Module Number	Title:		
5b	**Animal Models of Human Diseases**		
Module type: compulsory elective	**Language:** English		**Group Size:** 3 students
Study semester: 1	**Availability:** summer semester		**Duration:** 1 semester
Workload: 420 hrs	**Credits:** 14CP	**Contact time:** 225 hrs	**Independent Study:** 195 hrs

1 Courses

a) Lectures: 2 PPW

b) Practical Course: 18 PPW

2 Intended Learning Outcomes

The participants acquire knowledge regarding the basic concepts of vertebrate development. This includes differential gene expression, cell-cell communication, neurogenesis and neural crest cells, somitogenesis, organogenesis, hematopoesis, sex determination, germ cell development, regeneration and ageing. They acquire knowledge about developmental aberrations and dysplasia, causal to organ dysfunction (liver, heart, kidney, pancreas, adipocytes), focusing on ciliopathies, developmental malformations of bone, skeleton, heart and vasculature. A second focus is on the biological basis of brain disorders, especially temporal lobe epilepsies, metabolic encephalopathies, and disorders accompanied by disturbance in glutamatergic transmission, as well as on the pathophysiological role of glial cells.

The students will understand and be able to apply standard molecular, immunocytochemical and physiological experimental techniques and develop relevant experimental designs for given scientific questions. The students will know how to properly record, store, analyze, and illustrate the experimental data obtained with the specific techniques presented. They will learn to critically evaluate and interpret their experimental findings. They are able to give an informative overview of scientific questions, experimental design, results and interpretation of the performed experiments both in oral and in written form.

3 Content

Lecture:

Principles of experimental embryology: Specification, morphogen gradients, stem cell concept, cell adhesion; Molecular methods: qRT-PCR, micro array, WISH, transgenic animals, gene inactivation; Differential gene expression: Transcription factors, DNA methylation, chromatin, RNA stability; Cell-cell communication: paracrine and juxtacrine signals, Fgf signaling, Hh signaling, Wnt signaling, Tgf β signaling, cell death; Fertilization; axis specification in amphibians, fish, birds and mammals; Ectoderm: Development of CNS and epidermis, neural crest cells; Paraxiale Mesoderm: Somites und derivates; Intermediate Mesoderm: Kidney development; Lateral plate mesoderm: heart development, vascular development, hematopoesis; Endoderm: pharynx, stomach, intestine, liver, pancreas; Limb development; sex determination: gonad development, sex hormones, dose compensation, spermatogenesis, oogenesis, germ cell migration; regeneration and aging; congenital and acquired malformations in humans, Teratogene, In vitro-Fertilization; Embryonic stem cells, induced stem cells; regenerative medicine.

Molecular and cellular basis of neuronal and glial cell function, properties of glial cells and neuron-glia interaction, basic concepts of extra- and intracellular ion homeostasis, activity-related extra- and intracellular ion signaling (calcium, potassium, sodium, pH). Excitotoxicity and role of ion dysbalance in brain pathology. Glial cells as central elements in brain pathology. Model systems for investigation of neurological disease, molecular and cellular basis of neurological and neurodegenerative disease (epilepsy, spreading depression, ischemia/anoxia, hepatic encephalopathy, neurodegenerative disease).

Practical course:

Preparation of embryos; genotyping, identification of mutant phenotype; staining of

	cartilage and bone; Immune staining of pancreas and liver (adipositas model). Histological analysis of kidneys, spinal cord and brain (ciliopathy) as well as heart insufficiency and arteriosclerosis. Immune staining of signal components in cilia; Western blot analysis of signal pathways in organs. Determination of metabolic parameters in mice (indirect calorimetry: energy utilization and food intake); weight development, physical activity). Analysis of fat mass in mice by NMR. Whole mount in situ analysis. Digital documentation of results. Preparation of acute tissue slices of the mouse brain, electrophysiological techniques in acute brain slices (field potential recording, ion-selective microelectrodes, whole-cell patch-clamp). Measurement of electrical signals under physiological conditions and their alteration under pathophysiological conditions. Intracellular, dynamic life imaging of ion signals in neurons and astrocytes und physiological and pathophysiological conditions (e. g. calcium imaging, sodium imaging and/or imaging of pH dynamics). Short oral presentation of the experimental results and their interpretation at the end of the course.
4	**Teaching methods** Lecture and practical course
5	**Prerequisites** **Formal:** Successful completion of module 1. Accepted for master programs in Biology, Biochemistry or Translational Neurosciences; Proficiency in English level B2 of Common European Framework of Reference for Languages (CEFR) **With regards to content:**
6	**Examination types:** **Cumulative Examination:** 1. Written examination about the contents of the lecture (70% of overall mark), 2. Description of analyses by pictures and notes, performance of experiments and analyses (15%)**,** 3. Presentation: drafting of project, graphical description of project, presentation and discussion (15%)
7	**Requirements for award of credit points** Regular attendance at the practical course. Successful completion of a course project. Oral presentation in a seminar with an accompanying written handout. **To pass this module you have to pass all submodule examinations:** Final written examination, description of analysis, final oral presentation.
8	**Module applicability (in other study courses)** Master Biology Master Biology International Master Biochemistry
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. Ulrich Rüther, Prof. Dr. Christina Rose
11	**Further information** The regular attendance at the lectures is strongly recommended. The content of the lectures is prerequisite for the practical course.