 16 participants
- *Participating research groups:*
  Brown, Jessberger, Zeilhofer, Helmchen, Rajendran, Polymenidou, Fritschy, Rudin, Gerber, Weber, Wolfer, Hahnloser, Martin
- Weekly plan:

  Monday and Tuesday of the first week: Lectures and seminars;
  Wednesday of the first week till Tuesday of the third week: practical work in the laboratory to perform a small research project;
  End of last week: Debates, Pitching of business ideas, a technical tour and Final presentation by the students

- *Teaching language:* English
- *Location:*
  Institute of Pharmacology and Toxicology UZH -Irchel (Room 17H05)
  Practical exercises: in the laboratories of the participating groups (details to be announced on the beginning.)

Plan of the lectures

Nr.	*Date, time*	*Lecturer*	*Topic*
1.	20 minutes talk (TED talk style) + 20 minute discussion	Fritschy	Cytology of the nervous system
2.		Zeilhofer	Principles of chemical neurotransmission
3.		Gerber	Basic principles of patch-clamp recording in neurons
4.		Weber	In vivo imaging: fluorescence
5.		Rudin	In vivo imaging: MRI, PET
6.		Helmchen	2-photon microscopy and its applications in living rodents
7.		Brown	Reporter molecules for molecular and cellular interactions
8.		Rajendran	Systems biology approaches to study complexity
9.		Mansuy?	Epigenetics in development and disease
10.		Jinek?	CRISPR/ Cas9 in gene editing
11.		Picotti	Mass spectrometry
12.		Schwab?	Neve fiber Regeneration in Spinal Cord Injury
13.		Jessberger?	Tools to study Adult Neurogenesis
14.		Saab?	Molecules behind motivation
15.		Jancke	Cognitive Neuroanatomy (Structure-function relationship in brain activity)
16.		Enno Stephan?	Computational modeling of brain dysfunction

Special seminars

Nr.	*Date, time*	*Lecturer*	*Topic*
1.	XX, 13h00-17h00	Wolfer	Data analysis and presentation: examples of basic statistics
2.	10.06, 13h00-17h00	Panel of PIs	Debate part I (Motivational Prizes?)
3.	16.06, 13h00-17h00	Panel of PIs	Pitching for creative business ideas based on skill sets in Neuroscience (Motivational Prizes?)

Seminars are exercises and discussion focusing on global skills

Projects (modifications still possible)

Students will work in teams of 4 (either as 4 or teams of 2 each) and will select one of the participating laboratories for the experimental work in the lab. Each team will learn different techniques in at least 2 labs.

P1: Viral technologies for cellular and animal experiments

Prof. Steven A. Brown & Prof. Hanns U. Zeilhofer
Location: Institute of Pharmacology, Irchel Campus

In this practical course, participants will first learn to prepare their own transgenic viruses (lenti- and adeno-associated-virus) that either overexpress fluorescent proteins or silence endogenous genes. These viruses will then be used to investigate mechanisms of cellular signal transduction first in vitro in primary human cells, and later in vivo in cancer xenografts and in the nervous systems of living mice.

P2: Towards in vivo imaging of newborn cells in the adult hippocampus

Prof. Fritjof Helmchen and Prof. Sebastian Jessberger
Location: Brain Research Institute, Irchel Campus

The aim of this block course is to develop a feasible approach for in vivo 2-photon imaging of newborn neurons in the adult mouse dentate gyrus. The first part will include preparation of viruses to visualize newborn cells. The second part will be devoted to find a proper route (using microoptics) for gaining optical access to the dentate gyrus in the intact brain and to initiate first ex vivo imaging experiments to image dentate gyrus neurons.

P3: Manipulating genes and studying their effects on processes involved in dementia

Prof. Magdalini Polymenidou and Prof. Lawrence Rajendran
Location: IMLS, Irchel Campus and Division of Pyschiatry, Schlieren Campus

In this block course we aim to study the role of certain risk genes on Alzheimer's disease and other related dementias. Here we will use gene-silencing techniques using short interfering RNA (siRNA) and small molecule drugs to perturb the function of the gene products. The module is designed to provide theoretical basis and hands-on experience on gene silencing and manipulation in neurons and assay their effect on processes involved in dementia.

P4: Electron microscopy - tissue preparation and data acquisition from murine neocortex and avian neural tissue

Prof. Richard Hahnloser and Prof. Kevan Martin
Location: Institute of Neuroinformatics

The students will be guided through the process of sample preparation and imaging for electron microscopy (EM) of murine neocortex and avian neural tissue. The main advantages and disadvantages of various EM techniques will be discussed and compared to alternative imaging strategies. The students will have the opportunity to participate in the histological tissue preparation, the sectioning, as well as the image acquisition at the EM level, using different sampling techniques. They will also use state of the art software tools for image analysis.

Oral presentation *(Institute of Pharmacology and Toxicology UZH -Irchel (Room 17H05*)

All the students will prepare a short report and present it to the other participants and the panel of PIs on the last day of the course (Powerpoint, 15-20 minutes presentation + discussion).

Weekly plan Overview

Monday 1st-2nd June 2015: Lectures (TED talk style)

Wk 1-3	**03 - 16.06**
	Practical work

W 3		**Wednesday 16.06**
	08:15 – 10:00	Debate
	10:00 – 17:00	Data analysis Data Analysis of practical work

W 3		**Thursday 17.06**
	08:15 – 11:00	Pitching of creative business ideas in Neuroscience
	13:00 – 17:00	Technique Tour of the pathology unit

W 3		**Friday 17.06**
	08:15 – 12:00	Preparation of the presentation
	13:00 – 16:00	Oral presentations (in front of the PI panel) UZH Irchel (Room 17HO5)