Titel des Moduls:	**Developmental Neuroscience**		
	Elective Module (M.Sc.)		WM-07
Modulverantwortlicher:		**Fachbereich(e):**	
Driever, Wolfgang		**Developmental Biology**	
Typ:	Wahlpflichtmodul	**Fachsemester:**	2
Moduldauer:	1 Semester, Block	**ECTS:**	9
Turnus:	Summer semester	**Workload:**	270 h
Empfohlene Voraussetzung:		**Zwingende Voraussetzung:**	OM-02 and/or OM-05, SP1-02 and/or SP1-05
Verwendbarkeit:	M.Sc. Biology, Elective Module A+B in the Majors Neuroscience and Genetics & Developmental Biology		
Lehrende:	Arrenberg, Aristides / Driever, Wolfgang / Holzschuh, Jochen / Lecaudey, Virginie / Schweitzer, Jörn		

Veranstaltungstitel	**Lehrform**	**ECTS**	**SWS**	**Workload [h]**
Development of the Nervous System	Lecture	1,5	1,5	45
Methods in Developmental Neurobiology	Practical Exercise	6	6	180
Establishing the Nervous System	Seminar	1,5	1	45

Lernziele / Lernergebnisse	Students can • distinguish the basic mechanistic phases of nervous system development from neural induction to formation of functional neuronal connections • explain the molecular mechanisms of neural development (transcriptional control, signaling pathways) and explain them with examples • define the essential findings from a primary research publication in developmental neurosciences, and explain, interpret and discuss them together with the experimental logic in a scientific presentation • describe and employ important techniques and methods for analysis of the development of the nervous system • analyze their experiments using statistical tools and to evaluate their results critically.
Studienleistung	• at least 80% physical presence during lectures, practical classes and seminars. • active participation in lecture discussions, seminars and practicals • independent follow-up learning of the topics of lectures, seminars and practicals. • preparation of scientific standard protocols of laboratory projects • preparation and presentation of a scientific seminar
Prüfungsleistung & Benotung	none
Literatur	• Sanes et al., Development of the Nervous System (2012, 3rd. Ed. chapt.1-7) • Price et. al. Building Brains (2011, chapt.1-12) • Kandel et al. Principles of Neural Sciences (2012, 5th Ed. Part VIII)

Veranstaltungstitel:	**Development of the Nervous Sysstem**	
Lehrform:	Lecture	
Modul:	Elective Module „Developmental Neuroscience“	WM-07
Verwendbarkeit:	Elective Module „Developmental Neuroscience“	

Lehrsprache:	English	**Teilnehmerzahl:**	20
Moduldauer:	1 Semester, Block	**Fachsemester:**	2
Angebots-häufigkeit:	summer term only		

SWS / LVS	Präsenzstudium	Selbststudium	Workload Summe
1,5	18 h	27 h	45 h

Inhalte	The lecture series presents the distinct phases of nervous system development starting from neural induction during gastrulation until formation of functional axonal connections and synapses between neurons. Examples for molecular mechanisms (transcriptional regulation, signaling pathways) that contribute to these developmental processes will be presented in order to enable a mechanistic understanding of developmental control. In addition, important techniques and methods for analysis of nervous system development will be presented. Topics of the lectures: • Neuron and Glia • Neural Crest Introduction into neural development • Neural Induction • Neurulation • Anterioposterior Patterning in the Neural Plate; Regional Organizing Centers • Hindbrain Segmentation • Dorsoventral Patterning in the Nervous System • Axon Guidance systems molecular mechanisms • Axon Guidance spatial mechanisms and topographic representations • Neurotrophic Factors and Neuronal Cell Death • Synaptogenesis and Remodeling • and Peripheral Nervous System • Neurogenesis • Neuronal Differentiation • Sensory Organ Development • Neural Stem Cells • From Development to Behaviour: Ontogeny of visually mediated eye movements • Optogenetic techniques to study circuit development and function • 2-photon microscopy and optical techniques
Lehrmethoden und Medien	Lectures using PowerPoint or Keynote presentations Handouts of lecture slides as b&w prints and als color PDFs on Illias server. Up-to-date scientific reviews for each topic provided on Illias server Development of schemes using chalk / board Discussion of concepts and open questions

Modulhandbuch M.Sc. Biologie Wahlmodule

Lernziele / Lernergebnisse	The students are able to • structure the fundamental phases of development of the nervous system from neural induction to formation of functional neuronal connections • explain molecular mechanisms of neural development (transcriptional control, signaling mechanisms) using examples • present how neural cells are induced from pluripotent early embryonic cells by the signaling systems active in gastrulation • derive the fundamental morphogenetic processes during neurulation based on the participating signaling centers and the specific cell behavior • explain the organisation of the vertebrate brain and spinal cord based on the anterioposterior and dorsoventral patterning mechanisms that establish this organisation • explain the causal role that transcription factors and signals actin in pattern formation have during region specific neuronal differentiation • argue how Delta-Notch signaling control neurogenesis • explain the roles of neural stem cells and their stem cell niches in neural development and regeneration • develop how distinct molecular mechanisms contribute to formation of functional connections in axonogenesis and synaptogenesis • explain the formation of functional neuronal circuits in the embryo for simple behavioral paradigms (optomotor response, swim behavior of fishes) • explain important classical and modern techniques for the experimental analysis of the distinct phases of neural development
Studienleistung	independent follow-up learning of the topics of lectures using the lecture materials, text books and current scientific reviews
Prüfungsleistung & Benotung	none
Literatur	• Sanes et al., Development of the Nervous System (2012, 3rd. Ed. chapt. 1-7) • Price et. al. Building Brains (2011, chapt.1-12) • Kandel et al. Principles of Neural Sciences (2012, 5th Ed. Part VIII)
Weitere Informationen:	lecture materials will be made available on Illias

Veranstaltungstitel:	**Methods in Developmental Neurobiology**	
Lehrform:	Practical Exercise	
Modul:	Elective Module „Developmental Neuroscience“	WM-07
Verwendbarkeit:	Elective Module „Developmental Neuroscience“	

Lehrsprache:	English	**Teilnehmerzahl:**	12
Moduldauer:	1 Semester, Block	**Fachsemester:**	2
Angebots-häufigkeit:	summer term only		

SWS / LVS	Präsenzstudium	Selbststudium	Workload Summe
6	90 h	90 h	180 h

Inhalte	The practical classes present classical experimental embryology techniques as well as modern molecular genetics, signaling research, and microcopy techniques applied to the development of the nervous system using vertebrate model organisms. The trained techniques include: • life imaging using transmitted light, epifluorescence and confocal microscopy • analysis of genetic mutants • transgenic animal model systems • embryo culture • gene expression analysis and immunohistology • overexpression of genes using mRNA microinjection or conditional gene expression systems • pharmacological manipulation of signaling pathways • analysis of motor behavior development • analysis of sense organ development • analysis of axonogenesis
Lehrmethoden und Medien	Instructions for practical work by faculty. Students perform experiments independently in teams of two or small groups with support by teaching staff.
Lernziele / Lernergebnisse	The students are able to • operate transmitted light, epifluorescence and confocal microscopes and generate scientifically meaningful digital image data • apply specific experimental or genetic methods for in vivo fluorescent labelling of defined neuronal populations. • use time lapse analysis to investigate mechanisms and temporal progress of specific processes in neural development • identify essential anatomical structures in the nervous system of the vertebrate embryo • accomplish microinjections at the one-cell stage of embryos • apply gene expression analysis and immunohistology to study development of the nervous system. • evaluate different genetic techniques for the manipulation of signaling pathways and transcriptional control and apply appropriate techniques in experiments • evaluate and apply pharmacological techniques for signaling pathway manipulation • utilize open source software to analyze digital immunofluorescence image data • statistically evaluate data for significance.

Modulhandbuch M.Sc. Biologie Wahlmodule

Studienleistung	• at least 80% physical presence during practical classes. • active participation in lecture practical classes • independent follow-up learning of the topics of classes. • preparation of scientific standard protocols of laboratory projects
Prüfungsleistung & Benotung	none
Literatur	• Sanes et al., Development of the Nervous System (2012, 3rd. Ed. chapt. 1-7) • Price et. al. Building Brains (2011, chapt. 1-12) • Kandel et al. Principles of Neural Sciences (2012, 5th Ed. Part VIII)

Veranstaltungstitel:	**Establishing the Nervous System**	
Lehrform:	Seminar	
Modul:	Elective Module „Developmental Neuroscience“	WM-07
Verwendbarkeit:	Elective Module „Developmental Neuroscience“	

Lehrsprache:	English	**Teilnehmerzahl:**	12
Moduldauer:	1 Semester, Block	**Fachsemester:**	2
Angebots-häufigkeit:	summer term only		

SWS / LVS	Präsenzstudium	Selbststudium	Workload Summe
1	12 h	33 h	45 h

Inhalte	Each student presents a primary research scientific publication from the field of developmental neurosciences. The research ppaer will be discussed in the plenum by all participants of the seminar.
Lehrmethoden und Medien	Discussion of the independently prepared seminar presentation before and after the seminar with the supervising faculty member Students will be guided to contribute actively to the critical discussion of the publication in the plenum.
Lernziele / Lernergebnisse	The students are able to • recognize the important findings in a research publication and present them in a meaningful way using PowerPoint slides • critically evaluate the techniques, analysis methods and conclusions of a research publication • relate the findings of a primary research publication to the scientific context in this closer field of research • prepare and present a well structured scientific presentation.
Studienleistung	• at least 80% physical presence during seminar classes. • preparation and presentation of a scientific seminar reporting a primary research publication from the filed of developmental neurosciences.
Prüfungsleistung & Benotung	none
Literatur	• Sanes et al., Development of the Nervous System (2012, 3rd. Ed. chapt.1-7) • Price et. al. Building Brains (2011, chapt.1-12) • Kandel et al. Principles of Neural Sciences (2012, 5th Ed. Part VIII)