# Modules for Neuroscience

## Background Modules

**neu120 - Lab Exercises in Development and Evolution**

<table>
<thead>
<tr>
<th>Module label</th>
<th>Lab Exercises in Development and Evolution</th>
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<tbody>
<tr>
<td>Module code</td>
<td>neu120</td>
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<tr>
<td>Credit points</td>
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<tr>
<td>Workload</td>
<td>180 h</td>
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</tbody>
</table>

**Used in course of study**
- Master's Programme Neuroscience (Master) > Background Modules

**Contact person**
- Module responsibility
  - Ulrike Sienknecht
- Module counseling
  - Hans Gerd Nothwang

**Entry requirements**
- required previous credits

**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
- Fundamentals and concepts of developmental and evolutionary biology

**Module contents**
- Lab exercises in comparative developmental biology on mouse and chicken embryos. Methods: in-ovo live observation; developmental stage discrimination and description, tissue preparation for histology, sectioning, staining, and microscopy

**Reader's advisory**

**Language of instruction**
- English

**Duration (semesters)**
- 1 Semester

**Module frequency**
- jährlich

**Module capacity**
- unlimited

**Reference text**
- Course in the first half of the semester

**Modulart**
- je nach Studiengang Pflicht oder Wahlpflicht

**Lern-/Lehrform / Type of program**

**Vorkenntnisse / Previous knowledge**

**Examination**
- Time of examination: same winter term
- Type of examination: report

<table>
<thead>
<tr>
<th>Final exam of module</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
</tr>
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<tbody>
<tr>
<td>Exercises</td>
<td>4.00</td>
<td></td>
<td>56 h</td>
</tr>
<tr>
<td>Seminar</td>
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**Total time of attendance for the module**
- 56 h
### Module Information

**neu140 - Neurophysiology**

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<th>Module label</th>
<th>Neurophysiology</th>
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<tr>
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<td>Credit points</td>
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<td>Workload</td>
<td>270 h</td>
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**Used in course of study**

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

**Contact person**

- Module responsibility
  - Martin Greschner
- Module counseling
  - Karin Dedek
  - Jutta Kretzberg

**Entry requirements**

- attendance in pre-meeting

**Skills to be acquired in this module**

- Neurosci. knowlg. Expt. methods Independent research + Scient. literature + Social skills
- Interdiscipl. knowlg. + Matha/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 electrophysiological experiments. Gaining modern methodological skills.

**Module contents**

- Lecture: first week, 5*4 h introduction to current neurophysiology.
- Seminar: weeks 2-4, each 4 h discussion of background literature and results of own experiments.
- Lab course: weeks 2-4, each 25 h electrophysiological experiments with introduction to at least two of the techniques extracellular recording / intracellular recording / patch clamp

**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**

- BC (Basiscurriculum / Base curriculum)

**Modulart**

- je nach Studiengang Pflicht oder Wahlpflicht

**Vorkenntnisse / Previous knowledge**

**Examination**

<table>
<thead>
<tr>
<th>Time of examination</th>
<th>Type of examination</th>
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<tr>
<td>summer semester, first half</td>
<td>Portfolio consisting of short tests and short reports</td>
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**Course type**

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<th>Comment</th>
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<th>Workload attendance</th>
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<td>Lecture</td>
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<td>28 h</td>
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<tr>
<td>Seminar</td>
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**Total time of attendance for the module**

- 112 h
### neu150 - Neuroanatomy

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<td>Credit points</td>
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<td>Workload</td>
<td>180 h</td>
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<td>Used in course of study</td>
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<td>Contact person</td>
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<tr>
<td></td>
<td>Ulrike Janssen-Bienhold</td>
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<td>Karin Dedek</td>
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<td>Entry requirements</td>
<td>attendance in pre-meeting</td>
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<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>Theory: Improved theoretical and methodological knowledge in neurobiology. Discussion of scientific work and presentation of own results.</td>
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<tr>
<td></td>
<td>Practice: Performing neuroanatomical experiments. Gaining modern methodological skills.</td>
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<tr>
<td>Module contents</td>
<td>Lecture: 14 h Introduction to current neurobiological approaches and results.</td>
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<tr>
<td></td>
<td>Seminar: 14 h Discussion of background literature and results of own experiments.</td>
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<tr>
<td></td>
<td>Lab course: 3 weeks, each 24 h neuroanatomical experiments in small groups on vertebrate retina and brain.</td>
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<td>Reader's advisory</td>
<td>Background and seminar literature will be available in Stud.IP</td>
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<td>Links</td>
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<td>Duration (semesters): 1 Semester</td>
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<td>Modulelevel</td>
<td>BC (Basiscurriculum / Base curriculum)</td>
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<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
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<td>Lern-/Lehrform / Type of program</td>
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<td>Vorkenntnisse / Previous knowledge</td>
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<td>Examination</td>
<td>Time of examination</td>
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<td>Portfolio (75 %), report (25%)</td>
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neu170 - Molecular Genetics and Cell Biology

Module label: Molecular Genetics and Cell Biology
Module code: neu170
Credit points: 15.0 KP
Workload: 450 h

Used in course of study: Master's Programme Neuroscience (Master) > Background Modules

Contact person:
- Module responsibility: John Neidhardt
- Module counseling: Karl-Wilhelm Koch, Kathrin Thiedeck

Entry 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

Students interested in molecular genetics, cell biology, molecular biology, and neurobiology will achieve the knowledge after completion of the course:

- Genetic basis of diseases, inheritance patterns of diseases and gene therapeutic approaches
- Cell nucleus and genomic DNA, Nucleic acid structure and function
- Signaling and Cancer
- Gene expression
- RNA Processing
- Translation
- structures of proteins and protein functions
- Membranes and membran proteins
- Energie metabolism in the cell
- sequencing techniques and knowledge of several other selected lab techniques
- Basic knowledge of how to perform research projects.

Module contents:
Subjects of the lecture and seminar:
- Storing and processing of genetic information
- mutation analysis
- genetic high throughput techniques
- structure and function of proteins/membranes, cytoskeleton, meta-bolic signaling, molecular basis of neurodegenerative diseases.

Exercises: Learning current methods of human genetics, cellular and molecular neurobiology; introduction to cell cultivation techniques.

- DNA extraction and agarose gel analysis
- Sanger sequencing and sequence analysis
- PCR-based techniques
- bioinformatic analysis of high throughput data
- cell culture
- gene therapy of dominant diseases

Reader's advisory:
Several selected scientific papers for the seminar (selection may vary)
Textbooks of Molecular Cell Biology; Alberts, Molecular biology of the cell

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
- Modullevel: MM (Mastermodul)
- Modulart: Wahlpflicht

Lern-/Lehrform / Type of program
### Vorkenntnisse / Previous knowledge

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<th>Type of examination</th>
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<td>70% written exam, 30% presentation(s)</td>
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<td></td>
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<td>Presentation(s) within the frame of the seminar.</td>
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<td>Regular active participation is required for the module to be passed.</td>
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<th>Comment</th>
<th>SWS</th>
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<td>Seminar</td>
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**Total time of attendance for the module**: 140 h
neu190 - Biochemical concepts in signal transduction

Module label: Biochemical concepts in signal transduction
Module code: neu190
Credit points: 15.0 KP
Workload: 450 h

Used in course of study:
- Master's Programme Neuroscience (Master) > Background Modules

Contact person:
- Module responsibility: Karl-Wilhelm Koch
- Module counseling: Alexander Scholten

Entry 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

Upon successful completion of this course, students:
- know fundamental principles of molecular mechanisms of signal processing in cells
- know the properties and functional roles of proteins involved in signaling pathways
- have a basic understanding of structure-function relationships of receptor molecules (e.g. G-protein-coupled receptors) and their down-stream targets
- know the main hypotheses and their experimental confirmation in selected signal transduction pathways
- are able to discuss and present current concepts and knowledge of cellular signaling
- learn by selected experiments, how to study experimentally protein function in signaling
- are able to assess experimentally prepared data sets and have a good command of how to present them scientifically
- have a basic knowledge how to plan and perform a sequential set of experiments in molecular life sciences
- have a basic knowledge how to operate and use scientific equipment like spectrophotometer, fluorescence spectrophotometer, clean benches in cell culture and chromatographic systems (HPLC)

Module contents:

Lecture on the molecular fundamentals of cellular signal processes
Lecture topics:
- Introduction to the concept of signal transduction
- G protein-coupled receptors
- G proteins and effector molecules
- Biochemical properties of secondary messenger molecules
- Down-stream targets of secondary messengers and physiological responses
- Calcium and signaling networks
- Nitric Oxide and nitric oxide synthases
- Tyrosine-Kinase-receptors
- Signaling cascades of monomeric G proteins
- Molecular regulation of the cell cycle
- Biochemical aspects of sensory cells, their receptors and signaling pathways

Seminar:
Signal transduction
Students prepare presentations and discussions on current reviews written by leading experts in the fields; topics include: structural basis of G-protein coupled receptors, G proteins, adenylylate cyclases, cyclic nucleotide research, calcium signaling, signal transduction in vision, ion channel function, nitric oxide synthase function.

Exercises:
Students perform experiments on cellular signal transduction and enzymology; they learn to express proteins in heterologous cell systems; they learn how to purify proteins and characterize them in subsequent assay systems.

Reader's advisory:
Current reviews on topics of signal transduction as preparation for the presentation in the Seminar; list of reviews will be adjusted every year;
Textbooks of cell biology and biochemistry:
Alberts et al., Molecular Biology of the Cell, 5th edition or later; Stryer, Biochemistry, 7th edition or later; these textbooks are updated almost every 3 or 4 years.
Current literature on topics of signal transduction (as announced in the preparatory meeting).

Links:

Language of instruction: English
Duration (semesters) 1 Semester
Module frequency jährlich
Module capacity unlimited
Reference text Course in the second half of the semester
Regular active participation and seminar presentation(s) are required to pass the module.
Modullevel MM (Mastermodul)
Modulant Wahlpflicht

Lern-/Lehrform / Type of program

Vorkenntnisse / Previous knowledge

Examination Time of examination Type of examination
Final exam of module within 2 months after the end of the course 50% written exam of 90 min., 50% report(s) Paper(s) are to be read. Regular active participation is required for the module to be passed.

<table>
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<th>Workload attendance</th>
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<td>Exercises</td>
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<td>WiSe</td>
<td>112 h</td>
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<td>Seminar</td>
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<td>1.00</td>
<td>WiSe</td>
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Total time of attendance for the module 140 h
neu210 - Neurosensory Science and Behaviour - Part A

Module label: Neurosensory Science and Behaviour - Part A
Module code: neu210
Credit points: 9.0 KP

Workload: 270 h
- (4 SWS Lecture (VO) "Neuroethology" and "Behavioural ecology" Total workload 180h: 56h contact/ 60h background reading/ 64h exam preparation 2 SWS Seminar (SE) "Current issues of ethology" Total workload 90h: 28h contact/ 30h literature reading/ 32h preparation of presentation)

Used in course of study:
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

Contact person:
Module responsibility
- Georg Martin Klump

Authorized examiners:
- Jannis Hildebrandt
- Georg Martin Klump
- Ulrike Langemann
- Henrik Mouritsen

Module counceling:
- Ulrike Langemann
- Jannis Hildebrandt
- Henrik Mouritsen

Entry requirements:
Fundamentals of Neurobiology, Behavioural Biology, Evolution, Ecology

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 behavioural ecology and neuroethology
- are able to present and critically assess scientific data and approaches

Module contents:
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.

Reader's advisory:

Links:
Language of instruction: English
Duration (semesters): 1 Semester
Module frequency: jährlich
Module capacity: 30
Recommended in combination with: neu220 BM "Neurocognition and Psychopharmacology"
Shared course components with (cannot be credited twice): bio610 (5.02.611 "Verhaltensökologie", 5.02,612 "Aktuelle Themen der Ethologie")

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

Modulelevel:
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Modulart:
je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program:
Fundamentals of Neurobiology, Behavioural Biology, Evolution, Ecology

Vorkenntnisse / Previous knowledge:
Fundamentals of Neurobiology, Behavioural Biology, Evolution, Ecology
<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Final exam of module</strong></td>
<td>as agreed, usually in the break after the winter term</td>
<td>80% written exam (content of the two lecture series), 20% presentation(s)</td>
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<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
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<tr>
<td>Lecture</td>
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<td>56 h</td>
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<tr>
<td>Seminar</td>
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<td>2.00</td>
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<td>28 h</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 excercise (UE) Total workload 45h: 14h contact/ 31h paper reading)

Used in course of study

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

Contact person

Module responsibility
- Christiane Margarete Thiel

Authorized examiners
- Carsten Gießing
- Christiane Margarete Thiel

Module counselling
- Carsten Gießing

Entry 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

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 excercise either deepens that knowledge by excercises 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. The lecture contains several interactive parts to consolidate and critically evaluate the acquired knowledge. 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
<table>
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<th>Duration (semesters)</th>
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<td>Module frequency</td>
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| Module capacity      | 30 (Recommended in combination with neu210 "Neurosensory 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. |
| Modullevel           | --- |
| Modulart             | je nach Studiengang Pflicht oder Wahlpflicht |
| Lern-/Lehrform / Type of program | Fundamentals of Neurobiology, Behavioural Biology |
| Vorkenntnisse / Previous knowledge | --- |
| Examination          | Time of examination
Type of examination
Final exam of module
as agreed, usually in the break after the winter term 100% written exam (content of the lectures) |
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<th>Course type</th>
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<tbody>
<tr>
<td>Lecture</td>
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<td>Exercises</td>
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<td>Total time of attendance for the module</td>
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# Computational Neuroscience - Introduction

<table>
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<tr>
<td>Credit points</td>
<td>9.0 KP</td>
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<tr>
<td>Workload</td>
<td>270 h</td>
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<td>Used in course of study</td>
<td>• Master's Programme Neuroscience (Master) &gt; Background Modules</td>
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**Entry requirements**
- attendance in pre-meeting

**Skills to be acquired in this module**

Upon successful completion of this course, students
- have acquired good programming skills (in Matlab)
- are able to implement and apply algorithms
- 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 four 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.

- **Week 1**: Background and Matlab preparation week
  - practice of programming principles (functions, scripts, if, loops, structures, cell arrays)
  - revision of neuroscience backgrounds (neuron, membrane, spike)

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

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

- **Week 4**: Network models
  - small networks (lateral inhibition, central pattern generator)
  - larger networks (integrate and fire networks, rate models, inhibition-excitation balance, learning)

**Reader's advisory**
Dayan / Abbott: Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems. MIT Press (More text books will be suggested prior to the course).

Scripts for each course day will be provided prior to / during the course
Copies of scientific articles for the seminar will be provided prior to the course

**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
- Modullevel: MM (Mastermodul)
- Modulart: Wahlpflicht

**Lern-/Lehrform / Type of program**

**Vorkenntnisse / Previous knowledge**

**Examination**
- Time of examination: during the course
- Type of examination: Portfolio, consisting of daily short tests, programming exercises and short reports

**Final exam of module**
- Time of examination: during the course
- Type of examination: Portfolio, consisting of daily short tests, programming exercises and short reports

**Course type**
<table>
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<th>Lecture</th>
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<tr>
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<td>SWS</td>
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</table>
neu250 - Computational Neuroscience - Statistical Learning

Module label  Computational Neuroscience - Statistical Learning
Module code   neu250
Credit points  6.0 KP
Workload  180 h
(1 SWS Lecture (VO) Total workload 45h: 20h contact/25h individual revision of lecture contents, test preparation
1 SWS Seminar (SE) Total workload 45h: 20h contact/ 25h individual reading and test preparation
2 SWS Supervised excercise Total workload 90h: 60h contact/ 30h individual work on portfolio tasks (interpretation of simulation results))

Used in course of study  • Master's Programme Neuroscience (Master) > Background Modules

Contact person
Module responsibility
- Jutta Kretzberg

Authorized examiners
- Jörn Anemüller
- Jutta Kretzberg
- Jochem Rieger

Module counseling
- Jochem Rieger
- Jörn Anemüller

Entry requirements
attendance in pre-meeting

Skills to be acquired in this module
Upon successful completion of this course, students 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 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

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

Links
Language of instruction  English
Duration (semesters)  1 Semester
Module frequency  jährlich
Module capacity  18 (Recommended in combination with neu240 Computational Neuroscience - Introduction
Shared course components with (cannot be credited twice): psy220 Human Computer Interaction)

Reference text
Course in the first half of the semester Students without Matlab experience should take the optional Matlab course (1. week) of Computational Neuroscience - Introduction

Modullevel  ---
Modulart  Pflicht o. Wahlpflicht / compulsory or optional
Programming experience is highly recommended, preferably in Matlab.

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<th>Time of examination</th>
<th>Type of examination</th>
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<tbody>
<tr>
<td>Final exam of module</td>
<td>during the course</td>
<td>Portfolio, consisting of daily short tests, programming exercises and short reports</td>
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<table>
<thead>
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<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>1.00</td>
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<tr>
<td>Exercises</td>
<td>2.00</td>
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<td></td>
<td>28 h</td>
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<tr>
<td>Seminar</td>
<td>1.00</td>
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<td>14 h</td>
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</table>

**Total time of attendance for the module**: 56 h
### Module: Neurocognition & Psychophysics

**Module label:** Neurocognition & Psychophysics  
**Module code:** neu270  
**Credit points:** 15.0 KP  
**Workload:** 450 h  

**Used in course of study:**  
- Master's Programme Neuroscience (Master) > Background Modules  

**Contact person**  
- Module responsibility: Georg Martin Klump  
- Module counseling: Christiane Margarete Thiel, Ulrike Langemann, Carsten Gießing

**Entry requirements**  
- Neurosci. knowlg. Expt. methods + Independent research + Scient. literature + Social skills  
- Interdiscipl. knowlg. Maths/Stats/Progr. + Data present./disc. + Scientific English Ethics

**The aim of the module is the study of different aspects of psychophysics or neurocognition. Students participate in ongoing projects and gain a first insight into topical research.**

**Module contents**  
Students have the choice of two basic streams:  
Stream 1: "Neurocognition" comprises (i) an exercise "Introduction to MATLAB" [2 SWS], (ii) a lecture "Functional MRI data analysis" [2 SWS], and (3) a practical course [5 SWS] and a seminar "Experiments on Neurocognition" [1 SWS] including aspects of planning, performance and analysis of functional neuro-imaging studies using MATLAB based software.  
Stream 2 "Psychophysics of Hearing" comprises (i) exercise "Introduction to MATLAB", (ii) lecture and seminar "The sense of hearing", and (iii) a laboratory project in which psychoacoustical experiments into the function of the auditory system are performed.

**Reader's advisory**  

**Links**
- Language of instruction: English  
- Duration (semesters): 1 Semester  
- Module frequency: jährlich  
- Module capacity: unlimited  
- Reference text: Course in the second half of the semester  
- Regular active participation is required to pass the module  
- Modulelevel: MM (Mastermodul)  
- Modulart: Wahlpflicht

**Lern-/Lehrform / Type of program**

**Vorkenntnisse / Previous knowledge**

**Examination**  
<table>
<thead>
<tr>
<th>Time of examination</th>
<th>Type of examination</th>
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<tbody>
<tr>
<td>end of summer term</td>
<td>70% report or oral exam or written exam, 30% presentation (talk or poster)</td>
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**Course type**  
- Lecture: 2.00 SWS, Frequency: 28 h  
- Exercises: 2.00 SWS, Frequency: 28 h  
- Practical: 6.00 SWS, Frequency: 84 h

**Total time of attendance for the module:** 140 h
neu241 - Computational Neuroscience - Introduction

Module label: Computational Neuroscience - Introduction
Module code: neu241
Credit points: 12.0 KP
Workload: 360 h
(1 SWS Lecture Total workload 45h: 20h contact/25h individual revision of lecture contents, test preparation 1 SWS Seminar: Total workload 45h: 20h contact/25h individual reading and test preparation 6 SES Supervised exercise Total workload 270h: 135h contact/135h individual work on portfolio tasks (programming, interpretation of simulation results))

Used in course of study: Master's Programme Neuroscience (Master) > Background Modules

Contact person
Module responsibility
- Jutta Kretzberg
Authorized examiners
- Jutta Kretzberg
- Martin Greschner
- Jannis Hildebrandt
- Go Ashida

Entry requirements
Programming experience, preferably in Matlab (e.g. acquired by a 6 ECTS programming course)

Skills to be acquired in this module
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

++ Neurosci. knowlg.
+ Scient. Literature
+ Social skills
++ Math/stats/progr.
++ Data present./disc.
+ Scientific English

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: Network models small networks (lateral inhibition, central pattern generator) larger networks (Integrate and fire networks, rate models, inhibition-excitation balance, learning)

Reader's advisory
Sketchts for each course day will be provided prior to / during the course
Copies of scientific articles for the seminar will be provided prior to the course
Recommended textbooks or other literature:
Dayan / Abbott: Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems. MIT Press (More text books will be suggested prior to the course).
Trappenberg

Links
Language of instruction: English
Duration (semesters): 1 Semester
Module frequency: annually
Module capacity: 18

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 BM Computational Neuroscience - Statistical Learning (after the course)
<table>
<thead>
<tr>
<th>Modullevel</th>
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<tbody>
<tr>
<td>Modulart</td>
<td>Pflicht o. Wahlpflicht / compulsory or optional</td>
</tr>
<tr>
<td>Lern-/Lehrform / Type of program</td>
<td>Master of Science: Neuroscience</td>
</tr>
<tr>
<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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<th>Time of examination</th>
<th>Type of examination</th>
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<tbody>
<tr>
<td>Final exam of module</td>
<td>during the course</td>
<td>Portfolio, consisting of daily short tests, programming exercises, short reports</td>
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<table>
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<tr>
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<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
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<td>WiSe</td>
<td>0 h</td>
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<td>Seminar</td>
<td>0.00</td>
<td></td>
<td>WiSe</td>
<td>0 h</td>
</tr>
<tr>
<td>Exercises</td>
<td>0.00</td>
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<td>WiSe</td>
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<tr>
<th>Total time of attendance for the module</th>
<th>0 h</th>
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neu280 - Research Techniques in Neuroscience

Module label  Research Techniques in Neuroscience
Module code  neu280
Credit points  6.0 KP

Workload  180 h
(2 SWS Lecture: 35 h contact / 45 h background reading / 10 h exam preparation
2 SWS Practical: 50 h contact / 30 h protocol preparation / 10 h exam preparation)

Used in course of study  • Master's Programme Neuroscience (Master) > Background Modules

Contact person
Module responsibility
  • Anna-Maria Hartmann
Authorized examiners
  • Anna-Maria Hartmann
  • Hans Gerd Nothwang
  • Christiane Margarete Thiel
  • John Neidhardt
  • Martin Greschner
  • Carsten Bantel

Entry requirements

Skills to be acquired in this module
  • Neurosci. knowlg.
  •+ Expt. Methods
  •+ Scient. Literature
  •+ Social skills
  •+ Interdiscipl. knowlg.
  •+ Maths/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 questionnaires 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
Module capacity  20 (Registration procedure / selection criteria: StudIP)

Modullevel  ---
Modulart  Pflicht o. Wahlpflicht / compulsory or optional
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### Vorkenntnisse / Previous knowledge

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### Course type

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<td>2.00</td>
<td>SuSe</td>
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<td>Practical (Practical)</td>
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<td>2.00</td>
<td>SuSe</td>
<td>28 h</td>
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### Total time of attendance for the module

56 h
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 / 60h individual reading 2 SWS Seminar (SE): Total workload 90h: 30h contact / 60h individual reading)

Used in course of study:
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

Contact person:
- Module responsibility: Michael Winkhofer
- Authorized examiners: Michael Winkhofer

Entry requirements:
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, baroreceptors
- 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: MM (Mastermodul / Master module)
Modulart: Wahlpflicht / Elective
<table>
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<th>je nach Studiengang Pflicht oder Wahlpflicht</th>
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<td>Lern-/Lehrform / Type of program</td>
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<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td>cell biology of neurons</td>
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<tr>
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<td>cell biology of neurons</td>
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<td>Examination</td>
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<td>Lecture</td>
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<td>2.00</td>
<td>SuSe</td>
<td>28 h</td>
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<tr>
<td>Seminar</td>
<td></td>
<td>2.00</td>
<td>SuSe</td>
<td>28 h</td>
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| Total time of attendance for the module | 56 h |
**neu300 - Functional MRI data analysis**

- **Module label**: Functional MRI data analysis
- **Module code**: neu300
- **Credit points**: 12.0 KP
- **Workload**: 360 h
  - 3 SWS Practical (PR) Total workload 225h: 70h contact / 100h experimental work / 55h exam preparation
  - 2 SWS Lecture (VO) Total workload 90h: 28h contact / 30h background reading / 32h exam preparation
  - 1 SWS Seminar (SE) Total workload 45h: 15h contact / 30h preparation of presentation
- **Used in course of study**
  - Master's Programme Biology (Master) > Background Modules
  - Master's Programme Biology (Master) > Background Modules
  - Master's Programme Neuroscience (Master) > Background Modules
- **Contact person**
  - Module responsibility
    - Carsten Gießing
  - Authorized examiners
    - Carsten Gießing
    - Christiane Margarete Thiel

**Entry requirements**
- + Neurosci. knowlg.
- ++ Expt. Methods
- + Social skills
- + Interdiscipl. knowlg.
- ++ Maths/Stats/Progr.
- + Data present./disc.
- + Scientific English

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.

**Module contents**
- 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.

**Reader's advisory**

**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}
- **Modulelevel**: MM (Mastermodul / Master module)
- **Modulart**: Wahlpflicht / Elective
- **Modulart**: je nach Studiengang Pflicht oder Wahlpflicht

**Examens-Lehrform / Type of program**

<table>
<thead>
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<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
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</thead>
<tbody>
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<td>end of summer term</td>
<td>70% oral exam or written exam, 30% presentations</td>
<td>In addition, mandatory but ungraded: Regular active participation</td>
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<table>
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<tr>
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<td>1.00</td>
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<td>14 h</td>
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<tr>
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<td>Comment</td>
<td>SWS</td>
<td>Frequency</td>
<td>Workload attendance</td>
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<tr>
<td>Lecture</td>
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<td>2.00</td>
<td>SuSe</td>
<td>28 h</td>
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**Total time of attendance for the module**

112 h
**neu305 - Essentials of fMRI Data Analysis with SPM and FSL**

<table>
<thead>
<tr>
<th>Module label</th>
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<tbody>
<tr>
<td>Module code</td>
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<tr>
<td>Credit points</td>
<td>6.0 KP</td>
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<tr>
<td>Workload</td>
<td>180 h (1 SWS Seminar (SE) fMRI: Experimental Design, Data Collection and Analysis Total workload 45h: 14h contact / 31h literature work 3 SWS Supervised exercise (UE) Statistical Analysis of fMRI Data with SPM and FSL Total workload 135h: 42h contact / 93h practice with sample fMRI data sets)</td>
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<td>Used in course of study</td>
<td>Master's Programme Neuroscience (Master) &gt; Background Modules</td>
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<tr>
<td>Contact person</td>
<td>Module responsibility</td>
</tr>
<tr>
<td></td>
<td>• Riklef Weerda</td>
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<tr>
<td></td>
<td>• Peter Sörös</td>
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<tr>
<td>Authorized examiners</td>
<td>• Riklef Weerda</td>
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<td></td>
<td>• Peter Sörös</td>
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<tr>
<td>Entry requirements</td>
<td>Skills to be acquired in this module</td>
</tr>
<tr>
<td></td>
<td>• Neurosci. knowlg.</td>
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<tr>
<td></td>
<td>• ++ Expt. Methods</td>
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<tr>
<td></td>
<td>• Independent research</td>
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<td>• Scient. Literature</td>
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<td>• ++ Maths/Stats/Progr.</td>
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<td>• Data present./disc.</td>
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<td>• Scientific English</td>
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<td>• Ethics</td>
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This module offers a concise introduction to the basic principles of functional magnetic resonance imaging (fMRI). Students will gain essential knowledge about experimental design, data collection and analysis. Special emphasis will be laid on the statistical background of fMRI data analysis and a hands-on introduction to SPM and FSL, two widely-used and free software packages for fMRI data analysis and results visualisation.

| Module contents | 1. Methodological basics of functional magnetic resonance imaging (fMRI)  |
|                | 2. Basic principles of fMRI experimental design and data collection  |
|                | 3. Statistical background of fMRI data analysis  |
|                | 4. Hands-on training in fMRI data analysis and results visualisation with SPM and FSL  |

**Reader's advisory**

Recommended textbook(s) or other literature:


**Links**

**Language of instruction**

English

**Duration (semesters)**

1 Semester

**Module frequency**

annually, winter term, first half

**Module capacity**

40

**Module level**

---

**Lern-/Lehrform / Type of program**

Wahlpflicht / Elective

**Vorkenntnisse / Previous knowledge**

Recommended previous knowledge / skills: statistics, MATLAB

**Examination**

<table>
<thead>
<tr>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>December</td>
<td>Witten exam (multiple choice) In addition, mandatory but ungraded: continuous active participation</td>
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</table>

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminar</td>
<td></td>
<td>0.00</td>
<td>WiSe</td>
<td>0 h</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>0.00</td>
<td>WiSe</td>
<td>0 h</td>
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**Total time of attendance for the module**

0 h
**neu310 - Psychophysics of Hearing**

<table>
<thead>
<tr>
<th>Module label</th>
<th>Psychophysics of Hearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>neu310</td>
</tr>
<tr>
<td>Credit points</td>
<td>12.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>360 h</td>
</tr>
</tbody>
</table>

<TABLE>

| "..." | 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) |

<table>
<thead>
<tr>
<th>Used in course of study</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Master's Programme Biology (Master) &gt; Background Modules</td>
</tr>
<tr>
<td>• Master's Programme Biology (Master) &gt; Background Modules</td>
</tr>
<tr>
<td>• Master's Programme Neuroscience (Master) &gt; Background Modules</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contact person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module responsibility</td>
</tr>
<tr>
<td>• Georg Martin Klump</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Authorized examiners</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Georg Martin Klump</td>
</tr>
<tr>
<td>• Ulrike Langemann</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Entry requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skills to be acquired in this module</td>
</tr>
<tr>
<td>• Neurosci. knowlg.</td>
</tr>
<tr>
<td>++ Expt. Methods</td>
</tr>
<tr>
<td>• Social skills</td>
</tr>
<tr>
<td>++ Maths/Stats/Progr.</td>
</tr>
<tr>
<td>• Data present./disc.</td>
</tr>
<tr>
<td>• Scientific English</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Module contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>The modul 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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reader's advisory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plack, Christopher J. (2005) The sense of hearing, Mahwah, NJ [u.a.] : Erlbaum (sufficient number of copies available in the university library)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Links</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language of instruction</td>
</tr>
<tr>
<td>English</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration (semesters)</th>
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</thead>
<tbody>
<tr>
<td>1 Semester</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module frequency</th>
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</thead>
<tbody>
<tr>
<td>annually, summer term, second half</td>
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<table>
<thead>
<tr>
<th>Module capacity</th>
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<tbody>
<tr>
<td>6 (in total with bio640)</td>
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<table>
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<th>Modullevel</th>
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<tbody>
<tr>
<td>MM (Mastermodul / Master module)</td>
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</table>

<table>
<thead>
<tr>
<th>Modulart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wahlpflicht / Elective</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modulart</th>
</tr>
</thead>
<tbody>
<tr>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lern-/Lehrform / Type of program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examination</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Time of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>end of summer term</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>70% report or oral exam, 30% presentation In addition, mandatory but ungraded: regular active participation</td>
</tr>
</tbody>
</table>

| Course type \n| Comment | SWS | Frequency | Workload attendance |
|---------|-------|----------|---------------------|
| Exercises | 1.00 | SuSe | 14 h |
| Seminar | 2.00 | SuSe | 28 h |
| Practical | 5.00 | SuSe | 70 h |
| Lecture | 0.00 | SuSe | 0 h |

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

<table>
<thead>
<tr>
<th>Module label</th>
<th>Introduction to Neurophysics</th>
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</thead>
<tbody>
<tr>
<td>Module code</td>
<td>neu320</td>
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<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
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</tbody>
</table>

(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)

<table>
<thead>
<tr>
<th>Used in course of study</th>
<th>Master's Programme Neuroscience (Master) &gt; Background Modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact person</td>
<td>Module responsibility</td>
</tr>
<tr>
<td></td>
<td>Jörn Anemüller</td>
</tr>
<tr>
<td></td>
<td>Authorized examiners</td>
</tr>
<tr>
<td></td>
<td>Jörn Anemüller</td>
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</table>

<table>
<thead>
<tr>
<th>Entry requirements</th>
<th>recommended in semester: 3 (with Matlab prereq.: 1)</th>
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<table>
<thead>
<tr>
<th>Skills to be acquired in this module</th>
<th>++ Neurosci. knowlg.</th>
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<tbody>
<tr>
<td></td>
<td>+ Independent research</td>
</tr>
<tr>
<td></td>
<td>+ Scient. Literature</td>
</tr>
<tr>
<td></td>
<td>++ Interdiscipl. knowlg.</td>
</tr>
<tr>
<td></td>
<td>++ Maths/Stats/Progr.</td>
</tr>
<tr>
<td></td>
<td>+ Data present./disc.</td>
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</tbody>
</table>

Students will learn to recognize the dynamics in neuronal networks as the result of an interplay of physical, chemical and biological processes. Overview over major physical measurement procedures for the quantification of structure and function in neuronal systems. Using the language of mathematics as a fundamental tool for the description of underlying biophysical processes with stochastics, linear algebra, differential equations. Information as represented on different length- and timescales: From microscopic processes to macroscopic functional models. Learning and adaptation as adjustment of a biophysical system to its environment.

**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, Dalibard (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**

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

**Module level**
---

**Modulart**
Pflicht o. Wahlpflicht / compulsory or optional

**Lern-/Lehrform / Type of program**
Master of Science: Neuroscience

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

**Examination**

<table>
<thead>
<tr>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>end of winter term</td>
<td>80% oral exam or written exam, 20% exercise work and presentation</td>
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**Course type**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Seminar</th>
<th>Exercises</th>
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**Frequency**

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<th>Seminar</th>
<th>Exercises</th>
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<tbody>
<tr>
<td>WSe</td>
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<td>WSe</td>
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**Workload attendance**

<table>
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<tr>
<th>Lecture</th>
<th>Seminar</th>
<th>Exercises</th>
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<tbody>
<tr>
<td>0 h</td>
<td>0 h</td>
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**Total time of attendance for the module**

<p>| |</p>
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<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>0 h</td>
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</table>
bio605 - Molecular Genetics and Cell Biology

Module label: Molecular Genetics and Cell Biology
Module code: bio605
Credit points: 12.0 KP
Workload: 360 h

Used in course of study:
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

Contact person:
- Module responsibility: John Neidhardt
- Authorized examiners:
  - John Neidhardt
  - Karl-Wilhelm Koch
  - Kathrin Thedieck
- Module counseling:
  - Karl-Wilhelm Koch
  - Kathrin Thedieck

Entry requirements:
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

Modulart:
Wahlpflicht / Elective

Lern-/Lehrform / Type of program:

Vorkenntnisse / Previous knowledge:
Zellbiologische Grundkenntnisse, Genetik, Biochemie

Examination:
- Time of examination
- Type of examination

Final exam of module:
written examination (70 %), paper(s) presentation 30 %; not graded: signed lab protocols, regular active participation is required for the module to be passed.

Course type:
Comment:
SWS:
Frequency:
Workload attendance:
<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
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</thead>
<tbody>
<tr>
<td>Lecture</td>
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<td>2.00</td>
<td>WiSe</td>
<td>28 h</td>
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<tr>
<td>Seminar</td>
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<td>1.00</td>
<td>WiSe</td>
<td>14 h</td>
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<tr>
<td>Exercises</td>
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<td>5.00</td>
<td>WiSe</td>
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**Total time of attendance for the module** 112 h
**bio695 - Biochemical concepts in signal transduction**

<table>
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<tr>
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<tr>
<td>Workload</td>
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</table>

**Used in course of study**
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

**Contact person**
- Module responsibility
  - Karl-Wilhelm Koch
- Authorized examiners
  - Karl-Wilhelm Koch
  - Alexander Scholten
- Module counceling
  - Alexander Scholten

**Entry requirements**
- 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**
- 20

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

**Modulart**
- Wahlpflicht / Elective

**Lern-/Lehrform / Type of program**
- Vorkenntnisse / Previous knowledge
- Examination Time of examination Type of examination
- Final exam of module 90 minutes written exam written examination (50%) protocolls (50%)

<table>
<thead>
<tr>
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<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
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<tbody>
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</tr>
<tr>
<td>Seminar</td>
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<td>1.00</td>
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<td>14 h</td>
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<tr>
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**Total time of attendance for the module**
- 112 h
bio845 - Introduction to Development and Evolution

<table>
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<td>Workload</td>
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<td>- Master's Programme Biology (Master) &gt; Background Modules</td>
</tr>
<tr>
<td></td>
<td>- Master's Programme Neuroscience (Master) &gt; Background Modules</td>
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<tr>
<td>Contact person</td>
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<tr>
<td>Module responsibility</td>
<td>Ulrike Sienknecht</td>
</tr>
<tr>
<td>Authorized examiners</td>
<td>Ulrike Sienknecht, Maike Claßen, Lena Ebbers</td>
</tr>
<tr>
<td>Module counceling</td>
<td>Maike Claßen</td>
</tr>
<tr>
<td>Entry requirements</td>
<td>Upon successful completion of this course, students</td>
</tr>
<tr>
<td></td>
<td>• know the fundamental problems organisms share in development</td>
</tr>
<tr>
<td></td>
<td>• know the common basic steps of ontogenesis after comparing the life cycles of different species (both vertebrates and invertebrates)</td>
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<tr>
<td></td>
<td>• know the fundamentals of the genetic control of cell fate specification, morphogenesis, and organo-genesis</td>
</tr>
<tr>
<td></td>
<td>• know the principles of gene regulatory networks in development and are able to explain examples</td>
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<tr>
<td></td>
<td>• are able to explain and discuss mechanisms of development across taxonomic groups and questions about the evolution of developmental mechanisms</td>
</tr>
<tr>
<td></td>
<td>• have in-depth knowledge of the development of animal nervous systems, including cellular and net-work properties</td>
</tr>
<tr>
<td></td>
<td>skills:</td>
</tr>
<tr>
<td></td>
<td>++ deepened biological expertise</td>
</tr>
<tr>
<td></td>
<td>+ deepened knowledge of biological working methods</td>
</tr>
<tr>
<td></td>
<td>++ interdisciplinary thinking</td>
</tr>
<tr>
<td></td>
<td>++ critical and analytical thinking</td>
</tr>
<tr>
<td></td>
<td>+ independent searching and knowledge of scientific literature</td>
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<tr>
<td></td>
<td>+ ability to perform independent biological research</td>
</tr>
<tr>
<td></td>
<td>+ teamwork</td>
</tr>
<tr>
<td>Module contents</td>
<td>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:</td>
</tr>
<tr>
<td></td>
<td>• Introduction to Developmental Biology</td>
</tr>
<tr>
<td></td>
<td>• Cell-Cell Communication</td>
</tr>
<tr>
<td></td>
<td>• Differential Gene Expression (I and II)</td>
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<tr>
<td></td>
<td>• Early Development of Vertebrates, Gastrulation</td>
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<tr>
<td></td>
<td>• Neurulation</td>
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<tr>
<td></td>
<td>• Brain Development</td>
</tr>
<tr>
<td></td>
<td>• Axonal Growth, Target Selection, Synaptogenesis and Refinement</td>
</tr>
<tr>
<td></td>
<td>• Neural Crest</td>
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<tr>
<td></td>
<td>• Mesoderm Development</td>
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<td></td>
<td>• Limb Development</td>
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<tr>
<td></td>
<td>• Developmental Mechanisms of Evolutionary Change</td>
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<td></td>
<td>• Model Organisms in Developmental Bioplogy</td>
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<td></td>
<td>• Transgenic Mice</td>
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<td></td>
<td>• Medical Implications of Developmental Biology</td>
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<tr>
<td>Links</td>
<td>English</td>
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<tr>
<td>Duration (semesters)</td>
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<tr>
<td>Module frequency</td>
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<tr>
<td>Module capacity</td>
<td>20 (</td>
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selection criteria: sequence of registration

<table>
<thead>
<tr>
<th>Reference text</th>
<th>associated with bio846 (previously neu120) (Lab Exercises in Development and Evolution)</th>
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<tbody>
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<td>Modullevel</td>
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<td>Wahlpflicht / Elective</td>
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<tr>
<td>Lern-/Lehrform / Type of program</td>
<td>organismic biology, developmental biology, evolutionary biology, neurobiology, genetics, molecular biology</td>
</tr>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td>Time of examination Type of examination</td>
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<tr>
<td>Final exam of module</td>
<td>same winter term oral exam of 30 minutes</td>
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<tr>
<td>Seminar</td>
<td></td>
<td>2.00</td>
<td>WiSe</td>
<td>28 h</td>
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Total time of attendance for the module: 56 h
bio846 - Lab Exercises in Development and Evolution

**Module label**
Lab Exercises in Development and Evolution

**Module code**
bio846

**Credit points**
6.0 KP

**Workload**
180 h

**Used in course of study**
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

**Contact person**

Module responsibility
- Ulrike Sienknecht

Authorized examiners
- Ulrike Sienknecht
- Hans Gerd Nothwang

Module counseling
- Hans Gerd Nothwang

**Entry requirements**

**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 embryo handling, tissue preparation (including cryosectioning), dissection of inner ears, and the use of different histological 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 note-book
- know how to carry out formal laboratory reports (and the anatomy of a scientific paper)

and in addition, 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

**Module contents**
Lab exercises in comparative developmental biology on 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.

Lectures in the field of auditory system development, such as:
- Development of the Inner Ear
- Development of the Middle Ear
- Evolution of the Central and Peripheral Auditory System
- Development and Layout of the Central Auditory System

**Reader's advisory**

**Links**

Language of instruction
English

Duration (semesters)
1 Semester

Module frequency

Module capacity
6
selection criteria: sequence of registration

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

Modullevel
MM (Mastermodul / Master module)

Modulart
Wahlpflicht / Elective

Lern-/Lehrform / Type of program
organismic biology, experience with lab work

Vorkenntnisse / Previous knowledge

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<th>Type of examination</th>
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<td>same winter term</td>
<td>report (50%) and presentation (50%)</td>
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Course type | Comment | SWS | Frequency | Workload attendance |
--- | --- | --- | --- | --- |
Lecture | 0.50 | WiSe | 7 h |
Seminar | 0.50 | WiSe | 7 h |
Exercises | 3.00 | WiSe | 42 h |

Total time of attendance for the module
56 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)

Used in course of study:
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

Contact person:
- Module responsibility: Martin Greschner
- Authorized examiners:
  - Martin Greschner
  - Karin Dedek
  - Ulrike Janssen-Bienhold
  - Christian Puller

Entry requirements:
- Basic knowledge of neurobiology

Skills to be acquired in this module:
++ Neurosci. knowl./
++ 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:
Language of instruction: English
Duration (semesters): 1 Semester
Module frequency: annually, summer term, first half (full time)
Module capacity: 12 - with Visual Neuroscience: Anatomy (
Shared course components with (cannot be credited twice):
neu151 BM Visual Neuroscience: Anatomy

Modullevel
MM (Mastermodul / Master module)

Modulart
Wahlpflicht / Elective

Lern-/Lehrform / Type of program

Vorkenntnisse / Previous knowledge
Basic knowledge in neurobiology

Examination
Final exam of module
during the course (summer semester, first half)
In addition, mandatory but ungraded: seminar presentation
PF

Course type
Lecture
Seminar
Exercises

Comment

SWS
2.00
2.00
2.00

Frequency
SuSe or WiSe
SuSe or WiSe
SuSe or WiSe

Workload attendance
28 h
28 h
28 h

Total time of attendance for the module
84 h
### neu340 - Invertebrate Neuroscience

<table>
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<tr>
<th>Module label</th>
<th>Invertebrate Neuroscience</th>
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<tbody>
<tr>
<td>Module code</td>
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<tr>
<td>Credit points</td>
<td>6.0 KP</td>
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<tr>
<td>Workload</td>
<td>180 h (1 SWS Seminar (SE) Total workload 45h: 15h contact / 30h background literature reading, preparation for short tests and results presentation 3 SWS Supervised exercise (UE) Total workload 135h: 70h contact / 65h data analysis and preparation of portfolio assignments)</td>
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**Used in course of study**
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

**Contact person**
- Module responsibility
  - Jutta Kretzberg
- Authorized examiners
  - Jutta Kretzberg

**Entry requirements**
- attendance in pre-meeting

**Skills to be acquired in this module**
- ++ Neurosci. knowlg.
- ++ Expt. Methods
- + Scient. Literature
- + Social skills
- + Maths/Stats/Progr.
- + 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 neuroscience
- 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 background module Neuropysiology 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

**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

**Links**
- Language of instruction: English
- Duration (semesters): 1 Semester
- Module frequency: annually, summer term, second half
- Module capacity: 12 (this module provides the background for neu345 "Neural Computation in invertebrate systems"

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

**Modulart**
- Wahlpflicht / Elective

**Lern-/Lehrform / Type of program**
- basic knowledge of neurobiology, basic MATLAB programming skills

**Vorkenntnisse / Previous knowledge**

**Examination**
- Time of examination: during the course (summer term, second half)
- Type of examination: Portfolio consisting of short tests and short reports
- In addition, mandatory but ungraded: seminar presentation

**Course type**

---

38 / 80
<table>
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<td>2.00</td>
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<tr>
<td>Exercises</td>
<td></td>
<td>2.00</td>
<td>SuSe or WiSe</td>
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**Total time of attendance for the module**

56 h
**neu345 - Neural Computation in Invertebrate Systems**

<table>
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<th>Neural Computation in Invertebrate Systems</th>
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<tr>
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<tr>
<td>Credit points</td>
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<tr>
<td>Workload</td>
<td>180 h (1 SWS Seminar: Total workload 45 h: 15 h contact + 30 h background literature reading and preparation of results presentation</td>
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**Used in course of study**
- Master's Programme Neuroscience (Master) > Background Modules

**Contact person**
- Module responsibility
  - Jutta Kretzberg
- Authorized examiners
  - Jutta Kretzberg

**Entry requirements**

**Skills to be acquired in this module**
- Upon successful completion of this course, students
  - have knowledge on some examples of invertebrate neuronal system
  - have knowledge on neural coding and corresponding data analysis techniques
  - have acquired skills in data analysis
  - have practiced to generate a scientific hypothesis and choose suitable experimental or modeling methods
  - are able to critically evaluate and discuss experimental results

- + Neurosci. knowlg.
- ++ Expl. 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 list 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 mandatory scientific literature (3 articles) 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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<tr>
<th>Language of instruction</th>
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<td>Module frequency</td>
<td>12 (but only 6 for experimental projects)</td>
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<td>Wahlpflicht / Elective</td>
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<td>Vorkenntnisse / Previous knowledge</td>
<td>neu 340 invertebrate neuroscience</td>
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**Examination**
- Time of examination
- Type of examination
- Final exam of module: During the course (summer term, second half) PF

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<td>Seminar</td>
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<td>2.00</td>
<td>SuSe or WiSe</td>
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<td>SuSe or WiSe</td>
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**neu350 - Biological Foundations of Neuroscience**

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<td>Credit points</td>
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<td>Workload</td>
<td>180 h</td>
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<td>(Lecture Total workload 90 h: 28 h contact / 14 h tutorial / 48 h self-study and preparation for exam Seminar Total workload 90 h: 28 h contact / 62 h self-study and preparation for exam)</td>
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<td>Used in course of study</td>
<td>Master's Programme Neuroscience (Master) &gt; Background Modules</td>
</tr>
<tr>
<td>Contact person</td>
<td>Module responsibility</td>
</tr>
<tr>
<td></td>
<td>Christian Puller</td>
</tr>
<tr>
<td>Authorized examiners</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Christian Puller</td>
</tr>
<tr>
<td></td>
<td>John Neidhardt</td>
</tr>
<tr>
<td></td>
<td>Karl-Wilhelm Koch</td>
</tr>
<tr>
<td></td>
<td>Anna-Maria Hartmann</td>
</tr>
<tr>
<td></td>
<td>Martin Greschner</td>
</tr>
<tr>
<td></td>
<td>Georg Martin Klump</td>
</tr>
<tr>
<td></td>
<td>Marta Owczarek-Lipska</td>
</tr>
<tr>
<td>Entry requirements</td>
<td>Recommended in combination with &quot;Research Techniques in Neuroscience&quot;</td>
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<tr>
<td>Skills to be acquired in this module</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>++ Neurosci. knowlg.</td>
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<tr>
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<td>+ Scient. Literature</td>
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<td>+ Social skills</td>
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<tr>
<td></td>
<td>+ Interdiscipl. knowlg.</td>
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<td>+ Scientific English</td>
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<tr>
<td>Module contents</td>
<td>The background module consists of a lecture series and an associated seminar.</td>
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<td>The following topics are covered:</td>
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<td>• Biochemistry</td>
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<td></td>
<td>• Genetics</td>
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<td></td>
<td>• Electrophysiology</td>
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<td></td>
<td>• Cell biology</td>
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<tr>
<td></td>
<td>• Systems Neuroscience</td>
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<tr>
<td>Reader's advisory</td>
<td>Neuroscience, newest edition; Purves; Sinauer Associates</td>
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<tr>
<td></td>
<td>Stryer Biochemistry and Alberts et al. Molecular Biology of the Cell, several editions</td>
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<tr>
<td></td>
<td>Molecular Biology of the Gene, Watson (Pearson Verlag)</td>
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<td>Examination</td>
<td>Time of examination</td>
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<td>at the end of the course</td>
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<tr>
<td>Course type</td>
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<td>Lecture</td>
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<td>Seminar</td>
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<tr>
<td>Total time of attendance for the module</td>
<td>56 h</td>
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neu360 - Auditory Neuroscience

Module label: Auditory Neuroscience
Module code: neu360
Credit points: 6.0 KP
Workload: 180 h (1 SWS Lecture (VO) Total workload 45h: 14 h contact / 31 h background reading 1 SWS Seminar (SE) Total workload 45h: 14 h contact / 15 h background reading / 16 h preparation and presentation 2 SWS Supervised exercise (UE) Total workload 90h: 10 h contact / 20 h literature search / 60 h work on essay paper)

Used in course of study:
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Biology (Master) > Background Modules
- Master's Programme Neuroscience (Master) > Background Modules

Contact person:
- Module responsibility
  - Christine Köppel
- Authorized examiners
  - Georg Martin Klump
  - Christine Köppel

Entry requirements:
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:
Required reading:
About 20 selected original papers (selection varies)

Recommended textbook(s) or other literature:
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
  - Recommended in combination with:
    - BM neu211 "Neurosensory Science and Behaviour"
    - or BM neu270 "Neurocognition and Psychophysiology"
    - or skills module biox "Current Topics in Hearing Science"
<table>
<thead>
<tr>
<th>Module level</th>
<th>MM (Mastermodul / Master module)</th>
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<td>Wahlpflicht / Elective</td>
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<td>Basics of Neurosensory Science and Behavioural Biology</td>
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<td>Final exam of module</td>
<td>within a few weeks of the end of summer term lecture period</td>
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<tbody>
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<td>Lecture</td>
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<td>2.00</td>
<td>SuSe</td>
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<td>Seminar</td>
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<td>2.00</td>
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<td>Exercises</td>
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<td>2.00</td>
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Total time of attendance for the module: 84 h
**neu370 - Neuroprosthetics**

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<tr>
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<tr>
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<tr>
<td>Credit points</td>
<td>6.0 KP</td>
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<td>Workload</td>
<td>180 h</td>
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<td>Master's Programme Neuroscience (Master) &gt; Background Modules</td>
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**Contact person**

**Entry requirements**

**Skills to be acquired in this module**

**Module contents**

**Reader's advisory**

**Links**

<table>
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<tr>
<th>Language of instruction</th>
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**Module frequency**

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<td>Modulart</td>
<td>Wahlpflicht / Elective</td>
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**Lern-/Lehrform / Type of program**

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<th>Time of examination</th>
<th>Type of examination</th>
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<td>Course type</td>
<td>Comment</td>
<td>SWS</td>
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<tr>
<td>Seminar</td>
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<td>2.00</td>
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<tr>
<td>Exercises</td>
<td></td>
<td>2.00</td>
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</table>

**Total time of attendance for the module**

84 h
Research Modules

neu410 - Auditory Neuroscience

Module label  
Auditory Neuroscience

Module code  
eu410

Credit points  
15.0 KP

Workload  
450 h

Used in course of study  
- Master's Programme Neuroscience (Master) > Research Modules

Contact person  
Module responsibility
  - Christine Köppl
Module counseling
  - Georg Martin Klump
  - Jannis Hildebrandt

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

Introduction to independent, experimental research in auditory sensory physiology. May serve as preparation for a Master thesis.

Upon successful completion of this course, students
  • have profound knowledge on auditory sensory processing, including cochlear transduction mechanisms, central auditory processing and auditory psychophysics
  • 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
  • have in-depth knowledge on a specific research question in auditory neuroscience
  • are able to discuss current hypotheses and controversies regarding their research question
  • are able to perform experiments addressing their research topic and can describe the principles and the pros and cons of the experimental technique used
  • are able to critically evaluate and discuss experimental results

Module contents  
One week introductory block course "Fundamentals of Auditory Physiology", 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 course is followed by 6 weeks of small-group laboratory-based projects, participating in the supervisor's ongoing research. This includes experimental work, data analysis, literature study, participation in the group seminar and in a poster presentation of concurrent Research Modules.

There are three options for the lab projects:
  - Option 1: Cochlea and auditory brainstem (Köppl)
  - Option 2: Auditory cortex (Hildebrandt)
  - Option 3: Central auditory mechanisms (Klump)

Reader's advisory  
About 20 selected original papers (selection varies)

Links  
Language of instruction  
English

Duration (semesters)  
1 Semester

Module frequency  
jährlich

Module capacity  
unlimited

Reference text  
Introductory block course will be held in the first week of winter term, lab component is flexible and subject to individual arrangement. Participation in a joint poster presentation of concurrent research modules is required to pass the module.

Modullevel  
---

Modulart  
je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program
### Vorkenntnisse / Previous knowledge

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
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<td>Final exam of module</td>
<td>within 2 months after completion of experimental work</td>
<td>Internship report</td>
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<th>Frequency</th>
<th>Workload attendance</th>
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<tr>
<td>Lecture</td>
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<td>1.00</td>
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<tr>
<td>Seminar</td>
<td></td>
<td>1.00</td>
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<td>14 h</td>
</tr>
<tr>
<td>Projektorientiertes Modul</td>
<td></td>
<td>8.00</td>
<td>WiSe</td>
<td>112 h</td>
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**Total time of attendance for the module**: 140 h
neu440 - Visual Neuroscience

Module label: Visual Neuroscience
Module code: neu440
Credit points: 15.0 KP
Workload: 450 h

Used in course of study: Master's Programme Neuroscience (Master) > Research Modules

Contact person
Module responsibility
- Ulrike Janssen-Bienhold
Module counseling
- Karin Dedek
- Martin Greschner

Entry requirements
- Attendance in pre-meeting, priority is given to students who attended neu140 BM Neurophysiology and / or neu150 BM Neuroanatomy

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
- During the module the students acquire advanced theoretical knowledge of the molecular and cellular characteristics of retinal circuits and physiology.
- Students learn to plan and perform a research project independently (includes: literature research and usage of data banks (PUBMED, Gene Bank, Expasy etc.)
- Students are introduced to scientific writing / have to write a scientific report.
- Students acquire advanced skills in data analysis (including statistics, computational neuroscience, image analysis)
- The module can serve the purpose of preparing for a Master's thesis.

Module contents
1. Independent performance of an individual research project in small groups. Dates are individually arranged with the respective supervisor. Available project topics will be presented in the pre-meeting. Methods include:
   Option 1: Molecular Neuroscience
   Option 2: Neuroanatomy
   Option 3: Neurophysiology
2. Participation in the "Journal club" seminar, including presentation of the project and the results obtained.

Reader's advisory
- http://webvision.med.utah.edu/ (H. Holb et al. (2016) The organization of the retina and visual system)
- 20 to 30 selected original papers on vision research (depending on individual project)

Links
Language of instruction: English
Duration (semesters): 1 Semester
Module frequency: halbjährlich
Module capacity: unlimited

Reference text
Regular active participation and presentation(s) within the scope of the seminar are required to pass the module. Furthermore, participation in a joint poster presentation of concurrent research modules is required to pass the module.

Modullevel
---

Modulart
je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program

Vorkenntnisse / Previous knowledge

Examination
- Time of examination
- Type of examination

Final exam of module
- flexible, after individual project
- Internship report

Course type
- Comment
- SWS
- Frequency
- Workload attendance
Seminar
2.00
Workload attendance: 28 h
Projektorientiertes Modul
8.00
WiSe
Workload attendance: 112 h

Total time of attendance for the module: 140 h
**neu470 - Molecular Sensory Neuroscience**

<table>
<thead>
<tr>
<th>Module label</th>
<th>Molecular Sensory Neuroscience</th>
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<tr>
<td>Module code</td>
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<td>Credit points</td>
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<td>Workload</td>
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<tr>
<td>Used in course of study</td>
<td>• Master's Programme Neuroscience (Master) &gt; Research Modules</td>
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<tr>
<td>Contact person</td>
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</tr>
<tr>
<td></td>
<td>Module responsibility</td>
</tr>
<tr>
<td></td>
<td>• Karl-Wilhelm Koch</td>
</tr>
<tr>
<td></td>
<td>Module counseling</td>
</tr>
<tr>
<td></td>
<td>• Hans Gerd Nothwang</td>
</tr>
<tr>
<td></td>
<td>• Kathrin Thedieck</td>
</tr>
<tr>
<td></td>
<td>• John Neidhardt</td>
</tr>
<tr>
<td></td>
<td>• Anna-Maria Hartmann</td>
</tr>
<tr>
<td>Entry requirements</td>
<td></td>
</tr>
<tr>
<td>For students putting emphasis on cell biological, molecular biological, genetic, biochemical and/or neurobiological fields. The module can serve the purpose of preparing for a Master’s thesis. Upon successful completion of this course, students have an advanced knowledge in molecular cell biology have acquired methodological and experimental skills in molecular cell biology have an advanced knowledge of how to perform research projects have advanced skills in presenting and discussing scientific data they have obtained, analysed and put in a wider framework of a current scientific topic.</td>
<td></td>
</tr>
<tr>
<td>Module contents</td>
<td>Theory and practice of topics related to issues in molecular sensory neuroscience; independent treatment of an individual project; acquiring an advanced theoretical knowledge in selected fields of the molecular biology of the cell (points of emphasis: genetics, biochemistry, cell biology; topics depending on working groups). There are several options for the lab projects, in the broad categories of: 1. Protein function in neurosensory signaling (Koch) Heterologous expression in cell cultures of a protein involved in visual transduction or magnetoreception 2. Neurosensory genetics (Nothwang) 3. Metabolic signalling networks (Thediek) 4. Human genetics: mutation identification, pathogenic processes and therapy development (Neidhardt)</td>
</tr>
<tr>
<td>Reader's advisory</td>
<td>Specific literature of the topics indicated above; original papers related to the current research question; will be different for every student and every year. Textbooks of Cell Biology, Biochemistry, Genetics; Alberts et al. Molecular Biology of the Cell (5th Edition or later); Stryer Biochemistry (7th Edition or later); Lehninger Biochemistry (4th Edition or later). These textbooks are updated almost every 3 or 4 years.</td>
</tr>
<tr>
<td>Links</td>
<td></td>
</tr>
<tr>
<td>Languages of instruction</td>
<td>German, English</td>
</tr>
<tr>
<td>Duration (semesters)</td>
<td>1 Semester</td>
</tr>
<tr>
<td>Module frequency</td>
<td>halbjährlich</td>
</tr>
<tr>
<td>Module capacity</td>
<td>unlimited</td>
</tr>
<tr>
<td>Reference text</td>
<td>Time is flexible and subject to individual arrangement. An accepted internship report and participation in a joint poster presentation of concurrent research modules are required to pass the module.</td>
</tr>
<tr>
<td>Modulart</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
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<tr>
<td>Lern-/Lehrform / Type of program</td>
<td></td>
</tr>
<tr>
<td>Examination</td>
<td>Time of examination</td>
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<tr>
<td></td>
<td>Type of examination</td>
</tr>
<tr>
<td>Final exam of module</td>
<td>as agreed; usually within 2 months of the conclusion of lab work oral exam of 30 min. in Cell Biology, Genetics or Biochemistry, depending on the chosen option Participation in seminar, Signed project report</td>
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<td>Course type</td>
<td>Projektorientiertes Modul</td>
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<td><strong>SWS</strong></td>
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<tr>
<td><strong>Frequency</strong></td>
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<td><strong>Workload attendance</strong></td>
<td>140 h</td>
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## neu510 - Computation in Sensory Systems

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<th>Computation in Sensory Systems</th>
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<td>neu510</td>
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<tr>
<td>Credit points</td>
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<td>Workload</td>
<td>450 h</td>
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<tr>
<td>Used in course of study</td>
<td>Master's Programme Neuroscience (Master) &gt; Research Modules</td>
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<tr>
<td>Contact person</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Module responsibility</td>
</tr>
<tr>
<td></td>
<td>○ Jutta Kretzberg</td>
</tr>
<tr>
<td></td>
<td>Module counseling</td>
</tr>
<tr>
<td></td>
<td>○ Martin Greschner</td>
</tr>
<tr>
<td></td>
<td>○ Jannis Hildebrandt</td>
</tr>
<tr>
<td></td>
<td>○ Jochem Rieger</td>
</tr>
<tr>
<td>Entry requirements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>attendance in pre-meeting, priority is given to students who attended BM Computational Neuroscience</td>
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<tr>
<td>Skills to be acquired in this module</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ Neurosci. knowlg.</td>
</tr>
<tr>
<td></td>
<td>+ Expt. methods</td>
</tr>
<tr>
<td></td>
<td>+ Independent research</td>
</tr>
<tr>
<td></td>
<td>+ Scient. literature</td>
</tr>
<tr>
<td></td>
<td>+ Social skills</td>
</tr>
<tr>
<td></td>
<td>+ Interdiscipl. knowlg.</td>
</tr>
<tr>
<td></td>
<td>+ Maths/Stats/Progr.</td>
</tr>
<tr>
<td></td>
<td>+ Data present./disc.</td>
</tr>
<tr>
<td></td>
<td>+ Scientific English</td>
</tr>
<tr>
<td></td>
<td>+ Ethics</td>
</tr>
<tr>
<td>Students perform individual research projects to learn:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>○ planning, performing and analyzing experiments and / or simulations</td>
</tr>
<tr>
<td></td>
<td>○ working with scientific background literature on the specific context of the project</td>
</tr>
<tr>
<td></td>
<td>○ oral presentation and discussion of backgrounds and results in the lab seminar</td>
</tr>
<tr>
<td></td>
<td>○ write a scientific report</td>
</tr>
<tr>
<td></td>
<td>○ prepare and present a scientific poster</td>
</tr>
<tr>
<td>Module can serve as preparation for a Master's thesis.</td>
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<tr>
<td>Module contents</td>
<td>Students can choose between five options (explained in more detail during the pre-meeting):</td>
</tr>
<tr>
<td></td>
<td>1. invertebrate somatosensory system (Kretzberg)</td>
</tr>
<tr>
<td></td>
<td>2. vertebrate visual system (Greschner)</td>
</tr>
<tr>
<td></td>
<td>3. vertebrate auditory system (Hildebrandt)</td>
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<tr>
<td></td>
<td>4. human perception-action cycle (Rieger)</td>
</tr>
<tr>
<td></td>
<td>5. advanced analysis of physiological data (Anemüller)</td>
</tr>
<tr>
<td>In options 1-4, depending on the student's interests and background, projects can be focussed on</td>
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</tr>
<tr>
<td></td>
<td>○ experiments (neurophysiology / behavior)</td>
</tr>
<tr>
<td></td>
<td>○ simulation</td>
</tr>
<tr>
<td></td>
<td>○ data analysis</td>
</tr>
<tr>
<td></td>
<td>○ combinations of these approaches</td>
</tr>
<tr>
<td>In all systems, project can be focussed on experiments (neurophysiology / behavior), simulation, data analysis or combinations of these approaches.</td>
<td></td>
</tr>
<tr>
<td>Reader's advisory</td>
<td>Will be given to the students depending on the project</td>
</tr>
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<td>Links</td>
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<tr>
<td>Language of instruction</td>
<td>English</td>
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<tr>
<td>Duration (semesters)</td>
<td>1 Semester</td>
</tr>
<tr>
<td>Module frequency</td>
<td>halbjährlich</td>
</tr>
<tr>
<td>Module capacity</td>
<td>unlimited</td>
</tr>
<tr>
<td>Reference text</td>
<td>The timing of individual projects can be discussed with the supervisor. Projects can also be scheduled during semester breaks, part-time options (lasting more than 7 weeks) are available.</td>
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<tr>
<td></td>
<td>○ priority for admission to the module is given to students who passed computational neuroscience background modules (neu240 / neu250)</td>
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<tr>
<td></td>
<td>○ Participation in a joint poster presentation of concurrent research modules is highly recommended.</td>
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<tr>
<td>Modullevel</td>
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<td>Modulsart</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
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<td>Lern-/Lehrform / Type of program</td>
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<td>Course type</td>
<td>Comment</td>
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<tr>
<td>--------------------------------</td>
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<tr>
<td>Seminar</td>
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<td>Projektorientiertes Modul</td>
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**Total time of attendance for the module**

140 h
# neu540 - Neural Basis of Perception

<table>
<thead>
<tr>
<th>Module label</th>
<th>Neural Basis of Perception</th>
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<tbody>
<tr>
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<tr>
<td>Credit points</td>
<td>15.0 KP</td>
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<tr>
<td>Workload</td>
<td>450 h</td>
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<tr>
<td>Used in course of study</td>
<td>Master's Programme Neuroscience (Master) &gt; Research Modules</td>
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</table>

## Contact person
- Module responsibility
  - Jutta Kretzberg
- Module counseling
  - Georg Martin Klump
  - Henrik Mouritsen
  - Michael Winkhofer

## Entry requirements
- attendance in pre-meeting, priority is given to students who attended at least one of the background modules listed as "recommended in combination with"

## 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, 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 can serve as preparation for a Master's thesis.

## Module contents
- Introductory lecture and seminar (either blocked or parallel to lab work) plus 6 weeks of small-group lab projects, participating in the supervisor's ongoing research, and in the respective group seminar. There are four options for the lab projects:
  - **Option 1:** Navigation mechanisms in nocturnal bird migration (Mouritsen) comprises (i) lecture "Bird migration", (ii) participation in group seminar, and (iii) a laboratory project "Navigation mechanisms in nocturnal bird migration" (flexible timing); including participation in investigations of navigation mechanisms in migratory birds (project focussing on behavioural biology, molecular biology or neuroanatomy).
  - **Option 2:** Invertebrate somatosensory system (Kretzberg), includes participation in group seminar, journal club and laboratory project (all flexible timing).
  - **Option 3:** Central auditory mechanisms (Klump), includes introductory block course "Fundamentals of Auditory Physiology" (one week at start of winter semester) , participation in group seminar and a laboratory project (flexible timing)
  - **Option 4:** Magnetic field perception (Winkhofer), includes participation in group seminar, journal club and laboratory project (all flexible timing).

## Reader's advisory

## Links
- [Language of instruction](#)
- [Duration (semesters)](#)
- [Module frequency](#)
- [Module capacity](#)

## Reference text
- Please note that different options have mandatory course components at different times.
- Priority for admission is given to students who attended at least one of the background modules listed as "recommended in combination with"

- Participation in a joint poster presentation of concurrent research modules is highly recommended.
<table>
<thead>
<tr>
<th>Modullevel</th>
<th>---</th>
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</thead>
<tbody>
<tr>
<td>Modulart</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
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</table>

**Lern-/Lehrform / Type of program**

**Vorkenntnisse / Previous knowledge**

<table>
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<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 after completion of experimental work</td>
<td>Internship report</td>
</tr>
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</table>

<table>
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<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
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</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>1.00</td>
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<td>14 h</td>
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<tr>
<td>Seminar</td>
<td></td>
<td>1.00</td>
<td></td>
<td>14 h</td>
</tr>
<tr>
<td>Projektorientiertes Modul</td>
<td>8.00</td>
<td>WiSe</td>
<td></td>
<td>112 h</td>
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</table>

**Total time of attendance for the module**

140 h
**Development and Evolution of the Auditory System**

<table>
<thead>
<tr>
<th>Module label</th>
<th>Development and Evolution of the Auditory System</th>
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</thead>
<tbody>
<tr>
<td>Module code</td>
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<td>Credit points</td>
<td>15.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>450 h</td>
</tr>
<tr>
<td>Used in course of study</td>
<td>Master's Programme Neuroscience (Master) &gt; Research Modules</td>
</tr>
</tbody>
</table>

**Contact person**

- Module responsibility
  - Ulrike Sienknecht
- Module counseling
  - Hans Gerd Nothwang
  - Christine Köppl

**Entry 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
- Introduction to experimental research in the field of development and evolution of the auditory system.

**Module contents**

Two-week introductory course into current research questions and techniques of the field; followed by 5 weeks of small-group lab projects, participating in the supervisor’s ongoing research, and in the group seminar. There are several options for the lab projects, in the broad categories of:
1. Molecular development and evolution of the peripheral auditory system (Sienknecht)
2. Molecular development and evolution of the central auditory system (Nothwang)
3. Comparative studies of the peripheral or central auditory system (Köppl)
4. Regenerative medicine of the auditory system (Löwenheim, Müller)

**Reader's advisory**

Springer Handbook of Auditory Research (SHAR); Sanes et al. eds. Development of the Nervous System, Academic Press; and research papers (original papers and reviews)

**Language of instruction**

English

**Duration (semesters)**

1 Semester

**Module frequency**

jährlich

**Module capacity**

unlimited

**Reference text**

Course in the second half of the semester usually in winter term; lab component is flexible and subject to individual arrangement. Participation in a joint poster presentation of concurrent research modules is required to pass the module.

**Modullevel**

---

**Modulart**

je nach Studiengang Pflicht oder Wahlpflicht

**Vorkenntnisse / Previous knowledge**

**Examination**

<table>
<thead>
<tr>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>within 2 months after completion of experimental work</td>
<td>Portfolio: 60% presentation, 40% internship report (paper or poster format)</td>
</tr>
</tbody>
</table>

**Course type**

| Lecture | 1.00 | 14 h |
| Seminar | 1.00 | 14 h |
| Projektorientiertes Modul | 9.00 | WiSe | 126 h |

**Total time of attendance for the module**

154 h
# neu610 - External Research Project

<table>
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<th>External Research Project</th>
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<td>15.0 KP</td>
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<tr>
<td>Workload</td>
<td>450 h</td>
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<tr>
<td></td>
<td>(260 h contact / 40 h background reading / 90 h written report / 60 h talk and poster preparation)</td>
</tr>
<tr>
<td>Used in course of study</td>
<td>• Master's Programme Neuroscience (Master) &gt; Research Modules</td>
</tr>
<tr>
<td>Contact person</td>
<td>Module responsibility</td>
</tr>
<tr>
<td></td>
<td>• Christine Köppl</td>
</tr>
<tr>
<td></td>
<td>Authorized examiners</td>
</tr>
<tr>
<td></td>
<td>• Lehrende der Neuroscience</td>
</tr>
<tr>
<td>Entry requirements</td>
<td>project and supervisor(s) need to be approved by the exam board prior to the start of lab work</td>
</tr>
<tr>
<td>Skills to be acquired in this module</td>
<td>+ Neurosci. knowlg.</td>
</tr>
<tr>
<td></td>
<td>++ Expt. methods</td>
</tr>
<tr>
<td></td>
<td>++ Independent research</td>
</tr>
<tr>
<td></td>
<td>++ Scient. literature</td>
</tr>
<tr>
<td></td>
<td>+ Social skills</td>
</tr>
<tr>
<td></td>
<td>+ Interdiscipl. knowlg.</td>
</tr>
<tr>
<td></td>
<td>++ Data present./disc.</td>
</tr>
<tr>
<td></td>
<td>+ Scientific English</td>
</tr>
</tbody>
</table>

Students are introduced to independent research in a specific area of neuroscience by a scientifically working group outside of the regular 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 in publication format
- 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.

## 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, if project options are sufficiently different (decision of the examination board needed)

Supervision of individual projects is limited to 15 ECTS for the same combination of student and supervisor (1 research module + Master thesis OR up to 3 research modules, including external research module)

### Reference text

- all members of the regular Neuroscience faculty at the University of Oldenburg can act as local supervisor, 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 local supervisor.

- Participation in a joint poster presentation of concurrent research modules is highly recommended.

<table>
<thead>
<tr>
<th>Modullevel</th>
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<tbody>
<tr>
<td>Modulart</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
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<table>
<thead>
<tr>
<th>Lern- / Lehrform / Type of program</th>
<th>Projektorientiertes Modul</th>
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</thead>
</table>

| Vorkenntnisse / Previous knowledge | |
|------------------------------------| |

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
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</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>within 2 months after conclusion of lab work</td>
<td>internship report</td>
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</table>

| Course type | |
|-------------| |

<table>
<thead>
<tr>
<th>SWS</th>
<th>10.00</th>
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<tbody>
<tr>
<td>Frequency</td>
<td>WiSe</td>
</tr>
<tr>
<td>Workload attendance</td>
<td>140 h</td>
</tr>
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</table>
neu600 - Neuroscience Research Project

Module label: Neuroscience Research Project
Module code: neu600
Credit points: 15.0 KP
Workload: 450 h
(Seminar (SE): 15 h contact / 30 h reading and presentation preparation Research Internship (IFP): 120 h contact / 125 h independent lab work / 40 h background reading / 90 h internship report / 30 h preparation)

Used in course of study:
- Master's Programme Neuroscience (Master) > Research Modules

Contact person:
Module responsibility
- Jutta Kretzberg
Authorized examiners
- Lehrende der Neuroscience

Entry requirements:
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:
Students perform individual research projects to learn:
- planning, performing and analyzing experiments and / or simulations
- working with scientific background literature on the specific context of the project
- oral and / or poster presentation and discussion of backgrounds and results in the lab seminar
- write a scientific report

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

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

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. 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.

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 a poster presentation at the neuroscience career day (in March) 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)

Modullevel: MM (Mastermodul / Master module)
Modulart: Wahlpflicht / Elective
### Lern- und Lehrform / Type of program

### Vorkenntnisse / Previous knowledge

<table>
<thead>
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<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
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</table>
| Final exam of module | * within 2 months after conclusion of lab work  
* in addition, mandatory but ungraded: presentation at lab seminar | PR                  |

<table>
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<th>Comment</th>
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<th>Frequency</th>
<th>Workload attendance</th>
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<td>4.00</td>
<td>SuSe or WiSe</td>
<td>56 h</td>
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<tr>
<td>Seminar</td>
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<td>2.00</td>
<td>SuSe or WiSe</td>
<td>28 h</td>
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**Total time of attendance for the module** 84 h
Skills Modules

neu710 - Neuroscientific Data Analysis in Matlab

<table>
<thead>
<tr>
<th>Module label</th>
<th>Neuroscientific Data Analysis in Matlab</th>
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<tbody>
<tr>
<td>Module code</td>
<td>neu710</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
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<tr>
<td>Workload</td>
<td>180 h</td>
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<tr>
<td></td>
<td>(1 SWS Lecture (VO) Total workload 45h: 10h contact / 20h background reading / 15h exam preparation</td>
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<td></td>
<td>1 SWS Seminar (SE) Total workload 45h: 10h contact / 20 h background reading / 15h preparation of</td>
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<tr>
<td></td>
<td>presentation 2 SWS Supervised exercise (UE) Total workload 90h: 20h contact / 70h home work)</td>
</tr>
</tbody>
</table>

Used in course of study
- Master's Programme Neuroscience (Master) > Skills Modules

Contact person
- Module responsibility
  - Jutta Kretzberg
- Authorized examiners
  - Jutta Kretzberg
  - Jannis Hildebrandt

Entry requirements
- Neurosci. knowlg.
- Social skills
- Interdiscipl. knowlg.
- + Maths/Stats/Progr.
- Scientific English

Upon successful completion of this course, students
* understand basic programming concepts.
* have good knowledge about the most important aspects of the programming language Matlab.
* are able to use the programming environment for Matlab.
* are able to write their own programs in Matlab.
* know how to use Matlab to specifically analyze neuroscientific data, including:
  > electrophysiological data (continuous and spike trains)
  > basic image processing
  > basic statistical testing.

Module contents
Lecture topics:
- Basic programming concepts: data types, variables, loops, scripts, functions, linear and object-oriented programming
- Good practice: documenting your own code, back-up and version control.
- Introduction to the programming environment Matlab including the documentation.
- Introduction to the programming language Matlab
- Efficient programming: memory use
- Working with continuous data: basic time series analysis (i.e. LFP and EEG data)
- Fourier transformation
- Short introduction of spike-extraction and spike-sorting
- Representation and processing of spike train data
- Basic image and image series processing for imaging data (i.e. Ca+ imaging, fMRI)
- Statistical testing with Matlab.
- Plotting and visualization.

During the seminar, we will discuss strategies for analysis and coding for specific relevant examples of neuroscientific data. The examples are prepared and presented by the students. Students will also present some of the work they did during the exercises. If students bring their own data or plan experiments for a research modul or their thesis project, there will be the opportunity to discuss both analysis strategies and possible implementation in Matlab. Exercise:
- Students will get coding exercises, where they will use the knowledge gained from the lecture. The exercises are a mix of short exercises and longer projects. Projects will be done in small groups (2-3 students).
- The students are encouraged to bring examples of data from experiments they have been involved in or are planning to do.

Reader's advisory
Pascal Wallisch: MATLAB for Neuroscientists, Elsevier, Oxford

Language of instruction
- English

Duration (semesters)
- 1 Semester

Module frequency
- annually, summer term

Module capacity
- 24

Reference text
- shared course components with (cannot be credited twice): pb150 Einführung in die Datenanalyse mit MATLAB
- ---

Modular level
- je nach Studiengang Pflicht oder Wahlpflicht

Lern-Lehrform / Type of program
- basic knowledge of math and statistics

Examination
- Time of examination
- Type of examination
<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
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<tbody>
<tr>
<td>Final exam of module</td>
<td>during the course</td>
<td>practical exercise - hand in code each week in addition, mandatory but ungraded: presentation during the seminar</td>
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<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
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<tr>
<td>Lecture</td>
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<td>1.00</td>
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<td>Exercises</td>
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<td>2.00</td>
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<td>28 h</td>
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<tr>
<td>Seminar</td>
<td></td>
<td>1.00</td>
<td></td>
<td>14 h</td>
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</table>

**Total time of attendance for the module** 56 h
neu720 - Statistical programming in R

Module label: Statistical programming in R
Module code: neu720
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)

Used in course of study:
- Master's Programme Biology (Master) > Skills Modules
- Master's Programme Biology (Master) > Skills Modules
- Master's Programme Neuroscience (Master) > Skills Modules

Contact person:
Module responsibility
- Fabian Otto-Sobotka
Authorized examiners
- Fabian Otto-Sobotka

Entry requirements:

Skills to be acquired in this module:
- Social skills
- Interdiscipl. knowlg.
- Math/Stats/Progr.
- Scientific English

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 these 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

Modulelevel: ---
Modulart: Wahlpflicht / Elective

Lern-/Lehrform / Type of program:

Vorkenntnisse / Previous knowledge:

Examination:
Time of examination: after the course
Type of examination: practical exercise

Final exam of module:

<table>
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<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
</tr>
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<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2.00</td>
<td>SuSe</td>
<td>28 h</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>2.00</td>
<td>SuSe</td>
<td>28 h</td>
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Total time of attendance for the module: 56 h
neu730 - Biosciences in the Public Eye and in our Laws

<table>
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<th>Module label</th>
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<tr>
<td>Module code</td>
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<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h (3.5 SWS Supervised exercise (UE) Total workload 158h: 48h contact / 40h preparation of presentation / 70h term paper 0.5 SWS Lecture (VO) Total workload 23h: 10h contact / 13 h background research)</td>
</tr>
</tbody>
</table>

**Used in course of study**

- 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
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- 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
- Dual-Subject Bachelor’s Programme Art and Media (Bachelor) > Fachnahe Angebote Biologie
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- Dual-Subject Bachelor’s Programme History (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor’s Programme Material Culture: Textiles (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor’s Programme Mathematics (Bachelor) > Fachnahe Angebote Biologie
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- Dual-Subject Bachelor’s Programme Technology (Bachelor) > Fachnahe Angebote Biologie
- Fach-Bachelor Pädagogisches Handeln in der Migrationsgesellschaft (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

**Contact person**

- Module responsibility
  - Christine Köppl
- Authorized examiners
  - Christine Köppl
Module counseling

Entry requirements
keine

Skills to be acquired in this module
+ Scient. Literature
++ Social skills
+ Data present./disc.
++ Ethics

Upon completion of this course, students

- have basic knowledge of non-biological aspects of professional life (e.g., law, management, languages)
- know the basic safety and environmental concerns in bioscientific workplaces
- are able to critically define and discuss ethical conflicts in biological research, e.g., in the context of stem cell research or data manipulation
- have the ability to communicate scientific concepts, both orally and in writing
- are able to prepare and give a coherent presentation in a team
- have practised to lead a group discussion

Module contents

Lectures introduce the legal framework and the application procedures for experimental work with animals, humans and genetically modified organisms. In supervised exercises, students research the ethical aspects and controversial issues of about 10 particular topics in the biosciences. They 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
Current law and interpretative commentaries, e.g., by the German Research Council (DFG) or the German Ethics Panel
Introductory papers aimed at lay persons, e.g. from “The Scientist” or widely respected newspapers
Problem-based, independent search for relevant scientific literature is an integral part of this module

Links

Languages of instruction
German, English

Duration (semesters)
1 Semester

Module frequency
annually, summer term

Module capacity
18

Module level
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Module type
Wahlpflicht / Elective

Lern- /Lehrform / Type of program

Vorkenntnisse / Previous knowledge

Examination
Final exam of module
within a few weeks of summer term lecture period
Term paper
In addition, mandatory but ungraded: Regular participation during the semester is required (max 3 days of absence)

Course type
Lecture
Seminar und Übung

Comment

SWS
2.00
2.00

Frequency
SuSe
SuSe

Workload attendance
28 h
28 h

Total time of attendance for the module
56 h
neu740 - Molecular Mechanisms of Ageing

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

Used in course of study

- Bachelor's Programme Biology (Bachelor) > Fachnahe Angebote Biologie
- Bachelor's Programme Business Administration and Law (Bachelor) > Fachnahe Angebote Biologie
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- Dual-Subject Bachelor's Programme Economic Education (Bachelor) > Fachnahe Angebote Biologie
- Dual-Subject Bachelor's Programme Economics and Business Administration (Bachelor) > Fachnahe Angebote Biologie
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- Master's Programme Biology (Master) > Skills Modules
- Master's Programme Biology (Master) > Skills Modules
- Master's Programme Neuroscience (Master) > Skills Modules

Contact person

Module responsibility

- Kathrin Thiedieck
- Lena Ebbers

Authorized examiners
Entry requirements

Skills to be acquired in this module

- Neurosci. knowlg.
- Expt. methods
- Scient. literature
- Social skills
- Interdiscipl. knowlg.
- Data present./disc.
- Scientific 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 philosphers 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 : Zellulare und molekulare Grundlagen, körperliche Veränderungen und Erkrankungen, Therapieansätze?tze
Ludger Rensing ; Volkhard Rippe

Links

- Language of instruction: English
- Duration (semesters): 1 Semester
- Module frequency: annually, summer term
- Module capacity: 16
<table>
<thead>
<tr>
<th>Modullevel</th>
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<tbody>
<tr>
<td>Modulart</td>
<td>Wahlpflicht / Elective</td>
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<tr>
<td>Lern-/Lehrform / Type of program</td>
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<tr>
<td>Vorkenntnisse / Previous knowledge</td>
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<tr>
<td>Examination</td>
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<thead>
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<th>Comment</th>
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<th>Frequency</th>
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<tr>
<td>Lecture</td>
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<td>2.00</td>
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<tr>
<td>Exercises</td>
<td></td>
<td>4.00</td>
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<td>56 h</td>
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Total time of attendance for the module 84 h
neu750 - Laboratory Animal Science

Module label     Laboratory Animal Science
Module code      neu750
Credit points    6.0 KP
Workload         180 h

Used in course of study
- Master's Programme Neuroscience (Master) > Skills Modules

Contact person

Module responsibility
- Christine Köppl

Module counseling
- Ulrike Langemann
- Georg Martin Klump
- Arne Nolte
- Gabriele Gerlach

Entry 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

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 and birds)
- 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 and birds
- 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” for rodents, birds and fish. We aim to obtain accreditation by the Federation of European Laboratory Animal Science Associations (FeLaSa) by mid-2017.

Module contents

Background knowledge on:
- 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:
- Handling and external examination of mouse, gerbil, zebra finch, chicken, zebra fish
- 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
- halbjährlich
### Module capacity
- unlimited

### Reference text
- Course in the semester break
- In addition to the exam, completion of an assignment is required to pass the module.
- GV-SOLAS accreditation aimed for in 2016, FELASA in 2017

### Module level
- ---

### Module art
- je nach Studiengang Pflicht oder Wahlpflicht

### Lern-Lehrform / Type of program

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

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<th>Frequency</th>
<th>Workload attendance</th>
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<tr>
<td>Exercises</td>
<td></td>
<td>3.00</td>
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<td>42 h</td>
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### Total time of attendance for the module
- 70 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)

**Used in course of study**  
- Master's Programme Biology (Master) > Skills Modules  
- Master's Programme Biology (Master) > Skills Modules  
- Master's Programme Neuroscience (Master) > Skills Modules  

**Contact person**  
**Module responsibility**  
  - Christine Köppl  
**Authorized examiners**  
  - Jannis Hildebrandt  

**Entry requirements**  
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  
Additional teachers in the module: outsourced to STELS-OL (Scientific and Technical English Language Service, Oldenburg); native English speaker with in-depth neuroscience knowledge
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<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
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**Lern-/Lehrform / Type of program**

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<td>Portfolio: 50% presentation, 50% assignment; bonus for active participation</td>
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<tr>
<td>Lecture</td>
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<td>1.00</td>
<td>WiSe</td>
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<tr>
<td>Exercises</td>
<td></td>
<td>3.00</td>
<td>WiSe</td>
<td>42 h</td>
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**Total time of attendance for the module**

56 h
neu770 - Basics of Statistical Data Analysis

Module label | Basics of Statistical Data Analysis
Module code | neu770
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 Seminar (SE) Total workload 113h: 28h contact / 20h background reading / 65h exercise solving)

Used in course of study
- Bachelor's Programme Physics, Engineering and Medicine (Bachelor) > Aufbaumodule
- Master's Programme Biology (Master) > Skills Modules
- Master's Programme Neuroscience (Master) > Skills Modules

Contact person
Module responsibility
- Fabian Otto-Sobotka

Authorized examiners
- Fabian Otto-Sobotka

Entry requirements
Skills to be acquired in this module
- Social skills
- Interdiscipl. knowl.
- Maths/Stats/Progr.
- Scientific English

Upon successful completion of this course, students
have basic statistical competencies for understanding data
understand the main statistical methods and their practical use through application
can evaluate statistical methods regarding the qualities and their limits

Module contents
- populations and samples; exploratory data analysis through describing statistics
- elementary probabilities and random variables
- important discrete and continuous distributions
- estimating parameters through the method of maximum likelihood
- confidence intervals and classical significance testing
- pairs of random variables; distribution and dependence
- classical regression analysis
- basic use of the software R to apply those methods

Reader's advisory
Will be available in Stud.IP

Links

Language of instruction
English

Duration (semesters)
1 Semester

Module frequency
annually, winter term

Module capacity
unlimited

Modulelevel
---

Modulart
Wahlpflicht / Elective

Vorkenntnisse / Previous knowledge
basic mathematical knowledge; une of probabilities recommended in combination with neu720 Statistical programming with R

Examination
Time of examination
written exam, 2h

Course type | Comment | SWS | Frequency | Workload attendance
--- | --- | --- | --- | ---
Lecture | | 2.00 | | 28 h
Seminar | | 2.00 | | 28 h

Total time of attendance for the module | 56 h
neu780 - Introduction to Data Analysis with Python

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<th>Module label</th>
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<tr>
<td>Module code</td>
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<tr>
<td>Credit points</td>
<td>6.0 KP</td>
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<tr>
<td>Workload</td>
<td>180 h (2 SWS Lecture total workload 90h: 30h contact / 60h individual reading 2 SWS Supervised exercise total workload 90h: 45h contact / 45h solving programming exercises)</td>
</tr>
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| Used in course of study       | Master's Programme Biology (Master) > Skills Modules  
|                               | Master's Programme Biology (Master) > Skills Modules  
|                               | Master's Programme Neuroscience (Master) > Skills Modules |
| Contact person                | Module responsibility                      |
|                               | Michael Winkhofer                          |
| Authorized examiners          | Michael Winkhofer                          |
| Entry requirements            | Skills to be acquired in this module       |
|                               | + Neurosci. knowlg.                        |
|                               | ++ Maths/Stats/Progr.                      |
|                               | + Data present./disc.                      |
|                               | 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/. 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 synthetica data from various noise models to assess signal-to-noise ratio in instrumental datasets.
| Module contents               | Data types and data structures, control structures, functions, modules, file input/output Standard libraries and SciPy libraries (Matplotlib, NumPy,...), scikit-image, VPython, ...
| Reader's advisory            | open access                                |
|                               | http://www.swaroopch.com/notes/python/     |
|                               | http://docs.python.org/3/tutorial/index.html |
| Links                         | English                                    |
| Language of instruction       | English                                    |
| Duration (semesters)          | 1 Semester                                 |
| Module frequency              | semester break, annually                   |
| Module capacity               | 20                                         |
| Reference text                | Shared course components with (cannot be credited twice): pb328 "Einführung in Datenanalyse mit Python" (Professionalisierungsmodul im Bachelorstudiengang Biologie) |
| Modullevel                    | ---                                        |
| Modulart                      | Wahlpflicht / Elective                     |
| Lern-/Lehrform / Type of program |                                         |
| Vorkenntnisse / Previous knowledge | No prior knowledge in programming required, but useful. |
| Examination                   | Time of examination                        |
|                               | Type of examination                        |
| Final exam of module          | term break, immediately after the course (2 weeks in February) |
|                               | assignment of programming exercises, 4 out of 5 exercises to be assessed |
| Course type                   | Comment                                    |
|                               | SWS | Frequency | Workload attendance |
| Lecture                       | 2.00 | WiSe | 28 h |
| Exercises                     | 2.00 | WiSe | 28 h |
| Total time of attendance for the module | 56 h |
# neu751 - Laboratory Animal Science

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<td>Credit points</td>
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<tr>
<td>Workload</td>
<td>90 h (one week full-time in semester break + flexible time for studying and exam preparation 1 SWS Lecture total workload 45h: 2h contact / 20h background reading / 23h exam preparation 1 SWS Supervised exercise total workload 45h: 35h contact / 10h background reading)</td>
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| Used in course of study | • Master's Programme Biology (Master) > Skills Modules  
• Master's Programme Biology (Master) > Skills Modules  
• Master's Programme Neuroscience (Master) > Skills Modules |
| Contact person        | Module responsibility  
  » Christine Köppl  
Authorized examiners  
  » Christine Köppl  
  » Georg Martin Klump  
  » Ulrike Langemann  
  » Arne Nolte |
| Entry requirements    | none                                                                 |
| Skills to be acquired in this module | ++ Expt. Methods  
+ Independent research  
+S cient. 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“. We aim to obtain accreditation by the Federation of European Laboratory Animal Science Associations (FeLaSa) by 2018.

| 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 • 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 15  
Registration procedure / selection criteria: StudIP, sequence of registration |
| Modullevel | --- |
| Modulart | je nach Studiengang Pflicht oder Wahlpflicht |
| Lern-/Lehrform / Type of program |
### Vorkenntnisse / Previous knowledge

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<td>written exam of 90 minutes</td>
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<th>Frequency</th>
<th>Workload attendance</th>
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<tr>
<td>Lecture</td>
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<td>1.00</td>
<td>SuSe and WiSe</td>
<td>14 h</td>
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<tr>
<td>Exercises</td>
<td></td>
<td>1.00</td>
<td>SuSe and WiSe</td>
<td>14 h</td>
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**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)

Used in course of study:
- Master's Programme Biology (Master) > Skills Modules
- Master's Programme Biology (Master) > Skills Modules
- Master's Programme Neuroscience (Master) > Skills Modules

Contact person:
Module responsibility:
- Jutta Kretzberg

Authorized examiners:
- Jutta Kretzberg
- Jannis Hildebrandt
- Christine Köppl

Entry requirements:

Skills to be acquired in this module:
- Neurosci. knowlg.
- Independent research
- 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 neuroscience.

Critical reading of neuroscience literature:
- Identify article type and audience
- Summarize scientific contents
- Identify strengths and weaknesses of methods, conclusions etc.
- Put into scientific context
- Discuss manuscript style
- Discuss social and ethical context and implications of the study

Critical discussion of own studies:
- 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:

The overall goal of critical discussion of neuroscientific results in a scientific, social and ethical context can be achieved by different options:
- Option 1: Seminar 'Neuroscience Journal Club': All students read and discuss 12 published papers (one each week). Different fields of neuroscience (e.g. molecular, cellular, behavioral, computational) will be covered with one classical and one recent paper each. Papers and questions about each paper will be provided prior to the start of the seminar. Students prepare answers to these questions independently and discuss their answers during the seminar. The module is passed when a student actively participated in the discussion of at least 10 papers.
- Option 2: Written report on a neuroscientific topic of the student's choice, based on scientific literature, e.g. in the context of an independent student study group. The report should discuss scientific results in a scientific and a social / ethical context.
- Option 3: Active participation in a scientific conference, workshop, summer school etc.: Participation in a scientific conference, workshop, summer school etc. lasting a minimum of 3 full days can be credited with 3 ECTS, if the student presents own scientific results (poster, talk) obtained, e.g., in a research module or Master thesis.
- Option 4: Participation in at least 20 scientific presentations (e.g. IBU / DfN colloquium, Hanse lecture neuroscience) and submission of a short (1 page) written summary of each talk. For other individual options (e.g. teaching in neuroscience) ask the module organizer.

Reader's advisory:

Option 1 (seminar): List of 12 published papers will be provided prior to the course. All students are required to read at least 10 of those.
Other options: dependent on the scientific topic
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

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<th>Links</th>
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<tbody>
<tr>
<td>Language of instruction</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>
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<td>Registration procedure / selection criteria: StudIP</td>
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<td>Modulelevel</td>
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<th>Lern-/Lehrform / Type of program</th>
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<tr>
<td>Vorkenntnisse / Previous knowledge</td>
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<th>Time of examination</th>
<th>Type of examination</th>
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<tbody>
<tr>
<td>Final exam of module</td>
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<tr>
<th>Workload attendance</th>
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<tbody>
<tr>
<td>28 h</td>
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</table>
neu800 - Introduction to Matlab

Module label
Introduction to Matlab

Module code
neu800

Credit points
3.0 KP

Workload
90 h
(2 SWS Supervised exercise (UE) "Introduction to MATLAB" Total workload 90h: 28h contact / 62h practising learned programming skills)

Used in course of study
- Master's Programme Biology (Master) > Skills Modules
- Master's Programme Neuroscience (Master) > Skills Modules

Contact person
Module responsibility
- Carsten Gießing

Authorized examiners
- Carsten Gießing

Entry requirements

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

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

Module contents
The modul comprises an introduction to data structures, flow control, loops, graphics, basic data analyses with MATLAB, scripts and functions.

Reader's advisory

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
MM (Mastermodul / Master module)

Modulart
Wahlpflicht / Elective

Lern-/Lehrform / Type of program

Vorkenntnisse / Previous knowledge

Examination
Time of examination
Type of examination
Final exam of module
end of summer term
Working on exercises
Regular active participation

Course type
Lecture
Seminar
Exercises

Comment

SWS
0.00
0.00
2.00

Frequency
SuSe
SuSe
SuSe

Workload attendance
0 h
0 h
28 h

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

Module label: International Meeting Contribution
Module code: neu810
Credit points: 3.0 KP
Workload: 90 h

Used in course of study:
- Master's Programme Biology (Master) > Skills Modules
- Master's Programme Neuroscience (Master) > Skills Modules

Contact person:
- Module responsibility:
  - Jutta Kretzberg
- Authorized examiners:
  - Jutta Kretzberg
  - Christine Köppel
  - Jannis Hildebrandt

Entry requirements:
Skills to be acquired in this module:
- + Neurosci. knowlg.
- ++ Independent research
- ++ Scient. Literature
- ++ Social skills
- + Interdiscipl. knowlg.
- ++ Data present./disc.
- + Scientific English
- ++ Ethics

Presentation and critical discussion of own studies in front of an international audience:
- 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.

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: MM (Mastermodul / Master module)
Modulart: Wahlpflicht / Elective

Lern-/Lehrform / Type of program:

Vorkenntnisse / Previous knowledge:

Examination:
Time of examination:
Type of examination:
Final exam of module:
none (only pass/fail)

Course type:
Seminar

SWS: 0.00
Frequency:
SuSe and WiSe
Workload attendance: 0 h