

Master's program

Interdisciplinary Neuroscience



Course Manual

To the examination regulations 2023

March 2026

Compulsory Modules

	Name of module
INS IN 1	Introduction to Neuroscience 1
INS IN 2	Introduction to Neuroscience 2
INS BM	Basic Methods in Neuroscience
INS MN	Methods in Neuroscience
INS CC	Current Concepts in Neuroscience
INS MA	Master thesis

Elective modules with optional courses**INS A: Elective Module Basic Neuroscience**

	Optional courses in elective A: Basic Neuroscience	Person in charge
INS A-0	External elective course “Basic Neuroscience”	Head of Master’s program
INS A-9	Electrophysiology and neurotransmitter dynamics of the dopamine system	Prof. Jochen Roeper
INS A-10	Neurophysiology and Behaviour	Prof. Bernd Grünewald
INS A-12	The Neuro-Vascular Interface	PD Dr. Stefan Liebner
INS A-14	Genetics and Epigenetics of Neurogenesis and Gliogenesis	Prof. Dorothea Schulte
INS A-15	Recording neuronal activity in freely behaving animals	Dr. Torfi Sigurdsson
INS A-21	Cellular, molecular and systemic Neurobiology in mouse and zebrafish	Prof. Amparo Acker-Palmer
INS A-23	Cellular and molecular mechanisms in neurovascular disorders	Prof. Jasmin Hefendehl
INS A-24	Deciphering brain activity during natural behaviour in real time	Dr. Martha Havenith, Dr. Marieke Schölvinck
INS A-25	Neuroscience of Navigation and Self-Motion	Dr. Jean Laurens
INS A-26	Analysis of Social Networks	Dr. Alison Barker
INS A-28	Sensorimotor behavior tests in mice – data acquisition and analysis	Prof. Markus Aswendt

INS B: Elective Module Clinical Neuroscience

	Optional courses in elective B: Clinical Neuroscience	Person in charge
INS B-0	External elective course “Clinical Neuroscience”	Head of Master’s program
INS B-4	Plasticity in Hippocampus – Morphology, Physiology, and Clinical Relevance	Prof. Thomas Deller, Prof. Bas-Orth
INS B-6	Experimental Brain Tumor Therapy	Prof. Donat Kögel
INS B-8	Clinical Neuroimaging	Prof. Stefan Weidauer
INS B-9	Clinical Auditory Neuroscience	Prof. Uwe Baumann
INS B-10	Experimental and Translational Psychiatry	Prof. David Slattery
INS B-11	Neurobiological human cell models	Dr. Denise Haslinger
INS B-12	Neuroimaging Biomarkers in Psychiatry	Prof. Christine Ecker
INS B-13	Translational Neuro-Oncology Research	Dr. Ann-Christin Hau
INS B-14	Computational Translational Psychiatry	Prof. Andreas Chiochetti
INS B-15	Psychotherapy Research in Acute Psychiatry	Apl. Prof. Viola Oertel
INS B-16	Machine Learning in Neurology	Prof. Felix Rosenow, Dr. Tristan Stoeber

INS C: Elective Module Cognitive and Computational Neuroscience

	Optional courses in elective C: Cognitive and Computational Neuroscience	Person in charge
INS C-0	External elective course „Cognitive and Computational Neuroscience“	Head of Master’s program
INS C-1	Modern non-invasive Methods in Human Cognition research	Prof. Jochen Kaiser
INS C-4	Virtual Hippocampus - Introduction to Computational Neuroscience	Prof. Peter Jedlicka
INS C-7	Cognitive Neuroscience – Higher Cognitive Functions	Prof. Christian Fiebach, Dr. Alessandro Tavano
INS C-8	Systems Neuroscience – Sensorimotor and Cognitive Networks	PD Dr. Christian Kell
INS C-10	Computational Neuroanatomy – quantitative analysis and modelling	Dr. Hermann Cuntz
INS C-11	Computational Modeling of Neuronal Plasticity	Prof. Jochen Triesch
INS C-15	Developmental and Cognitive Neuroscience	Prof. Yee-Lee Shing

INS C-16	Cognitive and perceptual processes in the human brain	Dr. Rosanne Rademaker
INS C-17	Cognitive and Neural Dynamics (CANDy)	Dr. Georgios Michalareas

INS D: Elective Module Applied Neuroscience

	Optional courses in elective D: Applied Neuroscience	Person in charge
INS D-0	External elective course „Applied Neuroscience“	Head of Master’s program
INS D-1	Behavioral Biology in Zoos	Prof. Paul Dierkes
INS D-2	Attention analysis of students’ media use via eye-tracking	Dr. Maruschka Weber

INS WP: Free choice studies

INS WP	Free-choice studies	Head of Master’s program
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Compulsory Modules:

INS IN 1 Introduction to Neuroscience 1	Einführung in die Neurowissenschaften 1	Compulsory module	8 CP = 240 h				8 CP
			Contact study 7 SWH / 105 h		Self study 135 h		
Content							
<p>Introductory session (WS) Introducing neurobiology research in Frankfurt. Presenting the Master's program</p> <p>Lecture Selected topics in Neuroscience I (WS) Content: Cellular, molecular and physiological background to the function of nerve and glia cells. Mechanisms of signal transduction. Plasticity, learning, memory, sensory systems, motor control, nervous system function, basis of cognition, development of the nervous system, rhythmic control of nerve function and anatomy of the human brain, good scientific practice</p> <p>Seminar related to the lecture Selected topics in Neuroscience I (WS) The students will assess research papers relevant to the lectures</p> <p>Colloquium (WS, SS) Participation in 7 neuroscience-oriented colloquia in the institutes</p> <p>Weekend seminar (WS) Presenting and discussing research projects within the Master's programme; thematisation of ethical and legally relevant aspects in the neurosciences</p>							
Learning results / Competence objectives							
The students have a broad interdisciplinary basic knowledge of the neurosciences and their possible applications. They are familiar with neuroscientific research concepts and are able to link different subfields and paradigms of neuroscience. They will be able to critically assess scientific research papers in the form of an oral presentation. They have knowledge of the guidelines for good scientific practice.							
Requirements for participating							
none							
Helpful previous knowledge							
none							
Assignment of module (program / department)			MSc Interdisciplinary Neuroscience / FB15				
Suitable for other study programs							
Times offered			In the winter semester, colloquia also in the summer semester				
Duration			2 Semesters				
Person in charge			Head of study program				
Semester-related proofs							
Proof of participation			Proof of participation (regular and active participation) for all events, (except lectures)				
Study achievements			1 seminar talk (30 minutes) in the seminar to the lecture series "Selected Topics in Neuroscience I"				
Teaching forms			Lecture, seminar, colloquia				
Tuition language			English				
Module exam			Form / duration/ content(if applicable)				
Module final exam consisting of:			Written exam for the lecture "Selected Topics of Neuroscience I" (duration: 90 minutes)				
Introduction to Neuroscience 1	Form of teaching	SWH	CP	Semester			
				1	2	3	4
Lecture Selected topics in Neuroscience I	V	3	4	X			
Seminar to the lecture Selected topics in Neuroscience I	S	1	2	X			
Introductory session	V	1	0.5	X			
Colloquia	Ko	0.5	0.5	X			
Weekend seminar	S	0,5	1	X			

Sum		7	8				
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INS IN 2 Introduction to Neuroscience 2	Einführung in die Neurowissenschaften 2	Compulsory module	5 CP = 150 h				5 CP
			Contact study 3 SWH / 45 h	Self study 105 h			
Content							
<p>Lecture Selected topics in Neuroscience II (SS) The lecture delves into specific aspects of experimental neurology, pathology and diagnostics including non-invasive studies of the human brain, degenerative diseases of the nervous system and medical psychology, as well as methodological developments such as optogenetics.</p> <p>Seminar to the Lecture Selected topics in Neuroscience II (SS) The students will assess research papers relevant to the lectures</p>							
Learning results / Competence objectives							
The students have a broad interdisciplinary basic knowledge of the neurosciences and their possible applications. They are familiar with neuroscientific research concepts and are able to link different subfields and paradigms of neuroscience. They will be able to critically assess scientific research papers in the form of an oral presentation.							
Requirements for participating							
none							
Helpful previous knowledge							
none							
Assignment of module (program / department)			MSc Interdisciplinary Neuroscience / FB15				
Suitable for other study programs							
Times offered			In the Summer semester				
Duration			1 Semester				
Person in charge			Head of study program				
Semester-related proofs							
Proof of participation			Proof of participation (regular and active participation) for the seminar				
Study achievements			1 seminar talk (30 minutes) in the seminar to the lecture series "Selected Topics in Neuroscience II"				
Teaching forms			Lecture, seminar				
Tuition language			English				
Module exam			Form / duration/ content(if applicable)				
Module final exam consisting of:			Written exam for the lecture "Selected Topics of Neuroscience II" (duration: 90 minutes)				
Introduction to Neuroscience 2	Form of teaching	SWH	CP	Semester			
				1	2	3	4
Lecture Selected topics in Neuroscience II	V	2	3		X		
Seminar to the lecture Selected topics in Neuroscience II	S	1	2		X		
Sum		3	5				

INS BM Basic Methods in Neuroscience	Basismethoden der Neurowissenschaften	Compulsory module	13 CP = 390 h		13 CP
			Contact study 11 SWH / 165 h	Self study 225 h	
Content					
<p>The module focusses on the following areas:</p> <p>(1) Methods of cell biology, molecular biology and genetics: Imparting of knowledge on practical and theoretical basics for working with chemical solutions, physical-chemical features of proteins and their isolation, subcellular fractioning and centrifugation, preparation of cell cultures, immune-histology and microscopy and the basic principles of molecular genetics and genomics.</p> <p>(2) Anatomy of the central nervous system: Using slices, plastic models and stored data-sets the structure and the development of the human brain and spinal cord are shown, including the autonomous nervous system and the cerebral blood supply. Furthermore imaging methods like MRI and fMRI are introduced. Also the evaluation of brains and animal model organisms are discussed.</p> <p>(3) Electrophysiology: In lectures and seminars/discussions the basics of membrane potentials, action potentials, forwarding of potentials, synaptic morphology/geometry/function are dealt with. Important methods for recognition and analysis of single neurons (extracellular, intracellular, patch-clamp) and neural networks activity are discussed. Both electrical and optical techniques of neural stimulation are presented.</p> <p>(4) MATLAB-programming and statistics: Basics of programming of neural data recordings and analysis with MATLAB are discussed. A focus lies on practical programming exercises. Basic statistical methods are introduced, discussed and realised in MATLAB.</p> <p>(5) Legal and ethical aspects of animal experimentation, genetic manipulations, biological safety and proper scientific conduct are imparted.</p>					
Learning results / Competence objectives					
<p>Within this module the students learn to discuss intensely and independently theoretical as well as practical contents of the study. They attain practical competence in cellular and molecular lab techniques, cell culture techniques and programming of neuro-biological questions in MATLAB. When having finished the module they have basic knowledge on neurogenetics. They have fundamental knowledge on human brain anatomy as well as animal models, can identify important cerebral structures and interpret histological preparations adequately. They possess basic knowledge regarding neural potentials and synaptic mechanisms and can assess potentialities and limitations of electro-physiological technologies. They can apply adequate statistical methods in assessing significance and comparison of neural records. They will attain competence regarding rules of good scientific practice, and to keep the directives regarding genetic works, bioassay practices, and animal welfare.</p>					
Requirements for participating					
none					
Helpful previous knowledge					
none					
Assignment of module (program / department)			MSc Interdisciplinary Neuroscience / FB15		
Suitable for other study programs					
Times offered			In the winter semester		
Duration			1 Semester (block course over 6 weeks)		
Person in charge			Head of study program		
Semester-related proofs					
Proof of participation			Regular participation in all events (except lectures)		
Study achievements			Successful completion of study achievements ("pass") in the form of tests/exercises following each of the focus areas listed under "Content" or a portfolio across all focus areas.		
Teaching forms			Lecture, seminar, exercises		
Tuition language			English		
Module exam			Form / duration / content (if applicable)		
Module final exam consisting of:			none		

		Form of teaching	SWH	CP	Semester				
					1	2	3	4	
	Basic Methods in Neuroscience	V, S, Üb	11	13	X				
	Methods of cell biology, molecular biology and genetics	V, S, Üb							
	Anatomy of the central nervous system	V, S, Üb							
	Electrophysiology	V, S, Üb							
	MATLAB programming and statistics	V, Üb							
	Legal and ethical aspects of animal experimentation	V, Üb							
	Sum		11	13					

INS MN Methods in Neuroscience	Vertiefung neurowissenschaftlicher Arbeitstechniken	Compulsory module	15 CP = 450 h				15 CP
			Contact study 15 SWH/ 225 h		Self study 225 h		
Content							
The module is a practical on “Deepening scientific research techniques”. The aim is to teach the students as much as possible about the most important experimental techniques recommended for the specialised topics of their Master’s project so that their thesis work can be completed successfully in the time available.							
Learning results / Competence objectives							
After completing the module, the students will be familiar with the basic techniques that apply directly to a Master’s project in their chosen topic. They will be able to efficiently find information about methods from publications and the Internet and evaluate the feasibility of experimental designs. They will be competent in criticizing methods and assessing artefacts.							
Requirements for participating							
Successful completion of the modules “Introduction to Neuroscience I”, “Introduction to Neuroscience II” and “Basic Methods in Neuroscience” as well as at least 2 out of the 3 elective modules.							
Helpful previous knowledge							
none							
Assignment of module (program / department)					MSc Interdisciplinary Neuroscience / FB15		
Suitable for other study programs							
Times offered					Each semester		
Duration					1 Semester (block course over 6 weeks)		
Person in charge					Representatives of elective modules		
Semester-related proofs							
Proof of participation							
Study achievements					Protocol (10–30 pages)		
Teaching forms					Practical		
Tuition language					English		
Module exam					Form / duration / content (if applicable)		
Module final exam consisting of:					none		
Methods in Neuroscience	Form of teaching	SWH	CP	Semester			
				1	2	3	4
Practical	P	15	15			X	

INS CC Current Concepts in Neuroscience	Forschungskonzepte in den Neurowissenschaften	Compulsory module	16 CP = 480 h				16 CP
			Contact study 16 SWH / 245 h		Self study 235 h		
Content							
The module comprises a project work and a seminar with the aim of providing students with the essential theoretical basis for developing a research concept in a neurobiological subfield. After familiarization with current literature work, students will identify critical open questions and develop research strategies to address them. During the seminar, the different research directions of the Master's program will be presented and discussed in the form of scientific posters.							
Learning results / Competence objectives							
Upon completion of the module, students are familiar with the development of scientific research concepts and are able to integrate them into a third-party funding proposal. The students have developed judgment regarding the relevance and realism of different and also contradictory theories and research concepts. The students acquire extended competences regarding rules of good scientific practice and ethical aspects of neuroscience. They are able to design, present and discuss a scientific poster.							
Requirements for participating							
Successful completion of the modules “Introduction to Neuroscience I”, “Introduction to Neuroscience II” and “Basic Methods in Neuroscience” as well as at least 2 out of the 3 elective modules.							
Helpful previous knowledge							
none							
Assignment of module (program / department)					MSc Interdisciplinary Neuroscience / FB15		
Suitable for other study programs							
Times offered							
Each semester							
Duration							
1 Semester block course over 6 weeks)							
Person in charge							
Representatives of elective modules							
Semester-related proofs							
Proof of participation							
Study achievements							
Written research concept (10–20 pages), 1 seminar talk (20 minutes), Production/presentation of 1-2 scientific posters							
Teaching forms							
Project, seminar							
Tuition language							
English							
Module exam					Form / duration / content (if applicable)		
Module final exam consisting of:					none		
Current Concepts in Neuroscience	Form of teaching	SWH	CP	Semester			
				1	2	3	4
Projectwork	Proj	15	15			X	
Weekend seminar	S	1	1			X	
Sum		16	16				

INS MA Masterthesis	Masterarbeit	Compulsory module	30 CP = 900 h				30 CP
			Contact study 30 SWH / 450 h		Self study 450 h		
Content							
As part of the Master's degree, the student works on a problem from the field of neuroscience comprehensively and in depth according to scientific methods. The work can be experimental, empirical or analytic. The results must be written up in a Master's thesis in the style of a scientific paper. The quality of the work will be assessed based on the written thesis by the supervisor and a second referee							
Learning results / Competence objectives							
After successful completion of the Master's thesis, students are able to identify, delimit and explain a research-related scientific problem in a subfield of neuroscience. They will be able to analyze, evaluate or solve it using specialized knowledge and scientific methods. They are able to critically analyze relevant contributions to research and assess their relevance to their own research question. They are able to appropriately present and critically evaluate the results within a given period of time using scientific standards, and to recognize and assess central lines of development in the relevant subfield.							
Requirements for participating							
Proof of at least 79 CP							
Helpful previous knowledge							
none							
Assignment of module (program / department)			MSc Interdisciplinary Neuroscience / FB15				
Suitable for other study programs							
Times offered			Each semester				
Duration			1 Semester				
Person in charge			Representatives of elective modules				
Semester-related proofs			none				
Proof of participation							
Study achievements							
Teaching forms							
Tuition language			English				
Module exam			Form / duration / content (if applicable)				
Module final exam consisting of:			Graded written work in the form of a Master's thesis (40–90 Seiten) the grade is double weighted against the grades of all other modules.				
Masterthesis	Form of teaching	SWH	CP	Semester			
				1	2	3	4
Masterarbeit		30	30				X

Optional courses in elective A: Basic Neuroscience

INS A-0 External elective course “Basic Neuroscience”	Externe Wahlpflichtveranstaltung, „Neurowissenschaftliche Grundlagenforschung“	Elective course			11 CP = 330 h					
					Contact study 11 SWH / 165 h		Self study 165 h		11 CP	
Content										
<p>This elective course teaches basic methods and techniques in the field of basic neuroscience research. Students work on their own current projects under supervision.</p> <p>The elective course can be offered by departments of Goethe University, by other universities in Germany and abroad as well as by non-university research institutions.</p>										
Learning results / Competence objectives										
The students have knowledge in conducting neurobiological experiments in the field of basic research. They are able to work on scientific questions based on relevant literature.										
Requirements for participating										
none										
Helpful previous knowledge										
none										
Assignment of course (program/department)					Interdisciplinary Neuroscience / FB 15					
Suitable for other study programs										
Times offered					Depending on provider					
Duration					Depending on provider					
Person in charge					Head of study program					
Semester-related proofs										
Proof of participation					Regular participation					
Study achievements					The regulations of the provider of the elective course are applied. If the provider does not request any study proofs, a working report must be written, and talks have to be given on both, results of own experiments (20 minutes) and topical literature (20 minutes).					
Teaching forms					Practical, seminar					
Tuition language					Depending on provider					
Module exam					Form / duration / content (if applicable)					
Module final exam consisting of:					The regulations of the provider of the elective course are applied. If grading is not scheduled by the provider, the module completion exam shows a graded protocol (10-30 pages).					
External elective course “Basic Neuroscience”	Form of teaching	SWH	CP	Semester						
				1	2	3	4			
				Practical	P	10	10	X		
				Seminar	S	1	1			
Sum		11	11							

INS A-9 Electrophysiology and neurotransmitter dynamics of the dopamine system	Elektrophysiologie und Neurotransmitterdynamik des dopaminergen Systems	Elective course	11 CP = 330 h				11 CP
			Contact study 11 SWH / 165 h	Self study 165 h			
Content							
The practical introduces the basic of chronic in vivo multi-electrode recordings of dopamine midbrain neurons and detection of in vivo dopamine dynamics with fiber photometry during motor behavior in mice. The students work on their own projects under supervision and present their results in the form of a seminar talk. In a further seminar talk they present an original piece of research from the field of basal ganglia neurophysiology and pathophysiology (e.g. Parkinson's disease, schizophrenia, drug addiction). The main focuses are recording, evaluation and analyzing of electrophysiological data and dopamine dynamics using Matlab and R. Sample data & guidance will be provided to learn key analysis techniques.							
Learning results / Competence objectives							
Students will gain expertise to perform electrophysiological and fiber photometric in vivo experiments to record and/or analyze the electrical activity of dopamine neurons or changes in fluorescence that reflect dopamine dynamics in vivo. They learn to combine in vivo techniques with neuroanatomical and immunohistological analyses for validation of recordings site and expression of genetically encoded sensors. They learn the basics of time series analysis of both continuous fluorescence signals as well as discrete spike trains using Matlab & R. The study relevant literature to enhance their understanding of dopamine dysfunction in Parkinson disease and/or schizophrenia.							
Requirements for participating							
Willingness to work with mouse models							
Helpful previous knowledge							
Basic Matlab knowledge							
Assignment of course (program/department)			MSc Interdisciplinary Neuroscience / FB 15				
Suitable for other study programs							
Times offered			in the summer semester				
Duration			1 Semester (block course over 4 weeks)				
Person in charge			Dr. Pascal Vogel / Prof. Jochen Roper/ Prof. Gaby Schneider				
Semester-related proofs							
Proof of participation			regular participation				
Study achievements			Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature				
Teaching forms			Practical, seminar				
Tuition language			English				
Module exam			Form / duration / content (if applicable)				
Module final exam consisting of:			Practical: graded protocol (10-30 pages)				
Cognition in mouse models of mental disorders: focus on dopaminergic systems	Form of teaching	SWH	CP	Semester			
				1	2	3	4
	Practical	P	10	10			
	Seminar	S	1	1		X	
	Sum		11	11			

INS A-10 Neurophysiology and Behaviour	Neurophysiologie und Verhalten	Elective course		11 CP = 330 h			
				Contact study 11 SWH / 165 h		Self study 165 h	
Content							
<p>The practical investigates the neurophysiological basis of behaviour control. The students work on their own project on a theme defined together beforehand. The techniques that are taught include: cell physiology (patchclamp conductance, intracellular conductance, calcium imaging, cell culture); neuroanatomy (staining methods, brain preparation, confocal laser microscopy, fluorescence microscopy); behavioural experiments (behaviour pharmacology, extracellular conductance, learning and memory, social behaviour). Insects (honey bees, drosophila) are used as model organisms. The principle areas are: how ion channels and transmitter receptors work, neuromodulation, learning behaviour, olfactory memory formation, and social behaviour of bees. The students present their results in the form of a seminar talk and poster. In a further seminar talk they learn how to critically assess analytic physiological and behavioural research papers. These presentations are held in English and the students receive comprehensive feedback about the content and style of the presentation. They become familiar with writing a scientific publication by producing a protocol in the form of a paper.</p>							
Learning results / Competence objectives							
<p>The students can plan, carry out and evaluate neurobiological experiments. They have knowledge in the measurement of ionic currents and perform behavioral observations and behavioral quantifications. They are familiar with neuroanatomical methods. They are familiar with approaches to scientific questions and literature work and prepare scientific papers and presentations.</p>							
Requirements for participating							
none							
Helpful previous knowledge							
none							
Assignment of course (program/department)				MSc Interdisciplinary Neuroscience / FB 15			
Suitable for other study programs							
Times offered				in the summer semester			
Duration				1 Semester (block course over 4 weeks)			
Person in charge				Prof. Bernd Grünewald			
Semester-related proofs							
Proof of participation				regular participation			
Study achievements				Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature			
Teaching forms				Practical, seminar			
Tuition language				English			
Module exam				Form / duration / content (if applicable)			
Module final exam consisting of:				Practical: graded protocol (10-30 pages)			
Neurophysiology and Behaviour	Form of teaching	SWH	CP	Semester			
				1	2	3	4
	Practical	P	10	10	X		
	Seminar	S	1	1			
Sum		11	11				

INS A-12 The Neuro-Vascular Interface	Die neuro-vasculäre Schnittstelle	Elective course			11 CP = 330 h				11 CP
					Contact study 11 SWH / 165 h		Self study 165 h		
Content									
The course provides basic theoretical and experimental knowledge of the cerebrovascular system in embryonic development and under pathological conditions. The research focus is the development and maintenance of the blood-brain barrier (BBB), and its importance for neuronal function. Students will participate in current experiments in the laboratory setting that will contribute to the understanding of the molecular mechanisms of BBB formation. This work may include the following: basic work with transgenic mouse models (various reporter mouse lines for detection of the Wnt signaling pathway, as well as conditional/inducible "gain-" and "loss-of-function" lines), processing of brain tissue for in situ hybridization and immunohistochemistry, Isolation of cortex microcapillaries from mice, transfection and infection techniques of cells, immunofluorescence, confocal and live-cell microscopy, biochemical techniques such as protein gel electrophoresis, western blot and immunoprecipitation.									
Learning results / Competence objectives									
Students know basic techniques of cellular and molecular neurobiology. By the end of the course, they will have gained experience with transgenic mice and/or cells in vitro, and they will have learned how to process brain tissue from mice according to subsequent methods. Students operate in an international environment and are able to communicate and write scientifically in English.									
Requirements for participating									
None									
Helpful previous knowledge									
None									
Assignment of course (program/department)					MSc Interdisciplinary Neuroscience / FB 15				
Suitable for other study programs									
Times offered					in the summer semester				
Duration					1 Semester (block course over 4 weeks)				
Person in charge					Dr. Stefan Liebner				
Semester-related proofs									
Proof of participation					regular participation				
Study achievements					Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature				
Teaching forms					Practical, seminar				
Tuition language					English				
Module exam					Form / duration / content (if applicable)				
Module final exam consisting of:					Practical: graded protocol (10-30 pages)				
The Neuro-Vascular Interface	Form of teaching	SWH	CP	Semester					
				1	2	3	4		
				Practical	P	10	10		
				Seminar	S	1	1	X	
Sum		11	11						

INS A-14 Genetics and Epigenetics of Neurogenesis and Gliogenesis	Genetik und Epigenetik der Neurogenese und Gliogenese	Elective course			11 CP = 330 h			
					Contact study 11 SWH / 165 h		Self study 165 h	
Content								
<p>The topic of this practical is the control of neuron and glia production by genetic and epigenetic processes. We study this in healthy organisms and in different disease states, with a focus on glial, brain tumors and childhood neurodevelopmental disorders. Depending on the ongoing projects at the time of the course, the course will teach the following skills: bioinformatic analyses of existing genome-wide datasets (ChIP-seq, RNA-seq), culturing and differentiation of cell lines and stem cells (adult neural stem cells, mouse ES cells), qPCR, CRISPR/Cas-based methods for genome modification, retro- and lentiviral gene transfer, immunohistochemistry and microscopy, basic biochemical methods.</p> <p>Students work as full members of the research group, with supervision, on their own small projects.</p>								
Learning results / Competence objectives								
<p>Students have hands-on experience with basic as well as some advanced molecular-genetic methods. They have solid knowledge of the regulation of gene expression, different epigenetic modifications on chromatin (e.g. histone modifications, DNA methylation) and stem cell biology. Students will have gained experience in developing and conducting their own research project.</p>								
Requirements for participating								
none								
Helpful previous knowledge								
none								
Assignment of course (program/department)					MSc Interdisciplinary Neuroscience / FB 15			
Suitable for other study programs								
Times offered					in the summer semester			
Duration					1 Semester (block course over 4 weeks)			
Person in charge					Prof. Dorothea Schulte			
Semester-related proofs								
Proof of participation					regular participation			
Study achievements					Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature			
Teaching forms					Practical, seminar			
Tuition language					English			
Module exam					Form / duration / content (if applicable)			
Module final exam consisting of:					Practical: graded protocol (10-30 pages)			
Genetics and Epigenetics of Neurogenesis and Gliogenesis	Form of teaching	SWH	CP	Semester				
				1	2	3	4	
Practical	P	10	10		X			
Seminar	S	1	1					
Sum		11	11					

INS A-15 Recording neuronal activity in freely behaving animals	Ableitungen der neuronalen Aktivität in sich frei bewegenden Tieren	Elective course		11 CP = 330 h				1 1 C P
				Contact study 11 SWH / 165 h		Self study 165 h		
Content								
During this event, participants will learn methods for studying neuronal activity in freely moving animals. This will focus on one of two methods (depending on the experiments running in the lab during the time window of the course): extracellular recordings using fixed implanted electrodes or calcium imaging using a miniaturized microscope. Participants will learn to perform behavioral tests in mice, how measurement probes are implanted in the mouse brain using stereotactic surgery, both the theory behind the measurement methods and their use for recording neural activity during behavioral tasks; methods for analyzing neural signals related to mouse behavior; and histological methods to confirm the placement of the measurement probes. The collected and analyzed data will be presented at the end of the practicum.								
Learning results / Competence objectives								
Students will have learned animal behavioral training, basic knowledge of techniques for recording and analyzing the neural activity of freely moving animals, and they will be able to address scientific questions based on relevant literature.								
Requirements for participating								
none								
Helpful previous knowledge								
none								
Assignment of course (program/department)				MSc Interdisciplinary Neuroscience / FB 15				
Suitable for other study programs								
Times offered				in the summer semester				
Duration				1 Semester (block course over 4 weeks)				
Person in charge				Dr. Torfi Sigurdsson				
Semester-related proofs								
Proof of participation				regular participation				
Study achievements				Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature				
Teaching forms				Practical, seminar				
Tuition language				English				
Module exam				Form / duration / content (if applicable)				
Module final exam consisting of:				Practical: graded protocol (10-30 pages)				
Recording neuronal activity in freely behaving animals	Form of teaching	SWH	CP	Semester				
				1	2	3	4	
Practical	P	10	10		X			
Seminar		1	1					
Sum		11	11					

INS A-21 Cellular, molecular and systemic neurobiology in mouse and zebrafish	Zelluläre, molekulare und systemische Neurobiologie in Maus und Zebrafisch	Elective course		11 CP = 330 h				11 CP
				Contact study 11 SWH / 165 h		Self study 165 h		
Content								
<p>The practical provides basic theoretical and experimental knowledge in the field of cellular, molecular and systemic neurobiology in mouse and zebrafish. Students work on their own projects under supervision and present the results in the form of a lecture. In another lecture they present an original paper from the thematic area of their projects. They learn how to write a scientific paper by designing a protocol of results accordingly.</p> <p>The practical is divided into two units. The first part includes the following work: Basic techniques of mouse genetics, processing of brain tissue for immunohistochemistry, basics of working with neuronal cell cultures including generation of primary neuronal, astrocytic or endothelial cell cultures, immunofluorescence microscopy, confocal microscopy and biochemical techniques including protein gel electrophoresis and western blot. In the second part of the practical, students are introduced to basic genetic techniques used in zebrafish research. This includes learning molecular biology and histology methods, using various microscopes, manipulating zebrafish embryos, and performing simple behavioral tests.</p>								
Learning results / Competence objectives								
Students will have experience in basic techniques of cellular, molecular and systemic neurobiology. They can independently perform sterile work on cultured cells, independent work on fluorescence microscope and stereomicroscope, basic zebrafish work such as handling embryos and genetic techniques, and computational analysis of laboratory data and image files. Students will operate in an international environment and will be able to present and communicate their results in English.								
Requirements for participating								
none								
Helpful previous knowledge								
none								
Assignment of course (program/department)				MSc Interdisciplinary Neuroscience / FB 15				
Suitable for other study programs								
Times offered				in the summer semester				
Duration				1 Semester (block course over 6 weeks)				
Person in charge				Prof. Amparo Acker-Palmer, Dr. Bettina Kirchmaier				
Semester-related proofs								
Proof of participation				regular participation				
Study achievements				Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature				
Teaching forms				Practical, seminar				
Tuition language				English				
Module exam				Form / duration / content (if applicable)				
Module final exam consisting of:				Practical: graded protocol (10-30 pages)				
Cellular, molecular and systemic neurobiology in mouse and zebrafish	Form of teaching	SWH	CP	Semester				
				1	2	3	4	
	Practical	P	10	10	X			
	Seminar	S	1	1				
Sum		11	11					

INS A-23 Cellular and molecular mechanisms in neurovascular disorders	Zelluläre und molekulare Mechanismen neurovaskulärer Erkrankungen	Elective course			11 CP = 330 h				11 CP
					Contact study 11 SWH / 165 h		Self study 165 h		
Content									
The practical course provides basic theoretical and experimental knowledge in the field of neurodegenerative and vascular diseases. The practical course includes cellular and molecular aspects addressed in the model organism mouse. These include the following work: Basic techniques of mouse genetics and experimental OR methods, processing of brain tissue for immunohistochemistry, basics of working with primary cell cultures, immunofluorescence microscopy, confocal microscopy, and biochemical techniques. Primary cell culture experiments are used to analyze techniques such as phagocytosis efficiency of different cell types. Immunohistochemistry is used to analyze cell specific markers in different disease states. Microscopy allows us to record the cellular and systemic events. The data obtained will be further analyzed by the students, thus teaching them how to use image processing and analysis software. In addition, students will have the opportunity to observe surgical methods such as experimental stroke surgery and in vivo 2-photon microscopy.									
Learning results / Competence objectives									
Students will be familiar with the basic techniques used in the study of neurodegenerative diseases, among others. The different methods allow to ask targeted questions. Accordingly, the students can assess the advantages and disadvantages of different model systems. The students operate in an international environment and are able to present and communicate their results in English.									
Requirements for participating									
none									
Helpful previous knowledge									
none									
Assignment of course (program/department)					MSc Interdisciplinary Neuroscience / FB 15				
Suitable for other study programs									
Times offered									
in the summer semester									
Duration									
1 Semester (block course over 4 weeks)									
Person in charge									
Prof. Jasmin Hefendehl									
Semester-related proofs									
Proof of participation					regular participation				
Study achievements					Seminar: 1 talk (20 minutes) on the results of own experiments and on current literature				
Teaching forms									
Practical, seminar									
Tuition language									
English									
Module exam					Form / duration / content (if applicable)				
Module final exam consisting of:					Practical: graded protocol (10-30 pages)				
Cellular and molecular mechanisms in neurovascular disorders	Form of teaching	SWH	CP	Semester					
				1	2	3	4		
	Practical	P	10	10					
	Seminar	S	1	1		X			
Sum		11	11						

INS A-24 Deciphering brain activity during natural behaviour in real time	Dekodierung von Hirnaktivität während des natürlichen Verhaltens in Echtzeit	Elective course			11 CP = 330 h				11 CP
					Contact study 11 SWH / 165 h		Self study 165 h		
Content									
<p>People often can't multitask - but their brains can! Cognitive processes such as learning and attention are often represented simultaneously in the same brain areas. Previous studies have focused predominantly on how each of these processes affects neuronal activity in isolation. In contrast, in our lab we are investigating how neurons simultaneously represent such cognitive processes and whether these are evolutionarily conserved or vary between species. To this end, we are conducting parallel experiments in monkeys and mice. These animals are trained to perform naturalistic foraging tasks in a virtual environment, while we record the activity of large neuronal populations in their visual system. Different tasks will be offered depending on when the practical begins, including mouse/monkey behavioral training, Matlab/Python programming, psychophysics in humans, virtual reality (VR) experiments, and in vivo electrophysiology.</p>									
Learning results / Competence objectives									
<p>Students will be familiar with all the techniques required for in vivo electrophysiology: handling animals (mice and/or monkeys), training the animals to perform a natural task in a virtual environment, surgeries to implant electrodes, and electrophysiological recordings from these electrodes as the animals perform their task. In addition, students are able to perform VR psychophysics on human subjects, and are given their own data analysis project to learn Matlab/Python programming. Students are in an international environment and are able to present and communicate their results in English.</p>									
Requirements for participating									
none									
Helpful previous knowledge									
none									
Assignment of course (program/department)					MSc Interdisciplinary Neuroscience / FB 15				
Suitable for other study programs									
Times offered					Each semester				
Duration					1 Semester (block course over 4-6 weeks)				
Person in charge					Dr. Martha Havenith / Dr Marieke Schölvinck				
Semester-related proofs									
Proof of participation					regular participation				
Study achievements					Seminar: 1 talk (20 minutes) on the results of own experiments and on current literature				
Teaching forms					Practical, seminar				
Tuition language					English				
Module exam					Form / duration / content (if applicable)				
Module final exam consisting of:					Practical: graded protocol (10-30 pages)				
Deciphering brain activity during natural behaviour in real time	Form of teaching	SWH	CP	Semester					
				1	2	3	4		
				Practical	P	10	10		
				Seminar	S	1	1	X	X
Sum		11	11						

INS A-25 Neuroscience of Navigation and Self-Motion	Neurowissenschaftliche Grundlagen der Navigation und Eigenbewegung	Elective course		11 CP = 330 h				11 CP
				Contact study 11 SWH / 165 h		Self study 165 h		
Content								
We interact with the world by moving and navigating through it whenever we walk into our kitchen or explore a new shopping mall; and whenever we drive a car or climb a mountain path. The research group is studying the circuits in the brain responsible for sensing how our bodies move, controlling balance, and navigating the world. Neural derivations are performed on small, squirrel-sized monkeys called marmosets in experiments where they can sit on moving platforms or move freely in natural cages. We are a computational laboratory, and develop models of self-motion perception based in particular on the Bayesian formalism. Students learn the techniques of extracellular recordings and neural data analysis, motion and navigation science, and theoretical and systems neuroscience, and can then conduct an in-depth research project in one of the lab's topics: Navigation (head-directional cell system), intrinsic motion (vestibular system), cerebellar physiology, Bayesian modeling.								
Learning results / Competence objectives								
Students are familiar with systems neuroscience techniques: chronic implant design and operation; neural spiking data and LFP analysis; 3D motion tracking and analysis, robotic platform programming. They have also become familiar with one of the scientific areas of the lab: navigation, self-motion sensing, cerebellar physiology, Bayesian modeling. Students are in an international environment and are able to present and communicate their results in English.								
Requirements for participating								
none								
Helpful previous knowledge								
Basic knowledge of Matlab programming. Lab projects are typically focused on motion science, data analysis, and modeling, so a basic knowledge of algebra and statistics is helpful.								
Assignment of course (program/department)				MSc Interdisciplinary Neuroscience / FB 15				
Suitable for other study programs								
Times offered				Each semester				
Duration				1 Semester (block course over 4 weeks)				
Person in charge				Dr. Jean Laurens				
Semester-related proofs								
Proof of participation				regular participation				
Study achievements				Seminar: 1 talk (20 minutes) on the results of own experiments and on current literature				
Teaching forms				Practical, seminar				
Tuition language				English				
Module exam				Form / duration / content (if applicable)				
Module final exam consisting of:				Practical: graded protocol (10-30 pages)				
Neuroscience of Navigation and Self-Motion	Form of teaching	S W H	CP	Semester				
				1	2	3	4	
Practical	P	10	10					
Seminar	S	1	1	X	X			
Sum		11	11					

INS A-26 Analysis of Social Networks	Analyse von sozialen Netzwerken	Elective course	11 CP = 330 h				11 CP	
			Contact study 11 SWH / 165 h		Self-study 165 h			
Content								
This practical will provide an introduction into bioacoustics, neuroethology, and machine learning. Participants will have the opportunity to be involved in projects studying the interaction between vocal communication and cooperation, using the naked mole-rat as a model species. Students will have the opportunity to collect and analyze vocalization data using programs in Python and R and to develop machine learning tools for characterizing acoustic features of different vocalization types. Additionally, students will have the opportunity to participate in behavioral studies of naked mole-rats in a wide range of cooperative assays.								
Learning results / Competence objectives								
Students will be able to use Python modules to analyze bioacoustics and neuronal data, as well as design and perform basic behavioral tests.								
Requirements for participating								
none								
Helpful previous knowledge:								
Proficiency in Python, knowledge of Matlab and R								
Assignment of course (program/department)					Interdisciplinary Neuroscience / faculty 15			
Suitable for other study programs								
Times offered								
in the summer semester								
Duration								
1 semester (block course over 4 weeks)								
Person in charge								
Dr. Alison Barker								
Semester-related proofs								
Proof of participation					Regular participation			
Study achievements					Seminar: 1 seminar talk (20 minutes) on experimental results, 1 seminar talk (20 minutes) on current publications			
Teaching forms								
Practical, seminar								
Tuition language								
English								
Module exam								
Module final exam consisting of:					Form / duration / content (if applicable)			
					Practical: Graded protocol (10-30 pages)			
Analysis of Social Networks		Teaching forms	SWH	CP	Semester			
					1	2	3	4
Practical		P	10	10		X		
Seminar		S	1	1				
Sum			11	11				

INS A-28 Sensorimotor behavior tests in mice – data acquisition and analysis	Sensomotorische Verhaltenstests in Mäusen – Aufnahme und Analyse der Daten	Elective course		11 CP (insg.) = 330 h				11 CP
				Contact study 11 SWH / 165 h		Self study 165 h		
Content								
Quantitative measures of sensorimotor behavior in mice are essential for all experiments with the aim to uncover mechanisms of basic brain function and the deficit thereof, e.g. after neurological disorders such as stroke. Although mice are most frequently used, one should be aware of some basic differences to human biomechanics and the concept of testing deficits, which in humans often involves verbal commands. To this end, we are conducting a variety of spontaneous, non-forced behavior tests, which mimic natural movement of mice (e.g., locomotion, climbing, grasping, and exploration). We cover gross and fine motor skills, coordination, and balance, as well as ML-based marker-less pose estimation using Deeplabcut to extract kinematic features, which can be translated to the assessments in patients. Different tasks will be offered depending on ongoing experiments in the lab, including mouse behavior testing, video data recording, data curation, application of Deeplabcut, and data analysis.								
Learning results / Competence objectives								
Students will have a solid overview of behavior test in mice, the advantages of combining different tests as well as novel kinematic analysis. Students will operate in an international environment and will be able to present and communicate their results in English.								
Requirements for participating								
none								
Helpful previous knowledge								
none								
Assignment of course (program/department)				MSc Interdisciplinary Neuroscience / FB 15				
Suitable for other study programs								
Times offered				Each semester				
Duration				1 Semester (block course over 6 weeks)				
Person in charge				Prof. Dr. Markus Aswendt				
Semester-related proofs								
Proof of participation				regular participation				
Study achievements				Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature				
Teaching forms				Practical, seminar				
Tuition language				English				
Module exam				Form / duration / content (if applicable)				
Module final exam consisting of:				Practical: graded protocol (10-30 pages)				
Sensorimotor behavior tests in mice – data acquisition and analysis	Form of teaching	SWH	CP	Semester				
				1	2	3	4	
Practical	P	10	10					
Seminar	S	1	1	X	X			
Sum		11	11					

Optional courses in elective B: Clinical Neuroscience

INS B-0 External elective course “Clinical Neuroscience”	Externe Wahlpflichtveranstaltung „Klinische Neurowissenschaften“	Elective course			11 CP = 330 h				11 CP
					Contact study 11 SWH / 165 h		Self study 165 h		
Content									
<p>The elective course teaches basic methods and techniques in the field of clinical neuroscience. Students work on their own projects under supervision.</p> <p>The elective course can be offered by departments of Goethe University, by other universities in Germany and abroad as well as by non-university research institutions.</p>									
Learning results / Competence objectives									
The students have knowledge in conducting neuroscientific investigations in the field of clinical research. They are able to work on scientific questions based on relevant literature.									
Requirements for participating									
none									
Helpful previous knowledge									
none									
Assignment of course (program/department)					MSc Interdisciplinary Neuroscience / FB 15				
Suitable for other study programs									
Times offered					Depending on provider				
Duration					Depending on provider				
Person in charge					Head of study program				
Semester-related proofs									
Proof of participation					regular participation				
Study achievements					The regulations of the provider of the elective course are applied. If the provider does not request any study proofs, a working report must be written, and talks have to be given on both, results of own experiments (20 minutes) and topical literature (20 minutes).				
Teaching forms					Practical, seminar				
Tuition language					Depending on provider				
Module exam					Form / duration / content (if applicable)				
Module final exam consisting of:					The regulations of the provider of the elective course are applied. If grading is not scheduled by the provider, the module completion exam shows a graded protocol (10-30 pages).				
External elective course “Clinical Neuroscience”		Form of teaching	SWH	CP	Semester				
					1	2	3	4	
Practical		P	10	10	X				
Seminar		S	1	1					
Sum			11	11					

INS B-4 Plasticity in the Hippocampus – Morphology, Physiology, and Clinical Relevance	Plastizität im Hippocampus – Morphologie, Physiologie und klinische Relevanz	Elective course			11 CP = 330 h				11 CP
					Contact study 11 SWH / 165 h		Self study 165 h		
Content									
<p>Practical and seminar provide an interdisciplinary overview of plastic changes in the hippocampus. The course will focus on questions concerning morphological, molecular and physiological changes of hippocampal neurons in response to physiological activity, neuronal overexcitation or CNS damage. It will also address cellular network dynamics and molecular mechanisms of hippocampal plasticity and homeostasis. Experiments will be performed in organotypic hippocampal slice cultures. The goal is to learn various techniques to study hippocampal plasticity, including optogenetic and pharmacological manipulation of cellular activity, functional live cell imaging, immunocytochemistry, patch clamp electrophysiology, and methods in molecular biology. Students will learn appropriate techniques in the context of their own project, perform their own experiments under instruction, and present their results in a seminar. The weekly seminars will train students to work with scientific publications, multiple models and methods, and discuss the translation of results to clinical applications in the field of neurological diseases using examples and original papers.</p>									
Learning results / Competence objectives									
The students have knowledge in the basics of electrophysiological and anatomical work, in the preparation of organotypic slice cultures and in confocal microscopy. They are able to work on scientific questions based on relevant literature.									
Requirements for participating									
none									
Helpful previous knowledge									
Experience working experimentally in a "wet lab".									
Assignment of course (program/department)					MSc Interdisciplinary Neuroscience / FB 15				
Suitable for other study programs									
Times offered									
in the summer semester									
Duration									
1 Semester (block course over 4-6 weeks)									
Person in charge									
Dr. Tijana Radic, Dr. Tassilo Jungentz, Prof. Carlos Bas Orth, Prof. Thomas Deller									
Semester-related proofs									
Proof of participation					regular participation				
Study achievements					Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature, 1 work report (if the final module exam is a written exam)				
Teaching forms									
Practical, seminar									
Tuition language									
English									
Module exam					Form / duration / content (if applicable)				
Module final exam consisting of					Practical: graded protocol (10-30 pages) oder written exam (45 minutes)				
Plasticity in the Hippocampus – Morphology, Physiology, and Clinical Relevance	Form of teaching	SWH	CP	Semester					
				1	2	3	4		
					X				
Practical	P	10	10						
Seminar	S	1	1						
Sum		11	11						

INS B-6 Experimental Brain Tumor Therapy	Experimentelle Therapie von Hirntumoren	Elective course		11 CP = 330 h		11 CP	
				Contact study 11 SWH / 165 h	Self study 165 h		
Content							
In the practical course, experiments are performed using the following methodological approaches: Cultivation of brain tumor cells (adherent culture and tumor spheroids), application of different cancer drugs in vitro, determination of cell death and cell viability, assays for monitoring autophagy and the autophagic flux, FACS techniques, visualization of proteins by immunofluorescence microscopy and by western blot;							
Learning results / Competence objectives							
Students will acquire experience in current cell biological and molecular biological techniques in experimental neuroscience. They will obtain knowledge on data analysis and interpretation, and on mechanistic aspects of drug-induced tumor cell killing. They will also learn how to address scientific questions in the context of relevant literature.							
Requirements for participating							
none							
Helpful previous knowledge							
basic knowledge in cell culturing							
Assignment of course (program/department)				MSc Interdisciplinary Neuroscience / FB 15			
Suitable for other study programs							
Times offered							
in the summer semester							
Duration							
1 Semester (block course over 4 weeks)							
Person in charge							
Prof. Donat Kögel							
Semester-related proofs							
Proof of participation				regular participation			
Study achievements				Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature			
Teaching forms							
Practical, seminar							
Tuition language							
English							
Module exam				Form / duration / content (if applicable)			
Module final exam consisting of:				Practical: graded protocol (10-30 pages)			
Brain Damage and Neuroprotection	Form of teaching	SWH	CP	Semester			
				1	2	3	4
	Practical	P	10	10	X		
	Seminar	S	1	1			
Sum		11	11				

INS B-8 Clinical Neuroimaging	Klinisches Neuroimaging	Elective course			11 CP = 330 h			
					Contact study 11 SWH / 165 h		Self study 165 h	
Content								
<p>The practical course introduces the basics of image analysis, image interpretation and the preparation of findings in examinations of the CNS (cerebral and spinal) with imaging procedures in neuroradiology. The following procedures are used: magnetic resonance imaging (MRI) of the head and spine, computed tomography (CT) of the skull and spine, digital cerebral and spinal subtraction angiography (DSA), as well as introduction to the basics of interventional neuroradiological procedures.</p> <p>In addition, the practical course teaches theoretical / physical principles of the individual examination modalities in neuroradiology with emphasis on magnetic resonance imaging. The following will be covered: physical principles of MRI / image formation, sequences and sequence parameters of MRI, diffusion and perfusion weighted MRI imaging, tractography (fiber tracking), functional MRI (fMRI), nuclear spin spectroscopic examinations (MR spectroscopy).</p> <p>Depending on the project, (co-) authorship in a publication may also be possible and encouraged.</p>								
Learning results / Competence objectives								
<p>The students have knowledge of neuroanatomy (cerebral/spinal) as well as of the cranial skeleton and the spine and basic knowledge of the relevant neurological diseases. They also have basic knowledge of the indication of neuroradiological examinations, image formation and image interpretation as well as the assignment to individual typical clinical pictures.</p> <p>They are able to deal with scientific questions based on relevant literature.</p>								
Requirements for participating								
none								
Helpful previous knowledge								
Basic knowledge of German language								
Assignment of course (program/department)					MSc Interdisciplinary Neuroscience / FB 15			
Suitable for other study programs								
Times offered								
Each semester								
Duration								
1 Semester (block course over 4-6 weeks)								
Person in charge								
Prof. Weidauer, Prof. Hattingen, Dr. Polkowski								
Semester-related proofs								
Proof of participation					regular participation			
Study achievements					Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature			
Teaching forms								
Practical, seminar								
Tuition language								
English								
Module exam					Form / duration / content (if applicable)			
Module final exam consisting of:					Practical: graded protocol (10-30 pages)			
Clinical Neuroimaging	Form of teaching	SWH	CP	Semester				
				1	2	3	4	
				X				
				Practical	P	10	10	
Seminar	S	1	1					
Sum		11	11					

INS B-9 Clinical Auditory Neuroscience	Klinische Auditorische Neurowissenschaften	Elective course			11 CP = 330 h			
					Contact study 11 SWH / 165 h		Self study 165 h	
Content								
<p>The practical provides knowledge of the most important objective and subjective audiometric measurement techniques for the differential diagnosis of hearing disorders. Sound and speech audiometry as well as the application of otoacoustic emissions, impedance audiometry, and different techniques of brainstem audiometry (BERA, CERA, ASSR, MMN) are used. The treatment of hearing impairment with implantable hearing aids and cochlear implants is demonstrated in practical use. The use of intraoperative electrophysiological conduction techniques will be demonstrated.</p> <p>An own current project is determined within the scope of the course, which is to be worked on by the students under guidance. The results are to be presented in a lecture. Another lecture is scheduled to present original work in the field of electrophysiological stimulation/derivation of auditory potentials. Main topics are: Psychoacoustic measurements of auditory perception during electrical stimulation by cochlear implants, investigation of new rejection techniques for frequency-specific diagnosis of hearing disorders, creation of software protocols for data acquisition and stimulus generation.</p>								
Learning results / Competence objectives								
The students are able to perform psychoacoustic experiments and measurement of acoustically evoked potentials, and have basic knowledge of audiometry as well as basic knowledge of the function of hearing implants. They are able to work on scientific questions based on relevant literature.								
Requirements for participating								
none								
Helpful previous knowledge								
none								
Assignment of course (program/department)					MSc Interdisciplinary Neuroscience / FB 15			
Suitable for other study programs								
Times offered					Each semester			
Duration					1 Semester (block course over 4 weeks)			
Person in charge					Prof. Uwe Baumann			
Semester-related proofs								
Proof of participation					regular participation			
Study achievements					Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature			
Teaching forms					Practical, seminar			
Tuition language					English			
Module exam					Form / duration / content (if applicable)			
Module final exam consisting of:					Practical: graded protocol (10-30 pages)			
Clinical Auditory Neuroscience	Form of teaching	SWH	CP	Semester				
				1	2	3	4	
	Practical	P	10	10	X			
	Seminar	S	1	1				
Sum		11	11					

INS B-10 Experimental and Translational Psychiatry	Experimentelle und translationale Psychiatrie	Elective course			11 CP (insg.) = 330 h			
					Contact study 11 SWH / 165 h		Self study 165 h	
Content								
The goal of this practical is to introduce students to a range of experimental techniques for the study of psychiatric disorders. In doing so, they will be able to participate in a wide range of translational projects. These include cell culture techniques for functional evaluation of candidate genes previously identified in large cohorts and behavioral analysis of mice that have been pharmacologically treated or genetically modified (e.g., viral gene transfer, gene knockout). Following such experiments, a series of immunohistochemical and histological characterizations will be performed. In addition, there is an opportunity to gain insight into neural imaging techniques (e.g., functional magnetic resonance imaging, electroencephalography, and magnetoencephalography) for detecting abnormalities of neural processing and coordination in psychiatric disorders.								
Learning results / Competence objectives								
Students will have knowledge of a range of commonly used molecular and behavioral methods for analyzing psychiatric disorders and will be able to design their own experiments using the knowledge thus acquired. In addition, a series of seminars (and optional participation in case presentations) will provide students with basic knowledge regarding these disorders, particularly affective disorders, anxiety disorders, schizophrenia, and attention-deficit/hyperactivity disorder.								
Requirements for participating								
none								
Helpful previous knowledge								
none								
Assignment of course (program/department)					MSc Interdisciplinary Neuroscience / FB 15			
Suitable for other study programs								
Times offered					Each semester			
Duration					1 Semester (block course over 6 weeks)			
Person in charge					Prof. David Slattery			
Semester-related proofs								
Proof of participation					regular participation			
Study achievements					Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature			
Teaching forms					Practical, seminar			
Tuition language					English			
Module exam					Form / duration / content (if applicable)			
Module final exam consisting of:					Practical: graded protocol (10-30 pages)			
Experimental and Translational Psychiatry	Form of teaching	SWH	CP	Semester				
				1	2	3	4	
				X				
Practical	P	10	10					
Seminar	S	1	1					
Sum		11	11					

INS B-11 Neurobiological human cell models	Neurobiologische humane Zellmodelle	Elective course			11 CP = 330 h			
					Contact study 11 SWH / 165 h		Self study 165 h	
Content								
<p>The goal of this practical is for students to learn the basics of experimental techniques for studying genetic variants in human neural progenitor cells and to be able to apply them independently. These techniques include cell culture methods for culturing and neuronal differentiation, genomic editing of sequences (CRISPR/Cas9 techniques), and fluorescence and luciferase assays for functional analysis. Specifically, techniques for the production of cerebral organoids and iNeurons can be learned.</p> <p>Following genetic modification of cell lines, a series of immunohistochemical, functional and morphological assays will be applied and evaluated. In addition, insights into the basics of transcriptome and genome analysis can be gained.</p>								
Learning results / Competence objectives								
<p>The students have knowledge of the current molecular and cell biological methods for the analysis of human neurons and can plan and perform their own experiments with the knowledge thus acquired. At the end, students will have the necessary know-how to use human neural progenitor cells, or human stem cells and their derivatives as an effective model for psychiatric disorders. In addition, in a series of seminars, also in close collaboration with adult psychiatry, students are given the basic knowledge regarding underlying disorders such as autism spectrum disorder, attention deficit/hyperactivity syndrome, or social behavior disorder.</p>								
Requirements for participating								
none								
Helpful previous knowledge								
Cell culture experience								
Assignment of course (program/department)					MSc Interdisciplinary Neuroscience / FB 15			
Suitable for other study programs								
Times offered								
Each semester								
Duration								
1 Semester (block course over 6 weeks)								
Person in charge								
Dr. Denise Haslinger								
Semester-related proofs								
Proof of participation								
regular participation								
Study achievements								
Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature								
Teaching forms								
Practical, seminar								
Tuition language								
English								
Module exam					Form / duration / content (if applicable)			
Module final exam consisting of:					Practical: graded protocol (10-30 pages)			
Neurobiological human cell models	Form of teaching	SWH	CP	Semester				
				1	2	3	4	
Practical	P	10	10	X	X			
Seminar	S	1	1					
Sum		11	11					

INS B-12 Neuroimaging- Biomarkers in Psychiatry	Neuroimaging Biomarkers in in der Psychiatrie	Elective course			11 CP (insg.) = 330 h				11 CP
					Contact study 11 SWH / 165 h		Self study 165 h		
Content									
The goal of the practical is to provide students with insight into the analysis of magnetic resonance imaging (MRI) data of the human brain. This will include analysis of MRI data from individuals with autism spectrum disorder (ASD) compared to control groups in terms of different anatomical features of the human brain, such as cortex thickness, surface area, or gyrification index. Statistical analyses are performed based on regions of the brain defined based on a brain atlas. Common programs and software for the analysis of MRI data are used. There is also an opportunity to gain insight into neural imaging techniques and data management. Students will also gain knowledge of how structural MRI data is used to determine differences in neuroanatomy of psychiatric disorders such as ASD.									
Learning results / Competence objectives									
Students will be able to use common programs and software to analyze MRI data and will have acquired basic knowledge of Autism Spectrum Disorder and other psychiatric disorders as appropriate. They are able to perform their own analyses of a data set in the form of statistical evaluations using R and/or Matlab, visualize and present the results.									
Requirements for participating									
none									
Helpful previous knowledge									
Basic knowledge in MatLab and R									
Assignment of course (program/department)					MSc Interdisciplinary Neuroscience / FB 16				
Suitable for other study programs									
Times offered					each semester				
Duration					1 Semester (block course over 6 weeks)				
Person in charge					Prof. Christine Ecker				
Semester-related proofs									
Proof of participation					regular participation				
Study achievements					Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature				
Teaching forms					Practical, seminar				
Tuition language					English				
Module exam					Form / duration / content (if applicable)				
Module final exam consisting of:					Practical: graded protocol (10-30 pages)				
	Neuroimaging Biomarkers in Psychiatry	Form of teaching	SWH	CP	Semester				
					1	2	3	4	
	Practical	P	10	10	X	X			
	Seminar	S	1	1					
	Sum		11	11					

INS B-13 Translational Neuro- Oncology Research	Translationale Neuro- Onkologie-Forschung	Elective course	11 CP = 330 h		11 CP
			Contact study 11 SWH / 165 h	Self-study 165 h	
Content					
<p>During this practical, students have the opportunity to be involved in ongoing research projects in the field of translational, neuro-oncological research. This includes both participation in routine laboratory workflows and the development of an independent scientific project within the conceptual orientation of the "Translational Neuro-Oncology" working group.</p> <p>The routine laboratory processes include the generation of 3D cultures, so-called tumor organoids, based on surgical tissue from patients suffering from brain tumors. These organoids are routinely characterized on several molecular levels to ensure the preservation of the histopathological, (epi-)genetic and transcriptional features of the primary parental tumours. We are also using these tumor organoids as a preclinical model for our exploratory drug profiling workflow to eventually improve personalized medicine approaches and therapeutic options for cancer patients. Furthermore, we are generating patient-derived orthotopic xenografts (PDOXs) by intracortical implantation of the tumor organoids into immunodeficient mice. These PDOXs enable long-term propagation of patient tumors and are clinically relevant patient avatars for precision oncology studies.</p> <p>Additionally, we have a strong interest in recapitulating early brain tumor evolution by sequential oncogenic editing of the genome of human induced pluripotent stem cells (hiPSCs). Cerebral organoids, so-called "mini-brains", are used to grow hiPSC-derived brain tumors within a physiologically relevant 3D brain microenvironment. This model allows us to study the impact of specific mutations on tumor metabolism and to test new treatment strategies ex vivo.</p>					
Learning results / Competence objectives					
<p>After completing the internship, the students have gained theoretical knowledge and hands-on experience in the field of neuro- and cellular molecular biology including basic techniques of cellular model system development and, to a limited extent, of applied molecular biology. The students will be able to describe their purposes and apply them in practice.</p> <p>Basic techniques include the generation of brain tumor organoids from fresh tumor tissue, the cultivation of human brain tumor cell lines, working with hiPSCs and associated cerebral organoid cultures, and the practical use of various cellular assays. The standard techniques, taught in this internship, include the quantification of invasive cells, the measurement of proliferation behavior, the detection of tumorigenicity via colony formation and survival, as well as live cell imaging of 2D and 3D cell cultures and compound screenings in a medium-throughput manner. Array-based DNA methylation analysis, CRISPR-Cas based (epi)genome modification and the associated basic molecular biological methods and bio-informatic analyzes represent more specialized methods depending on the particular scientific project and are not necessarily always taught in this practical. Students will work on their own scientific project with the help and guidance of experienced scientists. They will be able to independently develop a patient-oriented, translational research hypothesis and how to design experiments to validate it. The students have acquired skills and knowledge in order to deal with advanced topics in cell, molecular and neurobiology as well as related disciplines, and will be able to evolve them independently.</p>					
Requirements for participating					
None					
Helpful previous knowledge:					
Experience with sterile cultivation of cell lines is an advantage					
Assignment of course (program/department)			MSC Interdisciplinary Neuroscience / FB 15		
Suitable for other study programs					
Times offered			Each semester		
Duration			1 Semester (block course 6 weeks)		
Person in charge			Dr. Ann-Christin Hau		
Semester-related proofs					
	Proof of participation		Regular participation		
	Study achievements		Seminar: 1 seminar talk (20 minutes) on literature, 1 seminar talk (20 minutes) on the research project		
Teaching forms			Practical, seminar		
Tuition language			English and/or German		
Module exam			Form / duration / content (if applicable)		

Module final exam consisting of:				Practical: Graded protocol (10-30 pages)			
Translational Neuro-Oncology Research	Teaching forms	SWH	CP	Semester			
				1	2	3	4
Practical	P	10	10	X	X		
Seminar	S	1	1				
Sum		11	11				

INS B-14 Computation translational Psychiatry	Computergestützte translationale Psychiatrie	Elective course			11 CP = 330 h				11 CP
					Contact study 11 SWH / 165 h		Self study 165 h		
Content									
<p>This course will focus on the computational aspects of neuropsychiatric research, mainly on performing large scale data analyses on data from patients including psychiatric diagnoses and traits and genomics. This includes working on high performance computational clusters and data-science environments, applying machine-learning algorithms and using software and algorithms for processing and analysing genetic datasets. Depending on the current demands in the lab copy-number variations, polygenetic (risk) scores and rare genetic variations in large genetic samples will be identified and tested for their association with psychiatric phenotypes will be identified.</p>									
Learning results / Competence objectives									
<p>The students will be able to autonomously work with code, writing their own analytical pipelines and get a better understanding about machine learning. The participants will work on specified research tasks based on the available datasets. In a series of seminars students will gain a better understanding on the psychiatric phenotypes and the currently ongoing research. Specifically basic knowledge about underlying disorders such as autism spectrum disorder, attention deficit/hyperactivity syndrome, or social behaviour disorder will be achieved.,</p>									
Requirements for participating									
None; affinity for coding or data is helpful									
Helpful previous knowledge									
Any programming experience (R, python, C++, Matlab etc)									
Assignment of course (program/department)					MSc Interdisciplinary Neuroscience / FB 15				
Suitable for other study programs									
Times offered					Each semester				
Duration					1 Semester (block course over 6 weeks)				
Person in charge					Prof. Andreas Chiochetti				
Semester-related proofs									
Proof of participation					regular participation				
Study achievements					Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature or algorithm				
Teaching forms					Practical, seminar				
Tuition language					English				
Module exam					Form / duration / content (if applicable)				
Module final exam consisting of:					Practical: graded protocol (10-30 pages) or programming task (1-30 pages)				
Neurobiological human cell models	Form of teaching		SWH	CP	Semester				
					1	2	3	4	
	Practical	P	10	10	X	X			
	Seminar	S	1	1					
Sum		11	11						

INS B-15 Psychotherapy research in acute psychiatry	Psychotherapie-forschung in der Akutpsychiatrie	Elective course		11 CP (insg.) = 330 h		11 CP					
				Contact study 11 SWH / 165 h	Self study 165 h						
Content											
<p>The aim of the course is to impart practical knowledge of psychotherapy research in acute psychiatry. Students will gain insights into different methodological techniques (e.g., functional magnetic resonance imaging, virtual reality) used in psychotherapy projects. The course also includes the assessment and analysis of fMRI or/and virtual reality data sets.</p> <p>In addition students will have the opportunity to take part in diagnostic sessions and to experience practical sessions in individual and group therapy settings as part of research projects.</p>											
Learning results / Competence objectives											
<p>The students will know how psychotherapy research projects are structured, which priorities are set and which methods are used. They will be able to analyse fMRI or/and virtual reality data and to plan an experiment accordingly. They have basic knowledge of psychiatric disorders. They are familiar with approaches to scientific questions and literature work and prepare scientific papers and presentations.</p>											
Requirements for participating											
none											
Helpful previous knowledge											
none											
Assignment of course (program/department)				MSc Interdisciplinary Neuroscience / FB 15							
Suitable for other study programs											
Times offered				in the winter semester							
Duration				1 Semester (block course over 6 weeks)							
Person in charge				apl. Prof. Viola Oertel							
Semester-related proofs											
Proof of participation				regular participation							
Study achievements				Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature							
Teaching forms				Practical, seminar							
Tuition language				English							
Module exam				Form / duration / content (if applicable)							
Module final exam consisting of:				Practical: graded protocol (10-30 pages)							
	Psychotherapy research in acute psychiatry	Form of teaching	SWH	CP	Semester						
					1	2	3	4			
					Practical	P	10	10	X		
					Seminar	S	1	1			
Sum		11	11								

INS B-16 Machine Learning in Neurology	Machinelles Lernen in der Neurologie	Elective course	11 CP = 330 h				11 CP	
			Contact study 11 SWH / 165 h		Self study 165 h			
Content								
<p>Machine Learning is a key driver of innovation in medical research and clinical practice. As part of the Department for Neurology at Goethe University Hospital, the Rosenow lab studies epilepsy in both animal models and human patients. In our research and clinical work we produce large volumes of multi-modal data that require advanced machine learning techniques for analysis.</p> <p>In this course, students will collaborate closely with lab members to design and execute a computational research project. These projects may address fundamental scientific questions or aim to enhance clinical workflows and patient outcomes. Throughout the course, students will receive expert guidance from neurologists and data scientists, ensuring a comprehensive learning experience that bridges medicine and Machine Learning.</p>								
Learning results / Competence objectives								
<p>Students will learn to apply advanced machine learning techniques to analyze multi-modal neurological data, design and execute computational research projects, collaborate effectively with interdisciplinary teams, and communicate their findings clearly to diverse audiences. They will also develop an understanding of the ethical considerations and data privacy issues involved in AI-driven medical research, ensuring responsible and impactful use of artificial intelligence in clinical neuroscience.</p>								
Requirements for participating								
Helpful previous knowledge								
Programming skills (Python)								
Assignment of course (program/department)			Interdisciplinary Neuroscience / FB 15					
Suitable for other study programs								
Times offered			Each semester					
Duration			1 Semester (block course over 4 weeks)					
Person in charge			Prof. Dr. Felix Rosenow, Dr. Tristan Stöber					
Semester-related proofs								
Proof of participation			regular participation					
Study achievements			Seminar: 1 talk (20 minutes) on the results of own experiments and on current literature					
Teaching forms			Practical, seminar					
Tuition language			English					
Module exam			Form / duration / content (if applicable)					
Module final exam consisting of:			Practical: graded protocol (10-30 pages)					
	Machine Learning in Neurology	Form of teaching	SWH	CP	Semester			
					1	2	3	4
	Practical	P	10	10	X	X		
	Seminar	S	1	1				
	Sum		11	11				

Optional courses in elective C: Cognitive and Theoretical Neuroscience

INS C-0 External Elective Course “Cognitive and theoretical Neuroscience”	Externe Wahlpflichtveranstaltung „Kognitive und theoretische Neurowissenschaften“	Elective course	11 CP = 330 h				11 CP	
			Contact study 11 SWH / 165 h	Self study 165 h				
Content								
The course teaches basic methods and techniques in the field of cognitive or/and theoretical neuroscience. Students work on their own current projects under supervision and present the results in the form of a seminar presentation. The course can be offered by departments of Goethe University, by other universities in Germany and abroad as well as by non-university research institutions.								
Learning results / Competence objectives								
Students gain knowledge in conducting neuroscientific investigations in the field of cognitive neuroscience or/and knowledge in computer-based modeling of neurobiological questions. They are able to address scientific questions based on relevant literature.								
Requirements for participating								
none								
Helpful previous knowledge								
none								
Assignment of course (program/department)			MSc Interdisciplinary Neuroscience / FB 15					
Suitable for other study programs								
Depending on provider								
Times offered								
Depending on provider								
Duration								
Depending on provider								
Person in charge								
Head of study program								
Semester-related proofs								
Proof of participation								
regular participation								
Study achievements								
The regulations of the provider of the elective course are applied. If the provider does not request any study proofs, a working report must be written, and talks have to be given on both, results of own experiments (20 minutes) and topical literature (20 minutes).								
Teaching forms								
Practical, seminar								
Tuition language								
Depending on provider								
Module exam								
Form / duration / content (if applicable)								
The regulations of the provider of the elective course are applied. If grading is not scheduled by the provider, the module completion exam shows a graded protocol (10-30 pages).								
External elective course “Cognitive and theoretical Neuroscience”		Form of teaching	SWH	CP	Semester			
					1	2	3	4
Practical		P	10	10	X			
Seminar		S	1	1				
Sum			11	11				

INS C-1 Non-Invasive Methods in Human Cognition Research	Nicht-invasive Methoden der Kognitionsforschung am Menschen	Elective course		11 CP = 330 h				11 CP
				Contact study 11 SWH / 165 h	Self study 165 h			
Content								
The practical course teaches basic techniques of non-invasive research of human cognitive functions. This includes behavioral studies or measurements of brain activity using electro/magnetoencephalography (EEG/MEG) or functional magnetic resonance imaging (fMRI). After a theoretical introduction to the methodological principles and the research question, students conduct their own experiments on questions of perception, attention or working memory. They will be made aware of the advantages and disadvantages of the respective research method and learn the basic evaluation steps. The questions to be worked on are based on current projects in the Institute of Medical Psychology.								
Learning results / Competence objectives								
The students have basic knowledge of the design and implementation of cognitive experiments in humans. They are familiar with behavioral or psychophysiological methods (fMRI, EEG, MEG) and are able to address scientific questions based on relevant literature.								
Requirements for participating								
none								
Helpful previous knowledge								
Basic knowledge in cognitive psychology								
Assignment of course (program/department)				MSc Interdisciplinary Neuroscience / FB 15				
Suitable for other study programs								
Times offered				in the summer semester				
Duration				1 Semester (block course over 4 weeks)				
Person in charge				Prof. Jochen Kaiser				
Semester-related proofs								
Proof of participation				regular participation				
Study achievements				Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature				
Teaching forms				Practical, seminar				
Tuition language				English				
Module exam				Form / duration / content (if applicable)				
Module final exam consisting of:				Practical: graded protocol (10-30 pages)				
Non-Invasive Methods in Human Cognition Research	Form of teaching	SWH	CP	Semester				
				1	2	3	4	
	Practical	P	10	10				
	Seminar	S	1	1		X		
Sum		11	11					

INS C-4 Virtual Hippocampus – Introduction to Computational Neuroscience	Virtueller Hippocampus – Einführung in die Computer-Modellierung neuronaler Systeme	Elective course			11 CP (insg.) = 330 h			
					Contact study 11 SWH / 165 h		Self study 165 h	
Content								
The practical provides an overview of computational modeling of neural systems with particular emphasis on modeling of hippocampal neurons and networks. The course is an introduction to computational neuroscience, which studies the brain at different levels (from synapses and dendrites to neurons and neural circuits) using computer models. The goal is to learn standard techniques for the formation, management, and use of models that are closely linked to experimental data, especially those involving hippocampal cells with complex anatomical and biophysical properties. Planned computational experiments (in silico) include large-scale network simulations in biophysically realistic and data-driven models of the hippocampus, and single-cell simulations in morphologically reconstructed neurons in the hippocampus. The relevance of computational models to understanding brain function will be discussed using examples from recent research articles.								
Learning results / Competence objectives								
The students have basic knowledge of compartment and network modeling. They can use NEURON (software for biologically motivated simulations of neurons and networks of neurons, http://www.neuron.yale.edu/neuron) and are able to address scientific questions based on relevant literature.								
Requirements for participating								
None								
Helpful previous knowledge								
Programming experience								
Assignment of course (program/department)					MSc Interdisciplinary Neuroscience / FB15			
Suitable for other study programs								
Times offered								
Each semester								
Duration								
1 Semester (block course over 4 weeks)								
Person in charge								
Prof. Dr. Peter Jedlicka								
Semester-related proofs								
Proof of participation					regular participation			
Study achievements					Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature			
Teaching forms								
Practical, seminar								
Tuition language								
English								
Module exam					Form / duration / content (if applicable)			
Module final exam consisting of:					Practical: graded protocol (10-30 pages) or programming task (1-30 pages)			
Virtual Hippocampus – Introduction to Computational Neuroscience	Form of teaching	SWH	CP	Semester				
				1	2	3	4	
	Practical	P	10	10	X			
	Seminar	S	1	1				
Sum		11	11					

INS C-7 Cognitive Neuroscience – Higher Cognitive Functions	Höhere kognitive Funktionen	Elective course			11 CP (insg.) = 330 h			
					Contact study 11 SWH / 165 h		Self study 165 h	
Content								
<p>The practical gives an insight into the research of the neuronal basis of higher cognitive performance on the basis of current projects in the area of working memory, language processing, movement perception or executive control, as well as partly also their development in children of primary school age.</p> <p>Depending on the current research projects, the practical course enables the students to participate in neurocognitive studies (fNIRS, fMRI, EEG, behavioral measurements) as well as in the field of data processing of neurophysiological data. The aim is to learn the theoretical background of the projects as well as the collection, analysis and interpretation of the corresponding data. In doing so, students are encouraged to work independently and to carry out parts of the study themselves.</p>								
Learning results / Competence objectives								
Students are familiar with cognitive and neurocognitive models as well as experimental psychological methods, and are familiar with the basics of collecting and analyzing neurocognitive data. They are able to address scientific questions based on relevant literature.								
Requirements for participating								
None								
Helpful previous knowledge								
Basic knowledge in Matlab, Python oder other programming skills								
Assignment of course (program/department)					MSc Interdisciplinary Neuroscience / FB15			
Suitable for other study programs								
Times offered								
Each semester								
Duration								
1 Semester (block course over 4 weeks)								
Person in charge								
Prof. Christian Fiebach, Dr. Alessandro Tavano								
Semester-related proofs								
Proof of participation								
regular participation								
Study achievements								
Seminar: 1 talk (20 minutes) on the results of own experiments or on current literature								
Teaching forms								
Practical, seminar								
Tuition language								
English								
Module exam					Form / duration / content (if applicable)			
Module final exam consisting of:					Practical: graded protocol (10-30 pages)			
Cognitive Neuroscience – Higher Cognitive Functions	Form of teaching	SWH	CP	Semester				
				1	2	3	4	
Practical	P	10	10		X			
Seminar	S	1	1					
Sum		11	11					

INS C-8 Systems Neuroscience – Sensorimotor and cognitive networks	Sensomotorische und kognitionstragende Netzwerke	Elective course			11 CP (insg.) = 330 h			
					Contact study 11 SWH / 165 h		Self study 165 h	
Content								
<p>The practical introduces students to neural networks (cortical and subcortical) that are important for cognitive and sensorimotor processing. One focus is on the study of hemispheric lateralization, particularly with respect to language processing and motor control of hand movements. Another part of the group is concerned with the translation of the findings into immediate patient care, e.g. using closed-loop control.</p> <p>Healthy volunteers and patients are studied with respect to their behavioral responses and using electro- and magneto-encephalographic techniques. In addition, electrocorticographic data are collected from patients during brain surgery or stereo-EEG in epilepsy patients.</p> <p>Students become familiar with the methods used and acquire knowledge of the organizing principles of neuronal networks. Students will be assigned to a current project, will participate in data collection and/or analysis, and will attend weekly seminars.</p>								
Learning results / Competence objectives								
<p>Students are familiar with the collection and evaluation of data sets from imaging procedures or neurophysiological experiments on healthy control subjects and patients and are able to address scientific questions based on relevant literature.</p>								
Requirements for participating								
None								
Helpful previous knowledge								
Programming knowledge in Python and/or Matlab								
Assignment of course (program/department)					MSc Interdisciplinary Neuroscience / FB15			
Suitable for other study programs								
Times offered								
Each semester								
Duration								
1 Semester (Block course over 4-6 weeks)								
Person in charge								
PD Dr. Christian Kell								
Semester-related proofs								
Proof of participation					regular participation			
Study achievements					Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature			
Teaching forms								
Practical, seminar								
Tuition language								
English								
Module exam					Form / duration / content (if applicable)			
Module final exam consisting of:					Practical: graded protocol (10-30 pages)			
Systems Neuroscience – Sensorimotor and cognitive networks	Form of teaching	SWH	CP	Semester				
				1	2	3	4	
	Practical	P	10	10	X			
	Seminar	S	1	1				
Sum		11	11					

INS C-10 Computational neuroanatomy – quantitative analysis and modelling	Neuroanatomische Modellierung	Elective course			11 CP (insg.) = 330 h				11 CP
					Contact study 11 SWH / 165 h		Self study 165 h		
Content									
Based on neuroanatomical data obtained thanks to state-of-the-art developments in microscopy technology and neurogenetic techniques, models are created with a focus on dendritic and axonal interactions. Image processing techniques and quantitative analysis methods are applied in the computer to digitize anatomical components from the microscopy images. The digital form then allows measured geometric properties to be assigned biophysical principles. For example, time-lapse methods can be used to observe and measure the precise assembly of neurons into circuits during development. The structure of dendrites and axons then allows conclusions to be drawn about the interconnection and functioning of circuits in the nervous system. The laws learned from this are then tested in simple quantitative models. This course on computational neuroanatomy thus bridges the gap between data analysis and the design of a scientific theory using simple computer models.									
Learning results / Competence objectives									
The participants are able to deal scientifically with biological data using quantitative methods (incl. use of Matlab). Furthermore, they will be able to create simple models that are strongly related to the biological data. The projects will be approaches from current research topics of the group.									
Requirements for participating									
None									
Helpful previous knowledge									
Programming skills (e.g. Python, Matlab, Java)									
Assignment of course (program/department)					MSc Interdisciplinary Neuroscience / FB15				
Suitable for other study programs									
Times offered									
Each semester									
Duration									
1 Semester (block course over 4 weeks)									
Person in charge									
Dr. Hermann Cuntz									
Semester-related proofs									
Proof of participation					regular participation				
Study achievements					Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature				
Teaching forms									
Practical, seminar									
Tuition language									
English									
Module exam					Form / duration / content (if applicable)				
Module final exam consisting of:					Practical: graded protocol (10-30 pages) or programming task (1-30 pages)				
Computational neuroanatomy – quantitative analysis and modelling	Form of teaching	SWH	CP	Semester					
				1	2	3	4		
	Practical	P	10	10	X				
	Seminar	S	1	1					
Sum		11	11						

INS C-11 Computational Modeling of Neuronal Plasticity	Computer-Modellierung neuronaler Plastizität	Elective course		11 CP (insg.) = 330 h		11 CP	
				Contact study 11 SWH / 165 h	Self study 165 h		
Content							
The practical provides an introduction to the development and implementation of computational models of neural networks and the modeling of neural plasticity mechanisms. The course is a hands-on introduction to core computational neuroscience methods that use computational models to study the workings of the brain at various levels. Standard neuron models and network architectures are programmed and analyzed by the students themselves. The focus is on the role of plasticity mechanisms, their influence on network dynamics, and their role in learning processes. The possibilities and limitations of computer models for understanding brain function are discussed using examples from the literature.							
Learning results / Competence objectives							
The students have knowledge in programming computer models of neuron networks, as well as of different plasticity mechanisms and learning processes. They are able to work on a scientific problem against the background of relevant literature.							
Requirements for participating							
Please consult with the person in charge before applying regarding prior experience							
Helpful previous knowledge							
Programming skills in at least one programming language (e.g., Python, Matlab, Java). Background in a quantitative discipline (e.g., physics, mathematics, computer science, or engineering). Basic knowledge of linear algebra, probability, differential equations, numerical methods.							
Assignment of course (program/department)				MSc Interdisciplinary Neuroscience / FB15			
Suitable for other study programs							
Times offered				Each semester			
Duration				1 Semester (block course over 4 weeks)			
Person in charge				Prof. Dr. Jochen Triesch			
Semester-related proofs							
Proof of participation				regular participation			
Study achievements				Seminar: 1 talk (20 minutes) on the results of own experiments			
Teaching forms				Practical, seminar			
Tuition language				English			
Module exam				Form / duration / content (if applicable)			
Module final exam consisting of: :				Practical: graded protocol (10-30 pages) or programming task (1-30 pages)			
Computational Modeling of Neuronal Plasticity	Form of teaching	SWH	CP	Semester			
				1	2	3	4
Practical	P	10	10		X		
Seminar	S	1	1				
Sum		11	11				

INS C-15 Developmental cognitive neuroscience	Neurokognitive Entwicklung	Elective course		11 CP = 330 h				11 CP
				Contact study 11 SWH / 165 h		Self study 165 h		
Content								
<p>Our brain is highly plastic and undergoes dynamic changes across the lifespan. These developmental changes are reflected in modifications of cognitive functions, such as learning and memory. In our lab, we are interested in how the human brain and cognitive systems develop throughout the lifespan, particularly in how age-related neurocognitive changes influence the way we learn and extract regularities from the environment and our ability to create memories of unique experiences.</p> <p>For this, we conduct experiments in which we test participants of different age groups, using cognitive tasks designed to tap into specific processes involved in learning and memory.</p> <p>Depending on the stage of the experiment that you will work on, you may get experience in programming cognitive tasks, Matlab/Python/R programming, processing of behavioural/neuroimaging data, and/or conducting statistical/computational model analyses.</p>								
Learning results / Competence objectives								
<p>Students will be familiar with various techniques used to collect experimental human data: cognitive tasks to collect behavioral data from participants, neuroimaging data while participants are performing tasks, and/or computer modeling of participant data. In addition, students will be able to design and program cognitive tasks, and have learned various methods for data analysis, for which they will use Matlab/Python/R programming. Students have worked in an international environment and are able to present and communicate their results in English.</p>								
Requirements for participating								
none								
Helpful previous knowledge								
none								
Assignment of course (program/department)				MSc Interdisciplinary Neuroscience / FB 15				
Suitable for other study programs								
Times offered				Each semester				
Duration				1 Semester (Block course over 4 weeks full-day, or 8 weeks half-day)				
Person in charge				Prof. Dr. Yee Lee Shing				
Semester-related proofs								
Proof of participation				regular participation				
Study achievements				Seminar: 1 talk (20 minutes) on the results of own experiments and on current literature				
Teaching forms				Practical, seminar				
Tuition language				English				
Module exam				Form / duration / content (if applicable)				
Module final exam consisting of:				Practical: graded protocol (10-30 pages)				
Developmental cognitive neuroscience	Form of teaching	SWH	CP	Semester				
				1	2	3	4	
	Practical	P	10	10				
	Seminar	S	1	1	X	X		
Sum		11	11					

INS C-16 Cognitive and perceptual processes in the human brain	Kognitive und Wahrnehmungsprozesse im menschlichen Gehirn	Elective course	11 CP = 330 h				11 CP
			Contact study 11 SWH / 165 h		Self study 165 h		
Content							
Our lab studies basic human cognitive processes such as attention and working memory and how these cognitive processes affect our basic perception of the world. Consequently, most of this work uses the human visual system as the basis for such questions because the visual system is well defined and it can be imaged in humans using non-invasive imaging techniques such as fMRI. In this course, students will work with members of the lab to define a research project. Possible research projects could range from designing and programming experiments to collecting behavioral and/or neuroimaging data (EEG or MEG) to using computational techniques to analyze these data. The analysis of fMRI data is also possible.							
Learning results / Competence objectives							
Students are familiar with the many aspects of cognitive neuroscience research. They have learned about both cognition (e.g., attention, working memory, etc.) and the visual system (e.g., retinotopic organization in cortex, tuning properties of early sensory neurons, etc.) and computational approaches (e.g., multivariate analysis, simulations, etc.). They have experience with all techniques used in the laboratory including fMRI, MEG, psychophysics, data analysis, and computational modeling. Students operate in a close and very international environment, with ample opportunity to perfect both their social and scientific communication skills in English.							
Requirements for participating							
Helpful previous knowledge							
Programming skills (Matlab oder Python)							
Assignment of course (program/department)			Interdisciplinary Neuroscience / FB 15				
Suitable for other study programs							
Times offered			Each semester				
Duration			1 Semester (block course over 4 weeks)				
Person in charge			Dr. Rosanne Rademaker				
Semester-related proofs							
Proof of participation			regular participation				
Study achievements			Seminar: 1 talk (20 minutes) on the results of own experiments and on current literature				
Teaching forms			Practical, seminar				
Tuition language			English				
Module exam			Form / duration / content (if applicable)				
Module final exam consisting of:			Practical: graded protocol (10-30 pages)				
Cognitive and perceptual processes in the human brain	Form of teaching	SWH	CP	Semester			
				1	2	3	4
Practical	P	10	10				
Seminar	S	1	1	X	X		
Sum		11	11				

INS C-17 Cognitive and Neural Dynamics (CANDy)	Kognitive und neuronale Dynamik beim Menschen	Elective course		11 CP (insg.) = 330 h				
				Contact study 11 SWH / 165 h		Self study 165 h		11 CP
Content								
<p>This elective course provides research-oriented training in the study of cognitive and neural dynamics in humans using non-invasive electrophysiological methods, with a primary focus on magnetoencephalography (MEG). Students work on supervised research projects embedded in ongoing activities of the MEG Laboratory at the Cooperative Brain Imaging Center (CoBIC), Goethe University Frankfurt. The practical covers experimental design, data acquisition, and data analysis using modern electrophysiological approaches and prepares students for independent Master's thesis work.</p> <p>Project topics may include perception, prediction and timing, sensorimotor synchronization, resting-state brain dynamics, large-scale network connectivity, naturalistic paradigms, and MEG/EEG analysis pipelines.</p>								
Learning results / Competence objectives								
<p>After successful completion of the course, students understand the biophysical principles of signal generation and measurement in human electrophysiology (MEG/EEG) and the strengths and limitations of these methods. They are able to design and implement cognitive experiments for electrophysiological recordings, acquire high-quality data following established standards, and preprocess and analyze MEG/EEG data using modern analysis pipelines, including time–frequency analysis, source reconstruction, and connectivity estimation. Students can critically evaluate and interpret their results in relation to current scientific literature, reflect on methodological choices, and present and document their findings in clear scientific oral and written formats.</p>								
Requirements for participating								
none								
Helpful previous knowledge								
Basic knowledge in neuroscience or cognitive psychology is helpful; programming experience (e.g. MATLAB or Python) is advantageous but not required								
Assignment of course (program/department)				MSc Interdisciplinary Neuroscience / FB 15				
Suitable for other study programs								
Times offered				Each semester				
Duration				1 Semester (block course over 4 weeks)				
Person in charge				Prof. Georgios Michalareas				
Semester-related proofs								
Proof of participation				regular participation				
Study achievements				Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature				
Teaching forms				Practical, seminar				
Tuition language				English				
Module exam				Form / duration / content (if applicable)				
Module final exam consisting of:				Practical: graded protocol (10-30 pages)				
	Cognitive and Neural Dynamics (CANDy)	Form of teaching	SWH	CP	Semester			
					1	2	3	4
	Practical	P	10	10				
	Seminar	S	1	1	X	X		
	Sum		11	11				

Optional courses in elective D: Applied Aspects of Neuroscience

INS D-0 External Elective Course “Applied Aspects of Neuroscience”	Externe Wahlpflichtveranstaltung „Angewandte Aspekte in den Neurowissenschaften“	Elective course	11 CP = 330		11 CP			
			Contact study 11 SWH / 165 h	Self study 165 h				
Content								
This elective course teaches basic methods and techniques in applied areas of neuroscience. Students work on their own projects under supervision and present the results in the form of a seminar presentation. The course can be offered by departments of Goethe University, by other universities in Germany and abroad as well as by non-university research institutions.								
Learning results / Competence objectives								
Students have knowledge in conducting scientific investigations in the field of applied neuroscience. They are able to work on scientific questions against the background of relevant literature.								
Requirements for participating								
none								
Helpful previous knowledge								
none								
Assignment of course (program/department)		Interdisciplinary Neuroscience / FB 15						
Suitable for other study programs								
Times offered		Depending on provider						
Duration		Depending on provider						
Person in charge		Head of study program						
Semester-related proofs								
Proof of participation		regular participation						
Study achievements		The regulations of the provider of the elective course are applied. If the provider does not request any study proofs, a working report must be written, and talks have to be given on both, results of own experiments (20 minutes) and topical literature (20 minutes).						
Teaching forms		Practical, seminar						
Tuition language		Depending on provider						
Module exam		Form / duration / content (if applicable)						
Module final exam consisting of:		The regulations of the provider of the elective course are applied. If grading is not scheduled by the provider, the module completion exam shows a graded protocol (10-30 pages).						
External elective course “Applied Aspects of Neuroscience”	Form of teaching	SWH	CP	Semester				
				1	2	3	4	
	Practical	P	10	10	X			
	Seminar	S	1	1				
Sum		11	11					

INS D-1 Behavioral Biology in Zoos	Verhaltensbiologie in Zoos	Elective course	11 CP (insg.) = 330 h		11 CP		
			Contact study 11 SWH / 165 h	Self study 165 h			
Content							
<p>The course includes the components seminar, practical & excursion. In the seminar, basic aspects and current topics of zoo biology are taught at the beginning using original papers, which are presented by the students in a lecture and then discussed. The excursions to different zoos and the research practical at the Opel Zoo serve to deepen theoretical foundations. Emphasis is placed on ecological, physiological and ethological research contexts. Other topics include: Historical development of zoos, zoos & species conservation, population biology & breeding programs in zoos, animal husbandry (nutrition, behavior, enrichment, community husbandry), veterinary basics, organization and structural development, enclosure design and planning, educational work in zoos. The methodological approach to the practical course components includes, depending on the chosen content focus, classical and modern methods of behavioral research, laboratory activities (microscopic and physiological examinations), imaging techniques (e.g. thermographic measurements with infrared cameras or video analyses with high-speed cameras).</p>							
Learning results / Competence objectives							
<p>The students have knowledge in basic contents of zoo biology (behavioral research in zoos, enrichment, animal husbandry, species protection aspects) and in the application of modern imaging techniques (thermography, high-speed cameras). They have methodological knowledge to conduct behavioral studies and are able to address scientific questions against the background of relevant literature.</p>							
Requirements for participating							
none							
Helpful previous knowledge							
none							
Assignment of course (program/department)			MSc Interdisciplinary Neuroscience / FB15				
Suitable for other study programs							
Times offered			in the summer semester				
Duration			1 Semester (block course over 5 weeks)				
Person in charge			Prof. Paul Dierkes				
Semester-related proofs							
Proof of participation			regular participation				
Study achievements			Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature				
Teaching forms			Seminar, Practical, Excursion				
Tuition language			English				
Module exam			Form / duration / content (if applicable)				
Module final exam consisting of:			Practical: graded protocol (10-30 pages)				
:							
Behavioral Biology in Zoos	Form of teaching	SWH	CP	Semester			
				1	2	3	4
Practical	P	10	10				
Seminar	S	1	1		X		
Exkursion	Ex						
Sum		11	11				

INS-D2 Attention analysis of students' media use via eye-tracking	Eye-tracking Verhaltensanalyse von Studierenden beim Umgang mit diversen Lehr-Medien	Elective course			11 CP = 330 h				11 CP
					Contact study 11 SWH / 165 h		Self-study 165 h		
Content									
<p>The goal of the course is to provide an introduction to the study of attention and cognitive processing during presentation and use of diverse media using modern neuroscience techniques as eye-tracking and retrospective think-alouds (RTA: interviewing subjects for cognitive process data in addition to their eye-tracking data). Depending on the projects in progress at the time of the module, the course will consist of practical tasks in the following methods: Design of experiments, Recording and analysis of eye-tracking data, Recording and analysis of RTAs, Statistical analysis.</p> <p>Students will work in the research group under supervision on their own clearly defined projects embedded in the research focus of the group.</p>									
Learning results / Competence objectives									
Students will have practical and theoretical experience with basic and advanced methods for studying the cognitive and physiological processing of visual information, including eye-tracking, RTAs, and log-data analysis of online searches. Students are familiar with developing, implementation, analyzing, and presenting their own research questions.									
Requirements for participating									
German language skills for subject interviews as well as analysis of eye-tracking data from German texts.									
Helpful previous knowledge:									
Willingness to work with subjects (medical students).									
Assignment of course (program/department)					Interdisciplinary Neuroscience / faculty 15				
Suitable for other courses									
Times offered					Each semester, depending on availability				
Duration					1 semester (block course over 4-6 weeks)				
Person in charge					Dr. Maruschka Weber				
Semester-related proofs									
Proof of participation					Regular participation				
Study achievements					Seminar: 1 seminar talk (20 min) on experimental results, 1 seminar talk (20 min) on current publications				
Teaching forms					Practical, seminar				
Tuition language					English				
Module exam					Form / duration / content (if applicable)				
Module completion exam					Practical: Graded protocol (10-30 pages)				
Attention analysis of students' media use via eye-tracking		Teaching forms	SWH	CP	Semester				
					1	2	3	4	
Practical		P	10	10	X	X			
Seminar		S	1	1					
Sum			11	11					

INS WP Free-choice Studies	Freies Studium	Wahlpflichtmodul	11 CP = 330 h				11 CP	
			Contact study 11 SWH / 165x h		Self study 165x h			
Content								
See description of the selected module								
Courses from all departments of Goethe University can be credited. Courses from the departments of Computer Science and Mathematics (FB12), Biochemistry, Chemistry and Pharmacy (FB14), Biosciences (FB15), Philosophy and Historical Sciences (FB8), Psychology and Sports Sciences (FB5) seem to be particularly suitable. The module can also be from other universities in Germany and abroad. Alternatively, a business or research practical (4-6 weeks) can be carried out in a university or non-university research institution or company.								
Learning results / Competence objectives								
See description of the selected module								
Requirements for participating								
none								
Helpful previous knowledge								
none								
Assignment of module (program / department)					Interdisciplinary Neuroscience / FB 15			
Suitable for other study programs								
Times offered					Depending on provider			
Duration					Depending on provider			
Person in charge					Head of study program			
Semester-related proofs								
Proof of participation					regular participation			
Study achievements					The regulations of the provider of the course are applied. If the provider does not request any study proofs, a working report must be written, and talks have to be given on both, results of own experiments (20 minutes) and topical literature (20 minutes).			
Teaching forms					Practical, Übung, Vorlesung, Seminar, Exkursion			
Tuition language					Je nach Anbieter			
Module exam					Form / duration / content (if applicable)			
Module final exam consisting of:					The regulations of the provider of the course are applied. If grading is not scheduled by the provider, the module completion exam shows a graded protocol (10-30 pages).			
Free-choice studies		Form of teaching	SWH	CP	Semester			
					1	2	3	4
Practical, tutorial, lecture, seminar, excursion		P, Ü, V, S, Ex	11	11	X			
Sum			11	11				