| Module Number | Title: |
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| **3a** | **Basic Concepts and Techniques of Molecular Neurobiology** |

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| **Module type:** compulsory elective | **Language:** English | | **Group Size:** 6 students |
| **Study semester:** 1 | **Availability:** winter semester | | **Duration:** 1 semester |
| **Workload:** 420 hrs | **Credits:** 14 CP | **Contact time:** 134 hrs | **Independent Study:** 286 hrs |

**1 Courses**

a) Lecture 2 PPW
b) Practical course 10 PPW

**2 Intended Learning Outcomes**

Students are able to formulate and explain basic principles of molecular and cellular neuroscience. They can apply the basic neurocytological methodologies for setting up and maintaining primary nerve cell cultures under sterile conditions, characterize the cultures with emphasis on neurite outgrowth and assess and judge the results. Students are capable of preparing microscopic slices of differently embedded nervous system tissues and carry out immunohistochemical characterization of major cell types in the nervous system. They can identify different cell types of the spinal cord by fluorescence microscopic evaluation of immunohistological stainings. Students are able to carry out computer-aided quantitative analysis of immunocytological stainings in neurite outgrowth experiments and explain the results. They can explain the basic principles of gene expression, RNA extraction, cDNA synthesis and principle and use of qPCR, can apply protocols of these techniques and analyse the results. Students can recognize and explain the reasonable selection and complementation of histological and molecular experimental techniques in order to solve a neuroscientific problem. They are able to prepare scientific documentations of the laboratory work and formulate experimental protocols according to good scientific practice standards. Students can work autonomously and accurately with laboratory measuring equipment/apparatus.

**3 Content**

**Lecture:**

Neurocytology: neurons and glial cells – morphology and function in the nervous system; extracellular matrix: structure and function in the nervous system; cell-cell communication and neurobiochemistry of the synapse;
Neurodegeneration: peripheral and central nervous system injury, Wallerian degeneration, CNS regeneration barriers, axon regeneration and functional recovery, signalling mechanisms.
Cell culture systems: basic principles of cell cultures, advantages and challenges of cell culture systems, cell lines in research, primary cells, quality control, trophic factors.
Molecular neuroscience: basic principles of gene expression regulation, composition and function of different RNA types, DNA, isolation methods from cell cultures and tissues and quantitative gene expression analysis methods.
Basic histological methods: methods for characterizing injured and healthy nervous system tissue, (fluorescence-) microscopy techniques and software tools for image analysis. Qualitative and quantitative analysis of immunocytological stainings – use and methodological limits, study design considerations in neuroscience.
Documentation of scientific experiments: lab book and protocol writing according to good scientific practice.

**Practical course:**

Characterization of central nervous system cell types: neural tissue embedding and sectioning (frozen tissue and paraffin embedded tissue). Immunohistochemical characterization of nervous system cells in healthy spinal cord tissue and after spinal cord injury with single antibody stainings and double stainings. Morphological and

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| | immunocytochemical characterisation of cells: light microscopy and immunofluorescence imaging. Data evaluation, qualitative description of imaging results and adequate documentation.<br><br>Introduction to neurocytology: handling of neuronal primary cultures sourced from rat brain. Working under sterile conditions, coating of growth substrate, seeding, fixation and immunocytological staining of primary cortex neurons. Lysis of neurons for RNA extraction. Quantitative Image J analysis of neurite outgrowth in neurons under different growth conditions, data evaluation and basic statistics.<br><br>Gene expression analysis: Extraction of RNA from primary cortex neurons, preparation of cDNA, qPCR analysis of growth associated genes in neurons under different growth conditions. Data evaluation, interpretation and documentation.<br><br>**Seminar:**<br>Seminars on cellular composition and function of nervous system cells, training on Image J as image analysis tool, experimental results discussions, final presentation of experimental designs and practical results by students as lectures at the end of the practical. |
| **4** | **Teaching methods**<br>Lecture, practical course, group work, seminar papers, oral presentation, written minutes, lab book, experimental protocols |
| **5** | **Prerequisites**<br>**Formal:** Successful completion of module 1; Proficiency in English level B2 of Common European Framework of Reference for Languages (CEFR)<br>**With regards to content:** Basic knowledge of neurobiology |
| **6** | **Examination type**<br>**Cumulative Examination:**<br>written exam (70% of total grade)<br>written summary of the practical course (30% of total grade) |
| **7** | **Requirements for award of credit points**<br>Regular participation in the practical training and successful participation in the written examination. Regular participation in the seminar and presentation. Delivery of written summary of practical course. |
| **8** | **Module applicability (in other study courses)**<br>Master Biology |
| **9** | **Assessment**<br>The mark given will contribute to the final grade in proper relation to its credits. |
| **10** | **Module convenor and main lecturers**<br>Dr. Nicole Brazda, Dr. Frank Bosse, Dr. Veronica Estrada, Prof. Dr. H.W. Müller, Dr. Jessica Schira |
| **11** | **Further information**<br>The regular attendance at the lectures is strongly recommended. The content of the lectures is prerequisite for the practical course and the seminar. |