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# Background Modules

## neu150 - Visual Neuroscience - Anatomy

<table>
<thead>
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<th>Visual Neuroscience - Anatomy</th>
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<tr>
<td>Credit points</td>
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<tr>
<td>Workload</td>
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**Applicability of the module**
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Molecular Biomedicine (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

**Responsible persons**
- Janssen-Bienhold, Ulrike (Module responsibility)
- Dedek, Karin (Module counselling)
- Janssen-Bienhold, Ulrike (Authorized examiners)
- Dedek, Karin (Authorized examiners)

**Prerequisites**
attendance in pre-meeting

**Skills to be acquired in this module**
- Neurosci. knowl. Expt. methods Independent research + Scient. literature + Social skills
- Interdiscipl. knowl. Mathe/Stats/Progr. + Data present./disc. + Scientific English Ethics
- Theory: Improved theoretical and methodological knowledge in neurobiology. Discussion of scientific work and presentation of own results.
- Practice: Performing neuroanatomical experiments. Gaining modern methodological skills.

**Module contents**
- Lecture: 14 h Introduction to current neurobiological approaches and results.
- Seminar: 14 h Discussion of background literature and results of own experiments.
- Lab course: 3 weeks, each 24 h neuroanatomical experiments in small groups on vertebrate retina and brain.

**Reader's advisory**
Background and seminar literature will be available in Stud.IP

**Links**
- Language of instruction: English
- Duration (semesters): 1 Semester
- Module frequency: jährlich
- Module capacity: unlimited
- Reference text: Course in the first half of the semester Regular active participation and presentation(s) within the scope of the seminar are required to pass the module

**Modullevel / module level**
BC (Basiscurriculum / Base curriculum)

**Modulart / typ of module**
je nach Studiengang Pflicht oder Wahlpflicht

**Vorkenntnisse / Previous knowledge**

<table>
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<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
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<tr>
<td>Final exam of module</td>
<td>summer semester, first half</td>
<td>Portfolio (75 %), report (25%)</td>
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<td>Seminar</td>
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**Total time of attendance for the module**
70 h
### neu210 - Neurosensory Science and Behaviour

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<td>Workload</td>
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<td>4 SWS Lecture (VO) “Neuroethology” and “Behavioural ecology”</td>
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<td>Total workload 180h: 56h contact/ 60h background reading/ 64h exam preparation</td>
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<td>2 SWS Seminar (SE) “Current issues of ethology”</td>
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<td>Total workload 90h: 28h contact/ 30h literature reading/ 32h preparation</td>
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<td>Applicability of the module</td>
<td>- Master's Programme Biology (Master) &gt; Background Modules</td>
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<td></td>
<td>- Master's Programme Biology (Master) &gt; Background Modules</td>
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<td></td>
<td>- Master's Programme Neuroscience (Master) &gt; Background Modules</td>
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<tr>
<td>Responsible persons</td>
<td>Klump, Georg Martin (Module responsibility)</td>
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<td></td>
<td>Langemann, Ulrike (Module counselling)</td>
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<td></td>
<td>Mouritsen, Henrik (Module counselling)</td>
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<td></td>
<td>Feenders, Gesa (Module counselling)</td>
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<tr>
<td></td>
<td>Klump, Georg Martin (Authorized examiners)</td>
</tr>
<tr>
<td></td>
<td>Mouritsen, Henrik (Authorized examiners)</td>
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<tr>
<td></td>
<td>Langemann, Ulrike (Authorized examiners)</td>
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<tr>
<td></td>
<td>Feenders, Gesa (Authorized examiners)</td>
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<tr>
<td>Prerequisites</td>
<td>Fundamentals of Neurobiology, Behavioral Biology, Evolution, Ecology</td>
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<tr>
<td>Skills to be acquired in this module</td>
<td>++ Neurosci. knowlg. + Expt. methods + Independent research + Scient. literature + Social skills</td>
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<td></td>
<td>++ Interdiscipl. knowlg. Maths/Stats/Progr. + Data present./disc. + Scientific English Ethics</td>
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<tr>
<td></td>
<td>Upon successful completion of this course, students</td>
</tr>
<tr>
<td></td>
<td>- know the fundamentals of behavioural ecology and neuroethology</td>
</tr>
<tr>
<td></td>
<td>- are able to present and critically assess scientific data and approaches</td>
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<tr>
<td>Module contents</td>
<td>The lecture “Neuroethology” provides an introduction to the mechanisms underlying the behaviour of animals. Subjects are, e.g., the mechanisms of perception, control of movement patterns, mechanisms of learning, orientation and navigation. The lecture “Behavioural ecology” provides an introduction to topics such as predator-prey interactions, optimal food utilization, spatial and temporal distribution of animals, social relations and group formation, mating systems and reproductive strategies, sexual selection, investment of parents in offspring, and communication. In the seminar “Current issues of Ethology”, current original literature relating to behavioural biology is reported and discussed.</td>
</tr>
<tr>
<td>Links</td>
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<td>Language of instruction</td>
<td>English</td>
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<td>Duration (semesters)</td>
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<td>Module frequency</td>
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<td>Module capacity</td>
<td>30 (Recommended in combination with: neu220 BM “Neurocognition and Psychopharmacology” Shared course components with (cannot be credited twice): bio610 (5.02.611 “Neuroethologie”, 5.02.612 “Verhaltensökologie”, 5.02.613 “Aktuelle Themen der Ethologie”)</td>
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<tr>
<td>Reference text</td>
<td>Course in the second half of the semester Regular active participation is required to pass the module.</td>
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<td>Modullevel / module level</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
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<td>Modulart / typ of module</td>
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<td>Vorkenntnisse / Previous knowledge</td>
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**Total time of attendance for the module** 84 h
neu220 - Neurosensory Science and Behaviour - Part B

Module label: Neurosensory Science and Behaviour - Part B
Module code: neu220
Credit points: 6.0 KP
Workload: 180 h
- 3 SWS Lecture (VO) "Introd. to Cognitive Neuroscience" and "Psychopharmacol." Total workload 135h: 45h contact/ 45 background reading/ 45h exam preparation
- 1 SWS Supervised exercise (UE) Total workload 45h: 14h contact/ 31h paper reading

Applicability of the module:
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Molecular Biomedicine (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

Responsible persons:
- Thiel, Christiane Margarete (Module responsibility)
- Thiel, Christiane Margarete (Module counselling)
- Thiel, Christiane Margarete (Authorized examiners)
- Gießing, Carsten (Authorized examiners)

Prerequisites:

Skills to be acquired in this module:
++ Neurosci. knowlg. + Expt. methods Independent research + Scient. literature + Social skills
++ Interdiscipl. knowlg. Maths/Stats/Progr. + Data present./disc. + Scientific English Ethics

Upon successful completion of this course, students:
- know the fundamentals of neurotransmission
- know the basic neural mechanisms underlying attention, learning, emotion, language and executive functions
- understand the relationship between disturbances in neurotransmitter systems, cognitive functions and psychiatric disease
- know the principles of drug treatment for psychiatric disorders
- have in-depth knowledge in selected areas of these topics
- are able to understand, explain and critically assess neuroscientific approaches in animals and humans
- are able to understand and critically assess published work in the area of cognitive neuroscience

Module contents:
The lecture "Introduction to Cognitive Neuroscience" gives a short introduction into neuroanatomy and cognitive neuroscience methods and then covers different cognitive functions.
- Lecture topics:
  - History of cognitive neuroscience
  - Methods of cognitive neuroscience
  - Attention
  - Learning
  - Emotion
  - Language
  - Executive functions.

The supervised exercises either deepen that knowledge by exercises or discussions of recent papers/ talks on the respective topic covered during that week.

The lecture "Psychopharmacology" illustrates the connection between neurotransmitters and behaviour and its links to psychiatric disease.
- Lecture topics:
  - Introduction to Terms and Definitions in Drug Research
  - DOPAMINERGIC AND NORADRENERGIC SYSTEM
  - CHOLINERGIC AND SEROTONERGIC SYSTEM
  - GABAERGIC AND GLUTAMATERGIC SYSTEM
  - ADDICTION
  - DEPRESSION
  - SCHIZOPHRENIA
  - ANXIETY
  - ALZHEIMER'S DISEASE

Reader's advisory:

Links:

Language of instruction: English
### Duration (semesters)
1 Semester

### Module frequency
jährlich

### Module capacity
30 (Recommended in combination with neu210 "Neurosensoric Science and Behaviour", neu300 "Functional MRI data analysis" Shared course components with (cannot be credited twice): bio610 and psy181 (5.02.614 "Introduction to Cognitive Neuroscience", 5.02.615 "Psychopharmacology")

### Reference text
Course in the second half of the semester
Regular active participation is required to pass the module.

### Module level / module level
je nach Studiengang Pflicht oder Wahlpflicht

### Lehr-/Lernform / Teaching/Learning method

### Vorkenntnisse / Previous knowledge
Fundamentals of Neurobiology, Behavioural Biology

### Examination
<table>
<thead>
<tr>
<th>Time of examination</th>
<th>Type of examination</th>
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<tr>
<td>as agreed, usually in the break after the winter term</td>
<td>100% written exam (content of the lectures)</td>
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### Course type

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<td>Lecture</td>
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<td>Exercises</td>
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### Total time of attendance for the module
56 h
# neu250 - Computational Neuroscience - Statistical Learning

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<tr>
<td>Credit points</td>
<td>6.0 KP</td>
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<tr>
<td>Workload</td>
<td></td>
</tr>
<tr>
<td>1 SWS Lecture (VL)</td>
<td>14 h contact / 22 h individual revision of lecture contents, test preparation, and application to portfolio tasks</td>
</tr>
<tr>
<td>1 SWS Seminar (SE)</td>
<td>14 h contact / 22 h individual reading and test preparation</td>
</tr>
<tr>
<td>3 SWS Supervised exercise</td>
<td>42 h contact / 66 h individual work on portfolio tasks (programming and interpretation of simulation or analysis results)</td>
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</tbody>
</table>

## Applicability of the module
- Master's Programme Neuroscience (Master) > Background Modules

## Responsible persons
- Anemüller, Jörn (Module responsibility)
- Anemüller, Jörn (Module counselling)
- Rieger, Jochem (Module counselling)
- Anemüller, Jörn (Authorized examiners)
- Rieger, Jochem (Authorized examiners)

## Prerequisites
- attendance in pre-meeting

## Skills to be acquired in this module
- have refined their programming skills (in Matlab) in order to efficiently analyze large-scale experimental data
- are able to implement a processing chain of prefiltering, statistical analysis and results visualization
- have acquired an understanding of the theoretical underpinnings of the most common statistical analysis methods and basic machine learning principles
- have practised using existing toolbox functions for complex analysis tasks
- know how to implement new analysis algorithms in software from a given mathematical formulation
- can interpret analysis results in a neuroscientific context
- have applied these techniques to both single channel and multi-channel neurophysiological data

### ++ Neurosci. knowlg.
- Scient. literature
- Social skills

### + Interdiscipl. knowlg.
- Maths/Stats/Progr.
- Data present./disc.

### + Scientific English

## Module contents
- data preprocessing, e.g., artifact detection and rejection, filtering, z-scoring, epoching
- data handling for high-volume data in Matlab
- introduction to relevant analysis toolbox software
- theory of multi-dimensional statistical analysis approaches, such as multi-dimensional linear regression, principal component analysis, independent component analysis, logistic regression, gradient-based optimization
- practical implementation from mathematical formulation to software code, debugging and unit testing
- postprocessing and results visualization
- consolidation during hands-on computer-based exercises (in Matlab)
- introduction to selected specialized analysis approaches during the seminar

## Reader's advisory
Wallisch et al.: MATLAB for Neuroscientists, 2nd Ed. Academic Press. More text books will be suggested prior to the course. Scientific articles: Copies of scientific articles for the seminar will be provided prior to the course

## Language of instruction
English
<table>
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<tr>
<th><strong>Duration (semesters)</strong></th>
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<tr>
<td><strong>Module frequency</strong></td>
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<tr>
<td><strong>Module capacity</strong></td>
<td>18 (Recommended in combination with neu240 Computational Neuroscience - Introduction Shared course components with (cannot be credited twice): psy220 Human Computer Interaction)</td>
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<tr>
<td><strong>Reference text</strong></td>
<td>Course in the first half of the semester Students without Matlab experience should take the optional Matlab course (1. week) of Computational Neuroscience - Introduction</td>
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<td><strong>Modullevel / module level</strong></td>
<td>Wahlpflicht / Elective</td>
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<tr>
<td><strong>Lehr-/Lernform / Teaching/Learning method</strong></td>
<td>Programming experience is highly recommended, preferably in Matlab</td>
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<td><strong>Final exam of module</strong></td>
<td>during the course Portfolio, consisting of daily short tests, programming exercises and short reports</td>
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<th><strong>SWS</strong></th>
<th><strong>Frequency</strong></th>
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<tr>
<td>Seminar</td>
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**Total time of attendance for the module**: 70 h
neu241 - Computational Neuroscience - Introduction

### Module label
Computational Neuroscience - Introduction

### Module code
neu241

### Credit points
12.0 KP

### Workload
360 h

2 SWS Lecture
Total workload 60h: 30h contact/30h individual revision of lecture contents, test preparation

1 SWS Seminar
Total workload 45h: 15h contact/30h individual reading and test preparation

10.5 SWS Supervised exercise
Total workload 255h: 145h contact/110h individual work on portfolio tasks (programming, interpretation of simulation results)

### Applicability of the module
- Master's Programme Neuroscience (Master) > Background Modules

### Responsible persons
- Kretzberg, Jutta (Module responsibility)
- Kretzberg, Jutta (Module counselling)
- Kretzberg, Jutta (Authorized examiners)
- Greschner, Martin (Authorized examiners)
- Ashida, Go (Authorized examiners)

### Prerequisites
Programming experience in Matlab (e.g. acquired by a 6 ECTS programming course)

### Skills to be acquired in this module
- **Neurosci. knowlg.
- Scient. Literature
- Social skills
- Interdiscipl. knowlg.
- Math/Stats/Progr.
- Data present./disc.
- Scientific English

Upon successful completion of this course, students
- are able to implement and apply algorithms in Matlab
- have learned to handle scientific data independently
- have acquired theoretical and practical knowledge of advanced data analysis techniques
- know about computational model approaches on different levels of abstraction
- know how to perform model simulations for single cells and small neuronal networks
- can interpret simulation results in a neuroscientific context

### Module contents
This course consists of six weeks with different topics, which are introduced in lectures, discussed in depth using selected literature in the seminar and consolidated in computer-based hands-on exercises (in Matlab). Portfolio tasks, mainly interpretation of programming results are given every day.

- **Weeks 1 and 2:** Spike train analysis
  response tuning, spike triggered average, receptive fields, linear-nonlinear model, spike correlation, linear reconstruction, classification

- **Weeks 3 and 4:** Neuron models
  Conductance-based single cell models using differential equations (passive membrane equation, integrate and fire, Hodgkin Huxley, alpha synapses)

- **Weeks 5 and 6:** Small network models
  Feed-forward and feed-back networks, lateral inhibition, central pattern generator, spike-timing dependent plasticity, multi-compartment models

### Reader's advisory
Skripts for each course day will be provided prior to / during the course
Copies of scientific articles for the seminar and as basis for portfolio assignments will be provided prior to the course.

Recommended textbooks or other literature:

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<tr>
<th>Language of instruction</th>
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<td>Module capacity</td>
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Registration procedure / selection criteria: StudIP; sequence of registration, attendance in pre-meeting

Recommended in combination with:
neu770 Neuroscientific data analysis in Matlab (prior to the course)
neu250 Computational Neuroscience - Statistical Learning (after the course)

<table>
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<tr>
<th>Modullevel / module level</th>
<th>Pflicht o. Wahlpflicht / compulsory or optional</th>
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<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
<td>Master of Science: Neuroscience</td>
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<td>Vorkenntnisse / Previous knowledge</td>
<td>Programming experience, preferably in Matlab (e.g. acquired by a 6 ECTS programming course)</td>
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<td>Portfolio, consisting of daily short tests, programming exercises, short reports</td>
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<td>Exercises</td>
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| Total time of attendance for the module | 189 h |
neu280 - Research Techniques in Neuroscience

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<td>2 SWS Lecture: 35 h contact / 45 h background reading / 10 h exam preparation</td>
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<td>2 SWS Practical: 50 h contact / 30 h protocol preparation / 10 h exam preparation</td>
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<tr>
<td>Applicability of the module</td>
<td>• Master's Programme Neuroscience (Master) &gt; Background Modules</td>
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**Responsible persons**
- Hartmann, Anna-Maria (Module responsibility)
- Hartmann, Anna-Maria (Module counselling)
- Hartmann, Anna-Maria (Authorized examiners)
- Nothwang, Hans Gerd (Authorized examiners)
- Thiel, Christiane Margarete (Authorized examiners)
- Neidhardt, John (Authorized examiners)
- Greschner, Martin (Authorized examiners)
- Bantel, Carsten (Authorized examiners)

**Prerequisites**

**Skills to be acquired in this module**
- Neurosci. knowlg.
- ++ Expt. Methods
- + Scient. Literature
- + Social skills
- + Interdiscipl. knowlg.
- + Math/Stats/Progr.
- + Data present./disc.
- + Scientific English
- ++ Ethics

1. have basic knowledge of different techniques (see content of the module) used in neurosciences
2. have basic knowledge of realizing clinical studies, generating questionaires and their biostatistical data analyses
3. have acquired practical skills in whole brain imaging (fMRI) and molecular techniques
4. have acquired practical skills in performing clinical studies

**Module contents**

Lecture topics:
1. Whole brain imaging (CT, MRI, fMRI, PET, EEG, MEG)
2. Animal Behaviour
3. Microscopy and Visualizing nervous system structure
4. Electrophysiology
5. Identifying Gene of Interest and Gene delivery strategies
6. Molecular Cloning, generation of transgenic organism, manipulating endogenous genes
7. Cell culture techniques
8. Biochemical assays and intracellular signalling
9. Clinical studies
10. questionnaire and biostatistics
11. judicial basics of scientific work

Laboratory course
1. molecular methods (site directed mutagenesis, PCR, midi preparation, sequencing, bioinformatics)
2. fMRI
3. clinical studies

**Reader's advisory**
Guide to Research Techniques in Neuroscience, 2nd Edition
Author(s): Carter & Shieh
Print Book ISBN: 9780128005118
eBook ISBN: 9780128005972

**Links**

**Language of instruction**
English

**Duration (semesters)**
1 Semester

**Module frequency**
summer term / annually
<table>
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<th>Module capacity</th>
<th>20 (Registration procedure / selection criteria: StudIP)</th>
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<td>Modulart / typ of module</td>
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<td>Lehr-/Lernform / Teaching/Learning method</td>
<td>Master of Science: Neuroscience</td>
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<td>Final exam of module</td>
<td>end of semester written exam</td>
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<td>Examination</td>
<td>Time of examination Type of examination</td>
</tr>
<tr>
<td>Course type Comment</td>
<td>SWS Frequency Workload of compulsory attendance</td>
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<tr>
<td>Lecture (Lecture)</td>
<td>2 SuSe 28</td>
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<td>2 SuSe 28</td>
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<td>Total time of attendance for the module</td>
<td>56 h</td>
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neu290 - Biophysics of Sensory Reception

**Module label**  
Biophysics of Sensory Reception

**Module code**  
neu290

**Credit points**  
6.0 KP

**Workload**  
180 h  
{  
2 SWS Lecture (VO) Total workload 90h: 30h contact / 60 h individual reading 2 SWS Seminar (SE) Total workload 90h: 30 h contact / 60h individual reading

**Applicability of the module**  
- Master's Programme Biology (Master) > Background Modules  
- Master's Programme Biology (Master) > Background Modules  
- Master's Programme Neuroscience (Master) > Background Modules

**Responsible persons**  
Winklhofer, Michael (Module responsibility)  
Winklhofer, Michael (Authorized examiners)  
Winklhofer, Michael (Module counselling)

**Prerequisites**  
Recommended previous knowledge/skills: cell biology of neurons

**Skills to be acquired in this module**  
++ Neurosci. knowlg.  
+ Independent research  
+ Scient. Literature  
++ Interdiscipl. knowlg.  
+ Data present./disc.

- to gain a general understanding of sensory reception  
- to acquire specific knowledge of sensory reception at the molecular and cellular level,  
  with focus on the relationship between structure and function of sensory molecules

- to be able to perform simple quantitative assessments of detection sensitivity to physical stimuli  
- to understand common features in transduction pathways among various senses

**Module contents**  
General aspects of sensory reception and signal transduction: adequate stimulus, threshold sensitivity and signal-to-noise limitations, activation of receptor proteins Evolutionary and ecological aspects of sensory reception The senses: Chemoreception in the gustatory cells and olfactory sensory neurons Thermoreception in the skin Infrared reception in the pit organ Mechanoreception - auditory hair cells, somatosensory neurons in the skin, lateral line, proprioceptors, baroceptors Photoreception - ciliary and rhabdomeric photoreceptor cells; Electroreception in Lorenzini ampullae of elasmobranch fish and in tuberous receptors of mormyrid fish; derived electroreceptors in aquatic mammals Magnetoreception - candidate structural correlates of magnetoreceptors

**Reader's advisory**  
Required reading:  
The reading list will be updated on an annual basis to include new developments. The current reading list can be found on StudIP.  
Recommended textbook(s) or other literature:  

**Links**

**Language of instruction**  
English

**Duration (semesters)**  
1 Semester

**Module frequency**  
annually, summer term, second half

**Module capacity**  
20

**Modullevel / module level**  
MM (Mastermodul / Master module)

**Modulart. / typ of module**  
Wahlpflicht / Elective
### Lehr-/Lernform / Teaching/Learning method

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<th>Time of examination</th>
<th>Type of examination</th>
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<td>appr. one week after the last lecture</td>
<td>Type of examination: written exam (75%), presentation in the seminar (25%) In addition, mandatory but ungraded: presentation on seminar</td>
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<table>
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<th>Frequency</th>
<th>Workload of compulsory attendance</th>
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<td>SuSe</td>
<td>28</td>
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<tr>
<td>Seminar</td>
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<td>2</td>
<td>SuSe</td>
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**Total time of attendance for the module** 56 h
neu300 - Functional MRI data analysis

<table>
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<th>Module label</th>
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<tr>
<td>Module code</td>
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<td>Credit points</td>
<td>12.0 KP</td>
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<tr>
<td>Workload</td>
<td>360 h</td>
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<tr>
<td>3 SWS Practical (PR)</td>
<td>Total workload 225h: 70h contact / 100h experimental work / 55h exam preparation</td>
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<tr>
<td>2 SWS Lecture (VO)</td>
<td>Total workload 90h: 28h contact / 30h background reading / 32h exam preparation</td>
</tr>
<tr>
<td>1 SWS Seminar (SE)</td>
<td>Total workload 45h: 15h contact / 30h preparation of presentation</td>
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<tr>
<td>Applicability of the module</td>
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<tr>
<td>Master's Programme Biology (Master) &gt; Background Modules</td>
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<tr>
<td>Master's Programme Biology (Master) &gt; Background Modules</td>
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<tr>
<td>Responsible persons</td>
<td>Gießing, Carsten (Module responsibility)</td>
</tr>
<tr>
<td>Gießing, Carsten (Authorized examiners)</td>
<td></td>
</tr>
<tr>
<td>Thiel, Christiane Margarete (Authorized examiners)</td>
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<tr>
<td>Prerequisites</td>
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<tr>
<td>+ Neurosci. knowlg.</td>
<td></td>
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<tr>
<td>++ Expt. Methods</td>
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<tr>
<td>+ Social skills</td>
<td></td>
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<tr>
<td>++ Interdiscl. knowlg.</td>
<td></td>
</tr>
<tr>
<td>++ Maths/Stats/Progr.</td>
<td></td>
</tr>
<tr>
<td>+ Data present./disc.</td>
<td></td>
</tr>
<tr>
<td>+ Scientific English</td>
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</tr>
<tr>
<td>Skills to be acquired in this module</td>
<td></td>
</tr>
<tr>
<td>Students will learn the basics about planning and performing a neuroimaging study. They will focus on the statistical and methodological background of functional neuroimaging data analysis and analyse a sample functional MRI data set.</td>
<td></td>
</tr>
<tr>
<td>Module contents</td>
<td>The modul comprises (i) a lecture “Functional MRI data analysis” [2 SWS], and (ii) a practical course [5 SWS] and (iii) a seminar “Experiments on Neurocognition” [1 SWS] including aspects of planning, performance and analysis of functional neuro-imaging studies using MATLAB based software.</td>
</tr>
<tr>
<td>Links</td>
<td>Language of instruction: English</td>
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<tr>
<td>Duration (semesters)</td>
<td>1 Semester</td>
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<td>Module frequency</td>
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<tr>
<td>Module capacity</td>
<td>12 (in total with bio640) (shared course components with (cannot be credited twice): bio640)</td>
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<td>Modullevel / module level</td>
<td>MM (Mastermodul / Master module)</td>
</tr>
<tr>
<td>Modultyp / typ of module</td>
<td>Wahlpflicht / Elective</td>
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<tr>
<td>Vorkenntnisse / Previous knowledge</td>
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<tr>
<td>Examination</td>
<td>Time of examination: end of summer term</td>
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<tr>
<td>Course type</td>
<td>Comment</td>
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<tr>
<td>Practical training</td>
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<tr>
<td>Seminar</td>
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</table>

Links

Language of instruction: English

Duration (semesters): 1 Semester

Module frequency: annually, summer term, second half

Module capacity: 12 (in total with bio640) (shared course components with (cannot be credited twice): bio640)

Modullevel / module level: MM (Mastermodul / Master module)

Modultyp / typ of module: Wahlpflicht / Elective

Vorkenntnisse / Previous knowledge

Examination: Time of examination: end of summer term | Type of examination: 70% oral exam or written exam, 30% presentations In addition, mandatory but ungraded: Regular active participation

Course type | Comment | SWS | Frequency | Workload of compulsory attendance |
-------------|---------|-----|-----------|-----------------------------------|
Practical training | 5 | SuSe |          | 70                                  |
Seminar | 1 | SuSe |          | 14                                  |
<table>
<thead>
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<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
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<td>2</td>
<td>SuSe</td>
<td>28</td>
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</table>

**Total time of attendance for the module** 112 h
**neu310 - Psychophysics of Hearing**

**Module label**
- Psychophysics of Hearing

**Module code**
- neu310

**Credit points**
- 12.0 KP

**Workload**
- 360 h
  - 5 SWS Practical (PR) "Experiments in Hearing" Total workload 225h: 70h contact / 110h experimental work / 45h exam preparation
  - 1 SWS Supervised exercise (UE) "Fundamentals in psychoacoustic data analysis" Total workload 45h: 15h contact / 30h practising data analysis (incl. SPSS)
  - 2 SWS Seminar (SE) "Hearing" Total workload 90h: 30h contact / 60h background reading

**Applicability of the module**
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

**Responsible persons**
- Klump, Georg Martin (Module responsibility)
- Klump, Georg Martin (Authorized examiners)
- Langemann, Ulrike (Authorized examiners)

**Prerequisites**

**Skills to be acquired in this module**
- + Neurosci. knowlg.
- ++ Expt. Methods
- + Social skills
- ++ Maths/Stats/Progr.
- + Data present./disc.
- + Scientific English

Students will learn the basics about performing a psychoacoustic experiment. Based on an experiment in which they study their own hearing, they will learn how to conduct a behavioural study in hearing and analyze the data. In addition, they will be provided with an overview of the mechanisms of auditory perception.

**Module contents**
The module comprises (i) a seminar “Hearing” [2 SWS], (ii) an exercise “Fundamentals in psychoacoustic data analysis” [1 SWS], and a (iii) practical course [7 SWS] including aspects of planning and conducting psychoacoustic experiments.

**Reader's advisory**
Plack, Christopher J. (2005) The sense of hearing. Mahwah, NJ [u.a.] : Erlbaum (sufficient number of copies available in the university library)

**Links**

**Language of instruction**
- English

**Duration (semesters)**
- 1 Semester

**Module frequency**
- annually, summer term, second half

**Module capacity**
- 6 (in total with bio640)

**Module level / module level**
- MM (Mastermodul / Master module)

**Modulart / typ of module**
- Wahlpflicht / Elective

**Vorkenntnisse / Previous knowledge**

**Examination**

<table>
<thead>
<tr>
<th>Time of examination</th>
<th>Type of examination</th>
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<tr>
<td>end of summer term</td>
<td>70% report or oral exam, 30% presentation In addition, mandatory but ungraded: regular active participation</td>
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**Course type**

<table>
<thead>
<tr>
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<th>Comment</th>
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<tr>
<td>Exercises</td>
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<tr>
<td>Lecture</td>
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**Total time of attendance for the module**
- 112 h
neu320 - Introduction to Neurophysics

Module label          Introduction to Neurophysics
Module code           neu320
Credit points          6.0 KP

Workload              180 h
                      (2 SWS Lecture
                      total workload 90h: 28h contact / 62h background reading/exam preparation
                      2 SWS Supervised exercise total workload 90h: 28h contact / 62h self-conducted exercise work/literature reading)

Applicability of the module
- Master's Programme Neuroscience (Master) > Background Modules

Responsible persons
- Anemüller, Jörn (Module responsibility)
- Anemüller, Jörn (Authorized examiners)

Prerequisites
- recommended in semester: 3 (with Matlab prereq.: 1)

Skills to be acquired in this module
+ Neurosci. knowlg.
+ Independent research
+ Scient. Literature
++ Interdiscipl. knowlg.
++ Maths/Stats/Progr.
+ Data present./disc.

Module contents
- Biophysics of synaptic and neuronal transmission
- Single neuron models: Hodgkin Huxley model, integrate and fire model, firing rate model
- Biophysics of sensory systems in the auditory, visual and mechano-sensory modality
- Description of neuronal dynamics: Theory of dynamical systems, from microscopic to macroscopic activity - Principles of neuronal activity measurements: from single-cell recordings to EEG, MEG and fMRI
- Functional description of small neuronal networks: Receptive fields and their description with linear and non-linear models - The neuronal code: Spikes, spike trains, population coding, time- vs. rate-code - Decoding neuronal activity and its applications
- Simulation of artificial neural networks as a functional model, Hopfield network, Boltzmann machine, Perceptron and deep networks - Informationtheoretic approaches, stimulus statistics, entropy, mutual information
- Learning and plasticity, conditioning and reinforcement learning, Hebbian learning, long-term potentiation and long-term depression

Reader's advisory
- Chow, Gutkin, Hansel, Meunier, Dallibard (Eds.): Methods and Models in Neurophysics (2003)
- Galizia, Lledo (Eds.): Neurosciences, from molecule to behauvior (2013)
- Gerstner, Kistler, Naud, Paninski: Neuronal Dynamics - From single neurons to networks and models of Cognition (2014)

Links
Language of instruction English
Duration (semesters) 1 Semester
Module frequency winter term / annually
Module capacity 30 (Registration procedure / selection criteria: StudIP)
**Reference text**
Recommended in combination with: 5.04.4012 Informationsverarbeitung und Kommunikation (phy350)
Will also be offered in "M.Sc. Physik, Technik, Medizin"

**Modullevel / module level**

**Modulart / typ of module**

**Lehr-/Lernform / Teaching/Learning method**
Master of Science: Neuroscience

**Vorkenntnisse / Previous knowledge**
Computer programming (preferably Matlab), basic mathematics (statistics, analysis, linear algebra)

**Examination**
Time of examination: end of winter term
Type of examination: 80% oral exam or written exam, 20% exercise work and presentation

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<th>Workload of compulsory attendance</th>
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<td>Seminar</td>
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<td>WiSe</td>
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<tr>
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**Total time of attendance for the module**: 0 h
**bio605 - Molecular Genetics and Cell Biology**

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<tr>
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<td>Workload</td>
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**Applicability of the module**
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Molecular Biomedicine (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

**Responsible persons**
- Neidhardt, John (Module responsibility)
- Neidhardt, John (Authorized examiners)
- Koch, Karl-Wilhelm (Authorized examiners)

**Prerequisites**
- BSc (Biologie, Biochemie)

**Skills to be acquired in this module**
- **++** deepened biological expertise
- **++** deepened knowledge of biological working methods
- **+** data analysis skills
- **++** interdisciplinary thinking
- **+** critical and analytical thinking
- **+** independent searching and knowledge of scientific literature
- **+** data presentation and discussion in German and English (written and spoken)
- **+** teamwork
- **+** ethics and professional behaviour
- **+** project and time management

Addressing students with an emphasis on molecular biology, molecular genetics, cell biology, and neurobiology

**Module contents**
- Lecture: To improve knowledge in molecular genetics, molecular biology and cell biology in correlation with human diseases.
- Exercise: Learn to transfer the theoretical knowledge to experiments. Gaining methodological knowledge in molecular genetics, cell biology and therapeutic approaches. Initial training on how to perform research projects.
- Subjects of the lecture and seminar: Molecular bases of neurodegenerative diseases, structure and function of DNA/RNA/proteins/membranes, cytoskeleton, cell cycle, programmed cell death, cells in the social structure.
- Exercises: Learning current methods of molecular biology and human genetics; high throughput technologies, introduction to cell cultivation techniques.

**Reader's advisory**
- Textbooks of Cell Biology

**Links**
- http://www.uni-oldenburg.de/humangenetik/

**Language of instruction**
- English

**Duration (semesters)**
- 1 Semester

**Module frequency**
- Module capacity: 15

**Reference text**
- associated with bio900

**Modullevel / module level**
- MM (Mastermodul / Master module)

**Lehr-/Lernform / Teaching/Learning method**
- Wahlpflicht / Elective

**Vorkenntnisse / Previous knowledge**
- Zellbiologische Grundkenntnisse, Genetik, Biochemie

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<td>written examination (70 %), paper(s) presentation 30 %; not graded: signed lab protocols, regular active participation is required for the module to be passed.</td>
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**Course type**

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<tr>
<td>Seminar</td>
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<td>WiSe</td>
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<tr>
<td>Exercises</td>
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<td>WiSe</td>
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<td>SWS</td>
<td>Frequency</td>
<td>Workload of compulsory attendance</td>
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<td></td>
<td></td>
<td>112 h</td>
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</table>
bio695 - Biochemical concepts in signal transduction

Module label: Biochemical concepts in signal transduction
Module code: bio695
Credit points: 12.0 KP
Workload: 360 h

Applicability of the module:
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Molecular Biomedicine (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

Responsible persons:
- Koch, Karl-Wilhelm (Module responsibility)
- Koch, Karl-Wilhelm (Authorized examiners)
- Scholten, Alexander (Authorized examiners)
- Scholten, Alexander (Module counselling)

Prerequisites:
- keine

Skills to be acquired in this module:
- ++ deepened biological expertise
- ++ deepened knowledge of biological working methods
- ++ data analysis skills
- interdisciplinary thinking
- ++ critical and analytical thinking
- independent searching and knowledge of scientific literature
- ++ data presentation and discussion in German and English (written and spoken)
- teamwork
- project and time management

Module contents:
- Lecture: Molecular fundamentals of cellular signal processes
- Seminar: Signal transduction
- Exercises: Experiments on cellular signal transduction and enzymology

Mechanisms of biochemical signal transduction are imparted theoretically and experimentally

Reader's advisory:
Textbooks of cell biology and biochemistry. Current literature on topics of signal transduction (as announced in the preparatory meeting).

Links:
Language of instruction: English
Duration (semesters): 1 Semester
Module frequency: Module
Module capacity: 20
Modullevel / module level: MM (Mastermodul / Master module)
Modulart / typ of module: Wahlpflicht / Elective

Vorkenntnisse / Previous knowledge:

Examination:
- Time of examination: 90 minutes written exam
- Type of examination: written examination (50%) protocols (50%)

Course type:
- Lecture: 1 SWS, Frequency: WiSe, Workload of compulsory attendance: 14 h
- Seminar: 1 SWS, Frequency: WiSe, Workload of compulsory attendance: 14 h
- Exercises: 6 SWS, Frequency: WiSe, Workload of compulsory attendance: 84 h

Total time of attendance for the module: 112 h
bio845 - Introduction to Development and Evolution

Module label: Introduction to Development and Evolution
Module code: bio845
Credit points: 6.0 KP
Workload: 180 h

Applicability of the module:
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

Responsible persons:
- Sienknecht, Ulrike (Module responsibility)
- Sienknecht, Ulrike (Module counselling)
- Sienknecht, Ulrike (Authorized examiners)
- Claußen, Maike (Authorized examiners)

Prerequisites:

Skills to be acquired in this module:
Upon successful completion of this course, students
- know the fundamental problems organisms share in development
- know the common basic steps of ontogenesis after comparing the life cycles of different species (both vertebrates and invertebrates)
- know the fundamentals of the genetic control of cell-fate specification, morphogenesis, and organogenesis
- know the principles of gene regulatory networks in development and are able to explain examples
- are able to explain and discuss mechanisms of development across taxonomic groups and questions about the evolution of developmental mechanisms
- have in-depth knowledge of the development of animal nervous systems, including cellular and net-work properties

Skills:
++ deepened biological expertise
+ deepened knowledge of biological working methods
++ interdisciplinary thinking
++ critical and analytical thinking
+ independent searching and knowledge of scientific literature
+ ability to perform independent biological research
+ teamwork

Module contents:
Lectures on the fundamentals and concepts of developmental biology, including evolutionary aspects. Parallel seminars matching the topics of the lectures and emphasizing discussion. Lecture topics:
- Introduction to Developmental Biology
- Cell-Cell Communication
- Differential Gene Expression (I and II)
- Early Development of Vertebrates, Gastrulation
- Neurulation
- Brain Development
- Axonal Growth, Target Selection, Synaptogenesis and Refinement
- Neural Crest
- Mesoderm Development
- Morphogenesis
- Developmental Mechanisms of Evolutionary Change
- Model Organisms in Developmental Biology
- Transgenic Mice
- Medical Implications of Developmental Biology

**Reader's advisory**

**Literature:**

*textbook:* Gilbert S.F.: Developmental Biology, Macmillan Publishers Ltd, 11th edition 2016 (current edition); and current literature on course topics

**Links**

<table>
<thead>
<tr>
<th>Language of instruction</th>
<th>English</th>
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<td>Duration (semesters)</td>
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<tr>
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</table>

**Reference text**

associated with bio846 (previously neu120) (Lab Exercises in Development and Evolution)

**Modulart / typ of module**

Wahlpflicht / Elective

**Vorkenntnisse / Previous knowledge**

organismic biology, developmental biology, evolutionary biology, neurobiology, genetics, molecular biology

**Course type**

| Lecture | 3 | WiSe | 45 |
| Seminar | 3 | WiSe | 45 |

**Total time of attendance for the module**

90 h
bio846 - Lab Exercises in Development and Evolution

<table>
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<tr>
<td>Module code</td>
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<tr>
<td>Credit points</td>
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<td>Workload</td>
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</table>

Applicability of the module
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

Responsible persons
- Sienknecht, Ulrike (Module responsibility)
- Sienknecht, Ulrike (Module counselling)
- Sienknecht, Ulrike (Authorized examiners)
- Claußen, Maike ( Authorized examiners)
- Ebbers, Lena ( Authorized examiners)

Prerequisites
- mandatory prerequisite is the module bio845 (neu110) (Introduction to Development and Evolution)

Skills to be acquired in this module
Upon successful completion of this course, students have skills in methods of developmental biology:
- are capable of performing live embryo husbandry
- are able to carry out in-ovo stainings
- are familiar with the use of embryonic stage discrimination standards for model organisms
- document the observed embryonic stages by drawings with anatomical labelling
- are familiar with tissue preparation (including cryosectioning), the use of different molecular markers, and immunohistological staining methods
- microscopy, data analysis, and photographic data documentation
- know the standards of proper documentation of research data and the universal format of a lab notebook
- know how to carry out formal laboratory reports (and the structure of a scientific paper)
- have basic knowledge in the field of auditory system development
- have basic knowledge of the organisation of the auditory system across vertebrate groups
- have basic knowledge of the development of the middle and inner ear, as well as selected auditory brain centres
- are able to summarize current hypotheses about the evolution of the auditory system in vertebrates skills:
  ++ deepened biological expertise
  ++ deepened knowledge of biological working methods
  ++ data analysis skills
  ++ critical and analytical thinking
  + independent searching and knowledge of scientific literature
  ++ ability to perform independent biological research
  + data presentation and discussion (written and spoken)
  + teamwork
  + ethics and professional behaviour
  + project and time management

Module contents
Lab exercises in developmental biology of auditory research model organisms, such as chicken and mouse
embryos. Practical introduction to methods, such as in-ovo live observation; developmental stage discrimination and description, tissue preparation for histology, sectioning, staining, and microscopy, including data analyses. Seminars in the field of auditory system development and methods based on current literature

### Reader's advisory


### Links

<table>
<thead>
<tr>
<th>Language of instruction</th>
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### Module frequency

| Module capacity | 6 (selection criteria: sequence of registration) |

### Reference text

Associated with bio845 (previously neu110) (Introduction to Development and Evolution)

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<td>Modulart / typ of module</td>
<td>Wahlpflicht / Elective</td>
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### Vorkenntnisse / Previous knowledge

organismic biology, experience with lab work

### Examination

<table>
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<th>Type of examination</th>
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### Course type

Exercises

### SWS

6

### Frequency

WiSe

### Workload attendance

84 h
neu141 - Visual Neuroscience - Physiology and Anatomy

Module label: Visual Neuroscience - Physiology and Anatomy
Module code: neu141
Credit points: 12.0 KP

Workload: 360 h
- 3 SWS Lecture (VO)
  Total workload 90 h: 30h contact / 60h background literature reading and preparation for sh
- 1 SWS Seminar (SE)
  Total workload 30h: 10h contact / 20h literature reading and preparation of result presentation
- 8 SWS Supervised exercise (UE)
  Total workload 240h: 200h contact / 40h results analysis, writing of short reports for portfolio

Applicability of the module
- Master’s Programme Biology (Master) > Background Modules
- Master’s Programme Biology (Master) > Background Modules
- Master’s Programme Molecular Biomedicine (Master) > Background Modules
- Master’s Programme Neuroscience (Master) > Background Modules

Responsible persons
- Greschner, Martin (Module responsibility)
- Greschner, Martin (Authorized examiners)
- Dedek, Karin (Authorized examiners)
- Janssen-Bienhold, Ulrike (Authorized examiners)
- Puller, Christian (Authorized examiners)

Prerequisites
- Basic knowledge of neurobiology

Skills to be acquired in this module
- ++ Neurosci. knowlg.
- ++ Expt. Methods
- + Independent research
- ++ Scient. Literature
- + Social skills
- + Maths/Stats/Progr.
- ++ Data present./disc.
- + Scientific English
- + Ethics

Upon successful completion of this course, students
- have basic knowledge of electrophysiological techniques used in neuroscience research
- have acquired first practical skills in some electrophysiological techniques
- have acquired basic skills in data analysis
- have knowledge on retinal physiology and anatomy of the visual system
- have basic knowledge of brain structures and their function
- have profound knowledge of the architecture and circuits of the vertebrate retina
- have acquired basic skills in histological techniques (tissue fixation, embedding, sectioning, staining procedures, immunohistochemistry)
- have acquired fundamental skills in microscopy (differential interference contrast microscopy, phase-contrast microscopy, confocal microscopy)

Module contents
The background module Neurophysiology consists of two weeks of theoretical introduction and two weeks of hands-on lab exercises in patch or extracellular recordings and two weeks of hands-on lab exercises in anatomy.

The seminars cover the following topics:
- Visual system
- Introduction to electrophysiological methods
- Introduction into methods used in neuranatomy and neurochemistry
- Introduction into microscopy and image analysis
- Presentation and discussion of results relating to the literature

Reader’s advisory
Course scripts and mandatory scientific literature discussed in the seminar will be available in Stud.IP. Background and seminar literature will be available in Stud.IP.

Links

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<td>Time of examination</td>
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<td>during the course (summer semester, first half) In addition, mandatory but ungraded: seminar presentation</td>
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<td>Comment</td>
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<tr>
<td>Lecture</td>
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<td>Seminar</td>
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<td>Exercises</td>
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<tr>
<td>Total time of attendance for the module</td>
<td>84 h</td>
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</table>
neu340 - Invertebrate Neuroscience

Module label: Invertebrate Neuroscience
Module code: neu340
Credit points: 6.0 KP
Workload: 180 h

(2 SWS Seminar (SE)
Total workload 72h: 28h contact / 44h background literature reading, preparation for short tests, portfolio assignments and results presentation

3 SWS Supervised exercise (UE)
Total workload 108h: 42h contact / 66h data analysis and preparation of portfolio assignments)

Applicability of the module
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

Responsible persons
Kretzberg, Jutta (Module responsibility)
Kretzberg, Jutta (Authorized examiners)

Prerequisites
attendance in pre-meeting

Skills to be acquired in this module
++ Neurosci. knowlg.
++ Expt. Methods
+ Scient. Literature
+ Social skills
+ Maths/Stats/Progr.
+ Independent Research
+ Data present./disc.
+ Scientific English
+ Ethics

Upon successful completion of this course, students
- have knowledge on invertebrate neuronal systems in comparison to vertebrate systems
- have discussed an overview of experimental and theoretical methods of invertebrate neuroscienc
- have acquired first practical skills in intracellular recordings from invertebrate neurons
- have acquired basic skills in data analysis
- have acquired an intuitive understanding of membrane potential and action potential generation based on computer simulations

Module contents
The module consists of three weeks of seminar and hands-on lab exercises on intracellular recordings from leech neurons, as well as computer simulations to study the basis of membrane potential and action potential generation.

The seminar covers the following topics:
- Invertebrate neuronal systems in comparison to vertebrate systems
- Ion channels, membrane potential and action potential generation
- Introduction to electrophysiological methods
- Introduction to data analysis methods

In the practical exercises, portfolio assignments will be performed on:
- Qualitative electrophysiological classification of different cell types in the leech nervous system
- Quantitative analysis (stimulus - response relationship) of at least one cell type
- Action potential generation: Comparison of model simulations and experiments
- Planning a small individual team-work project based on the techniques taught in this module, that can be used as basis for the module neu345

Reader's advisory
Course scripts and mandatory scientific literature (3 review articles) discussed in the seminar will be available in Stud.IP Background and seminar literature will be available in Stud.IP
<table>
<thead>
<tr>
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<td>Duration (semesters)</td>
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<td>Module frequency</td>
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<td>Wahlpflicht / Elective</td>
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<td>basic knowledge of neurobiology, basic MATLAB programming skills</td>
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neu345 - Neural Computation in Invertebrate Systems

Module label | Neural Computation in Invertebrate Systems
---|---
Module code | neu345
Credit points | 6.0 KP

Workload | 180 h
---|---
2 SWS Seminar
Total workload 72 h: 28 h contact / 15 h background literature reading, 14 h online science communication workshop, 15 h preparation for the presentation of results as scientific poster
3 SWS Supervised exercise
Total workload 108 h: 42 h contact / 66 h independent lab-work, self-organized team work, data analysis, and preparation of results figures and texts

Applicability of the module
- Master’s Programme Neuroscience (Master) > Background Modules

Responsible persons
Kretzberg, Jutta (Module responsibility)
Kretzberg, Jutta (Authorized examiners)

Prerequisites

Skills to be acquired in this module
Upon successful completion of this course, students
- have planned and conducted a small, self-defined and self-organized project in a team
- have knowledge on an invertebrate neuronal system
- have knowledge on neural coding and corresponding data analysis techniques
- have acquired skills in data analysis and / or experimental techniques and / or modeling
- are able to critically evaluate and discuss experimental results
- have prepared and presented a scientific poster

+ Neurosci. knowlw.
+ Expt. Methods
++ Independent research
+ Scient. Literature
++ Social Skills
+ Maths/Stats/Progr.
++ Data present./disc.
+ Scientific English
+ Ethics

Module contents
This module builds up on the knowledge and methods acquired in the module neu340 Invertebrate Neuroscience.

In the seminar, the knowledge on invertebrate systems and neural coding in general is deepened based on scientific literature.

In the practical exercise of the module, students can choose one topic from a range of different research questions on computation in the leech nervous system (e.g. comparison of different cell types, electrical and chemical synaptic connections, exact measurement of spike threshold, phase locking). Small groups (2-3) of students plan, perform, and analyze experiments (intracellular recordings) or model simulations (model framework will be provided or can be self-written based on module neu241 computational neuroscience - Introduction) to tackle their topic. The portfolio consists of assignments covering the planning, analysis, interpretation, and presentation of the results with feedback given during the course on each project stage.
Reader's advisory
Course scripts and background and seminar literature will be available in Stud.IP. Scientific literature discussed in the seminar depends on the project topics.

Links
Language of instruction English
Duration (semesters) 1 Semester

Module frequency
Module capacity 12 (but only 6 for experimental projects)
Module level / module level MM (Mastermodul / Master module)
Module type / typ of module Wahlpflicht / Elective

Teaching / Learning method

Previous knowledge neu 340 invertebrate neuroscience

Examination
Time of examination Type of examination
Final exam of module During the course (summer term, second half) Portfolio consisting of project plan, scientific poster, poster presentation

<table>
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<th>Comment</th>
<th>SWS</th>
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<th>Workload of compulsory attendance</th>
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<td>3</td>
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Total time of attendance for the module 70 h
neu350 - Biological Foundations of Neuroscience

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<tr>
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<td>Workload</td>
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<td>Lecture</td>
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<td></td>
<td>Total workload 90 h: 28 h contact / 14 h tutorial / 48 h self-study and preparation for exam</td>
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<td>Seminar</td>
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<td>Total workload 90 h: 28 h contact / 62 h self-study and preparation for exam</td>
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Applicability of the module
- Master's Programme Neuroscience (Master) > Background Modules

Responsible persons
- Puller, Christian (Module responsibility)
- Puller, Christian (Authorized examiners)
- Koch, Karl-Wilhelm (Authorized examiners)
- Neidhardt, John (Authorized examiners)
- Hartmann, Anna-Maria (Authorized examiners)
- Greschner, Martin (Authorized examiners)
- Klump, Georg Martin (Authorized examiners)
- Owczarek-Lipska, Marta (Authorized examiners)

Prerequisites
- Recommended in combination with "Research Techniques in Neuroscience"

Skills to be acquired in this module
- Upon successful completion of this course, students have acquired basic knowledge of fundamental principles of neurobiology. The aim of this background module is to provide a solid biological knowledge base required for studying advanced neuroscientific topics. It is designed in particular, but not exclusively, for students joining the local M.Sc. Neuroscience program from previous study paths with little (neuro)biological background.
  - ++ Neurosci. knowlg.
  - + Scient. Literature
  - + Social skills
  - + Interdiscipl. knowlg.
  - + Scientific English

Module contents
- The background module consists of a lecture series and an associated seminar.
- The following topics are covered:
  - Biochemistry
  - Genetics
  - Electrophysiology
  - Cell biology
  - Systems Neuroscience

Reader's advisory
- Neuroscience, newest edition; Purves; Sinauer Associates
- Stryer Biochemistry and Alberts et al. Molecular Biology of the Cell, several editions
- Molecular Biology of the Gene, Watson (Pearson Verlag)

Links

Languages of instruction

Duration (semesters)
- 1 Semester

Module frequency
- annually

Module capacity
- unlimited

Modullevel / module level
- MM (Mastermodul / Master module)

Modulart / typ of module
- Wahlpflicht / Elective

Lehr-/Lernform / Teaching/Learning method

Vorkenntnisse / Previous knowledge

Examination
- Time of examination
- Type of examination
- Final exam of module
- at the end of the course
<table>
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<th>Frequency</th>
<th>Workload of compulsory attendance</th>
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<td>SoSe oder WiSe</td>
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<tr>
<td>Seminar</td>
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<td>SoSe oder WiSe</td>
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**Total time of attendance for the module**

56 h
neu360 - Auditory Neuroscience

<table>
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<tr>
<td>Workload</td>
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<tr>
<td>1 SWS Lecture (VO)</td>
<td>Total workload 45h: 14 h contact / 31 h background reading</td>
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<tr>
<td>1 SWS Seminar (SE)</td>
<td>Total workload 45h: 14 h contact / 15 h background reading / 16 h preparation and presentation</td>
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<tr>
<td>2 SWS Supervised exercise (UE)</td>
<td>Total workload 90h: 10 h contact / 20 h literature search / 60 h work on essay paper</td>
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Applicability of the module

- Master's Programme Biology (Master) > Background Modules
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

Responsible persons

Köppl, Christine (Module responsibility)
Klump, Georg Martin (Authorized examiners)
Köppl, Christine (Authorized examiners)

Prerequisites

Recommended previous knowledge/skills: Basics of Neurosensory Science and Behavioural Biology

Skills to be acquired in this module

++ Neurosci. knowlg
+ Expt. methods
++ Scient. Literature
+ Social skills
++ Interdiscipl. knowlg
++ Data present./disc.
++ Scientific English
+ Ethics

Introduction to Auditory Physiology. May serve as preparation for a Research Module in this area.

Upon successful completion of this course, students

- have profound knowledge on auditory sensory processing at several levels (including cochlear transduction mechanisms, central auditory processing)
- have basic knowledge of the large range of techniques used in auditory research
- are able to read and critically report to others on an original research paper in auditory neuroscience
- are able to research and review a specific topic in auditory neuroscience

Module contents

One week introductory block course, comprised of a lecture series and matching seminar that emphasizes discussion.
Topics:
- Hair cells: structure, transduction mechanism, receptor potential, synaptic transmission
- Basilar papilla / cochlea: structure, micromechanics, amplification; otoacoustic emissions
- Auditory nerve: phase locking, rate coding. Excitation patterns
- Ascending auditory pathways: wiring, principles of excitation/inhibition, examples of cellular/molecular specialisations
- Sound localisation in birds and mammals
- Central auditory processing: imaging techniques, auditory streams, cortex, primates
- Relation between psychophysics and neurophysiology

The introductory block is followed by a supervised literature search and individually written term paper on a specific topic in auditory neuroscience.

Reader's advisory

About 20 selected original papers (selection varies)
Pickles JO (2012) An Introduction to the Physiology of Hearing. Brill, Netherlands

Links

Language of instruction
English

Duration (semesters)
1 Semester

Module frequency
annually, summer term, second half

Module capacity
15

BM neu211 "Neurosensory Science and Behaviour"
or BM neu270 "Neurocognition and Psychophysics"
or skills module biox "Current Topics in Hearing Science"

<table>
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<tr>
<th>Reference text</th>
<th>Registration procedure / selection criteria: StudIP, final acceptance after assignment of seminar presentation</th>
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<td>Modulart / typ of module</td>
<td>Wahlpflicht / Elective</td>
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<td>Lehr-/Lernform / Teaching/Learning method</td>
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<td>Vorkenntnisse / Previous knowledge</td>
<td>Basics of Neurosensory Science and Behavioural Biology</td>
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<tr>
<td>Examination</td>
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<td>Total time of attendance for the module</td>
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### neu370 - Neuroprosthetics

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<tr>
<td>Workload</td>
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2 SWS Lecture (total workload 90h: 30h contact/ 60h individual revision of lecture contents, test preparation)
1 SWS Seminar (total workload 45h: 15h contact / 30h individual reading and preparation)
1 SWS Supervised Exercise (total workload 45h: 15h contact / 30h individual work on portfolio tasks (interpretation of simulation results))

### Applicability of the module
- Master's Programme Neuroscience (Master) > Background Modules

### Responsible persons
- Dietz, Mathias (Authorized examiners)
- Dietz, Mathias (Module responsibility)
- Anna Dietze

### Further responsible persons
- Anna Dietze

### Prerequisites
- Either Neurophysics (5.04.4211) or Computational Neuroscience

### Skills to be acquired in this module
- Neurosci. knowlg.
- Expt. Methods
- Scient. Literature
- Social skills
- Interdiscipl. knowlg.
- Maths/Stats/Progr.
- Data present./disc.
- Ethics [nop]

Upon successful completion of this course, students
- understand how neuroprostheses work
- have an interdisciplinary understanding of the underlying principles of electrical stimulation of neurons
- can implement a coding strategy for neuroprostheses
- knows how a cochlear implant operates in detail and why it operates this way.

### Module contents
- Topics
  - electrical field distribution
  - electrical stimulation of neurons
  - biocompatibility
  - coding strategies
  - cochlear implants
  - student seminar presentations on various types of neuroprosthetics

### Reader’s advisory
Scientific articles: Copies of scientific articles for the seminar will be provided prior to the course
Text books or papers will be suggested prior to the course.

### Links

### Languages of instruction

### Duration (semesters)
1 Semester

### Module frequency
annually (summer term)

### Module capacity
20

### Modullevel / module level
EB (Ergänzungsbereich / Complementary)

### Modulart / typ of module
Wahlpflicht / Elective

### Lehr-/Lernform / Teaching/Learning method
Shared course components with (cannot be credited twice): 5.04.4216 (MSc PTM); 5.04.813 (MSc H&A)

### Vorkenntnisse / Previous knowledge
Programming experience in Matlab or Python

### Examination
<table>
<thead>
<tr>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
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<tbody>
<tr>
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### Final exam of module

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>SoSe oder WiSe</td>
<td>28</td>
</tr>
<tr>
<td>Seminar</td>
<td></td>
<td>2</td>
<td>SoSe oder WiSe</td>
<td>28</td>
</tr>
<tr>
<td>Exercises</td>
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<td>2</td>
<td>SoSe oder WiSe</td>
<td>28</td>
</tr>
<tr>
<td>Course type</td>
<td>Comment</td>
<td>SWS</td>
<td>Frequency</td>
<td>Workload of compulsory attendance</td>
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<td></td>
<td><strong>Total time of attendance for the module</strong></td>
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<td>84 h</td>
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</table>
psy270 - Functional MRI Data Analysis

Module label: Functional MRI Data Analysis
Module code: psy270
Credit points: 9.0 KP
Workload: 270 h

Applicability of the module:
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Neurocognitive Psychology (Master) > Mastermodule
- Master's Programme Neuroscience (Master) > Background Modules

Responsible persons:
- Gießing, Carsten (Module responsibility)
- Gießing, Carsten (Authorized examiners)

Prerequisites:
Enrolment in Master's programme Neurocognitive Psychology.

Skills to be acquired in this module:

Goals of module:
Students will learn the basics about planning and performing a neuroimaging study. They will focus on the statistical and methodological background of functional neuroimaging data analysis and analyse a sample functional MRI data set.

Competencies:
++ experimental methods
++ statistics & scientific programming
+ data presentation & discussion
++ group work

Module contents:
Theoretical knowledge on functional MRI data analysis
Planning, performance and analysis of functional neuroimaging studies using
MATLAB-based software
Hands-on fMRI data analysis with SPM

Reader's advisory:

Links:
Language of instruction: English
Duration (semesters): 1 Semester
Module frequency: The module will be offered every summer term.
Module capacity: 15
( The remaining places are reserved for Biology and Neuroscience students.)
Reference text:
Since the module is primarily offered for the Master's programme Biology it has to be offered as a blocked course. Please contact us if you are interested in the module but have problems with interfering other courses.

PLEASE NOTE:
We strongly recommend to take either psy170, psy270, psy280, or psy220 to gain methodological competencies (EEG, fMRI, TBS, HCI) that are needed for most practical projects and Master's theses!

Modullevel / module level: MM (Mastermodul / Master module)
Modulart / typ of module: Wahlpflicht / Elective
Lehr-/Lernform / Teaching/Learning method: blocked course with lecture, interactive seminar and exercise parts
Vorkenntnisse / Previous knowledge: Students need to have solid statistical knowledge as taught in the Introductory Course Statistics and in
### Research Methods.

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>end of summer term</td>
<td>Oral or written examination</td>
</tr>
</tbody>
</table>

Required active participation for gaining credits:
1-2 presentations
participation in discussions on other presentations
attendance of at least 70% in the seminars and exercises (use attendance sheet that will be handed out at the beginning of the term).

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
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</thead>
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<tr>
<td>Lecture</td>
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<td>28</td>
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<tr>
<td>Exercises</td>
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<td>2</td>
<td>SuSe</td>
<td>28</td>
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<tr>
<td>Seminar</td>
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<td>1</td>
<td>SuSe</td>
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**Total time of attendance for the module** 70 h
Research Modules

neu610 - External Research Project

<table>
<thead>
<tr>
<th>Module label</th>
<th>External Research Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>neu610</td>
</tr>
<tr>
<td>Credit points</td>
<td>15.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>450 h</td>
</tr>
<tr>
<td></td>
<td>{</td>
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<tr>
<td></td>
<td>240 h contact or individual lab work / 30 h data analysis / 40 h background reading / 50 h participation in seminar of host group and preparation of presentation / 60 h preparation of written internship report / 30 h science communication workshop with poster preparation and presentation)</td>
</tr>
<tr>
<td></td>
<td>}</td>
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</tbody>
</table>

Applicability of the module
- Master's Programme Neuroscience (Master) > Research Modules

Responsible persons
- Köppl, Christine (Module responsibility)
- der Neuroscience, Lehrende (Authorized examiners)

Further responsible persons
- all MSc Neuroscience teachers, see list of examiners

Prerequisites
- A learning agreement signed by the student, the supervisor at the host institution, and the Oldenburg supervisor (from the list of examiners), needs to be submitted to the examination office prior to the start of lab work.
- Module can be taken multiple times (see list of choices for each semester), however, examination of individual projects by the same supervisor is limited to EITHER two research projects (neu600 and / or neu610), OR one research project (neu600 or neu610) and the master thesis (first or second supervisor)

Skills to be acquired in this module
- + Neurosci. knowlg.
- ++ Expt. methods
- ++ Independent research
- ++ Scient. literature
- ++ Social skills
- + Interdiscipl. knowlg.
- ++ Data present./disc.
- + Scientific English
- + Ethics

Students are introduced to independent research in a specific area of neuroscience by a scientifically working group outside of the regular MSc Neuroscience faculty at the University of Oldenburg (usually a university, research institute, clinics or scientifically working company in Germany or abroad)

Students perform individual research projects to learn:
- planning and organization of a research project in a group outside of University of Oldenburg
- formulate a scientific hypothesis
- planning, performing and analyzing experiments and / or simulations
- working with scientific background literature on the specific context of the project
- oral presentation and discussion of backgrounds and results in the lab seminar
- write a scientific report
- prepare and present a scientific poster

Module contents

The External Research Module is carried out under the guidance and supervision of an experienced researcher who is not part of the regular Neuroscience faculty at the University of Oldenburg. It comprises approximately 7
(minimum 5) weeks of experimental or theoretical work, individually or in small groups, and, usually, participation in a regular group seminar during that time.

After completion of the lab work, students will continue to be advised during the writing phase of the project report by the external supervisor and / or by a local Neuroscience faculty member.

The timing of projects is by individual arrangement with the supervisor.

Participation in the Stud.IP workshop on science communication (https://elearning.uni-oldenburg.de/dispatch.php/course/overview?cid=6tc0dbbfa53d7b3f5e3660f52ac7d0f7) and a poster presentation at the biology & neuroscience student poster symposium is not mandatory but highly recommended.

Reader's advisory  Provided by external and / or local supervisor, depending on the project

Links

Language of instruction  English

Duration (semesters)  1 Semester

Module frequency  every semester

Module capacity  unlimited (
Module can be taken multiple times (see list of choices for each semester), however, examination of individual projects by the same supervisor is limited to EITHER two research projects (neu600 and / or neu610), OR one research project (neu600 or neu610) and the master thesis (first or second supervisor)

Reference text  All teachers from the list of MSc Neuroscience examiners at the University of Oldenburg can act as examiners, students should contact appropriate supervisors individually
Prior to project start, external and local supervisors must fill the learning agreement form. The supervisor at the host institution is invited to submit a short, written statement of assessment, final grading is done by the supervisor from the list of examiners.

Modullevel / module level  MM (Mastermodul / Master module)

Modulart / typ of module  Wahlpflicht / Elective

Vorkenntnisse / Previous knowledge

Examination  Time of examination  Type of examination
Final exam of module  within 2 months after conclusion of lab work  internship report

Course type  Project-oriented module

SWS  10

Frequency  SoSe und WiSe

Workload attendance  140 h
# neu600 - Neuroscience Research Project

<table>
<thead>
<tr>
<th>Module label</th>
<th>Neuroscience Research Project</th>
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<tbody>
<tr>
<td>Module code</td>
<td>neu600</td>
</tr>
<tr>
<td>Credit points</td>
<td>15.0 KP</td>
</tr>
</tbody>
</table>

## Workload

- 2 SWS Seminar (SE)
  - 28 h contact / 62 h reading and presentation preparation
- 8 SWS Research Internship (IFP)
  - 120 h contact / 120 h independent lab work / 30 h data analysis / 60 h preparation of written internship report / 30 h science communication workshop with poster preparation and presentation

## Applicability of the module

- Master's Programme Neuroscience (Master) > Research Modules

## Responsible persons

- Kretzberg, Jutta (Module responsibility)
- der Neuroscience, Lehrende (Authorized examiners)

## Further responsible persons

- all MSc Neuroscience teachers, see list of examiners

## Prerequisites

- Depending on project choice, please check Stud.IP and ask the supervisor. Module can be taken multiple times, however, supervision of individual projects is limited to 45 ECTS for the same combination of student and supervisor (1 research module + Master thesis OR up to 3 research modules, including external research projects)

## Skills to be acquired in this module

- Neurosci. knowlg.
- ++ Expt. Methods
- ++ Independent research
- ++ Scient. Literature
- + Social skills
- + Interdiscipl. knowlg.
- + Maths/Stats/Progr.
- + Data present./disc.
- + Scientific English
- + Ethics

Students perform individual research projects to learn:

- planning and organization of a research project in a group outside of University of Oldenburg
- formulate a scientific hypothesis
- planning, performing and analyzing experiments and / or simulations
- working with scientific background literature on the specific context of the project
- oral presentation and discussion of backgrounds and results in the lab seminar
- write a scientific report
- prepare and present a scientific poster

Module may serve as preparation for a Master's thesis.

## Module contents

The Research Module is carried out under the guidance and supervision of a member of the Neuroscience faculty at the University of Oldenburg (see list of examiners). It comprises approximately 7 (minimum 5) weeks of experimental or theoretical work, individually or in small groups, and a regular seminar for training, reporting and feedback advice during that time. Students can choose between many options of individual projects.
offered by the different groups involved in the MSc Neuroscience study program.

Research questions, methods and approaches differ between individual projects. Please refer to the list of options in Stud.IP and contact potential supervisors directly.

The timing of projects is by individual arrangement with the supervisor. Many, but not all, project options can also be scheduled during semester breaks, and/or as part-time options (lasting more than 7 weeks).

Note that, for some options, priority for admission to the project is given to students who passed a background module offered by the supervisor.

Participation in the Stud.IP workshop on science communication (https://elearning.uni-oldenburg.de/dispatch.php/course/overview?cid=6fc0dbba53d7b3f5e3680f52ac7d0f7) and a poster presentation at the biology & neuroscience student poster symposium is not mandatory but highly recommended.

Reader's advisory
Provided by the supervisor, depending on the project.

Links

Languages of instruction

Duration (semesters) 1 Semester
Module frequency every semester
Module capacity unlimited (no restriction)

Module level / module level MM (Mastermodul / Master module)
Modulart / typ of module Wahlpflicht / Elective

Lehr-/Lernform / Teaching/Learning method

Vorkenntnisse / Previous knowledge Depending on selected option – please contact the supervisor

Examination

Time of examination
Type of examination

Final exam of module PR

- within 2 months after conclusion of lab work
- in addition, mandatory but ungraded: presentation at lab seminar

Course type Comment SWS Frequency Workload of compulsory attendance

Project practical training 8 SoSe oder WiSe 112
Seminar 2 SoSe oder WiSe 28

Total time of attendance for the module 140 h
Skills Modules

neu710 - Neuroscientific Data Analysis in Matlab

<table>
<thead>
<tr>
<th>Module label</th>
<th>Neuroscientific Data Analysis in Matlab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>neu710</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
</tbody>
</table>

**Workload**

180 h

180 h

2 SWS Lecture (VL) and Seminar (SE)
Total workload 90 h: 28 h contact / 62 h individual preparation and working on assignments

2 SWS Supervised exercise (UE)
Total workload 90 h: 28 h contact / 62 h individual preparation and working on assignments

**Applicability of the module**

- Master's Programme Neuroscience (Master) > Skills Modules

**Responsible persons**

Kretzberg, Jutta (Module responsibility)
Kretzberg, Jutta (Authorized examiners)

**Prerequisites**

Skills to be acquired in this module

+ Neurosci. knowlg.
+ Social skills
+ Interdiscipl. knowlg.
++ Maths/Stats/Progr.
+ Scientific English
+ Ethics

Upon successful completion of this course, students

- understand basic programming concepts.
- have good knowledge about the most important aspects of the programming language Matlab and are able to write their own programs.
- have basic knowledge in statistical testing.
- have developed and applied a programs for the analysis of electrophysiological data.
- have practiced the interpretation of data analysis results in a neuroscience context

**Module contents**

In each of the seven weeks, one or two specific topics are introduced in the lecture, practiced in the exercises and applied to electrophysiological data in a programming task:

Matlab basics: Matlab windows, work space, vectors & matrices, saving & loading, graphics, scripts, functions

- Data types: numbers, logicals, text, categorical
- Control flow: if statements, loops (for, while)
- Software development: Flow charts, testing, debugging
- Working with data: Searching & sorting, logical indexing
- Advanced data types: sparse matrices, 3D matrices, cell arrays, structures, tables
- Statistics: random numbers, probability distributions, descriptive statistics, inferential statistics
- Application data analysis: Implementation of spike train analysis methods and graphics, function handles
- Application Modelling: curve fitting, simulation of time series

With completing the seven tasks, each participant develops a toolbox of the most common analysis methods for electrophysiological (spike and continuous) data. In addition to writing and commenting code, the programs are applied to experimental data. The tasks include questions about the interpretation of these analysis results.

Hence, the goal of this module is two-fold: Learning the programming language Matlab and analysis methods for electrophysiological data.
<table>
<thead>
<tr>
<th><strong>Reader's advisory</strong></th>
<th>Pascal Wallisch: MATLAB for Neuroscientists, Elsevier, Oxford</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Links</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Language of instruction</strong></td>
<td>English</td>
</tr>
<tr>
<td><strong>Duration (semesters)</strong></td>
<td>1 Semester</td>
</tr>
<tr>
<td><strong>Module frequency</strong></td>
<td>annually, winter term</td>
</tr>
<tr>
<td><strong>Module capacity</strong></td>
<td>24</td>
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<tr>
<td><strong>Modullevel / module level</strong></td>
<td>MM (Mastermodul / Master module)</td>
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<tr>
<td><strong>Modulart / typ of module</strong></td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
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<tr>
<td><strong>Lehr-/Lernform / Teaching/Learning method</strong></td>
<td></td>
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<tr>
<td><strong>Vorkenntnisse / Previous knowledge</strong></td>
<td>basic knowledge of math and statistics</td>
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<tr>
<td><strong>Examination</strong></td>
<td>Time of examination practical exercise - hand in code and interpretation each week</td>
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<tr>
<td><strong>Final exam of module</strong></td>
<td>during the course</td>
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<table>
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<tr>
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<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
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<tr>
<td>Lecture</td>
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<tr>
<td>Exercises</td>
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<td>2</td>
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<tr>
<td>Seminar</td>
<td></td>
<td>1</td>
<td></td>
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</tr>
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</table>

| **Total time of attendance for the module** | 56 h |
neu725 - Multivariate Statistics and Applications in R

Module label: Multivariate Statistics and Applications in R
Module code: neu725
Credit points: 6.0 KP
Workload: 180 h
  - 1.5 SWS Lecture (VO)
  - Total workload 68h: 28h contact / 20h background reading / 20h exam preparation
  - 2.5 SWS Supervised exercise (UE):
    - Total workload 113h: 28h contact / 20h background reading / 65h exercise solving

Applicability of the module: Master's Programme Neuroscience (Master) > Skills Modules
Responsible persons: Otto-Sobotka, Fabian (Module responsibility)
Otto-Sobotka, Fabian (Authorized examiners)
Prerequisites:
Skills to be acquired in this module:
  + Social skills
  + Interdiscipl. knowlg.
  ++ Maths/Stats/Progr.
  + Scientific English

  - students learn the use of the software R in application scenarios
  - students learn to actively "speak" the programming language R
  - students practice statistical data analysis with R

Module contents:
The lecture gives an intuitive introduction into the use of the statistics software R. We start by introducing the basic handling of R and the syntax of its programming language. We use those to obtain the first statistical analyses from R. The next important step is to create informative graphics to represent the statistical results. Finally, we look into programming concepts that allow for more complex statistical analyses.

Reader's advisory:
R Core Team - R: A language and environment for statistical computing (Reference Manual)

Links:
Language of instruction: English
Duration (semesters): 1 Semester
Module frequency: annually, summer term
Module capacity: 24
Reference text: Recommended previous knowledge / skills: basic statistical knowledge including regression analysis
Module level / module level: Wahlpflicht / Elective
Lehr-/Lernform / Teaching/Learning method
Vorkenntnisse / Previous knowledge
Examination: Time of examination: after the course, Type of examination: practical exercise
Final exam of module
  - Course type: Lecture
    - Comment: 2
    - SWS: 1.5
    - Frequency: SuSe
    - Workload of compulsory attendance: 28h
  - Course type: Exercises
    - Comment: 2
    - SWS: 2.5
    - Frequency: SuSe
    - Workload of compulsory attendance: 28h

Total time of attendance for the module: 56 h
# Biosciences in the Public Eye and in our Laws

<table>
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<tbody>
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<td>Credit points</td>
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<tr>
<td>Workload</td>
<td>180 h</td>
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<tr>
<td></td>
<td>(56h contact / 84h research for presentations / 40h term paper)</td>
</tr>
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</table>

### Applicability of the module

- Bachelor's Programme Biology (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Business Administration and Law (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Business Informatics (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Chemistry (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Comparative and European Law (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Computing Science (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Economics and Business Administration (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Environmental Science (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Intercultural Education and Counselling (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Mathematics (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Physical Education (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Physics, Engineering and Medicine (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Social Studies (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Sustainability Economics (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor's Programme Art and Media (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor's Programme Biology (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor's Programme Biology, Chemistry and Mathematics (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor's Programme Computer Science (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor's Programme Comparative and European Law (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor's Programme Economics and Business Administration (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor's Programme Education (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor's Programme English Studies (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor's Programme English Studies and Cultural Studies (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor's Programme Economics (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor's Programme Politics-Economics (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor's Programme Protestant Theology and Religious Education (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor's Programme Slavic Studies (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor's Programme Social Studies (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor's Programme Special Needs Education (Bachelor) > Fachnahe Angebote Biologie
- Master's Programme Biology (Master) > Skills Modules
- Master's Programme Biology (Master) > Skills Modules
- Master's Programme Neuroscience (Master) > Skills Modules

### Responsible persons

- Köppl, Christine (Module responsibility)
- Sienknecht, Ulrike (Module counselling)
- Köppl, Christine (Authorized examiners)
Prerequisites

Skills to be acquired in this module

- Expt. methods
- Scient. Literature
- Social skills
- Interdiscipl. knowlg
- Data present./disc.
- Scientific English
- Ethics

Upon completion of this course, students

- know basic rules of good scientific practise
- are aware of the legal framework that is relevant to biological research, e.g. on animal welfare or genetically modified organisms
- have practised to research and summarize different viewpoints on biological research, using both scientific (peer-reviewed) and non-scientific sources
- are able to identify and critically discuss ethical conflicts in biological research, e.g., in the context of stem cell research or data manipulation
- are able to prepare and give a coherent presentation in a team
- have practised to lead a group discussion

Module contents

In supervised exercises, students research the ethical aspects and controversial issues on several specific topics in the biosciences. Everyone participates in researching all topics. Students then take turns in summarizing and presenting each topic in small teams, and leading a critical discussion of each topic. Problem-based, independent research of the scientific background by the students is an integral part of this module.

Example topics:
- Good scientific practise and fraud
- Neuroenhancement
- Artificial intelligence
- Animal welfare, Animal experiments
- Overfishing, Nature conservation
- State-of-the-art genetic tools and their implications
- Genetically modified organisms, e.g., in food production, chimeras
- Stem cells
- Humans as experimental subjects

A bonus can be obtained through active participation during the semester. Active participation requires regular oral contributions to the group discussions, that go beyond giving your own talks. A bonus improves the exam mark by one step (0.3 or 0.4). The bonus is optional, an exam mark of 1.0 is achievable without a bonus. A bonus cannot be applied to pass a failed exam.

Reader's advisory

Links

Language of instruction English
Duration (semesters) 1 Semester
Module frequency annually, summer term
Module capacity 18
Module level / module level MM (Mastermodul / Master module)
Modulart / typ of module Wahlpflicht / Elective

Vorkenntnisse / Previous knowledge Fundamentals of genetics, physiology, ecology and biological systematics

Examination

<table>
<thead>
<tr>
<th>Final exam of module</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>within a few weeks of summer term lecture period</td>
<td>Term paper Regular participation during the semester is required (max 3 days of absence)</td>
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Course type Comment  SWS Frequency Workload of compulsory attendance

| Lecture | | | SuSe | 0 |
| Seminar and tutorial | 4 | SuSe | 56 |

Total time of attendance for the module 56 h
# Molecular Mechanisms of Ageing

<table>
<thead>
<tr>
<th>Module label</th>
<th>Molecular Mechanisms of Ageing</th>
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<tbody>
<tr>
<td>Module code</td>
<td>neu740</td>
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<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
<tr>
<td></td>
<td>4 SWS Supervised exercise (UE)</td>
</tr>
<tr>
<td></td>
<td>Total workload 180h: 26h contact / 50h group work / 50h prep. of thesis, presentations / 54h recap. literature</td>
</tr>
</tbody>
</table>

### Applicability of the module

- Bachelor's Programme Biology (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Business Administration and Law (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Business Informatics (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Chemistry (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Comparative and European Law (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Computing Science (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Economics and Business Administration (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Education (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Engineering Physics (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Environmental Science (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Intercultural Education and Counselling (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Mathematics (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Physics (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Physics, Engineering and Medicine (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Social Studies (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Sustainability Economics (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Art and Media (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Biology (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme English Studies (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Elementary Mathematics (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Computer Science (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme German Studies (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme History (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Material Culture: Textiles (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Music (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Philosophy / Values and Norms (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Protestant Theology and Religious Education (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Slavic Studies (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Social Studies (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Special Needs Education (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Sport Science (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Technology (Bachelor) > Fachnahe Angebote Biologie
- Fach-Bachelor Pädagogisches Handeln in der Migrationsgesellschaft (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Biology (Master) > Skills Modules
- Bachelor's Programme Biology (Master) > Skills Modules
- Bachelor's Programme Neuroscience (Master) > Skills Modules

### Responsible persons

- Thedeick, Kathrin (Module responsibility)
- Ebbers, Lena (Module responsibility)
Prerequisites

Skills to be acquired in this module

- Neurosci. knowlg.
- Expt. methods
- Scient. literature
- Social skills
- Interdiscipl. knowlg.
- Data present./disc.
- Scient. English
- Ethics

In this module the participants gain an overview of arguments and experimental strategies in ageing research. We will focus on the fields of medicine/epidemiology, biochemistry/ cell biology, physiology, and genetics. In addition, the main ageing theories will be covered. The participants work throughout the semester in project groups and present their results at a conference at the end of the course. Ethicists and philosophers from Germany and The Netherlands accompany the course, and chair at the conference a session on ethical aspects of ageing research. Under their moderation, the participants derive joint standpoints and policy recommendations.

At the end of this course the participants can

understand, analyse, and present scientific articles from ageing research

present the results of their studies and analyses using different presentation techniques

apply the learned contents in novel contexts (ethics in ageing research)

Topics

Major ageing theories

arguments and experimental strategies in the fields of medicine/epidemiology, biochemistry/ cell biology, physiology, genetics in ageing research

application of the learned contents in novel contexts (ethics in ageing research)

understanding, analysing, and presentation of scientific articles

presentation of results with different presentation techniques

Module contents

Lecture: major ageing theories and methods in ageing research are presented and discussed

Exercise: project work

1) Students: Choice of research focus
2) Independent work on the chosen research paper
3) Writing a 1 page thesis paper
4) Presentation in own expert group
5) Expert groups: research strategies, approaches, methods in chosen focus area
6) Development of a group resenation and group poster
7) Presentation at 1 day conference
8) Dutch and German ethics experts present bioethics and lobby work in German and Dutch political gremia
9) The students develop a comparative view on medical ethics in different countries and derive own standpoints and policy recommendations for the ethical assessment of metabolic and ageing research. The project work runs independently in the different expert groups throughout the semester and is organised via StudIP. The students and groups receive regular feedback and guidance in presence meetings.

The days for presence meetings and final conference are determined with the participants during the first meeting. The students organize their own work in groups according to the jigsaw concept. Their work is structured by a weekly schedule, tasks to be handed in at fixed deadlines across the semester, lectures and presence meetings.

Reader's advisory

Primary and secondary literature will be provided and introduced at the first meeting

Recommended textbook(s) or other literature:
Roger B. McDonald, Biology of aging, Garland Science

Altern : Zelluläre und molekulare Grundlagen, körperliche Veränderungen und Erkrankungen, Therapieansa?tze
Ludger Rensing ; Volkhard Rippe

Links

Language of instruction
English

Duration (semesters)
1 Semester

Module frequency
annually, summer term

Module capacity
16
## Module level / module level

**Modulart / typ of module**  
Wahlpflicht / Elective

## Teaching/Learning method

### Previous knowledge

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>end of semester</td>
<td>portfolio: thesis paper, oral presentation, poster presentation In addition, mandatory but ungraded: questionnaire on ageing theories, meeting protocols</td>
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</table>

## Course type

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>SuSe</td>
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<tr>
<td>Exercises</td>
<td></td>
<td>4</td>
<td>SuSe</td>
<td>56</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module** 84 h
neu760 - Scientific English

Module label: Scientific English
Module code: neu760
Credit points: 6.0 KP

Workload:
- 180 h
  - 0.5 SWS Lecture (VO)
    - Total workload 23h: 8h contact / 15h research for term paper
  - 3.5 SWS Supervised exercise (UE)
    - Total workload 158h: 46h contact / 46h preparation of texts and presentations / 66h term paper

Applicability of the module:
- Master's Programme Biology (Master) > Skills Modules
- Master's Programme Molecular Biomedicine (Master) > Skills Modules
- Master's Programme Neuroscience (Master) > Skills Modules

Responsible persons:
- Köppl, Christine (Module responsibility)
- Hildebrandt, Jannis (Authorized examiners)
- Köppl, Christine (Authorized examiners)

Prerequisites:
- non-native speakers

Skills to be acquired in this module:
- ++ Neurosci. knowlg.
- ++ Social skills
- ++ Data present./disc.
- ++ Scientific English

Upon completion of this course, students:
- have increased their proficiency in different forms of scientific presentation and communication in English, with special emphasis on neuroscience
- are able to express themselves with correct sentence structure and grammar, correct use of idioms and correct pronunciation
- are proficient in different contexts of scientific communication (e.g., paper, poster and informal exchange by email or phone)
- are able to recognize and avoid common errors of non-native speakers.

Module contents:
- Lectures cover
  - characteristics of the different forms of scientific presentations
  - sentence structure using the passive voice
  - scientific vocabulary and terminology as contrasted to common speech
  - appropriate language for communication with scientific editors and referees

Students read neuroscience texts of an advanced level and practice explaining and presenting these in both written and oral form. They also practice different contexts of scientific communication (e.g., paper, poster and informal exchange by email or phone). Emphasis is placed on individual problems in pronunciation and language use errors.

Reader's advisory:
http://users.wpi.edu/~nab/sci_eng/ScientificEnglish.pdf

Links:
Language of instruction: English
Duration (semesters): 1 Semester
Module frequency: annually, semester break
Module capacity: 12
Reference text:
Usually held in the break before summer term
Outsourced to STELS-OL (Scientific and Technical English Language Service); native English speaker with in-depth neuroscience knowledge.

Modulelevel / module level:
je nach Studiengang Pflicht oder Wahlpflicht

Modulart / typ of module:

Lehr-/Lernform / Teaching/Learning method:

Vorkenntnisse / Previous knowledge:
minimum English level B2 (C1 preferred) according to Common European Framework of Reference for Languages (CEFR)
priority to non-native speakers, higher semester
<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>within 2 months of completing the course</td>
<td>Portfolio: 70% several quick tests, texts, presentations, 30% term paper</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bonus system for active participation</td>
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<table>
<thead>
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<th>SWS</th>
<th>Frequency</th>
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**Total time of attendance for the module** 56 h
# neu780 - Introduction to Data Analysis with Python

<table>
<thead>
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<th>Introduction to Data Analysis with Python</th>
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<tbody>
<tr>
<td><strong>Module code</strong></td>
<td>neu780</td>
</tr>
<tr>
<td><strong>Credit points</strong></td>
<td>6.0 KP</td>
</tr>
<tr>
<td><strong>Workload</strong></td>
<td>180 h</td>
</tr>
</tbody>
</table>

- 2 SWS Lecture total workload 90h: 30h contact / 60h individual reading
- 2 SWS Supervised exercise total workload 90h: 45h contact / 45h solving programming exercises

<table>
<thead>
<tr>
<th><strong>Applicability of the module</strong></th>
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</thead>
<tbody>
<tr>
<td>- Master's Programme Biology (Master) &gt; Skills Modules</td>
</tr>
<tr>
<td>- Master's Programme Biology (Master) &gt; Skills Modules</td>
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<tr>
<td>- Master's Programme Neuroscience (Master) &gt; Skills Modules</td>
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</table>

<table>
<thead>
<tr>
<th><strong>Responsible persons</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Winklhofer, Michael (Module responsibility)</td>
</tr>
<tr>
<td>Winklhofer, Michael (Authorized examiners)</td>
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</table>

<table>
<thead>
<tr>
<th><strong>Prerequisites</strong></th>
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<tbody>
<tr>
<td>+ Neurosci. knowlg.</td>
</tr>
<tr>
<td>++ Maths/Stats/Progr.</td>
</tr>
<tr>
<td>+ Data present./disc.</td>
</tr>
</tbody>
</table>

The objective of the module is the acquisition of programming skills with focus on analysis of neurobiological datasets, using the programming language python. Python is available for any computer platform (PC, Mac, Linux) and is open source (for free), see [https://www.python.org/](https://www.python.org/).

Students will learn how to write effective scripts for data processing and visualisation, making use of pre-existing program libraries for various generic purposes (maths, statistics, plotting, image analysis).

Typical applications will be analysis of time series (e.g., electrophysiological recordings, movement data), images (e.g. immunohistochemical images, MRI slices), and spatio-temporal correlations in volume data. Students will also learn how to produce synthetic data from various noise models to assess signal-to-noise ratio in instrumental datasets.

<table>
<thead>
<tr>
<th><strong>Module contents</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Data types and data structures, control structures, functions, modules, file input/output Standard libraries and SciPy libraries (Matplotlib, NumPy,...), scikit-image, VPython, ...</td>
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</table>

<table>
<thead>
<tr>
<th><strong>Reader's advisory</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>open access</td>
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<table>
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<th><strong>Links</strong></th>
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<tr>
<td>Language of instruction</td>
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<tr>
<td>Duration (semesters)</td>
</tr>
<tr>
<td>Module frequency</td>
</tr>
<tr>
<td>Module capacity</td>
</tr>
<tr>
<td>Reference text</td>
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<table>
<thead>
<tr>
<th><strong>Modullevel / module level</strong></th>
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<tr>
<td>Wahlpflicht / Elective</td>
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<table>
<thead>
<tr>
<th><strong>Lehr-/Lernform / Teaching/Learning method</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Examination</strong></th>
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</thead>
<tbody>
<tr>
<td>Time of examination</td>
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<tr>
<td>term break, immediately after the course (2 weeks in February)</td>
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<table>
<thead>
<tr>
<th><strong>Course type</strong></th>
<th><strong>Comment</strong></th>
<th><strong>SWS</strong></th>
<th><strong>Frequency</strong></th>
<th><strong>Workload of compulsory attendance</strong></th>
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</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>WiSe</td>
<td>28</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>2</td>
<td>WiSe</td>
<td>28</td>
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</table>

| **Total time of attendance for the module** | 56 h |
neu751 - Laboratory Animal Science

<table>
<thead>
<tr>
<th>Module label</th>
<th>Laboratory Animal Science</th>
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<tbody>
<tr>
<td>Module code</td>
<td>neu751</td>
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<tr>
<td>Credit points</td>
<td>3.0 KP</td>
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<tr>
<td>Workload</td>
<td>90 h</td>
</tr>
<tr>
<td></td>
<td>one week full-time in semester break + flexible time for studying and exam preparation</td>
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<tr>
<td></td>
<td>1 SWS Lecture</td>
</tr>
<tr>
<td></td>
<td>total workload 45h: 2h contact / 20h background reading / 23h exam preparation</td>
</tr>
<tr>
<td></td>
<td>1 SWS Supervised exercise</td>
</tr>
<tr>
<td></td>
<td>total workload 45h: 35h contact / 10h background reading</td>
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</tbody>
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Applicability of the module
- Master's Programme Biology (Master) > Skills Modules
- Master's Programme Molecular Biomedicine (Master) > Skills Modules
- Master's Programme Neuroscience (Master) > Skills Modules

Responsible persons
- Köppl, Christine (Module responsibility)
- Köppl, Christine (Authorized examiners)
- Langemann, Ulrike (Authorized examiners)
- Nolte, Arne (Authorized examiners)
- Heyers, Dominik (Authorized examiners)
- Ebbers, Lena (Authorized examiners)
- Dedek, Karin (Authorized examiners)
- Schmaljohann, Heiko (Authorized examiners)
- Winklhofer, Michael (Authorized examiners)

Prerequisites
- none

Skills to be acquired in this module
++ Expt. Methods
+ Independent Research
+ Scient. Literature
++ Social skills
++ Interdiscipl. knowlg
+ Scientific English
++ Ethics

Upon successful completion of this course, students
- know the relevant EU legislation governing animal welfare and are able to explain its meaning in common language
- understand and are able to critically discuss salient ethical concepts in animal experimentation, such as the three Rs and humane endpoint
- have basic knowledge of the biology and husbandry of laboratory animal species held at the University of Oldenburg (rodents or birds or fish)
- are able to critically assess the needs and welfare of animals without compromising scientific integrity of the investigation
- have practical skills in handling small rodents or birds or fish
- have profound knowledge of anaesthesia, analgesia and basic principles of surgery
- have practised invasive procedures and euthanasia

NOTE: These objectives aim to satisfy the requirements for EU directive A „Persons carrying out animal experiments“ and EU directive D „Persons killing animals“.

Module contents
Background knowledge is taught using the third-party online platform "LAS Interactive" which concludes with a written exam that has to be passed before the practical part. Topics covered are:
- Legislation, ethics and the 3Rs
- Scientific integrity
- Data collection
- Basic biology of rodents, birds and fish
- Husbandry, and nutrition of rodents, birds and fish
- Animal Welfare
- Health monitoring
• Pain and distress
• Euthanasia

Practical procedures will first be demonstrated, important aspects will then be practiced under supervision by every participant, on an animal model of their choice (rodents, birds or fish):

• Handling and external examination
• Administration of substances, blood sampling
• Euthanasia and dissection
• Transcardial perfusion
• Anaesthesia and surgery

Reader's advisory

“LAS interactive” internet-based learning platform

Links

Language of instruction

English

Duration (semesters)

1 Semester

Module frequency

semester break, every semester

Module capacity

10 (Registration procedure / selection criteria: StudIP, sequence of registration)

Modullevel / module level

je nach Studiengang Pflicht oder Wahlpflicht

Lehr-/Lernform / Teaching/Learning method

Vorkenntnisse / Previous knowledge

Examination

Time of examination
immediately before the practical part

Type of examination
written exam of 90 minutes

Final exam of module

Course type
Lecture
Exercises

Comment

SWS
1
1

Frequency
SoSe und WiSe
SoSe und WiSe

Workload of compulsory attendance
14
14

Total time of attendance for the module

28 h
neu790 - Communicating Neuroscience

Module label | Communicating Neuroscience
Module code | neu790
Credit points | 3.0 KP
Workload | 90 h

(28 h contact / 62 h individual reading and preparing discussion questions)

Applicability of the module
- Master's Programme Biology (Master) > Skills Modules
- Master's Programme Neuroscience (Master) > Skills Modules

Responsible persons
- Kretzberg, Jutta (Module responsibility)
- Kretzberg, Jutta (Authorized examiners)
- Köppl, Christine (Authorized examiners)

Prerequisites

Skills to be acquired in this module

- Neurosci. knowlg.
- ++ Scient. Literature
- ++ Social skills
- + Interdiscipl. knowlg.
- ++ Data present./disc.
- + Scientific English
- ++ Ethics

Upon successful completion of this course, students will have thought about and discussed in depth scientific, social and ethical aspects of communication in and about neuroscience. In particular, participants practice critical reading of neuroscience literature, learn about the scientific publication process and discuss science communication to the general public.

Module contents

The overall goal of critical discussion of neuroscientific results in a scientific, social and ethical context requires preparation and active participation both before (Stud.IP wiki) and during the weekly sessions. Each participant is responsible for the preparation and moderation of at least one session in a group of 2-3 students. For passing the module, additional active participation is required in at least 10 of the seminar sessions. The specific papers and topics that are discussed vary, but typically cover:

- How to find literature?
- How to read different types of scientific papers: Classic papers, review papers, perspective papers, recent original papers?
- Publication process, Authorship and impact metrics
- Alternative publication paths and data sharing in neuroscience
- Science communication for the general public and on social media
- Face-to-face scientific communication

Reader's advisory

List of published papers, as well as online resources for preparation will be selected by the teachers and participants and announced via Stud.IP.

Background neuroscience textbooks, e.g.:
- Galizia, Lledo ‘Neuroscience – From Molecule to Behavior’, 2013, Springer
- Nicholls et al. ‘From Neuron to Brain’, 5th edition 2012, Sinauer
### Links
Related content: Science communication workshop:
https://elearning.uni-oldenburg.de/dispatch.php/course/overview?cid=6fc0dbfa53d7b3f5e3680f52ac7d0f7

<table>
<thead>
<tr>
<th>Language of instruction</th>
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<tr>
<td><strong>Duration (semesters)</strong></td>
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<td>Module frequency</td>
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<td>Module level / module level</td>
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<td>Wahlpflicht / Elective</td>
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<td><strong>Lehr-/Lernform / Teaching/Learning method</strong></td>
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<td>SWS</td>
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<td>Frequency</td>
<td>WiSe</td>
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<tr>
<td>Workload attendance</td>
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# neu800 - Introduction to Matlab

<table>
<thead>
<tr>
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<th>Introduction to Matlab</th>
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<tbody>
<tr>
<td>Module code</td>
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<tr>
<td>Credit points</td>
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<td>Workload</td>
<td>90 h</td>
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<tr>
<td></td>
<td>{</td>
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<tr>
<td></td>
<td>2 SWS Supervised exercise (UE) &quot;Introduction to MATLAB&quot;</td>
</tr>
<tr>
<td></td>
<td>Total workload 90h: 28h contact / 62h practising learned programming skills</td>
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<tr>
<td>Applicability of the module</td>
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<tr>
<td></td>
<td>• Master's Programme Biology (Master) &gt; Skills Modules</td>
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<td>• Master's Programme Biology (Master) &gt; Skills Modules</td>
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<tr>
<td></td>
<td>• Master's Programme Neuroscience (Master) &gt; Skills Modules</td>
</tr>
<tr>
<td>Responsible persons</td>
<td>Gießing, Carsten (Module responsibility)</td>
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<tr>
<td></td>
<td>Gießing, Carsten (Authorized examiners)</td>
</tr>
<tr>
<td>Prerequisites</td>
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<tr>
<td>Skills to be acquired in this module</td>
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</tr>
<tr>
<td></td>
<td>++ Expt. Methods</td>
</tr>
<tr>
<td></td>
<td>+ Social skills</td>
</tr>
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<td>+ Interdiscipl. knowlg.</td>
</tr>
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<td>++ Maths/Stats/Progr.</td>
</tr>
<tr>
<td></td>
<td>+ Data present./disc.</td>
</tr>
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<td></td>
<td>+ Scientific English</td>
</tr>
</tbody>
</table>

Within this introductory course students will learn the basics of MATLAB programming. Participants will be introduced in fundamental programming concepts.

<table>
<thead>
<tr>
<th>Module contents</th>
<th>The modul comprises an introduction to data structures, flow control, loops, graphics, basic data analyses with MATLAB, scripts and functions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Links</td>
<td></td>
</tr>
<tr>
<td>Language of instruction</td>
<td>English</td>
</tr>
<tr>
<td>Duration (semesters)</td>
<td>1 Semester</td>
</tr>
<tr>
<td>Module frequency</td>
<td>annually, summer term, second half</td>
</tr>
<tr>
<td>Module capacity</td>
<td>12 (in total with bio640) { shared course components with (cannot be credited twice): bio640 }</td>
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<td>Modullevel / module level</td>
<td>MM (Mastermodul / Master module)</td>
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<tr>
<td>Modulart / typ of module</td>
<td>Wahlpflicht / Elective</td>
</tr>
<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
<td></td>
</tr>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td></td>
</tr>
<tr>
<td>Examination</td>
<td>Time of examination</td>
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<tr>
<td>Final exam of module</td>
<td>end of summer term</td>
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<tr>
<td>Type of examination</td>
<td>Working on exercises Regular active participation</td>
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<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
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</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td></td>
<td>SuSe</td>
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<tr>
<td>Seminar</td>
<td></td>
<td></td>
<td>SuSe</td>
<td>0</td>
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<tr>
<td>Exercises</td>
<td></td>
<td>2</td>
<td>SuSe</td>
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</table>

**Total time of attendance for the module**: 28 h
neu810 - International Meeting Contribution

<table>
<thead>
<tr>
<th>Module label</th>
<th>International Meeting Contribution</th>
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<tbody>
<tr>
<td>Module code</td>
<td>neu810</td>
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<tr>
<td>Credit points</td>
<td>3.0 KP</td>
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<tr>
<td>Workload</td>
<td>90 h</td>
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</table>
| Applicability of the module| - Master's Programme Biology (Master) > Skills Modules  
- Master's Programme Biology (Master) > Skills Modules  
- Master's Programme Neuroscience (Master) > Skills Modules |
| Responsible persons        | Kretzberg, Jutta (Module responsibility)  
Kretzberg, Jutta (Authorized examiners)  
Köppl, Christine (Authorized examiners) |
| Prerequisites              | - Neurosci. knowlg.  
++ Independent research  
+ Scient. Literature  
++ Social skills  
++ Interdiscipl. knowlg.  
++ Data present./disc.  
+ Scientific English  
+ Ethics |
| Skills to be acquired in this module | - participate in an international meeting  
- prepare a poster or talk for an international meeting  
- present own results in a way that is appropriate for the target audience  
- put own studies into the context of scientific literature  
- acquire additional knowledge about a broader field of research |
| Module contents            | Active participation in a scientific conference, workshop, summer school etc, lasting a minimum of 3 full days.  
Student must be the presenter (poster or talk) and an author of the presented work, typically carried out in the context of a research module or the Master thesis.  
It is mandatory to present the poster or talk to Christine Köppl or Jutta Kretzberg prior to the meeting and incorporate the feedback on the presentation. |
<p>| Reader's advisory          | dependent on the scientific topic |
| Links                      |                                    |
| Language of instruction    | English                            |
| Duration (semesters)       | 1 Semester                         |
| Module frequency           | every semester, flexible           |
| Module capacity            | unlimited (please contact module organizer individually) |
| Modullevel / module level  | MM (Mastermodul / Master module)   |
| Modulart / typ of module   | Wahlpflicht / Elective             |
| Vorkenntnisse / Previous knowledge |                                    |
| Examination                |                                    |
| Time of examination        |                                    |
| Type of examination        | Final exam of module presentation (ungraded, pass/fail) |
| Course type                | Seminar                            |
| SWS                        | 2                                  |</p>
<table>
<thead>
<tr>
<th><strong>Frequency</strong></th>
<th>SoSe und WiSe</th>
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<tbody>
<tr>
<td><strong>Workload attendance</strong></td>
<td>28 h</td>
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</table>
# neu725 - Multivariate Statistics and Applications in R

## Module label
Multivariate Statistics and Applications in R

## Module code
neu725

## Credit points
6.0 KP

## Workload
180 h
- 2 SWS Lecture (30h contact / 60h self-studies and exam preparation)
- 2 SWS Seminar (30h contact / 60h statistical data analysis in R)

## Applicability of the module
- Master's Programme Biology (Master) > Skills Modules
- Master's Programme Biology (Master) > Skills Modules
- Master's Programme Neuroscience (Master) > Skills Modules

## Responsible persons
- Hildebrandt, Andrea (Module responsibility)
- Hildebrandt, Andrea (Authorized examiners)

## Prerequisites
- recommended in semester 1/3
  - weeks 11-13 of summer semester

## Skills to be acquired in this module
Students will acquire basic knowledge in planning empirical investigations, managing and understanding quantitative data and conducting a wide variety of multivariate statistical analyses. They will learn how to use the statistical methodology in terms of good scientific practice and how to interpret, evaluate and synthesize empirical results from the perspective of statistical modeling in basic and applied research context. The courses in this module will additionally point out statistical misconceptions and help students to overcome them.

- Independent research
- Scient. Literature
- Social skills
- Interdiscipl. knowledge
- Math/Stats/Progr.
- Data preset./disc.
- Scient. English
- Ethics

## Module contents
### Part 1: Multivariate Statistics I (lecture):
- Graphical representation of multivariate data
- The Generalized Linear Modeling (GLM) framework
- Multiple and moderated linear regression with quantitative and qualitative predictors
- Logistic regression
- Multilevel regression (Generalized Linear Mixed Effects Modeling – GLMM)
- Non-linear regression models
- Path modeling
- Factor analysis (exploratory & confirmatory)
  - (Multilevel) Structural equation modeling (SEM linear and non-linear)

### Part 2: Analysis Methods with R (seminar)
- Data examples and applications of GLM, GLMM, polynomial, spline and local regression, path modeling, factor analyses and SEM

## Reader's advisory
Course material will be available in Stud.IP

## Links
- Language of instruction: English
- Duration (semesters): 1 Semester
- Module frequency: winter term, annually
- Module capacity: unlimited
  - recommended in semester 1/3
  - weeks 11-13 of summer semester

## Module level / module level
- MM (Mastermodul / Master module)

## Modulart / typ of module
- Wahlpflicht / Elective

## Vorkenntnisse / Previous knowledge

## Examination
<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
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<tbody>
<tr>
<td>Final exam of module</td>
<td>End of winter semester</td>
<td>written exam</td>
</tr>
<tr>
<td>Examination</td>
<td>Time of examination</td>
<td>Type of examination</td>
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<td>-------------</td>
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<td>attendance of at least 70% in the seminars (in addition, mandatory but ungraded)</td>
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<tr>
<td>Course type</td>
<td>Comment</td>
<td>SWS</td>
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<tr>
<td>Lecture</td>
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<td>Exercises</td>
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<td>Module label</td>
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<tr>
<td>Credit points</td>
<td>3.0 KP</td>
<td></td>
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<tr>
<td>Workload</td>
<td>90 h (30h contact / 60h reading and preparation of oral and poster presentation)</td>
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<tr>
<td>Applicability of the module</td>
<td>- Master's Programme Biology (Master) &gt; Skills Modules</td>
<td></td>
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<tr>
<td></td>
<td>- Master’s Programme Biology (Master) &gt; Skills Modules</td>
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<tr>
<td></td>
<td>- Master’s Programme Neuroscience (Master) &gt; Skills Modules</td>
<td></td>
</tr>
<tr>
<td>Responsible persons</td>
<td>Mertsch, Sonja (Module responsibility)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mertsch, Sonja (Authorized examiners)</td>
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<tr>
<td>Prerequisites</td>
<td>Students will learn to read, interpret, present and discuss neuroscientific literature.</td>
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<tr>
<td></td>
<td>++ Neurosci. knowledge</td>
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<td></td>
<td>+ Exp. Methods</td>
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<tr>
<td></td>
<td>++ Scient. Literature</td>
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<td></td>
<td>++ Social skills</td>
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<td></td>
<td>++ Interdiscipl. knowledge</td>
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<td></td>
<td>++ Data present./disc.</td>
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<td></td>
<td>+ Scientific English</td>
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<td></td>
<td>+ Ethics</td>
<td></td>
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<tr>
<td>Module contents</td>
<td>Week 1: How to read and present a scientific paper and how to generate a scientific poster? Distribution of papers to participants</td>
<td></td>
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<tr>
<td></td>
<td>Week 2: Example presentation of a scientific paper by the teacher with discussion</td>
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<td></td>
<td>Week 3-13: Oral presentation / moderation of discussion of one scientific paper per week by one or two student(s)</td>
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<td></td>
<td>Week 14: Short poster presentations of all students</td>
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<td></td>
<td>The focus topic of the scientific literature will change between semesters.</td>
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<tr>
<td></td>
<td>In winter semester 2021/22, the topic will be regenerative ophthalmology with the focus on tissue engineering.</td>
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</tr>
<tr>
<td>Reader's advisory</td>
<td>Scientific literature will be available in Stud.IP</td>
<td></td>
</tr>
<tr>
<td>Links</td>
<td></td>
<td></td>
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<tr>
<td>Language of instruction</td>
<td>English</td>
<td></td>
</tr>
<tr>
<td>Duration (semesters)</td>
<td>1 Semester</td>
<td></td>
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<tr>
<td>Module frequency</td>
<td>winter term, annually</td>
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<tr>
<td>Module capacity</td>
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<td>Modullevel / module level</td>
<td>MM (Mastermodul / Master module)</td>
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<tr>
<td>Modulart / typ of module</td>
<td>Wahlpflicht / Elective</td>
<td></td>
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<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
<td></td>
<td></td>
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<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td></td>
<td></td>
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<tr>
<td>Examination</td>
<td>Time of examination</td>
<td></td>
</tr>
<tr>
<td>Final exam of module</td>
<td>during the semester</td>
<td></td>
</tr>
<tr>
<td>Time of examination</td>
<td>Type of examination</td>
<td></td>
</tr>
<tr>
<td></td>
<td>presentation and attendance of at least 70% in the seminars</td>
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<tr>
<td>Course type</td>
<td>Seminar</td>
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<tr>
<td>SWS</td>
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<tr>
<td>Frequency</td>
<td>WiSe</td>
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<tr>
<td>Workload attendance</td>
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</table>
gsw200 - Microscopic Imaging in Biomedical Sciences

Module label: Microscopic Imaging in Biomedical Sciences
Module code: gsw200
Credit points: 3.0 KP
Workload: 90 h

Applicability of the module:
- Master's Programme Molecular Biomedicine (Master) > Skills Modules
- Master's Programme Neuroscience (Master) > Skills Modules

Responsible persons:
Dedek, Karin (Module responsibility)
Dedek, Karin (Authorized examiners)
Groß, Petra (Authorized examiners)
Solovyeva, Vita (Authorized examiners)

Prerequisites:
Enrolment in Master’s programmes Molecular Biomedicine and Neuroscience.

Skills to be acquired in this module

Competencies:
+ deepened biological expertise
++ deepened knowledge of biological working methods
+ data analysis skills
++ interdisciplinary thinking
++ critical and analytical thinking
++ data presentation and discussion (written and spoken
+ team work

Module contents

The module focuses on microscopy, imaging and methods of microscopy.

Lecture:
Basics in optics, microscopy methods, image processing, biomedical applications

Seminar:
Examples for selected microscopy methods and their application

Different microscopical methods and their applications are discussed and compared. Students will understand the basics and limitations of microscopy methods and learn to evaluate them. Selected methods are demonstrated.

Reader's advisory:
Literature will be provided during the lecture/seminar

Links
Language of instruction: English
Duration (semesters): 1 Semester
Module frequency: afternoon event during winter semester
Module capacity: 16 (Selection criteria: attendance at first meeting)

Module level / module level: MM (Mastermodul / Master module)
Module art / typ of module: Wahlpflicht / Elective
Lehr-/Lernform / Teaching/Learning method: Lecture and Seminar

Vorkenntnisse / Previous knowledge: basic physics, basic cell biology

Examination:
Time of examination
Type of examination

Final exam of module
### Examination

<table>
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<tr>
<th>Time of examination</th>
<th>Type of examination</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Journal presentation (40%), written examination (60 min., 60%)</td>
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<tr>
<td></td>
<td>Note: to qualify for the exam, regular participation during the semester is mandatory, no more than 2 days of absence</td>
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<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
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<td>Lecture</td>
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<td>WiSe</td>
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<td>Seminar</td>
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<td>2</td>
<td>WiSe</td>
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**Total time of attendance for the module** 28 h
Abschlussmodul

mam - Master Thesis

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<th>Master Thesis</th>
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<tr>
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<tr>
<td>Credit points</td>
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</tr>
<tr>
<td>Workload</td>
<td>900 h</td>
</tr>
</tbody>
</table>

{2 SWS Seminar (SE): 28 h contact, 62 h individual preparation (reading, preparation of presentations)
18 SWS Thesis project: total 810 h. Percentages of contact (individual supervision) and independent work (independent lab work, data analysis, reading, thesis writing) depend on the topic and methods of the thesis project}

Applicability of the module
- Master’s Programme Neuroscience (Master) > Abschlussmodul

Responsible persons
Kretzberg, Jutta (Module responsibility)
der Neuroscience, Lehrende (Authorized examiners)

Prerequisites
The start of the master thesis requires prior completion of at least 60 ECTS.
Prior to the start of the thesis project, the form for application for the final thesis and final oral examination needs to be submitted to the examination office and approved by the examination committee. External examiners (not listed on the list of neuroscience examiners) need to apply for the status of an official examiner prior to the start of the project.
Depending on project choice, please ask the supervisor for additional requirements.

Skills to be acquired in this module
++ Neurosci. knowlg.
++ Expt. Methods
++ Independent research
++ Scient. Literature
++ Social skills
+ Interdiscipl. knowlg.
+ Maths/Stats/Progr.
++ Data present./disc.
+ Scientific English
+ Ethics

In their Master thesis, students perform individual research projects in the limited time of 6 month. Learning goals:
- planning and organization of a research project
- teamwork in a research group
- formulate a scientific hypothesis
- planning, performing and analyzing experiments and/or simulations
- working with scientific background literature on the specific context of the project
- oral presentation and discussion of backgrounds and results in the lab seminar
- write a scientific report
- optional: Prepare and present a scientific poster
Module contents

The master thesis comprises 6 months of experimental or theoretical work and thesis writing, and a regular seminar for training, reporting and feedback advice during that time. The aim, methods and results of the thesis are presented in a final oral presentation and exam (Master’s colloquium).

Students can choose between many options of individual projects, offered by the different groups involved in the MSc Neuroscience study program. Research questions, methods and approaches differ between individual projects. The timing of projects is by individual arrangement with the supervisor. Note that, for some options, priority for admission to the project is given to students who passed a background and / or research module offered by the supervisor.

Please refer to the Stud.IP MSc Neuroscience information community forum for information on the groups and contact potential supervisors directly.

The master thesis project is generally carried out under the guidance and supervision of a member of the Neuroscience faculty at the University of Oldenburg (see list of examiners) and additionally evaluated by a second examiner. External master thesis projects and / or evaluation by persons who are not on the list of examiners need prior approval by the examination committee.

Participation in the Stud.IP workshop on science communication (https://elearning.uni-oldenburg.de/dispatch.php/course/overview?cid=6fc0dbbfa53d7b3f5e3680f52ac7d0f7) and a poster presentation at the biology & neuroscience student poster symposium is not mandatory but highly recommended.

Reader’s advisory

Provided by the supervisor, depending on the project.

Links

Languages of instruction
- 1 Semester

Module frequency
- every semester

Module capacity
- unlimited

Module level / module level
- MM (Mastermodul / Master module)

Moduleart / typ of module
- Pflicht / Mandatory

Lehr-Lernform / Teaching/Learning method
- Individual project

Vorkenntnisse / Previous knowledge
- Depending on selected option – please contact the supervisor.

Examination
- Time of examination
- Type of examination

Final exam of module
- within 6 months after approval of the application
- Thesis (90%), oral presentation (10 %)

Course type
- Seminar

SWS
- 2

Frequency
- SoSe und WiSe

Workload attendance
- 28 h