

Titel des Moduls:	Developmental Neurobiology		
	Schwerpunktmodul II (M.Sc.)	SP2-05	
Modulverantwortlicher:	Fachbereich(e):		
Driever, Wolfgang	Entwicklungsbiologie		
Typ:	Wahlpflichtmodul	Fachsemester:	3
Moduldauer:	1 Semester, Block	ECTS:	21
Turnus:	Winter semester	Workload:	630 h
Empfohlene Voraussetzung:	WM-07	Zwingende Voraussetzung:	OM-02 and/or OM-05, SP1-02 or SP1-05
Verwendbarkeit:	M.Sc. Biology, Majors Neurosciences or Genetics & Developmental Biology		
Lehrende:	Arrenberg, Aristides / Baumeister, Ralf / Driever, Wolfgang / Eimer, Stefan / Holzschuh, Jochen / Lecaudey, Virginie / Metzger, Friedrich / Neubüser, Annette / Nitschke, Roland / Onichtchouk, Daria / Pyrowolakis, Giorgios / Schweitzer, Jörn / Gastdozenten		

Veranstaltungstitel	Lehrform	ECTS	SWS	Workload [h]
Neural Development and Disease	Lecture	1,5	1,5	45
From Genome to Organism: Molecular, Genetic and Cell Biology Approaches in Developmental Biology	Lecture	1	1	30
Developmental Neuroscience Lab Projects	Practical exercise	17	15	510
From Genes to Circuits and Behavior	Seminar	1,5	1	45

Lernziele / Lernergebnisse	<p>Students can</p> <ul style="list-style-type: none"> • explain detailed molecular mechanisms of neural development (transcriptional control, signaling pathways) and present them with examples • explain molecular mechanisms of nervous system development and relevance to human disease • integrate knowledge of several disciplines (developmental biology, genetics, physiology, neurology) to aid comprehension of complex neural systems • apply state-of-the-art technologies for research on nervous system development • analyze experiments using statistical tools and evaluate their results critically. • write a laboratory project report in the format of a scientific primary research publication • 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
Studienleistung	<ul style="list-style-type: none"> • at least 80% physical presence during lectures, practical exercises and seminars. • active participation in lecture discussions, seminars and lab projects • independent follow-up learning of the topics of lectures, seminars and lab projects. • preparation of scientific standard protocols of laboratory projects
Prüfungsleistung & Benotung	<ul style="list-style-type: none"> • Protocols of two laboratory projects (60%) • Oral presentation and exam (40%)
Literatur	<ul style="list-style-type: none"> • 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.) • Primary literature and academic reviews as provided by lecturers

Veranstaltungstitel:	Neural Development and Disease	
Lehrform:	Lecture	
Modul:	Schwerpunktmodul II „Developmental Neurobiology“	SP2-05
Verwendbarkeit:	Schwerpunktmodul II „Developmental Neurobiology“	

Lehrsprache:	english	Teilnehmerzahl:	20
Moduldauer:	1 Semester, Block	Fachsemester:	3
Angebots-häufigkeit:	winter semester only		

SWS / LVS	Präsenzstudium	Selbststudium	Workload Summe
1,5	20 h	25 h	45 h

Inhalte	<p>Advanced topics in neural development and neurobiology will be discussed with an exemplary focus on a specific, disease relevant neurotransmitter system, the dopaminergic system.</p> <p>Topics include:</p> <ul style="list-style-type: none"> • Molecular mechanisms of neuronal development • Development of neural circuits and behavior • How to make a dopaminergic neuron – in the embryo and from stem cells • Neuronal cell death and regeneration • Model organisms for dopaminergic function: <i>C. elegans</i>, zebrafish, mouse • Dopaminergic neuromodulation: circuit analysis and optogenetic manipulations • Disease example: Parkinson's disease – cells, molecules, circuits, behavior, treatments • Dopamine - clinical aspects • Development and disease: Reconstitution and regeneration following neurodegeneration
Lehrmethoden und Medien	<p>Lectures using PowerPoint or Keynote presentations. Handouts of lecture slides as PDFs on Ilias server.</p> <p>Up-to-date scientific reviews for each topic provided on Ilias server</p> <p>Development of schemes using chalk / board</p> <p>Discussion of concepts and open questions</p>
Lernziele / Lernergebnisse	<p>The students are able to</p> <ul style="list-style-type: none"> • explain molecular mechanisms of neural development (transcriptional control, signaling mechanisms) using examples • explain cellular mechanisms of neural development (intracellular trafficking, migration, axonogenesis, cell death) using examples • explain developmental aspects of neural circuit formation • explain links between developmental control defects and neurological or neurodegenerative diseases • explain current cellular and developmental basis for regenerative or reconstitutive approaches towards neurodegenerative disease • evaluate animal models and experimental approaches for research into neural development as well as cellular/developmental neurological diseases

Studienleistung	independent follow-up learning of the topics of lectures using the lecture materials, text books and current scientific reviews
Prüfungsleistung & Benotung	Topics of the lectures are topics of a 30 minute oral exam at the end of the module
Literatur	<ul style="list-style-type: none"> • 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.) • Primary literature and academic reviews as provided by lecturers

Veranstaltungstitel:	From Genome to Organism: Molecular, Genetic and Cell Biology Approaches in Developmental Biology	
Lehrform:	Lecture	
Modul:	Schwerpunktmodul II „Developmental Neurobiology“	SP2-05
Verwendbarkeit:	Schwerpunktmodul II „Developmental Neurobiology“	

Lehrsprache:	english	Teilnehmerzahl:	40
Moduldauer:	1 Semester, Block	Fachsemester:	3
Angebots-häufigkeit:	winter semester only		

SWS / LVS	Präsenzstudium	Selbststudium	Workload Summe
1	14 h	16 h	30 h

Inhalte	<p>Lecture series focusing on current methodology and technologies used in the field of developmental biology. Each lecture presents state of the art in a technology area.</p> <ul style="list-style-type: none"> • Extracting biological information using the genetic toolbox of model organisms including <i>C. elegans</i>, <i>Drosophila</i>, zebrafish, mouse • Reverse Genetics in Zebrafish • Genetic engineering in mice: Strategies to insert targeted mutations • Genetic engineering in mice: conditional mutagenesis and targeted gain-of-function studies • Observing dynamical biological processes <i>in vivo</i> in model organisms • Use of advanced microscopy methods to study cell biology • Methods to detect apoptotic cell death • Technologies for transcriptional regulatory network analysis • From gene regulatory networks to virtual embryo: Integrating regulatory mechanisms at the systems level
Lehrmethoden und Medien	<p>Lectures using PowerPoint or Keynote presentations Handouts of lecture slides as PDFs on Ilias server. Up-to-date scientific reviews for each topic provided on Ilias server Development of schemes using chalk / board Discussion of concepts and open questions</p>
Lernziele / Lernergebnisse	<p>The students are able to</p> <ul style="list-style-type: none"> • explain current state-of-the-art techniques combining embryology, cellular and molecular approaches in developmental neurosciences • 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

Studienleistung	independent follow-up learning of the topics of lectures using the lecture materials, text books and current scientific reviews
Prüfungsleistung & Benotung	Topics of the lectures are topics of a 30 minute oral exam at the end of the module
Literatur	<ul style="list-style-type: none"> • 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.) • Gilbert, Developmental Biology (2013, 10th Ed) • Primary literature and academic reviews as provided by lecturers

Veranstaltungstitel:	Developmental Neuroscience Lab Projects	
Lehrform:	Practical exercise	
Modul:	Schwerpunktmodul II „Developmental Neurobiology“	SP2-05
Verwendbarkeit:	Schwerpunktmodul II „Developmental Neurobiology“	

Lehrsprache:	english	Teilnehmerzahl:	12
Moduldauer:	1 Semester, Block	Fachsemester	3
Angebots-häufigkeit:	winter semester only		

SWS / LVS	Präsenzstudium	Selbststudium	Workload Summe
15	225 h	285 h	510 h

Inhalte	Students perform two small research projects integrated into participating research laboratories in the field of developmental neuroscience ("lab rotations"). At least one of the lab projects should contain molecular and cellular level analysis. Students learn how to develop and plan a project, apply current experimental approaches towards solution of a scientific question, and write a report in the format of a primary scientific publication.
Lehrmethoden und Medien	Instructions for practical work by faculty. Students perform experiments independently individually or in teams of two with support by teaching staff.
Lernziele / Lernergebnisse	Students can <ul style="list-style-type: none"> • develop and plan a small research project addressing a current question in developmental neurosciences • apply state-of-the-art technologies for research on nervous system development • analyze their experiments using statistical tools and to evaluate their results critically. • write a laboratory project report in the format of a scientific primary research publication
Studienleistung	<ul style="list-style-type: none"> • at least 80% physical presence during time of lab projects. • active planning and experimental execution of lab projects. • preparation of scientific standard protocols of laboratory projects
Prüfungsleistung & Benotung	<ul style="list-style-type: none"> • Protocols of two laboratory projects written in the format of a primary scientific publication. Each protocol will be graded and contribute 30% to the module grade (thus, the protocols together contribute 60% of grade) • Oral presentation and exam: One of the two laboratory projects has to be presented in the format of a scientific presentation (30 minutes); the presentation is directly followed by a discussion and exam (also 30 minutes) in which the student has to demonstrate knowledge of the scientific background in the field of the presentation as well as command of methodology & technologies used in the field of developmental neuroscience. The grade assigned for this presentation and exam will account for 40% of the total grade of the module.

Literatur	<ul style="list-style-type: none"> • 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.)
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Veranstaltungstitel:	From Genes to Circuits and Behavior	
Lehrform:	Seminar	
Modul:	Schwerpunktmodul II „Developmental Neurobiology“	SP2-05
Verwendbarkeit:	Schwerpunktmodul II „Developmental Neurobiology“	

Lehrsprache:	english	Teilnehmerzahl:	12
Moduldauer:	1 Semester, Block	Fachsemester:	3
Angebots-häufigkeit:	winter semester only		

SWS / LVS	Präsenzstudium	Selbststudium	Workload Summe
1	15 h	30 h	45 h

Inhalte	Each student presents a primary research scientific publication from the field of developmental neurosciences. The research paper 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 <ul style="list-style-type: none"> • 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	Preparation and presentation of a scientific seminar reporting a primary research publication from the field of developmental neurosciences.
Prüfungsleistung & Benotung	none
Literatur	<ul style="list-style-type: none"> • 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.)