Module Number	Title:
5c	**Methods in Neurosciences**

Module type: compulsory elective	**Language:** English		**Group Size:** 6 students
Study semester: 2	**Availability:** summer semester		**Duration:** 1 semester
Workload: 420 hrs	**Credits:** 14 CP	**Contact time:** 123 hrs	**Independent Study:** 297 hrs

1 Courses

a) Lectures 3 PPW
b) Practical courses 6 PPW
c) Seminars 2 PPW

2 Intended Learning Outcomes

This module consists of three parts:
1. Animal models of human disease
2. Comparative anatomy and histochemical techniques
3. Electrophysiology

In the first part we will introduce in vitro and in vivo models of diseases (using vertebrate and invertebrate species) and appropriate methods for their analysis with the focus on spinal cord injury, status epilepticus, hepatic encephalopathy, Alzheimer´s and Parkinson´s Diseases. The nematode C.elegans as a model organism to study neuropathologies, such as alpha-synucleinopathy, will be used in the practical.
After completion of the first part, students will be able to describe the general principles of selected methods to investigate locomotor activity (e.g. CatWalk, open field, rotarod) and cognitive abilities (e.g. water maze) of the rodents as well as locomotor and sensory activity of the nematode C. elegans. They will be capable to evaluate behavioural deficits associated with nervous system diseases documenting and analysing experimental results. Methods and data will be presented as a progress report.
In the second part of the module, students will be introduced in comparative vertebrate anatomy, with a focus on the dopaminergic system. They will acquire knowledge about major neuroanatomical similarities and differences between the different vertebrate clades and learn about non-standard model species. In the practical part, students will learn to obtain and preserve brain tissue and to use several staining methods to label components of the nervous system. After completion of the second part, students will be able to describe the macroscopic brain layout of the different vertebrate clades and will have understood major evolutionary changes in vertebrate brain structures, the cellular composition of the central nervous system and the structures of the dopaminergic system in mammals and birds. Students will be able to perform brain extractions, tissue fixation, different staining techniques and analysis of brain slices with light and electron microscopy. They will be able to present orally their experimental data and/or one of the seminal papers, discuss the presented data and to identify and plan follow up experiments.
After completion of the third part the students will be capable to explain the principles of electrophysiological recordings. They will be able to design and to perform electrophysiological experiments, to document and analyse their results and to summarize their findings in form of a scientific report.

3 Content

In the first part different methods for in vivo and in vitro models of brain disorders will be introduced in lectures and seminars. Methods to study locomotor and sensory deficits in the nematode C.elegans will be explored in wild type and transgenic animals overexpressing human alpha-synuclein in dopaminergic neurons.
In the second part students will be introduced to and perform the following techniques: animal anaesthesia and euthanasia, transcardial perfusion, tissue dissection &

	preparation, tissue fixation methods, different tissue cutting techniques, methods for tissue embedding for light- or electron microscopy, immunohistochemical staining and classic histological stainings. Furthermore, students will use light, fluorescence and electron microscopy to analyse and make pictures of their slices. In the third part students will learn to record and to interpret single-unit and network neuronal activities in rodent brain slices and primary cultures using microelectrodes and the patch-clamp technique. Human brain electrophysiological data analysis will be performed and discussed. Field potentials, action potentials, spontaneous synaptic activities, voltage- and ligand-gated ion channels will be studied. Neuronal identification will be performed with electrophysiological, pharmacological, immunohistochemical and molecular-biological (single-cell RT-PCR) methods. Transgenic mouse lines with a fluorescent reporter protein expressed under control of a cell-type specific promoter will be provided. Modelling of ligand-receptor interactions, molecular dynamics and macroscopic currents of ion channels will be performed with *in silico* electrophysiology computational methods.
4	**Teaching methods** Lectures, Seminars and Practical courses
5	**Prerequisites** **Formal:** Successful completion of module 1. Bachelor in natural sciences; Proficiency in English level B2 of Common European Framework of Reference for Languages (CEFR); **With regards to content:** Participants have a demonstrable focus on the area of neurosciences**.**
6	**Examination types** Written exam (90 minutes)
7	**Requirements for award of credit points** Regular and active participation in seminars and practical courses. Delivery of oral presentations (e.g. Powerpoint) of selected seminal papers and progress reports on experimental data. The written examination has to be passed.
8	**Module applicability (in other study courses)** The module is closely related to module 3a, 3c, 3d and 4c. Participants of Module 4b should not take Module 5c.
9	**Assessment** The mark given will contribute to the final grade in proper relation to its credits.
10	**Module convenor and main lecturers** Prof. Dr. Olga A. Sergeeva, Dr. Felix Ströckens, Prof. Dr. Esther Florin, Prof. Alfonso-Prieto, PD PhD MD Natascia Ventura
11	**Further information** The FELASA certificate, which can be obtained by attending Module 2c, is required for students who would like to practice anaesthesia and transcardial perfusion themselves (otherwise, the techniques will only be demonstrated by the supervisor). The attendance at lectures is strongly recommended. The content is prerequisite for practicals and seminars.