

# **Master Programme**

## **Physical Biology of Cells and Cell Interactions**

**(PBioC)**

### **Description of modules for the Master's course**

According to the study regulations from 2015

Status: December 2019

The English version is for general information only and not legally relevant.

## Overview of Modules:

### *Compulsory Modules (PM)*

- 1 Introduction to the Master Program and Basic Methods in Cell Biology
- 2 Advanced Cell Biology I
- 3 Advanced Cell Biology II
- 4 Current Concepts in Cell Biology
- 5 Advanced Methods in Cell Biology
- 6 Master Thesis

### *Export Module (EM)*

- 7 Module for students from other Masters

### *Module „Free Studies“*

- 8 Module “Free Studies” for Students of the Master PBioC

### *Elective Modules (Wahlpflicht; WP)*

	<b>Module name</b>	<b>Responsible</b>
9	External Practical Module Cell Biology	Head of The Master Degree Program
<del>10</del>	<del>Cell Biology and Physiology of Signal Transfer This module will be terminated in WS 2016/17</del>	<del>Prof. Dr. W. Volkhardt</del>
<del>11</del>	<del>How to make a Neuron: From Stem Cells to Stable Cell Lines. This module will be terminated in SS 2017</del>	<del>* Dr. K. Gampe</del>
12	Neurophysiology of Sensory Systems	Prof. Dr. M. Kössl
13	Auditory Function and Dysfunction: Behaviour and Physiology	PD Dr. B. Gaese
14	Information Processing in the Central Auditory System	PD Dr. B. Gaese
<del>15</del>	<del>Developmental Neurobiology This module will be terminated in WS 2016/2017</del>	<del>Prof. Dr. A. Acker-Palmer</del>
16	Physiology and Behaviour	Prof. Dr. M. Grünewald
17	Three-Dimensional Cell Cultures and Three-Dimensional Microscopy	Prof. Dr. E.H.K. Stelzer
18	Three-Dimensional Developmental Biology and Three-Dimensional Microscopy	Prof. Dr. E.H.K. Stelzer
<del>19</del>	<del>Three-Dimensional Plant Cell Biology and Three-Dimensional Microscopy This module will be terminated in SS 2018</del>	<del>Prof. Dr. E.H.K. Stelzer</del>

20	Cell Communication, Cell Adhesion and Cell Motility <i>This module will be terminated in WS 2017/18</i>	Prof. Dr. A. Starzinski-Powitz
21	Plant Cell Biology	Prof. Dr. E. Schleiff
22	Fungal Cell Biology	Prof. Dr. H. Osiewacz
23	Function and Evolution of Metabolic Pathways	Prof. Dr. I. Ebersberger
24	Special Aspects of Immunology	* PD Dr. Zoe Waibler
25	Developmental Genetics	Prof. Dr. D. Stainier
26	<del>Cell Biology and Gene Expression Control</del>	<del>* PD Dr. J. Lausen</del>
27	Endothelial Cells and Tumour Cell Biology	* Dr. B. Strilic
28	Principles of Tube Morphogenesis	* Dr. M. Nakayama
29	Developmental Cell Biology	Prof. Dr. V. Lecaudey
30	<del>Basics and Appliaance of Image and Data Analysis in Biology</del> <i>This module will be terminated in SS 2018</i>	<del>** Dr. S. Fischer</del>
31	<del>Biology of Extracellular Vesicles</del>	<del>* Dr. S. Momma</del>
32	<del>Special Aspects of Tumour Biology</del>	<del>*** Prof. Dr. K. Strebhardt</del>
33	Cellular RNA Biology	Prof. Dr. M. Müller-McNicoll
34	Neuronal basis of acoustic communication in mammals	**** Dr. Julio Hechavarria
35	Cellular, molecular and systemic Neurobiology in mouse and zebrafish	***** Prof. Dr. A. Acker-Palmer, Bettina Kirchmaier, Franziska Foss
36	<del>Basics of quantitative developmental biology— Analysis of dynamic processes</del>	<del>* Dr. C. Pohl</del>
37	Data analysis, mathematical modelling and simulation	Prof. Dr. F. Matthäus
38	Understanding the molecular mechanisms leading to Parkinson's disease	Prof. Dr. S. Eimer
39	Cellular and molecular mechanisms in neurodegenerative disorders	* Dr. J. Hefendehl
40	Molecular Psychiatry	* Dr. Florian Freudenberg

**Note:**

\* This module will take place under responsibility of the academic director of the Master course.

\*\* This module will take place under responsibility of Prof. Dr. E.H.K. Stelzer.

\*\*\* This module will take place under responsibility of Prof. Dr. K. Strebhardt and the academic director of the Master course.

\*\*\*\* This module will take place under responsibility of Prof. Dr. M. Kössl.

\*\*\*\*\* This module will take place under responsibility of Prof. Dr. A. Acker-Palmer.

MSc PBioC: 1	Introduction into the Master Program and Basic Methods in Cell Biology	Compulsory Module	14 CP (sum) = 420 h		14 SWH
			Contact-studies 14 SWH / 210 h	Self-studies 210 h	
<b>Contents</b>					
<p><b>The module focuses on 3 main areas:</b></p> <p>1. <u>Introduction to the Master's program</u>: In a two-day seminar there will be an introduction to the Master program. Here, the students are introduced to the qualification goals and research focuses of the degree program as well as the cell biological and physical fields of work, research groups and research projects, modules and module supervisors or their deputies of the Master's program. Students will have the opportunity to exchange information with the third semester students about the course and its contents.</p> <p>2. <u>Basic Methods in Cell Biology</u>: Another focus is an 8-week practical course on common molecular biological, protein biochemical, immunological, histological, cell biological, microscopic working methods and techniques as well as an introduction to bioinformatics. In groups, the participants elaborate the theoretical background of the different working methods and carry them out after briefing under scientific guidance and support. Students get to know different bioinformatics databases and their application. Students will learn methods and algorithms for the bioinformatics analysis of large sequence data sets.</p> <p>The students gain an insight into different experimental scientific working techniques, their theoretical basics and their evaluation. They will present and discuss their experimental results in a seminar. After completion of this module, the students will have learned a spectrum of methodological basics, which they can apply in the individual elective modules.</p> <p>3. <u>Legal and ethical aspects of life sciences</u>: The topics are taught in full-day lectures and seminars: Animal Protection Act, Bio- and Science Ethics, Contents of the Embryo Protection Act, Gene Technology Act, Biological Safety, Biological Substances Ordinance, Infection Protection Act, Occupational Safety and Health, the Rules of Good Scientific Practice as well as the Fundamentals of Patent Law are taught. The students are taught the following theoretical basics on 3 days, all day, regarding the aspect of animal protection law: Introduction to laboratory animal science, legal basics, ethical aspects of animal experiments, mouse, rat, rabbit: Anatomy, physiology, behaviour and feeding, general application and blood collection techniques, as well as rat, mouse and gerbil, breeding and genetics of laboratory rodents, basics of surgical work, basics of anaesthesia and pain control in laboratory animals, pain, suffering, damage and anxiety in laboratory animals, basics of killing in accordance with animal welfare, basics for statistical experiment planning, animal husbandry, health monitoring in laboratory animal populations, hygiene in animal husbandry, writing an application for an animal experiment.</p> <p>The theoretical and technical contents of this module are taught according to the legal requirements of animal protection. Participation is compulsory for all students of the Master's program and must be confirmed in writing. The module part is completed according to the legal requirements of animal protection.</p> <p>According to the Genetic Engineering Act, it is mandatory for students to take part in a S1 safety instruction. Students will be informed about the contents of the operating instructions for genetic engineering according to § 12 Abs. 2 GenTSV. This contains, among other things: Safety regulations in the laboratory, protective measures and rules of conduct, important aspects of occupational safety, completion of genetic engineering documents, obligation to keep records, conduct in the event of incidents in the laboratory.</p> <p>Students are introduced to the following topics on the subject of biological safety and the Ordinance on Biological Substances: Ordinance on safety and health protection in activities involving biological agents, what are biological agents, classification into risk groups, distinction between targeted and non-target activities, hazard assessment, duty to report and record, operating instructions, protective and hygiene measures, information for employees.</p> <p>Lectures and seminars on the topics: Legal and ethical aspects of the courses are mandatory for the students and must be confirmed by proof of attendance.</p>					
<b>Educational Objectives / Competences</b>					
<p>Within this introductory module, students learn to deal intensively and independently with the theoretical and practical contents of their studies and to plan the course of their studies. They learn to find their way in a scientific-English-speaking environment; to plan and carry out scientific experiments independently; and to critically evaluate, present and discuss experimental approaches and solutions according to the rules of Good Scientific Practice. After completing the internship, the student should be able to know basic molecular biological, protein-biochemical, immunological, cell biological and microscopic working methods common in research and to carry them out independently with the help of work instructions. The students know how to use selected databases of bioinformatics and how to apply them. They acquire the competence to select and apply suitable methods for defined scientific questions and to evaluate them critically. When working with genetically modified organisms and handling biological agents, students acquire the competence to comply with the guidelines of the operating instructions for genetic engineering work and the Ordinance on Biological Substances.</p> <p>They gain the competence that animal experiments can only be planned and carried out under bioethical and scientific aspects, taking into account and complying with the contents of the Animal Protection Act.</p> <p>After completion of the module, students will become familiar with the topics: Animal Protection Act, Bio- and Science Ethics, Contents of the Embryo Protection Act, Genetic Engineering Act, Biosafety, Bio substances Ordinance, Infection Protection Act, Occupational Safety and Health, the Rules of Good Scientific Practice and the Basics of Patent Law.</p>					
<b>Requirements for Participation</b>					



<b>MSc PBioC: 2</b>	<b>Advanced Cell Biology I</b>	<b>Compulsory Module</b>	<b>6 CP (sum) = 180 h</b>		<b>6 SWH</b>					
			<b>Contact - studies 6 SWH / 90 h</b>	<b>Self- studies 90 h</b>						
<b>Contents</b>										
Lecture series: Selected topics on physical biology of cells and cell interactions, cell biology, physiology, neurophysiology, cell types and their functions, developmental as well as molecular and biochemical principles of the function of various animal and plant cells, mechanisms of signal transmission and development of nerve cells and nerve systems. Seminars are based on the lectures on selected topics of physical biology of cells and cell biology. The students present relevant original publications. Colloquia: Students participate in 4 cell biology / physical biology oriented colloquia at the institute.										
<b>Educational Objectives / Competences</b>										
Students develop a broad interdisciplinary basic knowledge in the fields of cell biology, as well as its application possibilities. Students learn scientific research concepts, are able to link different fields and paradigms in cell biology with another. The student lectures on his/her results in a seminar and is, in this context, competent to process information from original publications.										
<b>Requirements for Participation</b>										
None										
<b>Recommended Requirements</b>										
Basic knowledge in cell biology and physical biology										
<b>Module Assignment (Studiengang / Fachbereich)</b>			Master PBioC - FB 15							
<b>Applicability to other Course of Study</b>			FB 15 Master's courses							
<b>Dates and Module Frequency</b>			Annually, first and second part of winter term							
<b>Duration</b>			2 days per week (90 min lecture and seminar)							
<b>Module Responsible</b>			Head of examination board							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			Participation in seminars and colloquia							
<b>Course Assessment</b>			20-30 min presentation in the seminar							
<b>Forms of Teaching</b>			lecture, seminar, colloquia, self-studies							
<b>Language</b>			English							
<b>Module Completion Test</b>			<b>Form / duration / content (if applicable)</b>							
Module Completion Test consists of			Examination (90 min), Content: Topics of the lecture and the seminar							
<b>Advanced Cell Biology I</b>		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>Lectures</b>		[V]	4	3	X					
<b>Seminar</b>		[S ]	1.5	2	X					
<b>Colloquia</b>		[Ko ]	0.5	1	X					
<b>Module Completion Test</b>					X					
<b>Sum</b>			6	6						

<b>MSc PBioC: 3</b>	<b>Advanced Cell Biology II</b>	<b>Compulsory Module</b>	<b>7 CP (sum) = 220 h</b>		<b>7 SW H</b>					
			<b>Contact-studies 7 SWH / 110 h</b>	<b>Self-studies 110 h</b>						
<b>Contents:</b>										
<p>Lecture series: Selected topics of cell biology of higher eukaryotes.          Contents: Cellular, molecular, physiological, structural and physical principles of development and function of higher eukaryote cells including plants; mechanisms of cell-cell and cell-matrix detection, receptor systems and their ligands, signal transmission, apoptosis, vesicular transport of cells, stem cell concepts and cellular plasticity, tumour biology and plant cell biology.          Seminar on the lectures: Selected topics of higher eukaryote cell biology. The students present relevant original publications.</p> <p>Lecture and seminar: Molecular principles of vertebrate genetics          Contents: Specific and current concepts of genetic analysis of eukaryotic genes and their products will be discussed here; targeted suppression of genes by homological recombination; functional suppression of genes, phenotype analyses.          The students present relevant original publications.</p> <p>Colloquia: Students participate in 4 cell biology / physical biology oriented colloquia at the institute.</p>										
<b>Educational Objectives / Competences</b>										
After completing the module, the students are familiar with the principles in cell biology and their uses. They learn cell biology research concepts on various model organisms and are able to link different subareas and paradigms of cell biology. They will have learned to present and discuss original publications in the form of a lecture.										
<b>Requirements for Participation</b>										
none										
<b>Recommended Requirements</b>										
Basic knowledge in cell biology										
<b>Module Assignment (Studiengang / Fachbereich)</b>			Master PBioC - FB 15							
<b>Applicability to other Course of Study</b>			FB 15 Master's courses							
<b>Dates and Module Frequency</b>			First and second part of summer term							
<b>Duration</b>			2 days per week (90 min lecture and seminar)							
<b>Module Responsible</b>			Head of examination board							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			Participation in seminars and colloquia							
<b>Course Assessment</b>			20-30 min presentation in the seminar							
<b>Forms of Teaching</b>			lecture, seminar, colloquia, self-studies							
<b>Language</b>			English							
<b>Module Completion Test</b>			<b>Form / duration / content (if applicable)</b>							
<b>Module Completion Test consists of</b>			Examination (90 min), Content: Topics of the lecture and the seminars: selected topics on higher eukaryote cell biology and molecular principles of vertebrate genetics.							
	<b>Advanced Cell Biology II</b>	<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Lectures</b>	[V]	4	4		X				
	<b>Seminar</b>	[S]	2.5	2		X				
	<b>Colloquia</b>	[Ko]	0.5	1		X				
	<b>Module Completion Test</b>									
<b>Sum</b>			7	7						

<b>MSc PBioC: 4</b>	<b>Current Concepts in Cell Biology</b>	<b>Compulsory Module</b>	<b>15 CP (sum) = 450 h</b>		<b>12 SWH</b>					
			<b>Contact-studies 12 SWH / 180 h</b>	<b>Self-studies 270 h</b>						
<b>Contents</b>										
The module includes a project and a seminar with the aim of teaching students the major theoretical principles of research concept development in cell biology. After familiarisation with the current literature, critical open questions are to be identified and research strategies for solving them are developed. The research concept is to be drafted in the form of an application for third-party subsidy.										
<b>Educational Objectives / Competences</b>										
After completing this module, students are familiar with the development of scientific research concepts and integrating them into third-party funding applications. The students can assess the relevance of different and conflicting theories and research concepts and transfer them into new contexts.										
<b>Requirements for Participation</b>										
Passing the following modules: Introduction into the Master's Program and Basic Methods in Cell Biology (module 1), Advanced Cell Biology I (module 2), Advanced Cell Biology II (module 3) and 2 of the 3 elective modules. Note: This project work can be done in any cell biology working group in the Master's course of the faculty of biosciences, FB 15, Goethe University and is not necessarily linked with the Master thesis.										
<b>Recommended Requirements</b>										
None										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master PBioC - FB 15							
<b>Applicability to other course of study</b>			FB 15 master's degree courses							
<b>Dates and Module Frequency</b>			at any time							
<b>Duration</b>			4-5 weeks, full-time							
<b>Module Responsible</b>			Head of examination board							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			none							
<b>Course Assessment</b>			Presentation of the research concept (20-30 min) in a seminar							
<b>Forms of Learning</b>			Project, seminar, self-studies							
<b>Language</b>			English							
<b>Module Completion Test</b>			<b>Form / duration / content (if applicable)</b>							
Module Completion Test consists of			Written research concept of 5-20 pages							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
		<b>Project work</b>	[Pr]	11	14			X	X	
		<b>Seminar</b>	[S]	1	1			X	X	
		<b>Module Completion Test</b>								
		<b>Sum</b>		12	15					

<b>MSc PBioC: 5</b>	<b>Advanced Methods in Cell Biology</b>	<b>Compulsory Module</b>	<b>15 CP (sum) = 450 h</b>					<b>15 SWH</b>		
			<b>Contact studies 15 SWH / 225 h</b>		<b>Self-studies 225 h</b>					
<b>Contents</b>										
The module consists of an internship and a seminar. The aim is to provide students the essential experimental techniques of the specific field of study intended for the Master thesis. This should be done in a way that the Master thesis can be successfully completed within the available time frame.										
<b>Educational Objectives / Competences</b>										
After completing the module, the students will be familiar with the practical principles related to their Master thesis. The students will be able to efficiently dissect methodical information from publications and the world wide web, to assess the feasibility of methodical approaches and to be able to critically evaluate methods and artefacts.										
<b>Requirements for Participation</b>										
Passing the following modules: Introduction into the Master's Programme and Basic Methods in Cell Biology (module 1), Advanced Cell Biology I (module 2), Advanced Cell Biology II (module 3), Current Concepts in Cell Biology (module 4) and the 3 elective modules.										
<b>Recommended Requirements</b>										
<b>Module Assignmet (Studiengang / Fachbereich)</b>				Master PBioC - FB 15						
<b>Applicability to other course of study</b>				FB 15 master's degree courses						
<b>Dates and Module Frequency</b>				Throughout the year; from the third semester on						
<b>Duration</b>				5-6 weeks						
<b>Module Responsible</b>				Head of examination board						
<b>Proof of Study</b>										
<b>Proof of Participation</b>				none						
<b>Course Assessment</b>				Presentation of 20-30 minutes, progress report in the working group						
<b>Forms of Learning</b>				practical course, seminar, self-studies						
<b>Language</b>				English						
<b>Module Completion Test</b>				<b>Form / duration / content (if applicable)</b>						
<b>Module Completion Test consists of</b>				Oral examination of 30 min						
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	14	14			X	X		
	<b>Seminar</b>	[S]	1	1			X	X		
	<b>Module completion test: Oral examination</b>									
	<b>Sum</b>		15	15						

<b>MSc PBioC: 6</b>	<b>Master Thesis</b>	<b>Compulsory Module</b>	<b>30 CP (sum.) = 900 h</b>		<b>30 SWH</b>					
			<b>Contact studies 30 SWH / 450 h</b>	<b>Self-studies 450 h</b>						
<b>Contents</b>										
In their Master thesis, students work on a scientific research question within six months and deepen their knowledge of scientific research methods. This may involve experimental, empirical or analytical work. The results must be summarised in a written Master thesis in the style of scientific publications. The supervisor and a second reviewer evaluate the quality of the performance.										
<b>Educational Objectives / Competences</b>										
After completing the module, the student is able to deal with scientific questions and problems and to embed the findings gained in the existing literature. The student learns to write papers in a scholarly publication style and to apply and assess modern research methods.										
<b>Requirements for Participation</b>										
Proof of having gained at least 90 CPs and having passed the module Advanced Methods in Cell Biology (module 5). The Master thesis is usually mentored by a university teacher, provided that he or she regularly hosts compulsory or elective modules in the Master's programme.										
<b>Recommended Requirements</b>										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master PBioC - FB 15							
<b>Applicability to other course of study</b>										
<b>Dates and Module Frequency</b>			The dates and frequency are pending							
<b>Duration</b>			6 months							
<b>Module Responsible</b>			Head of examination board							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			none							
<b>Course Assessment</b>			30 min presentation of the Master thesis in a seminar in the working group							
<b>Forms of Learning</b>			seminar, self-studies							
<b>Language</b>			English							
<b>Module Completion Test</b>			<b>Form / duration / content (if applicable)</b>							
<b>Module Completion Test consists of</b>			Written thesis (the mark will be double weighted compared to that/those gained in all other modules).							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
		<b>Seminar Presentation</b>	[S]	30				X		
		<b>Module Completion Test: Master Thesis</b>	[MA]					X		
		<b>Sum</b>		30						

<b>MSc PBioC: 7</b>	<b>Module for Students from other Masters</b>	<b>Export Module</b>	<b>15 CP = 450 h</b>		<b>15 SWH</b>					
			<b>Contact-studies 15 SWH / 225 h</b>	<b>Self-studies 225 h</b>						
<b>Contents</b>										
<p>The module is an export module and includes an elective module (Appendix 4) and completion of a project on current concepts in the specific subject module chosen. This is intended to ensure applicability to other FB 15 master's degree courses of study.</p> <p>This module specifies the performance required of students from other master's degree courses. Students must elaborate controversial key questions in the subject chosen using important original works and overview articles. Project work is to be written in the form of an overview or summary article the scope of which is agreed beforehand with the academic responsible for the module.</p>										
<b>Educational Objectives / Competences</b>										
Students will be familiarized with the theory and practice relevant to the specific module subject chosen and be able to prioritize current developments and controversies in the same field after completing the module.										
<b>Recommended Requirements</b>										
none										
<b>Special note:</b>										
This module only applies to students of other master's degree courses needing a module lasting half a semester for which 15 CPs are awarded.										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master Course of FB 15							
<b>Applicability to other course of study</b>			FB 15 master's degree courses as well as Master in Interdisciplinary Neuroscience.							
<b>Dates and Module Frequency</b>			Annually in winter and summer term.							
<b>Duration</b>			15 SWH							
<b>Module Responsible</b>			Head of examination board							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			none							
<b>Course Assessment</b>			Written project work							
<b>Forms of Learning</b>			practical course, seminar, self-studies							
<b>Language</b>			English							
<b>Module completion test</b>			<b>Form / duration / content (if applicable)</b>							
Module completion test			As indicated in the module description							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
		<b>Practical</b>	[P]	11	11	X	X			
		<b>Project work</b>	[Pr]	4	4	X	X			
		<b>Module completion test: Protocol, Examination, Written Elaboration</b>								
		<b>Sum</b>		15	15					

<b>MSc PBioC: 8</b>	<b>Module “Free Studies” for students from the Master PBioC</b>	<b>Import Module</b>	<b>11 CP = 330 h</b>		<b>11 SWH</b>					
			<b>Contact-studies 11 SWH / 165 h</b>	<b>Self-studies 165 h</b>						
<b>Contents</b>										
The students get the possibility to choose an elective module from the Master courses of other faculties of the Goethe University.										
<b>Educational Objectives / Competences</b>										
After completing the module, the student will be familiar with the theory and practice of the chosen subject and will be able to assess the current developments and controversies in the subject area.										
<b>Recommended Requirements</b>										
None										
<b>Special note:</b>										
This module can replace an elective module in Appendix 4. It requires the prior approval of the examination board or the academic head of the Master’s programme.										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master Course of FB 15							
<b>Applicability to other course of study</b>										
<b>Dates and Module Frequency</b>			Annually in winter and summer term.							
<b>Duration</b>			11 SWH							
<b>Module Responsible</b>			Head of examination board							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			none							
<b>Course Assessment</b>			The regulations of the provider of the module apply							
<b>Forms of Learning</b>			practical course, seminar, self-studies							
<b>Language</b>			English							
<b>Module completion test</b>			<b>Form / duration / content (if applicable)</b>							
<b>Module completion test</b>			The regulations of the provider of the module apply							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
		<b>Practical</b>	[P]	10	10	X	X			
		<b>Seminar</b>	[S]	1	1	X	X			
		<b>Module completion test: Protocol, Examination, Written Elaboration</b>								
		<b>Sum</b>		11	11					

<b>MSc PBioC: 9</b>	<b>External Practical Module Cell Biology</b>	<b>Elective Module</b>	<b>11 CP = 330 h</b>		<b>11 SWH</b>					
			<b>Contact-studies 11 SWH / 165 h</b>	<b>Self-studies 165 h</b>						
<b>Contents</b>										
The obligatory choice practical teaches the basic methods and techniques in basic cell biological and physical biology science. Students work on some current projects under supervision and present the results in the form of a seminar lecture. They learn how to draft scientific papers by writing a protocol of their results. The module can be offered by the faculties of the Goethe University, of other universities in Germany and elsewhere and by research facilities that are not part of any university.										
<b>Educational Objectives / Competences</b>										
Knowledge of how to perform cell biological or physiological experiments in the basic sciences field. Working out scientific problems against the background of relevant literature.										
<b>Recommended Requirements</b>										
none										
<b>Special note</b>										
Lectures and protocol in English. The module is an external one that can replace an elective module in Appendix 4, especially if performed during an ERASMUS study semester abroad. It requires the agreement of the examination board or the head of the Master's programme. It is co-supervised by a university teacher, who is involved in the Master's programme. The form of test performance required will be advised at the beginning of the respective semester. Aside from ERASMUS studies, there is no claim to perform the External Practical Module Cell Biology as long as practical courses from the Master Physical Biology of Cells and Cell Interactions can be offered.										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master Course of FB 15							
<b>Applicability to other course of study</b>										
<b>Dates and Module Frequency</b>			Annually in winter and summer term							
<b>Duration</b>			4-5 weeks, full-time							
<b>Module Responsible</b>			Head of examination board							
<b>Proof of Study</b>			The regulations of the provider apply. If a proof of study is not provided, an internship protocol (10 – 20 pages) must be written as well as a presentation in a seminar on the results has to be given (20 – 30 min).							
<b>Proof of Participation</b>			none							
<b>Course Assessment</b>			Protocol, seminar talk on the results of own scientific studies and on the current literature							
<b>Forms of Learning</b>			practical course, seminar, self-studies							
<b>Language</b>			English							
<b>Module completion test Module completion test</b>			<b>Form / duration / content (if applicable)</b> Protocol, poster or examination. The regulations of the provider apply. If a grading is not provided by the provider of this module, the protocol will be graded.							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
		Practical	[P]	10	10	X	X			
		Seminar	[S]	1	1	X	X			
		Module completion test: Protocol								
		Sum		11	11					

MSc PBioC: 10	Cell Biology and Physiology of Signal Transfer	Elective Module	11 CP = 330 h		11 SWH
			Contact-studies 11 SWH / 165 h	Self-studies 165 h	
<b>Contents</b>					
<b>This module is terminated in winter term 2016/17!</b>					

MSc PBioC: 11	How to make a Neuron: From Stem Cells to Stable Cell Lines.	Elective Module	11 CP (sum) = 330 h		11 SWH
			Contact studies 11 SWH / 165 h	Self-studies 165 h	
<b>Contents</b>					
<b>This module is terminated in summer term 2017!</b>					

<b>MSc PBioC: 12</b>	<b>Neurophysiology of Sensory Systems</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>		<b>11 SWH</b>					
			<b>Contact studies 11 SWH / 165 h</b>	<b>Self-studies 165 h</b>						
<b>Contents</b>										
Content: The practical teaches basic electrophysiological conductance techniques and bio-acoustic measuring techniques to investigate the auditory system in laboratory mammals and insects in vivo. The students work on their own projects with 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 auditory neurobiology. They learn how to present scientific work through writing up an appropriate result protocol. The main topics are: physiological properties of nerves in the midbrain and cortex, investigating active sensory amplification mechanisms in the inner ear, psychoacoustic analyses in humans, use of computer/software in evaluating data and generating stimuli.										
<b>Educational Objectives / Competences</b>										
Competence: Familiarity with carrying out electrophysiological experiments, measuring otoacoustic emissions, familiarity with anesthetizing and surgical procedures in animal experiments, application of neuroanatomical techniques, learning how to work on scientific questions based on relevant publications.										
<b>Recommended Requirements</b>										
none										
<b>Special note</b>										
none										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master Course of FB 15							
<b>Applicability to other course of study</b>			FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience.							
<b>Dates and Module Frequency</b>			Twice per year in the winter and summer semester, each in the first half; 4 weeks of block practical with seminars.							
<b>Duration:</b>			4-5 weeks, full-time							
<b>Module Responsible</b>			Prof. Dr. M. Kössl, PD Dr. M. Nowotny							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			none							
<b>Course Assessment</b>			A seminar talk on the results of one's own experiments and on recent scientific papers (20 – 30 min).							
<b>Forms of Learning</b>			practical course, seminar, self-studies							
<b>Language</b>			English							
<b>Module completion test</b>			<b>Form / duration / content (if applicable)</b>							
Module completion test			A protocol of 10-30 pages							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	10	10	X	X				
	<b>Seminar</b>	[S]	1	1	X	X				
	<b>Module completion test</b>									
	<b>Sum</b>		11	11						

<b>MSc PBioC: 13</b>	<b>Auditory Function and Dysfunction: Behaviour and Physiology</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>		<b>11 SWH</b>					
			<b>Contact studies 11 SWH / 165 h</b>	<b>Self-studies 165 h</b>						
<b>Contents</b>										
The practical teaches techniques to determine auditory function and dysfunction in rodents. These techniques can be used to determine effects of pharmacological or behavioural treatments of sensory disorders such as tinnitus or hearing loss. The focus is on behavioural techniques suitable to characterize the disorder rather precisely in comparison to normal functions. All steps that are necessary for a project in the field are taught in this practical: study design, animal handling, control of experimental parameters, pharmacological treatment of animals, and data analysis. The behavioural analysis is paralleled by basic electrophysiological measurements necessary to determine the effects of dysfunction and treatments at the physiological level. The students work on their own projects under supervision and present their results in the form of a seminar talk. The main focuses are: measuring and analysing behavioural data, performing efficient physiological experiments to determine auditory function, and statistical evaluation methods. Preparation of a potential publication will be the final part of the project. After completion, the individual projects will be presented and discussed in the form of a seminar talk. In a further seminar talk the students will present an original piece of research from the area of cognition and hearing.										
<b>Educational Objectives / Competences</b>										
Familiarity with carrying out well controlled behavioural experiments (animal handling, measuring and analysing behavioural data, statistical analysis). Performing physiological measurements including electrophysiological recording in minimally invasive preparations. Additional aspects are: introduction to software for data handling, signal processing, and graphical display. Deriving scientific questions from the current literature. Knowledge about the usage and limitations of animal models for neurological diseases.										
<b>Recommended Requirements</b>										
none										
<b>Requirements for participation</b>										
none										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master Course of FB 15							
<b>Applicability to other course of study</b>			FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience							
<b>Dates and Module Frequency</b>			Annually in the first part of summer term							
<b>Duration</b>			4-5 weeks, full-time							
<b>Module Responsible</b>			PD Dr. B. Gaese							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			none							
<b>Course Assessment</b>			20-30 min presentation in the seminar							
<b>Forms of Learning</b>			practical course, seminar, self-studies							
<b>Language</b>			English							
<b>Module completion test</b>			<b>Form / duration / content (if applicable)</b>							
Module completion test			A protocol of 10-30 pages must be drafted							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	10	10		X				
	<b>Seminar</b>	[S]	1	1		X				
	<b>Module completion test</b>									
	<b>Sum</b>		11	11						

<b>MSc PBioc: 14</b>	<b>Information Processing in the Central Auditory System</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>						<b>11 SWH</b>	
			<b>Contact-studies 11 SWH / 165 h</b>			<b>Self-studies 165 h</b>				
<b>Contents</b>										
The practical covers the whole range of techniques to investigate brain activity underlying the processing of sensory information in the auditory domain. The focus is on electrophysiological single cell techniques in rodents in the awake and anesthetized preparations. Brain activity is acquired and analysed with the goal to understand behavioural responses following auditory stimulation. Cognitive aspects (e.g. context-dependence) are taken into account. The students work on their own projects under supervision and present their results in the form of a seminar talk. The main focuses are measuring and analysing neuronal activity in different configurations of in-vivo recording techniques. The following analysis includes modern techniques of signal processing, efficient handling of larger data sets and statistical evaluation methods. Preparation of a potential publication will be the final part of the project. After completion, the individual projects will be presented and discussed in the form of a seminar talk. In a further seminar talk the students will present an original piece of research from the area of cognition and hearing.										
<b>Educational Objectives / Competences</b>										
Familiarity with carrying out physiological experiments (animal handling, surgery, measuring and analyzing electrical activity at the single neuron level. Combining physiology with neuroanatomical and histological staining techniques. Basic introduction to behavioural control. Introduction to software for data handling, signal processing, statistical analysis and graphical display. Understanding cognitive influences on sensory information processing as an important aspect of context-dependent behaviour. Deriving scientific questions from the current literature.										
<b>Recommended Requirements</b>										
none										
<b>Requirements for participation</b>										
none										
<b>Module Assignmet (Studiengang / Fachbereich)</b>				Master PBioC - FB 15						
<b>Applicability to other course of study</b>				FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience						
<b>Dates and Module Frequency</b>				Annually in the first part of summer term						
<b>Duration</b>				4-5 weeks, full-time						
<b>Module Responsible</b>				PD Dr. B. Gaese						
<b>Proof of Study</b>										
<b>Proof of Participation</b>				none						
<b>Course Assessment</b>				20-30 min presentation in the seminar						
<b>Forms of Learning</b>				practical course, seminar, self-studies						
<b>Language</b>				English						
<b>Module completion test</b>				<b>Form / duration / content (if applicable)</b>						
<b>Module completion test</b>				A protocol of 10-30 pages must be drafted						
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	10	10		X				
	<b>Seminar</b>	[S]	1	1		X				
	<b>Module completion test</b>									
	<b>Sum</b>		11	11						

MSc PBioC: 15	Developmental Neurobiology	Elective Module	11 CP (sum) = 330 h		11 SWH
			Contact-studies 11 SWH / 165 h	Self-studies 165 h	
<b>Contents</b>					
<b>This module is terminated in winter term 2016/17!</b>					

<b>MSc PBioC: 16</b>	<b>Physiology and Behaviour</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>						<b>11 SWH</b>	
			<b>Contact-studies 11 SWH / 165 h</b>			<b>Self-studies 165 h</b>				
<b>Contents:</b>										
<p>The module teaches physiological bases of behaviour control. Students will work on individual projects that are jointly designed. The techniques taught may comprise cell physiology (patch clamp, calcium imaging, extracellular recording), Neuroanatomy, behavioural experiments (behavioural pharmacology, learning and memory). Model organisms are insects, mainly the honey-bee. Conceptual focusses are: function of ion channels and transmitter receptors, neuromodulation, learning behaviour, olfaction, social behaviour of honeybees.</p> <p>The students will give oral presentations of their results and will create a scientific poster summarizing their experiments. In a second seminar talk they learn to critically present physiological and behavioural articles. Presentations, seminars and posters will be given in English and the students receive detailed feedback on their presentation style as well as on the scientific contents. By writing a protocol in a manuscript style the students get acquainted with preparing a manuscript draft for submission to a science journal.</p> <p>The students will be responsible – under supervision – for the study design, protocolling and analysing the original data. Each step will be developed during the course rather than working after a pre-defined protocol.</p>										
<b>Educational Objectives / Competences</b>										
Planning, conducting and analysing of behavioural physiological experiments; measuring of ionic currents; behavioural observations and quantifications; neuroanatomical methods. Approaching scientific topics; literature work. Preparing of scientific texts, posters and talks.										
<b>Requirements for Participation</b>										
none										
<b>Recommended Requirements</b>										
none										
<b>Module Assignmet (Studiengang / Fachbereich)</b>				Master PBioC - FB 15						
<b>Applicability to other course of study</b>				FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience						
<b>Module Frequency</b>				First half of winter and first half of summer term						
<b>Duration</b>				4-5 weeks, full-time						
<b>Module Responsible</b>				Prof. Dr. B. Grünewald						
<b>Proof of Study</b>										
<b>Proof of Participation</b>				none						
<b>Course Assessment</b>				30 min presentation in the seminar to the experimental results of the scientific studies						
<b>Forms of Learning</b>										
<b>Language</b>				English						
<b>Module Completion Test</b>				<b>Form / duration / content (if applicable)</b>						
<b>Module Completion Test consists of</b>				A protocol of 10-30 pages must be drafted						
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	10	10	X	X				
	<b>Seminar</b>	[S]	1	1	X	X				
	<b>Module Completion Test</b>									
	<b>Sum</b>		11	11						

<b>MSc PBioC: 17</b>	<b>Three-Dimensional Cell Cultures and Three-Dimensional Microscopy</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>		<b>11 SWH</b>					
			<b>Contact-studies 11 SWH / 165 h</b>	<b>Self-studies 165 h</b>						
<b>Contents:</b>										
<p>This internship teaches the basic concepts of three-dimensional cell biology and modern three-dimensional microscopy. The observation of live biological specimens under physiologically relevant conditions becomes increasingly important in the Life Sciences. Healthy as well as tumour cell lines, primary cells as well as stem cells, are cultivated and analysed under physiological conditions. These conditions are achieved with organ slices and three-dimensional cellular spheroids by growing them in collagen and many other hydrogels that mimic the extracellular matrix (e.g. Matrigel). Quantitative analyses of living three-dimensional structures requires fast optical sectioning. Confocal microscopy is only useful for relatively thin specimens, because of its slow scanning speed, high photo-bleaching rate and low efficiency in collecting light from thick specimens. Light sheet-based fluorescence microscopy in conjunction with three-dimensional specimen preparation techniques provides a suitable alternative. Students will participate in current research projects of the Stelzer group and are supervised by experienced members. They present their results in an oral presentation and in a written internship report.</p>										
<b>Educational Objectives / Competences</b>										
<p>The student learns the basic concepts of classical two-dimensional as well as three-dimensional cell culture. She or he is aware of several applications of three-dimensional cell cultures and knows which cell types are used in the Life Sciences. He or she understands the principles of optics in classical microscopy (characteristics of light, resolution, aperture) as well as photometry (energy, power). The student knows the differences between confocal and light sheet-based fluorescence microscopy and is able to estimate the limits of classical light microscopy in dense tissues. She or he masters the formation, isolation and staining of spheroids, cysts, organoids and three-dimensional tissue slices. The student has experience in the preparation of the specimens for different microscopes as well as the acquisition and processing of the images and the analysis of the data. At the end of the module the student presents the results in a written report and a talk</p>										
<b>Requirements for Participation</b>										
none										
<b>Recommended Requirements</b>										
none										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master PBioC - FB 15							
<b>Applicability to other course of study</b>			FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Master] as well as Master in Interdisciplinary Neuroscience							
<b>Module Frequency</b>			Annually in summer term							
<b>Duration</b>			5 weeks, full-time							
<b>Module Responsible</b>			Prof. Dr. E.H.K. Stelzer							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			none							
<b>Course Assessment</b>			presentation in the seminar to the experimental results of the scientific studies (15 min (+5 min discussion)), 5 min presentation to introduce the project,							
<b>Forms of Learning</b>			Practical, seminar, self-studies							
<b>Language</b>			English							
<b>Module Completion Test</b>			<b>Form / duration / content (if applicable)</b>							
<b>Module Completion Test consists of</b>			Internship report, protocol of 15-30 pages.							
<b>Cumulative Module Completion Test consists of</b>			none							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	10	10	X	X				
	<b>Seminar</b>	[S ]	1	1	X	X				
	<b>Module Completion Test</b>									
	<b>Sum</b>		11	11						

<b>MSc PBioC: 18</b>	<b>Three-Dimensional Developmental Biology and Three-Dimensional Microscopy</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>		<b>11 SWH</b>					
			<b>Contact-studies 11 SWH / 165 h</b>	<b>Self-studies 165 h</b>						
<b>Contents:</b>										
<p>This internship teaches state-of-the-art three-dimensional fluorescence microscopy and respective non-invasive sample mounting techniques. All steps are shown exemplarily in the investigation of insect embryogenesis. For more than a century, insect research has contributed significantly to genetics and developmental biology. The most prominent model organism is the common fruit fly/vinegar fly <i>Drosophila melanogaster</i>. However, over the last years it became apparent that focusing on a few established model organisms is not sufficient to understand the basic principles of insect development in detail. New insect species (emerging model organisms) are established in many laboratories to gain new insights into neglected or even unknown processes. For example, the red flour beetle <i>Tribolium castaneum</i> is used since its embryogenesis deviates substantially from that of <i>Drosophila</i> in many different aspects. Instead of wide field or confocal fluorescence microscopy, we use light sheet-based fluorescence microscopy, which allows us to image individuals for one week. Moreover, the imaged individual survives the procedure. Students will work on current research projects and are supervised by experienced members of the Stelzer group. They present their results in an oral presentation and a written internship report.</p>										
<b>Educational Objectives / Competences</b>										
<p>The student learns the principles of insect model organisms, such as <i>Tribolium castaneum</i>, in developmental biology. He or she is aware of current scientific questions in developmental biology and knows how to handle transgenic organisms. He or she understands the principles of optics in classical microscopy (characteristics of light, resolution, numerical aperture) as well as photometry (energy, power). The student knows the differences between confocal and light sheet-based fluorescence microscopy and is able to estimate the limits of classical light microscopy in dense tissues. He or she understands laboratory cultivation of <i>Tribolium</i> as well as preparation methods for confocal and light sheet-based fluorescence microscopes, in the context of long-term live imaging of <i>Tribolium</i> embryos <i>in toto</i>. The student analyses the data and understands the basics of scientific image processing and the embryonic development of <i>Tribolium</i>. The interns work under guidance on their own individual project based on the actual research topics of the Stelzer group. At the end of the course, they summarize their results and findings in a protocol and prepare a seminar under the guidance of their advisor.</p>										
<b>Requirements for Participation</b>										
none										
<b>Recommended Requirements</b>										
none										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master PBioC - FB 15							
<b>Applicability to other course of study</b>			FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience							
<b>Module Frequency</b>			Summer and winter term							
<b>Duration</b>			5 weeks, full-time							
<b>Module Responsible</b>			Prof. Dr. E.H.K. Stelzer							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			none							
<b>Course Assessment</b>			presentation in the seminar to the experimental results of the scientific studies (15 min (+5 min discussion)), 5 min presentation to introduce the project							
<b>Forms of Learning</b>			Practical, seminar, self-studies							
<b>Language</b>			English							
<b>Module Completion Test</b>			<b>Form / duration / content (if applicable)</b>							
Module Completion Test consists of			Internship report, protocol of 15-30 pages.							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	10	10	X	X				
	<b>Seminar</b>	[S]	1	1	X	X				
	<b>Module Completion Test, Protocol</b>									
	<b>Sum</b>		11	11						

MSc PBioC: 19	Three-Dimensional Plant Cell Biology and Three-Dimensional Microscopy	Elective Module	11 CP (sum) = 330 h		11 SWH
			Contact-studies 11 SWH / 165 h	Self-studies 165 h	
<b>Contents:</b>					
<b>This module is terminated in summer term 2018!</b>					

MSc PBioC: 20	Cell Communication, Cell Adhesion and Cell Motility	Elective Module	11 CP (sum) = 330 h		11 SWH
			Contact-studies 11 SWH / 165 h	Self-studies 165 h	
<b>Contents:</b>					
<b>This module is terminated in winter term 2017/18!</b>					

<b>MSc PBiOC: 21</b>	<b>Plant Cell Biology</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>		<b>11 SWH</b>					
			<b>Contact-studies 11 SWH / 165 h</b>	<b>Self-studies 165 h</b>						
<b>Contents:</b>										
<p>The practical course teaches basic techniques and experimental concepts of molecular cell biology and special questions of cellular and molecular aspects of plant physiology.</p> <p>Key features are: protein biochemical methods to study protein translocation and dynamics of chloroplasts, including subcellular fractionation, basics in plant cell culturing and transgenic (genetically modified) plants, in vivo and in situ measurement of protein activity and localization including digital image processing.</p> <p>The students will learn the handling of genetically modified plants, plant cell cultures and protoplasts e.g. culturing, passaging and transfection for ectopic expression or knockout of genes. The analysis comprises a broad spectrum of molecular biological and cell biological techniques like PCR, cloning, SDS-polyacrylamide gel electrophoresis, western blotting, immunofluorescence, measurement of protein activity and so on.</p> <p>The students work under supervision on their own scientific project which is leaned on the scientific work of the study group and present their experimental results in form of a seminar lecture. In another lab meeting the students present a recent publication on the field of cellular and molecular plant physiology. By performing a protocol with own scientific results, the students learn to write a scientific paper.</p>										
<b>Educational Objectives / Competences</b>										
<p>Skills taught: Knowledge to isolate plant cell organelles, independent characterization of organelle proteins, sterile working, culturing and transfection of cells, working with the fluorescence microscope and computational evaluation of experimental data and image files, knowledge in the analysis of transgenic plants, independent handling of scientific questions in the context of relevant scientific literature.</p>										
<b>Requirements for Participation</b>										
none										
<b>Recommended Requirements</b>										
none										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master PBioC - FB 15							
<b>Applicability to other course of study</b>			FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience							
<b>Module Frequency</b>			Annually in summer and winter term							
<b>Duration</b>			4-5 weeks, full-time							
<b>Module Responsible</b>			Prof. Dr. E. Schleiff							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			none							
<b>Course Assessment</b>			Protocol (10-30 pages), 20-30 min presentation in the seminar to the experimental results of the scientific studies							
<b>Forms of Learning</b>			Practical, seminar, self-studies							
<b>Language</b>			English							
<b>Module Completion Test</b>			<b>Form / duration / content (if applicable)</b>							
<b>Module Completion Test consists of</b>			Graded presentation (approx.. 30 min) with an introduction, presentation of the relevant literature, material and methods, results and a discussion							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	10	10	X	X				
	<b>Seminar</b>	[S ]	1	1	X	X				
	<b>Module Completion Test</b>									
	<b>Sum</b>		11	11						

MSc PBioC: 22	Fungal Cell Biology	Elective Module	11 CP (sum) = 330 h		11 SWH					
			Contact-studies 11 SWH / 165 h	Self-studies 165 h						
<b>Contents:</b>										
<p>The internship teaches principal techniques and concepts for dealing with specific questions on cell biology of fungi. The questions are not exclusively aiming at processes that are relevant for these model organisms, but can be transferred to higher systems (i.e. mechanisms of biological aging processes). The participant receives his or her own project on a current issue. Different approaches in the field of molecular biology are applied. Regularly taught methods include comparative studies of wild-type strains with genetically engineered strains (knock-out and overexpression strains). This approach allows to use various molecular, biochemical and cell biological techniques, to specifically gain insight into molecular regulatory pathways (i.e. signal transduction pathways). The focus is on the following techniques: production and transformation of fungal protoplasts, isolation of mitochondria, respiration measurements, "blue-native" gel electrophoresis, fluorescence microscopy of mitochondrial dynamics, Southern, Northern, Western blot, PCR, protein activity measurements, oxyBlot analysis and <i>in-silico</i> data analysis. At the end of the internship, each student presents his/her work and submits a protocol on the results of the project. In addition, he/she reports on a current scientific publication.</p>										
<b>Educational Objectives / Competences</b>										
<p>The student receives theoretical knowledge on the principal techniques and methods in molecular biological, biochemical and cell biological work. Experience in sterile and microbiological work are useful, but are also routinely taught during the internship. In the practical, the handling of English original literature is learned.</p>										
<b>Requirements for Participation</b>										
none										
<b>Recommended Requirements</b>										
none										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master PBioC - FB 15							
<b>Applicability to other course of study</b>			FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience							
<b>Module Frequency</b>			Annually in summer term							
<b>Duration</b>			4-5 weeks, full-time							
<b>Module Responsible</b>			Prof. Dr. H. Osiewacz							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			none							
<b>Course Assessment</b>			20-30 min seminar talk on the results of the own experiments and the current literature							
<b>Forms of Learning</b>			Practical, seminar, self-studies							
<b>Language</b>			English							
<b>Module Completion Test</b>			<b>Form / duration / content (if applicable)</b>							
Module Completion Test consists of			Protocol (10-30 pages)							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
		Practical	[P]	10	10	X				
		Seminar	[S]	1	1	X				
		Module Completion Test								
		Sum		11	11					

<b>MSc PBioC: 23</b>	<b>Function and Evolution of Metabolic Pathways</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>		<b>11 SWH</b>					
			<b>Contact-studies 11 SWH / 165 h</b>	<b>Self-studies 165 h</b>						
<b>Contents:</b>										
<p>In this practical we will provide an understanding of basic methods and algorithms for the bioinformatics analysis of large datasets. The students will work on problems circling around the functional characterization and evolution of metabolic pathways and functional protein complexes. We will integrate latest high throughput DNA sequencing data into the analysis whenever possible and appropriate.</p> <p>Emphasis will be put on the compilation of novel sequence data sets for analyses, on data mining for complementation of existing data sets, as well as on the bioinformatics methods for comparison and annotation of sequence data. The theoretical foundation of the analyses will be formed by self-reliant literature research in combination with the presentation of a publication from the area of applied bioinformatics. Towards the end of the internship the students will exercise the correct way of presenting scientific results by summarizing their achievements in an oral presentation as well as in written form in a report.</p>										
<b>Educational Objectives / Competences</b>										
Independent conduct of functional annotation of sequences, of bioinformatics annotation transfer and of prediction of functionally equivalent proteins under consideration of evolutionary relation-ships; Ability for management and bioinformatics analysis of large sequence sets; Mining of public databases; Knowledge of relational database systems; Generation and interpretation of phylogenetic profiles; Introduction into independent scientific research on the background of relevant literature.										
<b>Requirements for Participation</b>										
none										
<b>Recommended Requirements</b>										
none										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master PBioC - FB 15							
<b>Applicability to other course of study</b>			FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience							
<b>Module Frequency</b>			Annually in summer and winter term							
<b>Duration</b>			4-5 weeks, full-time							
<b>Module Responsible</b>			Prof. Dr I. Ebersberger							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			none							
<b>Course Assessment</b>			20-30 min presentation in the seminar to the experimental results of the scientific studies							
<b>Forms of Learning</b>			Practical, seminar, self-studies							
<b>Language</b>			English							
<b>Module Completion Test</b>			<b>Form / duration / content (if applicable)</b>							
<b>Module Completion Test consists of</b>			Protocol (10-30 pages) or poster							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	10	10	X	X				
	<b>Seminar</b>	[S]	1	1	X	X				
	<b>Module Completion Test</b>									
	<b>Sum</b>		11	11						

<b>MSc PBioC: 24</b>	<b>Special Aspects of Immunology</b>	<b>Elective Module</b>	<b>11 CP (sum.) = 330 h</b>						<b>11 SW H</b>	
			<b>Contact-studies 11 SWH / 165 h</b>	<b>Self-studies 165 h</b>						
<b>Contents</b>										
<p>In the practical course the students work on current projects of the working group. Main topics are immunological experiments in the murine system and in primary murine cells as well as primary human cell cultures.</p> <p>In vitro experiments with murine organs and the isolation of murine primary cells will be learned and performed.</p> <p>The analysis comprises a broad spectrum of immunological and cell culture techniques like: FACS, ELISA, Plaque-Assay, viral Infections, (q)RT-PCR and the culturing of primary human cells and the isolation of different cell types from blood donors as well as the separation of cells with MACS and Cell-Sorter.</p>										
<b>Educational Objectives / Competences</b>										
<p>The students will learn to plan and to perform complex immunological experiments.</p> <p>The results of the practical course are presented by every student on the form of a written protocol and a talk at the end of the course. The students also take part on the weekly lab meetings where they learn about the ongoing research of all the members of the group. In a Journal Club every student learns to presents a recent publication on the field of immunology and in context of their own projects.</p>										
<b>Requirements for Participation</b>										
none										
<b>Recommended Requirements</b>										
none										
<b>Module Assignmet (Studiengang / Fachbereich)</b>				Master PBioC - FB 15						
<b>Applicability to other course of study</b>				FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience						
<b>Module Frequency</b>				Annually in summer term an winter term						
<b>Duration</b>				4-5 weeks, full-time						
<b>Module Responsible</b>				PD Dr. Z. Waibler This module will be performed under responsibility of the head of the examination board.						
<b>Proof of Study</b>										
<b>Proof of Participation</b>										
<b>Course Assessment</b>				20-30 min presentation in the seminar to the experimental results of the scientific studies						
<b>Forms of Learning</b>				Practical, seminar, self-studies						
<b>Language</b>				English						
<b>Module Completion Test</b>				<b>Form / duration / content (if applicable)</b>						
Module Completion Test consists of				Protocol (10-30 pages)						
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	10	10	X	X				
	<b>Seminar</b>	[S]	1	1	X	X				
	<b>Module Completion Test</b>									
	<b>Sum</b>		11	11						

<b>MSc PBioC: 25</b>	<b>Developmental Genetics</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>				<b>11 SWH</b>			
			<b>Contact-studies 11 SWH / 165 h</b>		<b>Self-studies 165 h</b>					
<b>Contents:</b>										
<p>This practical course offers basic theoretical and experimental knowledge in the area of developmental genetics. Principal areas of research are the development, function and homeostasis of vertebrate organ systems including the cardiovascular system, lung and pancreas. The students take part on ongoing experiments in the laboratory to elucidate the cellular and molecular mechanisms underlying these processes. Their work includes: basic zebrafish or mouse genetics techniques and the handling of a zebrafish or mouse colony, live imaging of zebrafish embryos and larvae, processing of embryos or tissues for in situ hybridization and immunohistochemistry, immunofluorescence microscopy, confocal microscopy, molecular biology, embryological techniques (DNA and RNA injections into zebrafish embryos).</p> <p>The results of the practical course are presented by each student in the form of a written report as well as a talk at the end of the course. The students also take part in the weekly lab meetings where they learn about the ongoing research of all the members of the group. In a Journal Club each student presents a recent publication in the field of their own project</p>										
<b>Educational Objectives / Competences</b>										
<p>Students learn the basic techniques to study cellular and molecular aspects of developmental genetics (as detailed above). By the end of the course they have been in direct contact with zebrafish or mice and learn how to handle a zebrafish or mouse colony. The students are in an international environment and learn how to write and communicate their results in English</p>										
<b>Requirements for Participation</b>										
<p>The students should have a strong interest in developmental genetics. Some theoretical (and preferably practical) knowledge of basic molecular techniques and cell biology is expected.</p>										
<b>Recommended Requirements</b>										
<p>none</p>										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master PBioC - FB 15							
<b>Applicability to other course of study</b>			FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience							
<b>Module Frequency</b>			Annually in summer and winter term							
<b>Duration</b>			5 weeks, full-time							
<b>Module Responsible</b>			Prof. Dr. D. Stainier							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			none							
<b>Course Assessment</b>			20-30 min presentation in the seminar to the experimental results of the scientific studies							
<b>Forms of Learning</b>			Practical, seminar, self-studies							
<b>Language</b>			English							
<b>Module Completion Test</b>			<b>Form / duration / content (if applicable)</b>							
Module Completion Test consists of			Protocol (10-30 pages)							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	10	10	X					
	<b>Seminar</b>	[S ]	1	1	X					
	<b>Module Completion Test</b>									
	<b>Sum</b>		11	11						

MSc PBioC: 26	Cell Biology and Gene Expression Control	Elective Module	11 CP (sum) = 330 h		11 SW H
			Contact-studies 11 SWH / 165 h	Self-studies 165 h	
<b>This module is terminated in winter term 2019/20!</b>					

<b>MSc PBioC: 27</b>	<b>Endothelial Cells and Tumour Cell Biology</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>		<b>11 SWH</b>					
			<b>Contact-studies 11 SWH / 165 h</b>	<b>Self-studies 165 h</b>						
<b>Contents:</b>										
This training aims at teaching theoretical knowledge and practical experience in the fields of cellular and molecular biology, more specifically in the fields of endothelial and tumour cell biology. The student(s) will participate in ongoing projects in the lab, including the possibility to work on mice as model organism (depending on the project and availability- under supervision). The student(s) will also participate in regular meetings, and the obtained data will be summarized in a written protocol. The lab-atmosphere is international.										
<b>Educational Objectives / Competences</b>										
This training aims at learning different techniques from the above-mentioned fields, including cell culture of cell lines and primary cells, siRNA-mediated knock-down of genes, preparation of histological sections including staining, confocal microscopy and image analysis, PCR, Western blots, immunoprecipitation, etc.										
<b>Requirements for Participation</b>										
none										
<b>Recommended Requirements</b>										
none										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master PBioC - FB 15							
<b>Applicability to other course of study</b>			FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience							
<b>Module Frequency</b>			Annually in summer term							
<b>Duration</b>			4-5 weeks, daily							
<b>Module Responsible</b>			Dr. B. Strilic This module will be performed under responsibility of the head of the examination board.							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			none							
<b>Course Assessment</b>			20-30 min presentation in the seminar to the experimental results of the scientific studies							
<b>Forms of Learning</b>			Practical, seminar, self-studies							
<b>Language</b>			English							
<b>Module Completion Test</b>			<b>Form / duration / content (if applicable)</b>							
<b>Module Completion Test consists of</b>			Protocol (10-30 pages)							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	10	10	X	X				
	<b>Seminar</b>	[S ]	1	1	X	X				
	<b>Module Completion Test</b>									
	<b>Sum</b>		11	11						

<b>MSc PBioC: 28</b>	<b>Principles of Tube Morphogenesis</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>				<b>11 SWH</b>			
			<b>Contact-studies 11 SWH / 165 h</b>		<b>Self-studies 165 h</b>					
<b>Contents:</b>										
In this course, we will offer you the opportunity to learn basics of the theory and experimental techniques in cell biology, biochemistry and physiology. The course is especially focusing on tube formation processes during vascular and kidney epithelial morphogenesis. The students will be involved in ongoing projects in the laboratory to address molecular mechanisms underlying these processes. The work includes: molecular cloning, basic protein purification, gel electrophoresis, western blot, cell culture of both primary cell and established cell line, immunohistochemistry using cultured cells and tissues, genotyping of transgenic mice, isolation of mouse tissue, immunofluorescence and confocal microscopy observation.										
<b>Educational Objectives / Competences</b>										
In the journal club you will present a recent paper. In the end of the course, you will have an opportunity to present your progress during the course. You will work in a very international environment. All of the communication is in English.										
<b>Requirements for Participation</b>										
none										
<b>Recommended Requirements</b>										
none										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master PBioC - FB 15							
<b>Applicability to other course of study</b>			FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience							
<b>Module Frequency</b>			Annually in summer and winter term							
<b>Duration</b>			4-5 weeks, daily							
<b>Module Responsible</b>			Dr. M. Nakayama This module will be performed under responsibility of the head of the examination board.							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			none							
<b>Course Assessment</b>			20-30 min presentation in the seminar to the experimental results of the scientific studies							
<b>Forms of Learning</b>			Practical, seminar, self-studies							
<b>Language</b>			English							
<b>Module Completion Test</b>			<b>Form / duration / content (if applicable)</b>							
Module Completion Test consists of			Protocol (10-30 pages)							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	10	10	X	X				
	<b>Seminar</b>	[S ]	1	1	X	X				
	<b>Module Completion Test</b>									
	<b>Sum</b>		11	11						

<b>MSc PBioC: 29</b>	<b>Developmental Cell Biology</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>		<b>11 SWH</b>					
			<b>Contact-studies 11 SWH / 165 h</b>	<b>Self-studies 165 h</b>						
<b>Contents</b>										
<p>The practical course offers basic theoretical and experimental knowledge in the area of developmental cell biology. Principal areas of research are the mechanisms underlying cell migration and morphogenesis during organ formation using the zebrafish. Our main model system is the lateral line, a sensory system present in fish that derives from a group of cells that migrate in a collective manner. The students take part in ongoing experiments in the laboratory to elucidate, for example, the mechanisms underlying cell migration, cell differentiation, cell shape changes or cell proliferation in this system. The techniques used include basic genetics techniques, molecular biology, in situ hybridization and immunohistochemistry as well as handling zebrafish (crossing, injection, genotyping) and confocal and live imaging.</p> <p>The results of the practical course are presented by every student on the form of a written protocol and a talk at the end of the course. The students also take part on the weekly lab meetings where they learn about the ongoing research of the members of the group. In a Journal Club every student presents a recent publication on the field of their own projects.</p>										
<b>Educational Objectives / Competences</b>										
Students learn the basic techniques of molecular and developmental biology including zebrafish handling and modern live imaging techniques as detailed above. By the end of the course they have been in direct contact with mice and learn how to handle a mouse colony. The students are in an international environment and learn how to write and communicate their results in English.										
<b>Requirements for Participation</b>										
none										
<b>Recommended Requirements</b>										
none										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master PBioC - FB 15							
<b>Applicability to other course of study</b>			FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience							
<b>Module Frequency</b>			Annually in summer and winter term							
<b>Duration</b>			4-5 weeks, daily							
<b>Module Responsible</b>			Prof. Dr. V. Lecaudey							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			none							
<b>Course Assessment</b>			20-30 min presentation in the seminar to the experimental results of the scientific studies							
<b>Forms of Learning</b>			Practical, seminar, self-studies							
<b>Language</b>			English							
<b>Module Completion Test</b>			<b>Form / duration / content (if applicable)</b>							
Module Completion Test consists of			Protocol (10-30 pages)							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
		<b>Practical</b>	[P]	10	10	X	X			
		<b>Seminar</b>	[S ]	1	1	X	X			
		<b>Module Completion Test</b>								
		<b>Sum</b>		11	11					

MSc PBioC: 30	Basics and Appliance of Image and Data Analysis in Biology	Elective Module	11 CP (sum) = 330 h		11 SW H
			Contact-studies 11 SWH / 165 h	Self-studies 165 h	
<b>Contents</b>					
<b>This module is terminated in summer term 2018 and is replaced by module 37!</b>					

MSc PBioC: 31	Biology of Extracellular Vesicles	Elective Module	11 CP (sum) = 330 h		11 SW H
			Contact-studies 11 SWH / 165 h	Self-studies 165 h	
<b>This module is terminated in winter term 2019/20!</b>					

MSc PBioC: 32	Special Aspects of Tumour Biology	Elective Module	11 CP (sum) = 330 h		11 SW H
			Contact-studies 11 SWH / 165 h	Self-studies 165 h	
<b>This module is terminated in winter term 2019/20!</b>					

<b>MSc PBioC: 33</b>	<b>Cellular RNA Biology</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>		<b>11 SW H</b>					
			<b>Contact-studies 11 SWH / 165 h</b>	<b>Self-studies 165 h</b>						
<b>Contents</b>										
<p>In the practical course basics in RNA Biology and animal cell culture will be learned. The students will learn and perform the analysis of RNA expression and RNA-protein-interactions in cells. The students will work under supervision on their own scientific project which is leaned on the scientific work and ongoing experiments of the working group of AK Müller-McNicoll. The experimental results will be presented in a seminar and in form of a graded protocol. During the practical course the students learn to work with different eukaryotic cell lines, the production and transfection of siRNAs to knockdown specific proteins of interest, the purification of RNA-binding proteins from cells and the identification and quantification of bound RNAs via quantitative RT-PCR or other methods.</p> <p>Other techniques comprise immunofluorescence microscopy, PCR, western Blotting, DNA-cloning, mutagenesis of proteins, subcellular fractionation and differentiating of cells.</p>										
<b>Educational Objectives / Competences</b>										
<p>Students will be familiarized with scientific literature; will have additional knowledge in RNA biology and special methods of transcript analysis.</p> <p>They will get practical experience in sterile working with cells and their analysis. At the end of the course they will be able to work with cell cultures for further analysis. They learn how to write, communicate and present their results in English language.</p>										
<b>Requirements for Participation</b>										
none										
<b>Recommended Requirements</b>										
As a basic knowledge, the theoretical foundations of molecular techniques and cell biology are expected. English language skills are required as all laboratory and literature seminars are held in English.										
<b>Module Assignmet (Studiengang / Fachbereich)</b>				Master PBioC - FB 15						
<b>Applicability to other course of study</b>				FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience						
<b>Module Frequency</b>				Annually in summer and winter term						
<b>Duration</b>				5-6 weeks, daily						
<b>Module Responsible</b>				JP Michaela Müller-McNicoll (PhD)						
<b>Proof of Study</b>										
<b>Proof of Participation</b>										
<b>Course Assessment</b>				30 min presentation in the seminar on the experimental results of the scientific studies and on the current literature, protocol (10 – 30 pages)						
<b>Forms of Learning</b>				Practical, seminar, self-studies						
<b>Language</b>				English						
<b>Module Completion Test</b>				<b>Form / duration / content (if applicable)</b>						
Module Completion Test consists of				Protocol (10-30 pages)						
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	10	10	X	X				
	<b>Seminar</b>	[S]	1	1	X	X				
	<b>Module Completion Test</b>									
	<b>Sum</b>		11	11						

<b>MSc PBioC: 34</b>	<b>Neuronal basis of acoustic communication in mammals</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>						<b>11 SWH</b>	
			<b>Contact studies 11 SWH / 165 h</b>			<b>Self-studies 165 h</b>				
<b>Contents</b>										
<p>The main goal of this course is to understand how mammals communicate using acoustic information (sounds). The course is designed from the perspective of the “broadcaster-receiver” approach, and therefore it is consequently subdivided into two parts. The first part is meant for understanding the sounds broadcasted by two mammalian species (Mongolian gerbils and bats) while they are communicating. Basically, using bioacoustics tools, the students will try to figure out the vocal alphabet of bats and gerbils. The second part of the course deals with the receiver. In this part, the students will learn how the gerbil’s voice is processed in the brain by neurons located in the auditory cortex. The main aim here is to assess what happens in the brain when an animal hears a behaviourally relevant sound. At the beginning of each course part, there will be introductory discussions that will provide the students with the necessary theoretical background for conducting and understanding the different experiments. An introduction to statistics and to MATLAB will also be offered. The final report will be written in the form of a scientific paper, and the results will be presented in the form of a short talk.</p>										
<b>Educational Objectives / Competences</b>										
<p>By the end of the course, the students should be able to: (1) Understand basic concepts of bioacoustics such as the sound as a mechanical wave, sound transduction using microphones, analogue-to-digital conversion using sound cards. (2) Measure basic parameters of a sound wave (frequency, duration, intensity). (3) Perform basic surgeries required for acquiring neuronal data. (4) Understand basic neuroscience concepts such as: action potential, local field potential, receptive field, brain topography, spike clustering, brain oscillations. (5) Testing hypothesis using basic statistical tests (normality tests, parametric and non-parametric t-tests and analyses of variance (ANOVA)).</p>										
<b>Recommended Requirements</b>										
none										
<b>Requirements for participation</b>										
none										
<b>Module Assignmet (Studiengang / Fachbereich)</b>				Master PBioC - FB 15						
<b>Applicability to other course of study</b>				FB 15 master’s degree courses of study with integral part of Module 7 [Module for students from other Masters (Modul für Master anderer Masterstudiengänge)] as well as Master in Interdisciplinary Neuroscience						
<b>Dates and Module Frequency</b>				Once a year, summer semester						
<b>Duration</b>				5 weeks, full-time						
<b>Module Responsible</b>				Prof. Dr. Manfred Kössl, Dr. Julio Hechavarria						
<b>Proof of Study</b>										
<b>Proof of Participation</b>				Regular participation						
<b>Course Assessment</b>				1 seminar presentation on the results of one’s own experiments, 1 seminar presentation on recent scientific papers, work report						
<b>Forms of Learning</b>				Practical, self-study						
<b>Language</b>				English						
<b>Module completion test</b>				<b>Form / duration / content (if applicable)</b>						
<b>Module completion test</b>				Graded Protocol						
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	10	10		X				
	<b>Seminar</b>	[S]	1	1		X				
	<b>Module completion test</b>									
	<b>Sum</b>		11	11						

<b>MSc PBioC: 35</b>	<b>Cellular, molecular and systemic Neurobiology in mouse and zebrafish</b>	<b>Elective Module</b>	<b>11 CP = 330 h</b>				<b>11 SWH</b>	
			<b>Contact study 11 SWH / 165 h</b>	<b>Self-study 165 h</b>				
<b>Contents</b>								
<p>The practical course offers basic theoretical and experimental knowledge in the area of cellular, molecular and systemic neurobiology in mouse and zebrafish. The students work on their own projects under supervision and present the results in the form of a seminar talk. In a second seminar talk they present an original publication from the field of their projects. By writing a result protocol, they will learn how to write scientific reports.</p> <p>The practical course is divided in two units. The first part includes the following tasks: basic mouse genetic techniques, processing of brain tissue for immunohistochemistry, basic techniques of working with neuronal cell cultures, immunofluorescence microscopy, confocal microscopy, and biochemical techniques including protein gel electrophoresis and Western blotting. In the second part of the practical course, the students will be introduced to basic zebrafish genetics using methods in molecular biology and histological techniques, confocal microscopy and brightfield microscopy as well as zebrafish embryo manipulation and basic behavioural tests.</p>								
<b>Objectives</b>								
<p>Students learn the basic techniques for studying cellular, molecular, and systemic neurobiology (as detailed above). They work with cultured cells under sterile conditions, with the epifluorescence microscope and the stereo microscope. The students will be trained in zebrafish embryo handling and basic genetic techniques, and quantify and analyse the obtained data and images. The students are in an international environment and learn how to write and communicate their results in English.</p>								
<b>Requirements for participating</b>								
none								
<b>Helpful previous knowledge:</b>								
none								
<b>Assignment of module (course/department)</b>			Interdisciplinary Neuroscience / FB15					
<b>Suitable for other courses</b>			yes					
<b>Times offered</b>			Once per year; summer semester					
<b>Duration</b>			4 weeks					
<b>Person in charge</b>			Prof. Amparo Acker-Palmer, Dr. Bettina Kirchmaier, Franziska Foss-Helmer					
<b>Confirmation of completion</b>								
<b>Participation</b>			Regular participation					
<b>Course assessment</b>			1 seminar talk on the results of one's own experiments, 1 seminar talk on current publications, work report					
<b>Teaching forms</b>			Practical, seminar, self-studies					
<b>Tuition language</b>			English					
<b>Module exam</b>			<b>Form / duration / content (if applicable)</b>					
<b>Module completion exam</b>			Graded protocol (10 – 30 pages)					
		<b>Teaching form</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>			
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
	<b>Practical</b>	[P], [S]	11	11		X		
	<b>Module Completion Test</b>							
	<b>Sum</b>		11	11				

<b>MSc PBioC: 36</b>	<b>Basics and Appliance of Image and Data Analysis in Biology</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>		<b>11 SW H</b>
			<b>Contact-studies 11 SWH / 165 h</b>	<b>Self-studies 16h</b>	
<b>This module is terminated in winter term 2019/20!</b>					

<b>MSc PBioC: 37</b>	<b>Data analysis, mathematical modelling and simulation</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>		<b>11 SW H</b>					
			<b>Contact-studies 11 SWH / 165 h</b>	<b>Self-studies 165 h</b>						
<b>Contents</b>										
<p>This module provides a foundation of theoretical biology in the form of individual student research projects, mainly based on examples of cell migration. Methods and techniques, which are hereby acquired and applied, range from data or image analysis (such as segmentation, tracking, dimension reduction of large data sets, or network analysis), to the modelling and simulation of motile cells. Examples of projects involving modelling and simulation are collective migration (of cancer cells or in developmental processes), chemotaxis, pattern formation, or the description of chemical or mechanical regulatory mechanisms of motility. Alternatively, data analysis, modelling or simulation can be carried out based on a project providing suitable data collected during a previous module.</p> <p>Image analysis will mostly be carried out using conventional software tools (ImageJ, Matlab). For post-processing of the data, visualization or statistical analysis the student will be supported in the generation of own software. The students may code in the programming language of their choice. For beginners, an introduction to programming (in Python, Matlab or Julia) is provided. Also modelling and simulation will involve the generation of code. The topic and results of the research project will be presented in the group seminar. In addition, every student will submit a protocol comprising 10 – 30 pages..</p>										
<b>Educational Objectives / Competences</b>										
<p>The goal of the module is to provide and extend programming skills, data analysis methods and modelling approaches for dynamical or spatio-temporal processes, or large data sets. Students should be able to apply these methods/approaches in their future research and use them as a foundation for further development. Independent research, usage of original literature, and scientific writing will be strengthened.</p>										
<b>Requirements for Participation</b>										
none										
<b>Recommended Requirements</b>										
Basic programming skills, basics of statistics, good background in mathematics and/or physics										
<b>Module Assignmet (Studiengang / Fachbereich)</b>			Master PBioC - FB 15							
<b>Applicability to other course of study</b>			FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience							
<b>Module Frequency</b>			Annually in summer and winter term							
<b>Duration</b>			4-5 weeks, daily							
<b>Module Responsible</b>			Prof. Dr. F. Matthäus							
<b>Proof of Study</b>										
<b>Proof of Participation</b>			Regular participation							
<b>Course Assessment</b>			20 min presentation (15 + 5 min) in the seminar covering the experimental results and a short review of the relevant literature.							
<b>Forms of Learning</b>			Practical, seminar, self-studies							
<b>Language</b>			English							
<b>Module Completion Test</b>			<b>Form / duration / content (if applicable)</b>							
Module Completion Test consists of			Protocol (10-30 pages).							
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	10	10	X	X				
	<b>Seminar</b>	[S]	1	1	X	X				
	<b>Module Completion Test</b>									
	<b>Sum</b>		11	11						

<b>MSc PBioC: 38</b>	<b>Understanding the molecular mechanisms leading to Parkinson's disease</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>						<b>11 SWH</b>	
			<b>Contact-studies 11 SWH / 165 h</b>			<b>Self-studies 165 h</b>				
<b>Contents</b>										
<p>In this practical course, students learn how to use the multicellular model organism <i>C. elegans</i> to investigate the early molecular mechanisms and cellular alterations leading to the development of Parkinson's disease. The inactivation and analysis of homologous genes that are associated with the hereditary form of Parkinson's disease, attempts to understand the function of these genes in normal cells. In addition, it will be investigated, which cellular alterations result from the inactivation of these genes and what conclusions can be drawn on possible early mechanisms of Parkinson's disease development.</p> <p>The generated mutant animals are genetically, biochemically and cell biologically examined using high-resolution microscopy techniques such as confocal microscopy and electron microscopy. The students learn how to use the model system <i>C. elegans</i> and the latest methods of genetic manipulation such as CRISPR/Cas9-mediated genome editing or RNAi gene knockdown as well as quantitative evaluation of microscopy data. The students present their results in a seminar talk and in the form of a graded protocol.</p>										
<b>Educational Objectives / Competences</b>										
During the internship, students learn how genetic manipulation and analysis of a multicellular model organism can help to understand complex cellular relationships that can lead to the development of neurodegenerative disorders.										
<b>Requirements for Participation</b>										
none										
<b>Recommended Requirements</b>										
none										
<b>Module Assignmet (Studiengang / Fachbereich)</b>					Master PBioC - FB 15					
<b>Applicability to other course of study</b>					FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience					
<b>Module Frequency</b>					Annually in summer and winter term					
<b>Duration</b>					4-6 weeks, daily					
<b>Module Responsible</b>					Prof. Dr. S. Eimer					
<b>Proof of Study</b>										
<b>Proof of Participation</b>					Regular participation					
<b>Course Assessment</b>					Protocol and a 20 min presentation (15 + 5 min) in the seminar covering the experimental results and a short review of the relevant literature.					
<b>Forms of Learning</b>					Practical, seminar, self-studies					
<b>Language</b>					English					
<b>Module Completion Test</b>					<b>Form / duration / content (if applicable)</b>					
Module Completion Test consists of					Protocol (10-20 pages)					
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical</b>	[P]	10	10	X	X				
	<b>Seminar</b>	[S]	1	1	X	X				
	<b>Module Completion Test</b>									
	<b>Sum</b>		11	11						

<b>MSc PBioC: 39</b>	<b>Cellular and molecular mechanisms in neurodegenerative disorders</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>						<b>11 SWH</b>	
			<b>Contact-studies 11 SWH / 165 h</b>			<b>Self-studies 165 h</b>				
<b>Contents</b>										
<p>The practical course offers basic theoretical and experimental knowledge in the area of neurodegenerative and vascular disorders. The students work on their own projects under supervision and present the results in the form of a seminar talk. This talk also includes an original publication from the field of their projects. By writing a result protocol, they will learn how to write scientific reports.</p> <p>The practical course consists of systemic, cellular and molecular aspects that will be addressed. This includes the following techniques: <i>in vivo</i> 2-Photon Microscopy, Image- and data analysis, basic mouse genetic techniques, processing of brain tissue for immunohistochemistry, basic primary cell culture techniques, immunofluorescence microscopy, confocal microscopy as well as biochemical techniques including protein gel electrophoresis and Western blotting.</p>										
<b>Educational Objectives / Competences</b>										
<p>In this elective module, the student will learn fundamental techniques used to in the research area of neurodegenerative disorders (as described above) by using the mouse model organism. <i>In vivo</i> 2-Photon imaging enables us to record systemic as well as cellular processes in real time. The students are presented with the opportunity to observe <i>in vivo</i> animal handling and the live imaging process. The acquired data will be analyzed by the students, teaching them basic Image- and data analysis skills. The immunohistochemical stainings of brain sections will teach the students the technique as well as the underlying scientific question of the experiment. Moreover, the students will work with cultured cells under sterile conditions, with the epifluorescence – and stereo microscope. The students are in an international environment and learn how to write and communicate their results in English.</p>										
<b>Requirements for Participation</b>										
None										
<b>Recommended Requirements</b>										
None										
<b>Module Assignmet (Studiengang / Fachbereich)</b>				Master PBioC - FB 15						
<b>Applicability to other course of study</b>				FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience						
<b>Module Frequency</b>				Annually in summer term						
<b>Duration</b>				4-5 weeks, daily						
<b>Module Responsible</b>				Dr. J. Hefendehl This module will be performed under responsibility of the head of the program.						
<b>Proof of Study</b>										
<b>Proof of Participation</b>				Regular participation						
<b>Certificate of Performance</b>				20 min presentation (15 + 5 min) in the seminar covering the experimental results and a short review of the relevant literature.						
<b>Forms of Learning</b>				Practical, self-studies						
<b>Language</b>				English						
<b>Module Completion Test</b>				<b>Form / duration / content (if applicable)</b>						
<b>Module Completion Test consists of</b>				Graded protocol						
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical course</b>	[P]	11	11		X				
	<b>Seminar</b>									
	<b>Module Completion Test</b>									
	<b>Summ</b>		11	11						

<b>MSc PBioC: 40</b>	<b>Molecular Psychiatry</b>	<b>Elective Module</b>	<b>11 CP (sum) = 330 h</b>						<b>11 SWH</b>	
			<b>Contact-studies 11 SWH / 165 h</b>			<b>Self-studies 165 h</b>				
<b>Contents</b>										
<p>In this practical course the molecular and cellular causes of psychiatric disorders will be explored. Students will be introduced to a broad spectrum of translational methods. These include cell culture techniques for the functional study of candidate genes (including the production of primary cell cultures from humans and/or mice, production of viral vectors and viral gene transfer), molecular and cell biological mechanisms in the cell model and/or optionally in the mouse model (including behavioural biology in mice that have been genetically modified and/or pharmacologically treated). Following such experiments, various molecular biological (including quantitative PCR, Western blot, ELISA), neuroanatomical (brain preparation, cryostat cutting, staining methods), immunohistochemical and microscopic (including fluorescence microscopy with and without structured illumination) characterisations will be performed. It is also possible to gain insight into behavioral studies and imaging techniques (functional magnetic resonance imaging [fMRT], electroencephalography [EEG], magnetoencephalography [MEG]) used to evaluate abnormal neuronal processing in human psychiatric disorders.</p> <p>The experiments are carried out in the laboratories of the Department of Psychiatry, Psychosomatics and Psychotherapy of the University Hospital Frankfurt. Current projects of the department will be carried out under supervision. The results will be presented in a presentation in the lab seminar and documented in the form of a written report.</p>										
<b>Educational Objectives / Competences</b>										
<p>Students can plan, carry out and analyse experiments used to investigate psychiatric disorders. Students learn and develop scientific approaches and literature research. The students document their results and communicate them in oral and written form. In a series of seminars (including the opportunity to participate in case presentations), students also acquire basic knowledge of the psychiatric disorders studied and are able to describe them.</p>										
<b>Requirements for Participation</b>										
None										
<b>Recommended Requirements</b>										
None										
<b>Module Assignmet (Studiengang / Fachbereich)</b>					Master PBioC - FB 15					
<b>Applicability to other course of study</b>					FB 15 master's degree courses of study with integral part of Module 7 [Module for students from other Masters] as well as Master in Interdisciplinary Neuroscience					
<b>Module Frequency</b>					Annually in summer and winter term					
<b>Duration</b>					6 - 8 weeks					
<b>Module Responsible</b>					Dr. F. Freudenberg This module will be performed under responsibility of the head of the program.					
<b>Proof of Study</b>										
<b>Proof of Participation</b>					Regular participation					
<b>Certificate of Performance</b>					20 min presentation (15 + 5 min) in the seminar covering the experimental results and a short review of the relevant literature.					
<b>Forms of Learning</b>					Practical, seminar, self-studies					
<b>Language</b>					English					
<b>Module Completion Test</b>					<b>Form / duration / content (if applicable)</b>					
<b>Module Completion Test consists of</b>					Graded protocol (10 – 30 pages)					
		<b>Teaching forms</b>	<b>SWH</b>	<b>CP</b>	<b>Semester</b>					
					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	<b>Practical course</b>	[P]	10	10	X	X				
	<b>Seminar</b>	[S]	1	1	X	X				
	<b>Module Completion Test</b>									
	<b>Summ</b>		11	11						