Master

Physical Biology of Cells and Cell Interactions

(PBioC)

Description of modules for the Master’s course

Status: January, 2017

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
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)

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<td>9. External Practical Module Cell Biology</td>
<td>Head of The Master Degree Program</td>
</tr>
<tr>
<td>10. Cell Biology and Physiology of Signal Transfer</td>
<td>Prof. Dr. W. Volknandt</td>
</tr>
<tr>
<td>11. How to make a Neuron: From Stem Cells to Stable Cell Lines.</td>
<td>Dr. K. Gampe</td>
</tr>
<tr>
<td>12. Neurophysiology of Sensory Systems</td>
<td>Prof. Dr. M. Kössl, PD Dr. M. Nowotny</td>
</tr>
<tr>
<td>13. Auditory Function and Dysfunction: Behavior and Physiology</td>
<td>PD Dr. B. Gaese</td>
</tr>
<tr>
<td>14. Information Processing in the Central Auditory System</td>
<td>PD Dr. B. Gaese</td>
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<td>15. Developmental Neurobiology</td>
<td>Prof. Dr. A. Acker-Palmer</td>
</tr>
<tr>
<td>16. Physiology and Behavior</td>
<td>Prof. Dr. M. Grünewald</td>
</tr>
<tr>
<td>17. Three-Dimensional Cell Cultures and Three-Dimensional Microscopy</td>
<td>Prof. Dr. E.H.K. Stelzer</td>
</tr>
<tr>
<td>18. Three-Dimensional Developmental Biology and Three-Dimensional Microscopy</td>
<td>Prof. Dr. E.H.K. Stelzer</td>
</tr>
<tr>
<td>19. Three-Dimensional Plant Cell Biology and Three-Dimensional Microscopy</td>
<td>Prof. Dr. E.H.K. Stelzer</td>
</tr>
<tr>
<td>20. Cell Communication, Cell Adhesion and Cell Motility</td>
<td>Prof. Dr. A. Starzinski-Powitz</td>
</tr>
<tr>
<td>21. Plant Cell Biology</td>
<td>Prof. Dr. E. Schleiff</td>
</tr>
<tr>
<td>22. Fungal Cell Biology</td>
<td>Prof. Dr. H. Osiewacz</td>
</tr>
<tr>
<td>23. Function and Evolution of Metabolic Pathways</td>
<td>Prof. Dr. I. Ebersberger</td>
</tr>
</tbody>
</table>
24 Special Aspects of Immunology  **PD Dr. Zoe Waibler
25 Developmental Genetics  Prof. Dr. D. Stainier
26 Cell Biology and Gene Expression Control  **Dr. J. Lausen
27 Endothelial Cells and Tumor Cell Biology  **Dr. B. Strilic
28 Principles of Tube Morphogenesis  **Dr. M. Nakayama
29 Developmental Cell Biology  Prof. Dr. V. Lecaudrey
30 Basics and Appliance of Image and Data Analysis in Biology  ***Dr. S. Fischer
31 Biology of Extracellular Vesicles  ** Dr. S. Momma
32 Special Aspects of Tumor Biology  **** Prof. Dr. K. Strebhardt, Dr. Y. Matthess
33 Cellular RNA Biology  Prof. Dr. M. Müller-McNicoll
34 Neuronal basis of acoustic communication in mammals  *****Dr. Julio Hechavarria, Prof. Dr. M. Kössl
35 Cellular, molecular and systemic Neurobiology in mouse and zebrafish  Prof. Dr. A. Acker-Palmer, Bettina Kirchmaier, Franziska Foss

Note:

* This module will take place under responsibility of Prof. Dr. W. Volknandt.

** This module will take place under responsibility of academic direction 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 academic direction of the Master Course.

*****This module will take place under responsibility of Prof. Dr. M. Kössl.
The module focuses on 3 parts:

1. Introduction to the master’s degree program: In a seminar the fields of cell biology and physical biology and the Institute of Cell Biology and Neuroscience will be presented. There are presentations of the master’s degree program and research projects within it as well as objectives, participating groups, the curriculum and an overview of elective and compulsory modules. The contents of elective modules will be presented by their module leaders. The intention is to teach students the form and content of the program and enable them to get to know fellow students and university teaching staff.

2. Basic Methods in Cell Biology: In a practical course of 8-9 weeks basic and standard molecular biological, protein biochemical, immunological, histological, cellular, biotechnical and microscopic work methods and techniques are taught. In the field of bioinformatics an introduction of mining public databases and knowledge of relational database systems will be given. The handling of genome and proteome data-base systems will be learned. The participants work out the theoretical background to different working methods and carry same out after familiarisation under scientific guidance and monitoring. They will be taught how to select suitable methods for use in defined scientific problems and fields of application and to critically evaluate them. The students will present and discuss their experimental results in the seminar.

3. The third part of the module focuses on the mediation and education of legal and ethical aspects in biosciences. The topics are: animal welfare law, the German embryo protection law, gene technology law, safety and operating instructions for S1 laboratories, gene technology safety regulation (GenTSV), (§12 Abs. 2 GenTSV), bio-substances regulation (BioStoffV), biological safety, rules of good scientific practice, basics in patent law. Animal welfare law: The theoretical and professional contents of this module part will be lectured on three days and correspond to the legal requirements of animal protection. The participation is obligatory. For the students it is obligatory to participate in safety instructions for S1 safety laboratories after § 12 Abs. 2 GenTSV. Lectures and Seminars to the aspects: Legal and ethical aspects in Biosciences are obligatory for the students, the participation has to be proved.

Educational Objectives / Competences

The intention is to teach students the form and content of the program and enable them to get to know fellow students and university teaching staff.

Students are taught knowledge of various experimental scientific work techniques, their theoretical bases and their evaluation. On completion of their practical course they will have some knowledge of basic molecular biological, protein biochemical, immunological, cell biology and microscopic work methods and the ability to apply same with the aid of work instructions. They will be taught how to select suitable methods for use in defined scientific problems and fields of application and to critically evaluate them. The get knowledge of legal and ethical aspects in biosciences. They will get the competence to plan their scientific experiments on consideration of the guidelines and rules of animal welfare law, the German embryo protection law, gene technology law, safety and operating instructions for S1 laboratories, gene technology safety regulation and biological safety as well as rules of good scientific practice.

Requirements for Participation

None

The module starts in the first part of winter term and is obligatory.

Recommended Requirements
Certificate of Performance

Presentation an experimental method in the seminar (20-40min)
Protocol (10-15) pages

Forms of Teaching

practical, lecture, seminar,

Language

English

Module Completion Test

Module Completion Test consists of:

<table>
<thead>
<tr>
<th>Form / Duration</th>
<th>Protocol (10-15) pages</th>
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</thead>
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Certificate of Performance

Presentation an experimental method in the seminar (20-40min)
Protocol (10-15) pages

Language

English

Module Completion Test

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Presentation an experimental method in the seminar (20-40min)
Protocol (10-15) pages

Language

English

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Certificate of Performance

Presentation an experimental method in the seminar (20-40min)
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English

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Module Completion Test consists of:

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<tr>
<th>Form / Duration</th>
<th>Protocol (10-15) pages</th>
</tr>
</thead>
</table>
Contents

Lecture series: Selected chapters to 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 will be lectured.

Seminar on the lecture on selected chapters of physical biology of cells and cell biology: Students will draft papers on original publications relevant to the lecture.

Colloquium: Students must participate in 7 cell biology / physical biology oriented colloquia at the Institute.

Educational Objectives / Competences

Students are taught a wide interdisciplinary basic knowledge in the fields of physical biology, cell biology, developmental biology, physiology as well as neurophysiology and the uses of same. They learn scientific research concepts, are enabled to link differing cell biology parts and paradigms with one another and to lecture on original publications.

Requirements for Participation

None

Recommended Requirements

Basic knowledge in cell biology and physical biology

Module Assignment (Studiengang / Fachbereich)

Master PBioC - FB 15

Applicability to other Course of Study

FB 15 master’s degree courses

Dates and Module Frequency

First and second part of winter term

Duration

2 days per week (90 min lecture and seminar)

Module Responsible

Head of the Master Degree Program

Proof of Study

Participation in Seminar, Lectures and Colloquia

Certificate of Performance

20-30 min presentation in the seminar

Forms of Teaching

lecture, seminar, colloquia, self-studies

Language

English

Module Completion Test

Examination / 45 min / Content: Topics of Lecture and Seminar

Module Completion Test consits of

<table>
<thead>
<tr>
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<td>Colloquia</td>
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</table>
Advanced Cell Biology II

Contents:
Lecture series: Selected chapters of cell biology of higher eukaryotes
Contents: Cellular, molecular and physiological 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 higher eukaryote cell biology chapter. Students will draft papers and lectures on original publications relevant to the lecture/s.
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.
Students will draft papers and lectures on original publications relevant to the lecture.
Colloquium: Participation in 7 Institute colloquia of cell biological orientation.

Educational Objectives / Competences
Students will be taught a wide knowledge of cell biology principles and their uses. They will learn cell biology research concepts employing various model organisms and are enabled to link differing cell biology parts and paradigms with one another. They will be enabled to lecture on original publications and discuss same.

Requirements for Participation
none

Recommended Requirements
Basic knowledge in cell biology

Module Assignment (Studiengang / Fachbereich) Master PBioC - FB 15
Applicability to other Course of Study FB 15 master’s degree courses
Dates and Module Frequency First and Second part of summer term
Duration 2 days per week (90 min lecture and seminar)
Module Responsible Head of the Master Degree Program

Proof of Study
Proof of Participation Participation in Seminar, Lectures and Colloquia
Certificate of Performance 20-30 min presentation in the seminar

Forms of Teaching
lecture, seminar, colloquia, self-studies

Language
English

Module Completion Test
Form / Duration Examination / 90 min / Content: Topics of Lecture and Seminars: Selected chapter’s higher eukaryote cell biology and molecular principles of vertebrate genetics.

Module Completion Test consists of

<table>
<thead>
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<th>Advanced Cell Biology II</th>
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<td>Lectures</td>
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<td>X</td>
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<td>Seminar</td>
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<tr>
<td>Colloquia</td>
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Master PBioC: Module Description, Status: January 2017 / Page 7
Current Concepts in Cell Biology

### Contents
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 current literature critical open questions are to be identified and research strategies for solving same developed. The research concept is to be drafted in the form of an application for third party subsidy.

### Educational Objectives / Competences
Students will be familiarized with developing scientific research concepts and integrating them in requests for subsidies from third parties when they have completed this module.

### Requirements for Participation
Passing the introductory module: 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. This project work can be generated in any cell biology working group in the master's degree course of the faculty of biosciences, FB 15, Goethe University and is not necessarily linked with the master's degree thesis.

### Recommended Requirements
Keine

### Module Assignnet (Studienang / Fachbereich)
Master PBioC - FB 15

### Applicability to other course of study
FB 15 master’s degree courses

### Dates and Module Frequency
at any time

### Duration
4-5 weeks, whole day

### Module Responsible
Head of the Master Degree Program

### Proof of Study
Proof of Participation: none
Certificate of Performance: Proof of having held a lecture in the seminar (20-30 min) and presentation the research concept.

### Forms of Learning
seminar, self-studies

### Language
English

### Module Completion Test
Module Completion Test consists of

<table>
<thead>
<tr>
<th>I.V.-Form</th>
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<td>12</td>
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### Form / Duration
Written research concept of 5-20 pages

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Contents
The module has the aim of so intensively teaching students the major experimental techniques in the subject in which they hope to gain a master’s degree that they are able to pass that degree in the time allowed.

Educational Objectives / Competences
Students will be familiarised with the practical principles directly related to their master’s degree thesis in the subject chosen when they complete the module. They will then be able to efficiently obtain methodological information from publications and the Internet and evaluate the feasibility of methodological approaches. They will also be able to criticise methods and evaluate artefacts.

Requirements for Participation
Successfully passing the introductory module: 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.

Recommended Requirements

Module Assignment (Studiengang / Fachbereich) Master PBioC - FB 15
Applicability to other course of study FB 15 master’s degree courses
Dates and Module Frequency Throughout the year; from the third master’s degree course semester (by agreement).
Duration 5-6 weeks
Module Responsible Head of the Master Degree Program
Proof of Study none
Certificate of Performance Presentation of 20-30 minutes, progress report in the working group
Forms of Learning practical course, seminar, self-studies
Language English
Module Completion Test Form / Duration Oral examination of 30 min

<table>
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<td>Modulprüfung: Oral Examination</td>
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</table>
Contents
In their master’s degree theses students deal within a time limit of six months with a problem set therein comprehensively and in depth applying scientific methods. Theses may involve experimental, empirical or analytical work. The results must be summarised in a written master’s degree thesis in the style of scientific publications. The quality of the performance rendered will be marked based on evaluation of the written work by the mentor and a second examiner.

Educational Objectives / Competences
- Teaching the ability to comprehensively deal with scientific problems in depth and classify the knowledge gained in extant literature.
- Teaching the drafting of written papers in the style of scientific publications.
- Teaching the practical application and evaluation of modern research methods.

Requirements for Participation
- Proof of having gained at least 90 CPs and having passed Advanced Methods in Cell Biology (module 5).
- The master’s degree thesis is usually mentored by a university teacher regularly rendering compulsory or selective module teaching events in the master’s degree course.

Recommended Requirements

Module Assignment (Studiengang / Fachbereich) Master PBioC - FB 15

Applicability to other course of study

Dates and Module Frequency The dates and frequency are pending

Duration 6 months

Module Responsible Head of the Master Degree Program

Proof of Study

Certificate of Performance 30 min presentation of Master Thesis in the working group

Forms of Learning seminar, self-studies

Language English

Module Completion Test:
Module Completion Test consists of

Form / Duration Written in master’s degree thesis form (the mark will be doubly weighted compared to that/those gained in all other modules).

<table>
<thead>
<tr>
<th>LV-Form</th>
<th>SWS</th>
<th>CP</th>
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<td>Sum</td>
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</tbody>
</table>
## Contents

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.

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.

## Educational Objectives / Competences

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.

## Recommended Requirements

none

## Special note:

None

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.

## Module Assignmet (Studiengang / Fachbereich)

Master Course of FB 15

## Applicability to other course of study

FB 15 master’s degree courses as well as Master in Interdisciplinary Neuroscience.

## Dates and Module Frequency

Annually in winter and summer term.

## Duration

4-5 weeks, whole time

## Module Responsible

A Head of the Master Degree Program

## Proof of Study

Proof of Participation: none

Certificate of Performance:

seminar lecture (20-30 min) on the results of own scientific studies with current literature

## Forms of Learning

practical course, seminar, self-studies

## Language

English

## Module completion test

Form / Duration

As indicated in the module description

<table>
<thead>
<tr>
<th>Form</th>
<th>SWS</th>
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<td>Module completion test: Protocol, Examination, Written Elaboration</td>
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</table>
### [MSc PBioC: 8]

**Module “Free Studies” for Students from the Master PBioC**

|---------------|-------------------|-----------|-------------|

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<th>Contents</th>
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<tbody>
<tr>
<td>The students get the possibility to choose an elective module from the Master Courses other faculties of the Goethe University.</td>
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</table>

<table>
<thead>
<tr>
<th>Educational Objectives / Competences</th>
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<tbody>
<tr>
<td>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.</td>
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<table>
<thead>
<tr>
<th>Recommended Requirements</th>
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<tbody>
<tr>
<td>none</td>
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</table>

**Special note:**
- Performance of the module needs the approval and agreement of the academic head of the Master Physical Biology of Cells and Cell Interactions.

**Module Assignment (Studienang / Fachbereich)**
- Master Course of FB 15

**Applicability to other course of study**

**Dates and Module Frequency**
- Annually in winter and summer term.

**Duration**
- 4-5 weeks, whole time

**Module Responsible**
- Head of the Master Degree Program

**Proof of Study**
- none

<table>
<thead>
<tr>
<th>Certificate of Performance</th>
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<tbody>
<tr>
<td>The regulations of the provider, module leader will be applied.</td>
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</table>

**Forms of Learning**
- practical course, seminar, self-studies

**Language**
- English

<table>
<thead>
<tr>
<th>Module completion test</th>
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<tbody>
<tr>
<td><strong>Form / Duration</strong></td>
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<td>The regulations of the provider, module leader will be applied.</td>
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<td>Module completion test: Protocol, Examination, Written Elaboration</td>
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| Sum | 11 | 11 |

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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.

## Educational Objectives / Competences

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.

## Recommended Requirements

none

## Special note

Lectures and protocol in English. The module is an external one which can replace an obligatory choice module in Appendix 4 and requires the agreement of the PA or academic management of the master’s degree course concerned. It is an extension of the modules in the Physical Biology of Cells and Cell Interactions master’s degree course and is co-supervised by a university teacher of Physical Biology of Cells and Cell Interactions master’s degree course. 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.

## Module Assignmet (Studiengang / Fachbereich)

Master Course of FB 15

## Applicability to other course of study

### Dates and Module Frequency

Annually in winter and summer term

### Duration

4-5 weeks, whole time

### Module Responsible

Head of the Master Degree Program

### Proof of Study

none

### Certificate of Performance

The regulations of the provider, module leader will be applied, seminar lecture (20-30 min) on the results of own scientific studies with current literature

### Forms of Learning

practical course, seminar, self-studies

### Language

English

## Module completion test

**Form / Duration**

The regulations of the provider, module leader will be applied. A practical protocol of 10-30 pages must be drafted.

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Master PBioC: Module Description, Status: January 2017 / Page 13
Cell Biology and Physiology of Signal Transfer

This module will be terminated at winter term 2017!

Elective Module

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Contents

The practical course teaches basic cellular and molecular techniques of cell- and neurobiology. The students will be supervised during the work on their own projects, quantitative and qualitative data analysis and will document their results in a written protocol. At the end of the individual experiments results will be presented in an oral communication. Moreover, the students will present an original paper in the framework of cellular and molecular neurobiology in a seminar talk. By the appropriate creation of a results protocol they will learn the configuration of scientific work. Focuses are: proteinbiochemical methods to study the function of neurons including subcellular fractionation and immunodetection, basis of neuronal cell cultures work, immunocytoology of cultured cells including digital image processing, cell culture, proliferation and differentiation of cell lines, fluorescence microscopy.

Educational Objectives / Competences

Cellular and molecular techniques in cell biology and neurobiology (detailed above), skills fort the isolation of neuronal cell organelles, self-dependent characterization of organellar proteins, sterile work and culturing of cells, self-dependent work at the fluorescence microscope and computer-based evaluation of experimental data and image processing (CS Photoshop, Illustrator), self-dependent processing of data, written standard report and presentation of scientific questions in relation to the relevant literature.

Recommended Requirements

none

Special note

none

Module Assignment (Studiengang / Fachbereich)

Master Course of FB 15

Applicability to other course of study

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.

Dates and Module Frequency

Annually in the first part of winter term.

Duration

4-5 weeks, whole time

Module Responsible

Prof. Dr. W. Volknandt

Proof of Study

none

Certificate of Performance

seminar lecture (20-30 min) on the results of own scientific studies with current literature

Forms of Learning

practical course, seminar, self-studies

Language

English

Module completion test

Form / Duration

A protocol of 10-30 pages must be drafted.

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**Contents**

The practical course teaches cellular and molecular techniques of cell- and neurobiology with a focus on the proliferation and differentiation behavior of neural stem cells derived from neurogenic niches of adult mouse. The students will be supervised during the work on their own projects, quantitative and qualitative data analysis and will document their results in a written protocol. At the end of the individual experiments results will be presented in an oral communication.

Moreover, the students will present an original paper in the framework of cellular neurobiology in a seminar talk.

Focuses: cell culture of stable stable transfected cell lines, knockdown by RNA interference,, cell transfection (lipofection, electroporation), cultivation, proliferation and differentiation primary neural stem cells, making of cryosections, immunocyto- and enzymehistochemical methods, genotyping of transgenic mice, fluorescence microscopy

**Educational Objectives / Competences**

Cellular and molecular techniques in cell biology and neurobiology (detailed above), computer-based evaluation of experimental data and image processing (CS Photoshop, Illustrator), knowledge about laboratory animals (mouse), self-dependent processing of data, written standard report and presentation of scientific questions in relation to the relevant literature.

**Recommended Requirements**

none

**Special note**

none

**Module Assignmet (Studiengang / Fachbereich)**

Master Course of  FB 15

**Applicability to other course of study**

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

**Dates and Module Frequency**

Annually in the first part of summer term

**Duration**

4-5 weeks, whole time

**Module Responsible**

Dr. K. Gampe

This module will be on responsibility of Prof. Dr. W. Volkmannt

**Proof of Study**

**Proof of Participation**

none

**Certificate of Performance**

seminar lecture (20-30 min) on the results of own scientific studies with current literature

**Forms of Learning**

practical course, seminar, self-studies

**Language**

Englisch

**Module completion test**

**Form / Duration**

A practical protocol of 10-30 pages must be drafted
Contents
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.

Educational Objectives / Competences
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.

Recommended Requirements
none

Special note
none

Module Assignment (Studiengang / Fachbereich)
Master Course of FB 15

Applicability to other course of study
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.

Dates and Module Frequency
Twice per year in the winter and summer semester, each in the first half; 4 weeks of block practicals with seminars.

Duration:
4-5 weeks, whole time

Module Responsible
Prof. Dr. M. Kössl, PD Dr. M. Nowotny

Proof of Study
none

Certificate of Performance
Written practical protocol, 1 seminar talk on the results of one’s own experiments, 1 seminar talk on recent scientific papers.

Forms of Learning
practical course, seminar, self-studies

Language
English

Module completion test
Form / Duration
A protocol of 10-30 pages must be drafted

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Auditory Function and Dysfunction: Behavior and Physiology

Contents
The practical teaches techniques to determine auditory function and dysfunction in rodents. These techniques can be used to determine effects of pharmacological or behavioral treatments of sensory disorders such as tinnitus or hearing loss. The focus is on behavioral 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 behavioral 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 analyzing behavioral 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.

Educational Objectives / Competences
Familiarity with carrying out well controlled behavioral experiments (animal handling, measuring and analyzing behavioral 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.

Recommended Requirements
none

Requirements for participation
none

Module Assignmet (Studiengang / Fachbereich)
Masterstudiengang des FB 15

Applicability to other course of study
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

Dates and Module Frequency
Annually in the first part of summer term

Duration
4-5 weeks, whole day

Module Responsible
PD Dr. B. Gaese

Proof of Study

Proof of Participation
none

Certificate of Performance
20-30 min presentation in the seminar

Forms of Learning
practical course, seminar, self-studies

Language
English

Module completion test
A protocol of 10-30 pages must be drafted

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### Contents

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 analyzed with the goal to understand behavioral 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 analyzing 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.

### Educational Objectives / Competences

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 behavioral 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 behavior. Deriving scientific questions from the current literature.

### Recommended Requirements

Keine

### Requirements for participation

Keine

### Module Assignment (Studiengang / Fachbereich)

Master PBioC - FB 15

### Applicability to other course of study

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

### Dates and Module Frequency

Annually in the first part of summer term

### Duration

4-5 weeks, whole day

### Module Responsible

PD Dr. B. Gaese

### Proof of Study

Proof of Participation: none

### Certificate of Performance

20-30 min presentation in the seminar

### Forms of Learning

practical course, seminar, self-studies

### Language

English

### Module completion test

Form / Duration

A protocol of 10-30 pages must be drafted

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Contents
The practical course offers basic theoretical and experimental knowledge in the area of developmental neurobiology. Principal areas of research are the development and plasticity of the synapse as well as migration of neurons during cortex development. The students take part in ongoing experiments in the laboratory to elucidate the molecular mechanisms of these processes. Their work includes: basic mouse genetics techniques and the handling of a mouse colony, processing of brain tissue for in situ hybridization and immunohistochemistry, isolation of primary hippocampal and cortical neurons from mice, transfection of primary neurons, immunofluorescence microscopy, confocal microscopy, biochemical techniques including protein gel electrophoresis, western blot and immunoprecipitation.

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 in the weekly lab meetings where they learn about the ongoing research of all the members of the group. In a Journal Club every student presents a recent publication on the field of their own projects.

Educational Objectives / Competences
Students learn the basic techniques to study cellular and molecular Neurobiology (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.

Recommended Requirements

Requirements for participation

Module Assignmet (Studiengang / Fachbereich) Master PBioC - FB 15
Applicability to other course of study 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
Dates and Module Frequency winter and summer term
Duration 4-5 weeks, whole day
Module Responsible Prof. Dr. A. Acker-Palmer
Proof of Study none

Certificate of Performance

Forms of Learning practical course, seminar, self-studies
Language English

Module completion test
Form / Duration A protocol of 10-30 pages must be drafted

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Contents:

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, behaviour experiments (behavioural pharmacology, learning and memory). Model organisms are insects, mainly the honey-bee. Conceptional focusses are: function of ion channels and transmitter receptors, neuromodulation, learning behaviour, olfaction, social behaviour of honeybees.

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.

The students will be responsible – under supervision – for the study design, protocoling and analysing the original data. Each step will be developed during the course rather than working after a pre-defined protocol.

Educational Objectives / Competences

Planning, conducting and analyzing of behavioral physiological experiments; measuring of ionic currents; behavioural observations and quantifications; neuroanatomical methods. Approaching scientific topics; literature work. Preparing of scientific texts, posters and talks.

Requirements for Participation

none

Recommended Requirements

none

Module Assignmet (Studiengang / Fachbereich) Master PBioC - FB 15

Applicability to other course of study 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

Module Frequency First half of winter and first half of summer term

Duration 4-5 weeks, whole day

Module Responsible Prof. Dr. B. Grünewald

Proof of Study

Proof of Participation none

Certificate of Performance 20-30 min presentation in the seminar to the experimental results of the scientific studies

Forms of Learning

Language English

Module Completion Test

Module Completion Test consists of

Form / Duration A protocol of 10-30 pages must be drafted

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Contents:
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 tumor cell lines, primary cells as well as stem cells, are cultivated and analyzed 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.

Educational Objectives / Competences
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 be 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 in written report and a talk.

Requirements for Participation
None

Recommended Requirements
Our parts of the lecture „Advanced cell biology“

Module Assignment (Studienang / Fachbereich)
Master PBioC - FB 15

Applicability to other course of study
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

Module Frequency
Annually in summer term

Duration
5 weeks, daily

Module Responsible
Prof. Dr. E.H.K. Stelzer

Proof of Study
Proof of Participation
None

Certificate of Performance
presentation in the seminar to the experimental results of the scientific studies, 5 min presentation to introduce the project, 15 min (+5 min discussion) talk

Forms of Learning
Practical, seminar, self-studies

Language
English

Module Completion Test
Module Completion Test consists of
Internship report, protocol of 15-30 pages.

Cumulative Module Completion Test consists of
None

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Contents:

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 Drosophila melanogaster. 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 Tribolium castaneum is used since its embryogenesis deviates substantially from that of Drosophila 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.

Educational Objectives / Competences

The student learns the principles of insect model organisms, such as Tribolium castaneum, 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 Tribolium as well as preparation methods for confocal and light sheet-based fluorescence microscopes, in the context of long-term live imaging of Tribolium embryos in toto. The student analyzes the data and understands the basics of scientific image processing and the embryonic development of Tribolium. 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.

Requirements for Participation

none

Recommended Requirements

Our parts of the lecture „Advanced cell biology“

Module Assignment (Studienang / Fachbereich)

Master PBioC - FB 15

Applicability to other course of study

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

Module Frequency

Summer and winter term

Duration

5 weeks, daily

Module Responsible

Prof. Dr. E.H.K. Stelzer

Proof of Study

Proof of Participation

none

Certificate of Performance

presentation in the seminar to the experimental results of the scientific studies, 5 min presentation to introduce the project, 15 min (+5 min discussion) talk

Lehr- / Lernformen

Practical, seminar, self-studies

Unterrichts- / Prüfungssprache

English

Module Completion Test

Module Completion Test consists of

Internship report, protocol of 15-30 pages.

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Contents:
This internship teaches the principles of plant cell biology. A focus is the application of advanced three-dimensional fluorescence microscopy as a function of time. Developmental processes of biological specimens are performed under close-to-physiological conditions. The plants are oriented upwards during long-term observations. Their roots are perfused with ideal media while the leaves remain in the air. Additionally, we have full control over light, temperature, and the nutrient supply in our light sheet-based fluorescence microscopes (LSFM). The intrinsic properties of LSFM are high tempo-spatial resolution and low photo toxicity, which enable the observation of plant development on a cellular level in a three-dimensional, almost physiological environment over days without destroying the plant nor leading towards artificial stress responses. Besides LSFM, further microscopic techniques such as confocal and super resolution microscopy are applied based on the experimental question. Another focus is basic scientific image processing and advanced image analysis to handle the large amount of data, which results from LSFM. The interns work under guidance on their own individual project based on current 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 talk under the guidance of their advisor.

Educational Objectives / Competences
The student learns the principles and basic terms of plant cell biology. He or she knows current questions in developmental biology of plants and understands the handling of 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 knows the laboratory cultivation of plants as well as the preparation methods of plant specimens for long-term observations with a LSFM. Therefore, she or he has practical experience in the recording of dynamic processes at the cellular or subcellular level at high temporal resolution on a long-term scale. The student analyzes the data and applies basic scientific image processing for developmental aspects of *A. thaliana* (lateral root development).

The interns work under guidance on their own individual project based on current 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 talk under the guidance of their advisor.

Requirements for Participation

none

Recommended Requirements

Our parts of the lecture „Advanced cell biology“

Module Assignment (Studienangang / Fachbereich)

Master PBioC - FB 15

Applicability to other course of study

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

Module Frequency

summer and winter term

Duration

5 weeks, daily

Module Responsible

Prof. Dr. E.H.K. Stelzer

Proof of Study

none

Certificate of Performance

presentation in the seminar to the experimental results of the scientific studies, 5 min presentation to introduce the project, 15 min (+5 min discussion) talk

Lehr- / Lernformen

Practical, seminar, self-studies

Unterrichts- / Prüfungssprache

Englisch

Module Completion Test

Form / Duration / (Contents)
Internship report, protocol of 15-30 pages.

Cumulative Module Completion Test consists of

none
Contents:
The practical course offers basic theoretical and experimental knowledge in the area of molecular cell biology and specific questions to cell communication, cell adhesion and motility of cells in culture and organisms.
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.
Educational objectives are the handling and work with eukaryotic cell cultures e.g. passaging of cells, cell transfection for ectopic expression and knockdown of proteins.
The analysis comprises a broad spectrum of molecular biological and immunocytochemical techniques e.g. PCR, plasmid cloning, SDS-polyacrylamide gel electrophoresis, western blotting, immunofluorescence staining and microscopy of tissue sections and cells as well as performing tis-sue sections for histological analysis.
Experimental data will be digital recorded and analyzed.
Mining of public literature databases (PubMed) and the handling of genome and proteome data-base systems will be learned. 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 presents a recent publication on the field cell biology in context of their own projects.

Educational Objectives / Competences
Students learn the basic techniques for cellular and molecular biology (as detailed above). They will get practical experience in sterile working with eukaryotic cells. At the end of the course they will be able to work with cell cultures for further analysis.
Students will be familiarized with scientific literature and learn how to write, communicate and present their results in English.

Requirements for Participation
none

Recommended Requirements
none

Module Assignment (Studienang / Fachbereich) Master PBioC - FB 15

Applicability to other course of study 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

Module Frequency Annually in winter term

Duration 4-5 weeks, daily

Module Responsible Prof. Dr. A. Starzinski-Powitz

Proof of Study

Proof of Participation none

Certificate of Performance 20-30 min presentation in the seminar to the experimental results of the scientific studies, protocol 10-30 pages

Lehr- / Lernformen Practical, seminar, self-studies

Unterrichts- / Prüfungssprache English

Module Completion Test

Module Completion Test consists of Poster

Cumulative Module Completion Test consists of none

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MSc PBioC: 20

Cell Communication, Cell Adhesion and Cell Motility

This module will be terminated at winter term 2018!

Elective Module


Self-studies [165h]
Contents:
The practical course teaches basic techniques and experimental concepts of molecular cell biology and special questions of cellular and molecular aspects of plant physiology.

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.

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.

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.

Educational Objectives / Competences

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.

Requirements for Participation

none

Recommended Requirements

none

Module Assignment (Studiengang / Fachbereich)

Master PBioC - FB 15

Applicability to other course of study

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

Module Frequency

Annually in summer term

Duration

4-5 weeks, daily

Module Responsible

Prof. Dr. E. Schleiff

Proof of Study

Proof of Participation

none

Certificate of Performance

Protocol (10-30 pages), Poster 20-30 min presentation in the seminar to the experimental results of the scientific studies, poster presentation

Lehr- / Lernformen

Practical, seminar, self-studies

Unterrichts- / Prüfungssprache

English

Module Completion Test

Module Completion Test consists of

Form / Duration / (Contents)

Examination of 45 min to the practical course, experimental results and current literature

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## Contents:


## Educational Objectives / Competences

Die oder der Studierende erhält theoretische Kenntnisse der Grundtechniken und Methoden molekularbiologischer, biochemischer und zellbiologischer Arbeiten. Erfahrungen im sterilen, mikrobiologischen Arbeiten sind erwünscht, werden aber im Verlaufe des Praktikums auch routinemäßig vermittelt. Im Praktikum wird der Umgang mit englischsprachiger Originalliteratur erlernt und praktiziert.

## Requirements for Participation

Keine

## Recommended Requirements

Keine

## Module Assignment (Studiengang / Fachbereich)

Masterstudiengang des FB 15

## Applicability to other course of study

Alle Masterstudiengänge FB15 zusammen mit Ergänzungsteil aus Modul 7 [Module for students from other Masters (Modul für Master anderer Masterstudiengänge)] sowie Master in Interdisciplinary Neuroscience

## Module Frequency

Jährlich im Sommersemester

## Duration

4-5 Wochen ganztägig

## Module Responsible

Prof. Dr. H. Osiewacz

## Proof of Study

Proof of Participation

Certificate of Performance

Halten eines 20-30 minütigen Seminarvortrags zu den Ergebnissen der eigenen Experimente und über aktuelle Literatur

## Forms of Learning

Praktikum, Seminar, Selbststudium

## Language

Englisch

## Module Completion Test

Form / Dauer / ggf. Inhalt

Praktikumsprotokoll mit einem Umfang zwischen 10-30 Seiten,

## Forms of Learning

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**Contents:**

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.

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.

**Educational Objectives / Competences**

Independent conduct of functional annotation of sequences, of bioinformatics annotation transfer and of prediction of functionally equivalent proteins under consideration of evolutionary relationships; 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.

**Requirements for Participation**

none

**Recommended Requirements**

none

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<th>Module Assignment (Studiengang / Fachbereich)</th>
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<td>Prof. Dr. I. Ebersberger</td>
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<td>Protocol (10-30 pages) or poster</td>
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Contents
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.
In vitro experiments with murine organs and the isolation of murine primary cells will be learned and performed.
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.

Educational Objectives / Competences
The students will learn to plan and to perform complex immunological experiments.
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.

Requirements for Participation
none

Recommended Requirements
none

Module Assignmet (Studiengang / Fachbereich)  Master PBioC - FB 15

Applicability to other course of study  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

Module Frequency  Annually in summer term an winter term

Duration  4-5 weeks, daily

Module Responsible  PD Dr. Z. Waibler
This module will be performed under responsibility of the academic guidance of the Master Course.

Proof of Study

Proof of Participation

Certificate of Performance  20-30 min presentation in the seminar to the experimental results of the scientific studies

Forms of Learning  Practical, seminar, self-studies

Language  English

Module Completion Test  Protocol (10-30 pages)

Form / Duration

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Module Completion Test

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Master PBioC: Module Description, Status: January 2017 / Page 29

Contents:
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).

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.

Educational Objectives / Competences
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.

Requirements for Participation
none

Recommended Requirements
none

Module Assignmet (Studiengang / Fachbereich)
Master PBioC - FB 15

Applicability to other course of study
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

Module Frequency
Annually in summer and winter term

Duration
4-5 weeks, daily

Module Responsible
Prof. Dr. D. Stainier

Proof of Study

Proof of Participation
none

Certificate of Performance
20-30 min presentation in the seminar to the experimental results of the scientific studies

Forms of Learning
Practical, seminar, self-studies

Language
English

Module Completion Test

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Sum
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Module Completion Test

Protocol (10-30 pages)
Contents:
This practical course offers basic theoretical and experimental techniques in the field of cell-and molecular biology with the focus of the control of gene expression via transcription factors and micro RNA’s. The students work in the lab on their own project under scientific advice. Topics of interest are control of gene expression, epigenetics and tumor biology.

The students learn the handling and work with eukaryotic cell cultures e.g. passaging of cells, cell transfection for ectopic expression and knockdown of proteins. In addition basic molecular techniques e.g. PCR, molecular cloning, SDS-PAGE and Western Blotting will be performed.

The students will learn to document their results in a lab book. 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 presents a recent publication on the field cell biology in context of their own projects.

Educational Objectives / Competences
Students learn the basic techniques for cellular and molecular biology (as detailed above). They will get practical experience in sterile working with eukaryotic cells. At the end of the course they will be able to work with cell cultures for further analysis. Students will be familiarized with scientific literature and learn how to write, communicate and present their results in English.

Requirements for Participation
none

Recommended Requirements
none

Module Assignment (Studiengang / Fachbereich)
Master PBioC - FB 15

Applicability to other course of study
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

Module Frequency
Annually in summer term and winter term

Duration
4-5 weeks, whole day

Module Responsible
Dr. J. Lausen
This module will be performed under responsibility of the academic guidance of the Master Course.

Proof of Study:

Proof of Participation
none

Certificate of Performance
20-30 min presentation in the seminar to the experimental results of the scientific studies

Forms of learning
Practical, seminar, self-studies

Language
English

Module Completion Test

Module Completion Test consists of

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<td>Protocol: 10-30 pages</td>
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Contents:
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 tumor 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.

Educational Objectives / Competences
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.

Requirements for Participation
none

Recommended Requirements
none

Module Assignment (Studiengang / Fachbereich) Master PBioC - FB 15

Applicability to other course of study 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

Module Frequency Annually in summer term

Duration 4-5 weeks, daily

Module Responsible Prof. Dr. B. Strilic
This module will be performed under responsibility of the academic guidance of the Master Course.

Proof of Study

Proof of Participation none

Certificate of Performance 20-30 min presentation in the seminar to the experimental results of the scientific studies

Forms of learning Practical, seminar, self-studies

Language English

Module Completion Test

Module Completion Test consists of Protocol (10-30 pages)

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Contents:
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.

Educational Objectives / Competences
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.

Requirements for Participation
none

Recommended Requirements
none

Module Assignment (Studiengang / Fachbereich)
Master PBioC - FB 15

Applicability to other course of study
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

Module Frequency
Annually in summer and winter term

Duration
4-5 weeks, daily

Module Responsible
Dr. M. Nakayama
This module will be performed under responsibility of the academic guidance of the Master Course.

Proof of Study

Proof of Participation
none

Certificate of Performance
20-30 min presentation in the seminar to the experimental results of the scientific studies

Lehr- / Lernformen
Practical, seminar, self-studies

Unterrichts- / Prüfungssprache
English

Module Completion Test
Module Completion Test consists of

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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. 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.

Educational Objectives / Competences
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.

Requirements for Participation
none

Recommended Requirements
none

Module Assignment (Studiengang / Fachbereich) Master PBioC - FB 15
Applicability to other course of study 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

Module Frequency Annually in summer and winter term
Duration 4-5 weeks, daily
Module Responsible Prof. Dr. V. Lecaudey

Proof of Study

Certificate of Performance 20-30 min presentation in the seminar to the experimental results of the scientific studies

Lehr- / Lernformen Practical, seminar, self-studies

Unterrichts- / Prüfungssprache English

Module Completion Test Protocol (10-30 pages)

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Master PBioC: Module Description, Status: January 2017 / Page 33
Basics and Appliance of Image and Data Analysis in Biology

Contents
The internship provides the basics of image and data analysis of light microscopy images. In the Life Sciences, two and three-dimensional, time-lapse light microscopy has been established as a fundamental tool. To extract objective measurements from the images as required e.g. for cell and developmental biology, a quantitative analysis of the images is essential. This requires the application of image filtering, image segmentation and feature extraction. The main challenge is to determine the measurements that are relevant for a given biological question. The results are visualised and analysed statistically by applying hypothesis testing, data smoothing or regression analysis. Standard software tools like ImageJ or Mathematica are used during the project. The students work under guidance on current research topics of the Stelzer group. They summarise their results in a report and present them as a talk.

Educational Objectives / Competences
The student studies basic concepts of image and data analysis. She or he knows the common steps of an image processing pipeline. She or he understands the basic concepts of classical microscopy (resolution, aperture) as well as photometry (energy, power). The student learns 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 application of existing image and data analysis tools as well as visualisation software (e.g. Arivis’ 3DVision). Furthermore, the student has practical experience in programming image and data analysis applications. At the end of the module the student presents the results in a talk.

Requirements for Participation
Relevant parts of the lecture „Advanced cell biology“

Recommended Requirements

Module Assignment (Studiengang / Fachbereich) Master PBioC - FB 15
Applicability to other course of study 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
Module Frequency Annually in summer and winter term
Duration 4-5 weeks, daily
Module Responsible Dr. S. Fischer
This module will be performed under responsibility of Prof. Dr. E. H. K. Stelzer.
Proof of Study
Proof of Participation keine
Certificate of Performance 15 min presentation in the seminar to the experimental results of the scientific studies and 5 min discussion
Forms of Learning Practical, seminar, self-studies
Language English
Module Completion Test
Module Completion Test consists of

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Master PBioC: Module Description, Status: January 2017 / Page 34
Contents
Extracellular vesicles are released membrane vesicles from all cells which contain functional proteins as well as nucleic acids. The communication between cells via extracellular vesicles is a relatively new and complex field of research.
In the practical course the students will get an introduction to extracellular vesicles.
Main points are the aspects of purification, classification, analysis of RNA-Protein content as well as visualization and transfer analysis of functional molecules between cell populations in vitro and in vivo.
The students will work with different cell culture techniques, immunofluorescence microscopy, flow cytometric analysis and other related techniques.

Educational Objectives / Competences
The students will get knowledge and first experience in the field of Biology with extracellular vesicles and the communication via extracellular vesicles. They learn basic techniques to work with vesicles and they will learn to analyze the biological function. Students will be familiarized with scientific literature and learn how to write, communicate and present their results in English.

Requirements for Participation
none

Recommended Requirements
none

Module Assignment (Studiengang / Fachbereich) Master PBioC - FB 15

Applicability to other course of study 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

Module Frequency Annually in summer and winter term

Duration 4-5 weeks, daily

Module Responsible Dr. Stefan Momma
This module will be performed under responsibility of the academic guidance of the Master Course.

Proof of Study

Proof of Participation none

Certificate of Performance 20-30 min presentation in the seminar to the experimental results of the scientific studies

Forms of Learning Practical, seminar, self-studies

Language English

Module Completion Test Form / Duration Poster or Protocol (10-30 pages)

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Master PBioC: Module Description, Status: January 2017 / Page 35
The practical course gives a basic insight into experimental techniques and concepts of molecular tumor biology and to special scientific questions to cell cycle regulation and the function of protein kinases in tumor 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. Experimental educational objectives of the internship are the handling of tumor cells, culturing, passaging and transfections of tumor cells with expression plasmids. A main focus of the working group is the generation, planning and implementation of knockdown (RNAi)- and knockout (CRISPR/Cas9-Genome Editing, Homologous Recombination-) in cells and model systems in tumor research. Ongoing experiments and analysis include techniques of molecular biology, PCR, DNA cloning, SDS-PAGE, Western Blotting, Co-Immunoprecipitation, Kinase Assays, and Time-lapse experiments with established cell lines in culture. In addition the interaction of tumor proteins in cell lysates will be characterized by Mass-Spectrometry. Animal models (Xenograft, transgene tumor models) will be used for in vivo-questions. The experimental results will be presented by each student in a seminar at the end of the internship.

Educational Objectives / Competences

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 tumor biology and in context of their own projects.

Requirements for Participation

Recommended Requirements

Module Assignment (Studiengang / Fachbereich) Master PBioC - FB 15
Applicability to other course of study 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
Module Frequency Annually in summer and winter term
Duration 4-5 weeks, daily
Module Responsible Prof. Dr. K. Strebhardt, Dr. Y. Matthess
This module will be performed under responsibility of Prof. Dr. K. Strebhardt and the academic guidance of the Master Course.

Proof of Study

Proof of Participation
Certificate of Performance 20-30 min presentation in the seminar to the experimental results of the scientific studies
Forms of Learning Practical, seminar, self-studies
Language English

Module Completion Test
Module Completion Test consists of
Form / Duration Poster or Protocol (10-30 pages)

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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. Other techniques comprise immunofluorescence microscopy, PCR, western Blotting, DNA-cloning, mutagenesis of proteins, subcellular fractionation and differentiating of cells.

Educational Objectives / Competences
Students will be familiarized with scientific literature; will have additional knowledge in RNA biology and special methods of transcript analysis. 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.

Requirements for Participation
none

Recommended Requirements

Module Assignmet (course /department)
Master PBioC - FB 15

Applicability to other course of study
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

Module Frequency
Annually in summer and winter term

Duration
5-6 weeks, daily

Module Responsible
JP Michaela Müller-McNicoll (PhD)

Proof of Participation
Certificate of Performance
20-30 min presentation in the seminar to the experimental results of the scientific studies

Forms of Learning
Practical, seminar, self-studies

Language
English

Module Completion Test
Module Completion Test consists of
Protocol (10-30 pages)

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Contents

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 behaviorally 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.

Educational Objectives / Competences

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, analog-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).

Recommended Requirements

none

Requirements for participation

none

Module Assignment (course /department) Master PBioC - FB 15

Applicability to other course of study 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

Dates and Module Frequency

Once a year, summer semester

Duration

5 weeks, whole day

Module Responsible

Dr. Julio Hechavarria / Prof. Dr. Manfred Kössl

Proof of Study

Proof of Participation

Regular participation

Certificate of Performance

1 seminar presentation on the results of one’s own experiments, 1 seminar presentation on recent scientific papers, work report

Forms of Learning

Practical, self-study

Language

English

Module completion test

Form / duration / content (if applicable)

Graded Protocol or exam (45min)

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Cellular, molecular and systemic Neurobiology in mouse and zebrafish

Elective module

11 CP = 330 h

11 SWS

Contact study
11 SWS / 165 h
Self-study
165 h

Contents

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.

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 light microscopy as well as zebrafish embryo manipulation and basic behavioral tests.

Objectives

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.

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)

Master PBioC - FB 15

Suitable for other courses

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

Times offered

Once per year; summer semester

Duration

4 weeks

Person in charge

Prof. Amparo Acker-Palmer, Bettina Kirchmaier, Franziska Foss

Confirmation of completion

Regular participation

Course assessment

1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report

Teaching forms

Practical, self-study

Tuition language

English

Module exam

Form / duration / content (if applicable)

Module completion exam

Graded protocol

Teaching forms

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