# Modules for Neuroscience

## Background Modules

**neu110 - Development and Evolution**

<table>
<thead>
<tr>
<th>Module label</th>
<th>Development and Evolution</th>
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<tbody>
<tr>
<td>Module code</td>
<td>neu110</td>
</tr>
<tr>
<td>Credit points</td>
<td>9.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>270 h</td>
</tr>
<tr>
<td>Used in course of study</td>
<td>Master Neuroscience &gt; Background Modules</td>
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**Ansprechpartner/-in**

- Ulrike Sienknecht
- Prüfungsberechtigt
- Alle hier genannten

**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

- Fundamentals and concepts of developmental and evolutionary biology

**Module contents**

- Lectures on the fundamentals and concepts of developmental biology, and introduction to the development of the auditory system, including evolutionary aspects. Parallel seminars matching the topics of the lectures.

**Literaturempfehlungen**

- Gilbert S.F., Development, Macmillan Publishers Ltd;

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

**Lern-Lehrform / Type of program**

**Vorkenntnisse / Previous knowledge**

<table>
<thead>
<tr>
<th>Examination</th>
<th>Prüfungszeiten</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>same winter term</td>
<td>oral exam of 30 minutes</td>
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**Course type**

<table>
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<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
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<tbody>
<tr>
<td>Lecture</td>
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<td>42 h</td>
</tr>
<tr>
<td>Seminar</td>
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<td>42 h</td>
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**Präsenzzeit Modul insgesamt**

84 h
### neu120 - Lab Exercises in Development and Evolution

<table>
<thead>
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<tr>
<td><strong>Credit points</strong></td>
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<td><strong>Workload</strong></td>
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<td>Master Neuroscience &gt; Background Modules</td>
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<tr>
<td><strong>Ansprechpartner/-in</strong></td>
<td>Module responsibility</td>
</tr>
<tr>
<td></td>
<td>⊗ Ulrike Sienknecht</td>
</tr>
<tr>
<td></td>
<td>⊗ Prüfungsberechtigt</td>
</tr>
<tr>
<td></td>
<td>⊗ Alle hier genannten</td>
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<tr>
<td></td>
<td>⊗ Module counseling</td>
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<tr>
<td></td>
<td>⊗ Hans Gerd Nothwang</td>
</tr>
<tr>
<td><strong>Entry requirements</strong></td>
<td>required previous credits</td>
</tr>
<tr>
<td><strong>Skills to be acquired in this module</strong></td>
<td>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</td>
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<tr>
<td><strong>Module contents</strong></td>
<td>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</td>
</tr>
<tr>
<td><strong>Links</strong></td>
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<tr>
<td><strong>Language of instruction</strong></td>
<td>English</td>
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<tr>
<td><strong>Duration (semesters)</strong></td>
<td>1 Semester</td>
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<tr>
<td><strong>Module frequency</strong></td>
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<td><strong>Module capacity</strong></td>
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#### Vorkenntnisse / Previous knowledge

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<th>Prüfungszeiten</th>
<th>Type of examination</th>
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#### Final exam of module

<table>
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<tr>
<td>Exercises</td>
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<td>4.00</td>
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<tr>
<td>Seminar</td>
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<td></td>
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**Präsenzzeit Modul insgesamt**: 56 h
**neu140 - Neurophysiology**

**Module label**
- Neurophysiology

**Module code**
- neu140

**Credit points**
- 9.0 KP

**Workload**
- 270 h

**Used in course of study**
- Master Neuroscience > Background Modules

**Ansprechpartner/-in**
- Module responsibility
  - Martin Greschner
- Prüfungsberechtigt
- Alle hier genannten

**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. + Maths/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

**Literaturempfehlungen**
- 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**
- MM (Mastermodul)

**Modulart**
- Wahlpflicht

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

**Vorkenntnisse / Previous knowledge**

**Examination**
- Prüfungszeiten

**Final exam of module**
- summer semester, first half
  - Portfolio consisting of short tests and short reports

**Course type**
- Lecture
  - Comment: 2.00
  - Workload: 28 h

- Seminar
  - Comment: 1.00
  - Workload: 14 h

- Practical
  - Comment: 5.00
  - Workload: 70 h

**Präsenzzeit Modul insgesamt**
- 112 h
neu150 - Neuroanatomy

Module label: Neuroanatomy
Module code: neu150
Credit points: 6.0 KP
Workload: 180 h
Used in course of study: Master Neuroscience > Background Modules

Ansprechpartner/-in:
- Ulrike Janssen-Bienhold

Prüfungsberechtigt:
- Alle hier genannten

Module counseling:
- Karin Dedek

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. Maths/Stats/Progr. + Data present./disc. + Scientific English
- Ethics
Theory: Improved theoretical and methodological knowledge in neurobiology. Discussion of scientific work and presentation of own results.
Practice: Performing neuroanatomical experiments. Gaining modern methodological skills.

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

Literaturempfehlungen:
- Background and seminar literature will be available in Stud.IP

Links
- Languages of instruction: German, 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: MM (Mastermodul)
Modulart: Wahlpflicht

Vorkenntnisse / Previous knowledge:

Vorkenntnisse / Previous knowledge:

Examination Prüfungszeiten Type of examination
Final exam of module summer semester, first half Portfolio (75 %), report (25 %)

Course type Comment SWS Frequency Workload attendance
- Lecture 1.00 14 h
- Seminar 1.00 14 h
- Practical 3.00 WiSe 42 h

Präsenzzeit Modul insgesamt 70 h
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 Neuroscience > Background Modules

Ansprechpartner/-in:
- John Neidhardt
- Alle hier genannten

Module counseling:
- Karl-Wilhelm Koch
- Kathrin Thedieck

Entry requirements:

Skills to be acquired in this module:
- Neurosci. knowlg. + Expt. methods Independent research + 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

Literaturempfehlungen:
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
Modulelevel: MM (Mastermodul)
<table>
<thead>
<tr>
<th>Modulart</th>
<th>Wahlplicht</th>
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<tr>
<td>Lern-/Lehrform / Type of program</td>
<td></td>
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<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td></td>
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<tr>
<td>Examination</td>
<td>Prüfungszeiten</td>
</tr>
<tr>
<td>Final exam of module</td>
<td>70% written exam, 30% presentation(s)</td>
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<table>
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<tr>
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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></td>
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<tr>
<td>Exercises</td>
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<td>6.00</td>
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<td>84 h</td>
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<tr>
<td>Seminar</td>
<td></td>
<td>2.00</td>
<td></td>
<td>28 h</td>
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Präsenzzeit Modul insgesamt 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 Neuroscience > Background Modules

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, adenylate 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.

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).
<table>
<thead>
<tr>
<th>Links</th>
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<tbody>
<tr>
<td>Language of instruction</td>
<td>English</td>
</tr>
<tr>
<td>Duration (semesters)</td>
<td>1 Semester</td>
</tr>
<tr>
<td>Module frequency</td>
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<td>Module capacity</td>
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<td>Course in the second half of the semester. Regular active participation and seminar presentation(s) are required to pass the module.</td>
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<tr>
<td>Modullevel</td>
<td>MM (Mastermodul)</td>
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<tr>
<td>Modulart</td>
<td>Wahlpflicht</td>
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</table>

**Lern-Lehrform / Type of program**

**Vorkenntnisse / Previous knowledge**

<table>
<thead>
<tr>
<th>Examination</th>
<th>Prüfungszeiten</th>
<th>Type of examination</th>
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<tbody>
<tr>
<td>Final exam of module</td>
<td>within 2 months after the end of the course</td>
<td>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.</td>
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**Course type**

<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>Lecture</td>
<td>1.00</td>
<td>WiSe</td>
<td></td>
<td>14 h</td>
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<tr>
<td>Exercises</td>
<td>8.00</td>
<td>WiSe</td>
<td></td>
<td>112 h</td>
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<tr>
<td>Seminar</td>
<td>1.00</td>
<td>WiSe</td>
<td></td>
<td>14 h</td>
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**Präsenzzeit Modul insgesamt**

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
Used in course of study: Master Neuroscience > Background Modules

Module responsibility
- Georg Martin Klump

Prüfungsberechtigt
- Alle hier genannten

Module counseling
- Ulrike Langemann
- Jannis Hildebrandt
- Henrik Mouritsen

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 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.

Literatureempfehlungen

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

Vorkenntnisse / Previous knowledge
Examination Prüfungszeiten Type of examination
Final exam of module: as agreed, usually in the break after the winter term
80% written exam (content of the two lecture series), 20% presentation(s)

Course type Comment SWS Frequency Workload attendance
Lecture 4.00 56 h
Seminar 2.00 28 h
Präsenzzeit Modul insgesamt 84 h
### neu220 - Neurosensory Science and Behaviour - Part B

<table>
<thead>
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<th>Module label</th>
<th>Neurosensory Science and Behaviour - Part B</th>
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<tbody>
<tr>
<td>Module code</td>
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<td>Master Neuroscience &gt; Background Modules</td>
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<tr>
<td>Ansprechpartner/-in</td>
<td>Module responsibility</td>
</tr>
<tr>
<td></td>
<td>Christiane Margarete Thiel</td>
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<td>Alle hier genannten</td>
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<td></td>
<td>Module counseling</td>
</tr>
<tr>
<td></td>
<td>Carsten Gießing</td>
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#### 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 will:
- know the fundamentals of neurotransmission
- know the basic neural mechanisms underlying attention, learning, emotion, language and executive functions
- understand the relationship between disturbances in neurotransmitter systems, cognitive functions and psychiatric disease
- know the principles of drug treatment for psychiatric disorders
- have in-depth knowledge in selected areas of these topics
- are able to understand, explain and critically assess neuroscientific approaches in animals and humans
- are able to understand and critically assess published work in the area of cognitive neuroscience

#### Module contents

The lecture "Introduction to Cognitive Neuroscience" gives a short introduction into neuroanatomy and cognitive neuroscience methods and then covers different cognitive functions.

**Lecture topics:**
- History of cognitive neuroscience
- Methods of cognitive neuroscience
- Attention
- Learning
- Emotion
- Language
- Executive functions.

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

The lecture "Psychopharmacology" illustrates the connection between neurotransmitters and behaviour and its links to psychiatric disease. The lecture contains several interactive parts to consolidate and critically evaluate the acquired knowledge.

**Lecture topics:**
- Introduction to Terms and Definitions in Drug Research
- Dopaergic and Noradrenergic System
- Cholinergic and Serotonergic System
- GABAergic and Glutamatergic System
- Addiction
- Depression
- Schizophrenia
- Anxiety
- Alzheimer's Disease

#### Literaturempfehlungen


#### 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.

**Modullevel**
- MM (Mastermodul)
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<td>Lern-Lehrform / Type of program</td>
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<tr>
<td>Examination</td>
<td>Prüfungszeiten</td>
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<tr>
<td>Final exam of module</td>
<td>as agreed, usually in the break after the winter term</td>
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<tr>
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<td>3.00</td>
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<td>42 h</td>
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<td>1.00</td>
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<tr>
<td>Präsenzzeit Modul insgesamt</td>
<td></td>
<td>56 h</td>
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neu240 - Computational Neuroscience - Introduction

Module label: Computational Neuroscience - Introduction
Module code: neu240
Credit points: 9.0 KP
Workload: 270 h
Used in course of study: Master Neuroscience > Background Modules

Ansprechpartner/-in:
- Module responsibility: Jutta Kretzberg
- Prüfungsberechtigt
- Alle hier genannten
- Module counseling: Martin Greschner, Jannis Hildebrandt

Entry requirements: attendance in pre-meeting

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

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)

Literatureempfehlungen:
(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 Prüfungszeiten Type of examination
Final exam of module during the course Portfolio, consisting of daily short tests, programming exercises and short reports
Course type Comment SWS Frequency Workload attendance
Lecture 1.00 14 h
<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>Exercises</td>
<td></td>
<td>4.00</td>
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<tr>
<td>Seminar</td>
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<td>1.00</td>
<td></td>
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<td>Präsenzeit Modul insgesamt</td>
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<td></td>
<td>84 h</td>
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</table>
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 Neuroscience > Background Modules

Ansprechpartner/-in:
Module responsibility:
- Jutta Kretzberg
Prüfungsberechtigt:
- Jutta Kretzberg
- Martin Greschner
- Jannis Hildebrandt

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

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)

Literaturempfehlungen:
Skripts 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)

Modulelevel: ---
Modulart: Pflicht o. Wahlpflicht / compulsory or optional
Lern-Lehreform / Type of program: Master of Science: Neuroscience

Vorkenntnisse / Previous knowledge:
Examination Prüfungszeiten Type of examination
Final exam of module: during the course Portfolio, consisting of daily short tests, programming exercises, short reports

Course type Comment SWS Frequency Workload attendance
Exercises 0.00 WiSe 0 h
Lecture 0.00 WiSe 0 h
<table>
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<th>Frequency</th>
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<tr>
<td>Seminar</td>
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<td></td>
<td>WiSe</td>
<td>0 h</td>
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<tr>
<td>Präsenzzeit Modul insgesamt</td>
<td></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  
**Used in course of study**
- Master Neuroscience > Background Modules  
**Ansprechpartner/-in**
- Module responsibility: Jutta Kretzberg  
- Prüfungsberechtigt: Alle hier genannten  
- 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.  
**Literaturempfehlungen**
- 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: unlimited  
- 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**: MM (Mastermodul)  
**Modulart**: Wahlpflicht  
**Lern-Lehrform / Type of program**

<table>
<thead>
<tr>
<th>Examination</th>
<th>Prüfungszeiten</th>
<th>Type of examination</th>
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</thead>
<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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**Course type**
- Comment  
- SWS  
- Frequency  
- Workload attendance
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<th>Frequency</th>
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<td>Exercises</td>
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<td><strong>Präsenzzeit Modul insgesamt</strong></td>
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<td>56 h</td>
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neu270 - Neurocognition & Psychophysics

Module label: Neurocognition & Psychophysics
Module code: neu270
Credit points: 15.0 KP
Workload: 450 h
Used in course of study: Master Neuroscience > Background Modules

Ansprechpartner/-in:
- Georg Martin Klump
- Alle hier genannten

Module responsibility:
- Georg Martin Klump

Prüfungsberechtigt:
- Christiane Margarete Thiel
- Ulrike Langemann
- 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
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.

Literaturempfehlungen:

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

Module level: MM (Mastermodul)
Modulart: Wahlpflicht

Lern-/Lehrform / Type of program:

Vorkenntnisse / Previous knowledge:

Examination Prüfungszeiten Type of examination
Final exam of module end of summer term 70% report or oral exam or written exam, 30%
presentation (talk or poster)

Course type Comment Frequency Workload attendance
Lecture 2.00 28 h
Exercises 2.00 28 h
Practical 6.00 84 h
Präsenzzeit Modul insgesamt 140 h
### neu280 - Research Techniques in Neuroscience

<table>
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<td>Credit points</td>
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<td>Workload</td>
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<td>Used in course of study</td>
<td>Master Neuroscience &gt; Background Modules</td>
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<td></td>
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<tr>
<td></td>
<td>- Anna-Maria Hartmann</td>
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<td></td>
<td>- Anna-Maria Hartmann</td>
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<td>- Hans Gerd Nothwang</td>
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<td>- Christiane Margarete Thiel</td>
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<td>- John Neidhardt</td>
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<td>- Martin Greschner</td>
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<td>- Carsten Bantel</td>
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<td>- Alexandra Philipsen</td>
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</table>

**Entry requirements**

**Skills to be acquired in this module**

**Module contents**

**Literaturempfehlungen**

**Links**

**Language of instruction**

**Duration (semesters)**

**1 Semester**

**Module frequency**

**Module capacity**

**20**

**Modullevel**

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

**Vorkenntnisse / Previous knowledge**

**Examination**

**Prüfungszeiten**

**Type of examination**

**Final exam of module**

<table>
<thead>
<tr>
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<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
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<tr>
<td>Practical</td>
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<td>2.00</td>
<td>SoSe</td>
<td>28 h</td>
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**Präsenzzeit Modul insgesamt**

56 h
**neu290 - Biophysics of Sensory Reception**

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<td>6.0 KP</td>
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<tr>
<td>Workload</td>
<td>180 h</td>
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</table>

**Used in course of study**
- Master Neuroscience > Background Modules

**Ansprechpartner/-in**

**Entry requirements**

**Skills to be acquired in this module**

**Module contents**

**Literaturempfehlungen**

**Links**

**Language of instruction**
- German

**Duration (semesters)**
- 1 Semester

**Module frequency**

**Module capacity**
- unlimited

**Module level**
- ---

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

**Lern-Lehrform / Type of program**

**Vorkenntnisse / Previous knowledge**

**Examination**

**Prüfungszeiten**

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<th>Type of examination</th>
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**Final exam of module**

| G | |

**Course type**

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<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
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<tr>
<td>Lecture</td>
<td>0.00</td>
<td>WiSe</td>
<td>0 h</td>
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<tr>
<td>Seminar</td>
<td>0.00</td>
<td>WiSe</td>
<td>0 h</td>
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**Präsenzzeit Modul insgesamt**
- 0 h
neu300 - Functional MRI data analysis

Module label: Functional MRI data analysis
Module code: neu300
Credit points: 12.0 KP
Workload: 360 h

Used in course of study:
- Master Neuroscience > Background Modules

Entry requirements

Skills to be acquired in this module

Module contents

Literaturempfehlungen

Links

Language of instruction: German

Duration (semesters): 1 Semester

Module frequency

Module capacity: unlimited

Modullevel

Modulart: je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program

Vorkenntnisse / Previous knowledge

Examination
Prüfungszeiten
Type of examination

Final exam of module
G

Course type
Practical
Seminar
Lecture
Präsenzzeit Modul insgesamt

Comment
SWS
Frequency
Workload attendance
0.00
WiSe
0 h
0.00
WiSe
0 h
0.00
WiSe
0 h
0 h

Präsenzzeit Modul insgesamt
0 h
**neu305 - Essentials of fMRI Data Analysis with SPM and FSL**

<table>
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<th>Module label</th>
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<td>Workload</td>
<td>180 h</td>
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**Used in course of study**
- Master Neuroscience > Background Modules

**Entry requirements**

**Skills to be acquired in this module**

**Module contents**

**Literaturempfehlungen**

**Links**

**Language of instruction**
- German

**Duration (semesters)**
- 1 Semester

**Module frequency**

**Module capacity**
- unlimited

**Modullevel**
- ---

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

**Lern-Lehrform / Type of program**

**Vorkenntnisse / Previous knowledge**

**Final exam of module**

<table>
<thead>
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<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
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<tbody>
<tr>
<td>Seminar</td>
<td>0.00</td>
<td></td>
<td>WiSe</td>
<td>0 h</td>
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<tr>
<td>Exercises</td>
<td>0.00</td>
<td></td>
<td>WiSe</td>
<td>0 h</td>
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**Präsenzzeit Modul insgesamt**
- 0 h
neu310 - Psychophysics of Hearing

Module label: Psychophysics of Hearing
Module code: neu310
Credit points: 12.0 KP
Workload: 360 h

Used in course of study:
- Master Neuroscience > Background Modules

Skills to be acquired in this module:

Module contents:

Literaturempfehlungen:

Links:

Language of instruction: German
Duration (semesters): 1 Semester

Module frequency:
Module capacity: unlimited
Modullevel: ---
Modulart: je nach Studiengang Pflicht oder Wahlpflicht

Lern-Lehrform / Type of program:

Vorkenntnisse / Previous knowledge:

Examination: Prüfungszeiten
Type of examination: G

Final exam of module:

Course type | Comment | SWS | Frequency | Workload attendance
---|---|---|---|---
Exercises | | 0.00 | WiSe | 0 h
Seminar | | 0.00 | WiSe | 0 h
Practical | | 0.00 | WiSe | 0 h
Lecture | | 0.00 | WiSe | 0 h

Präsenzzeit Modul insgesamt: 0 h
neu320 - Introduction to Neurophysics

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

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

Used in course of study:
- Master Neuroscience > Background Modules

Ansprechpartner/-in:
- Module responsibility
  - Jörn Anemüller

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

Skills to be acquired in this module:
- 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
- Information-theoretic approaches, stimulus statistics, entropy, mutual information
- Learning and plasticity, conditioning and reinforcement learning, Hebbian learning, long-term potentiation and long-term depression

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

Links:
- Language of instruction: English
- Duration (semesters): 1 Semester
- Module frequency: winter term / annually
- Module capacity: 30 (Registration procedure / selection criteria: StudIP)
- Reference text: Recommended in combination with: 5.04.4012 Informationsverarbeitung und Kommunikation (phy350)
- Will also be offered in "M.Sc. Physik, Technik, Medizin" (Studiangang in preparation)
- Modulelevel: ---
- 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: end of winter term
- Prüfungszeiten: 80% oral exam or written exam, 20% exercise work
- Type of examination:
<table>
<thead>
<tr>
<th>Examination</th>
<th>Prüfungszeiten</th>
<th>Type of examination and presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course type</td>
<td>Comment</td>
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<td>Lecture</td>
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<td>Seminar</td>
<td>0.00</td>
<td>WiSe</td>
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<tr>
<td>Exercises</td>
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<tr>
<td><strong>Präsenzzeit Modul insgesamt</strong></td>
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</table>
Research Modules

neu410 - Auditory Neuroscience

<table>
<thead>
<tr>
<th>Module label</th>
<th>Auditory Neuroscience</th>
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<tbody>
<tr>
<td>Module code</td>
<td>neu410</td>
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<tr>
<td>Credit points</td>
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<tr>
<td>Workload</td>
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<td>Used in course of study</td>
<td>Master Neuroscience &gt; Research Modules</td>
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Ansprechpartner/-in

- Christine Köppl

Prüfungsberechtigt

- Alle hier genannten

Module counseling

- Georg Martin Klump
- Jannis Hildebrandt

Entry requirements

Skills to be acquired in this module

- + Neurosci. knowlg. Expt. methods
- + Independent research
- + Scientif. literature
- + Social skills
- + Interdiscipl. knowlg.
- + 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)

Literaturempfehlungen

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.

Modulelevel

- MM (Mastermodul)
<table>
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<tr>
<th>Modulart</th>
<th>Wahlpflicht</th>
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<th>Internship report</th>
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<table>
<thead>
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<th>Frequency</th>
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<tr>
<td>Seminar</td>
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<td>14 h</td>
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<table>
<thead>
<tr>
<th>Präsenzzeit Modul insgesamt</th>
<th>140 h</th>
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neu440 - Visual Neuroscience

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

Used in course of study:
- Master Neuroscience > Research Modules

Ansprechpartner/-in:
- Ulrike Janssen-Bienhold (Module responsibility)
- Prüfungsberechtigt
- Alle hier genannten

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:
- 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.

Literaturempfehlungen:
- 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: MM (Mastermodul)
Modulart: Wahlpflicht

Lern-Lehrform / Type of program:

Vorkenntnisse / Previous knowledge:

Examination: flexible, after individual project
Internship report: 

Final exam of module:
- Seminar: 2.00 SWS, 28 h workload
- Projektorientiertes Modul: 8.00 WiSe, 112 h workload

Präsenzzeit Modul insgesamt: 140 h
### neu470 - Molecular Sensory Neuroscience

**Module label**
Molecular Sensory Neuroscience

**Module code**
neu470

**Credit points**
15.0 KP

**Workload**
450 h

**Used in course of study**
- Master Neuroscience > Research Modules

**Ansprechpartner/-in**
Module responsibility
- Karl-Wilhelm Koch

Prüfungsberechtigt
- Alle hier genannten

Module counseling
- Hans Gerd Nothwang
- Kathrin Thedieck
- John Neidhardt
- Anna-Maria Hartmann

**Entry requirements**
Skills to be acquired in this module
- + Neurosci. knowlg.
- + Exp. methods
- + Scient. literature
- + Social skills
- + Interdiscipl. knowlg.
- Maths/Stats/Progr.
- Data present./disc.
- + Scientific English
- + Ethics

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.

**Module contents**
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)

**Literaturempfehlungen**
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.

**Links**
Languages of instruction
- German, English

Duration (semesters)
- 1 Semester

Module frequency
- halbjährlich

Module capacity
- unlimited

Reference text
- 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.

### Examination

<table>
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<th>Examination</th>
<th>Prüfungszeiten</th>
<th>Type of examination</th>
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<td>Final exam of module</td>
<td>as agreed; usually within 2 months of the conclusion of lab work</td>
<td>oral exam of 30 min. in Cell Biology, Genetics or Biochemistry, depending on the chosen option Participation in seminar,</td>
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<td>Type of examination</td>
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<table>
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<td>WiSe</td>
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<tr>
<td>Workload attendance</td>
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neu510 - Computation in Sensory Systems

Module label: Computation in Sensory Systems
Module code: neu510
Credit points: 15.0 KP
Workload: 450 h
Used in course of study: Master Neuroscience > Research Modules

Ansprechpartner/-in
Module responsibility
- Jutta Kretzberg
Prüfungsberechtigt
- Alle hier genannten
Module counseling
- Martin Greschner
- Jannis Hildebrandt
- Jochem Rieger

Entry requirements
attendance in pre-meeting, priority is given to students who attended BM Computational Neuroscience

Skills to be acquired in this module
- Planning, performing and analyzing experiments and / or simulations
- Oral presentation and discussion of backgrounds and results in the lab seminar
- Write a scientific report
- Prepare and present a scientific poster

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
- 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
Students can choose between five options (explained in more detail during the pre-meeting):
1. Invertebrate somatosensory system (Kretzberg)
2. Vertebrate visual system (Greschner)
3. Vertebrate auditory system (Hildebrandt)
4. Human perception-action cycle (Rieger)
5. Advanced analysis of physiological data (Anemüller)

In options 1-4, depending on the student's interests and background, projects can be focussed on

- Experiments (neuropysiology / behavior)
- Simulation
- Data analysis or
- Combinations of these approaches

In all systems, project can be focussed on experiments (neuropysiology / behavior), simulation, data analysis or combinations of these approaches.

Literaturempfehlungen
Will be given to the students depending on the project

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

Reference text
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.

- Priority for admission to the module is given to students who passed computational neuroscience background modules (neu240 / neu250)
- Participation in a joint poster presentation of concurrent research modules is highly recommended.

Module level: MM (Mastermodul)
<table>
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<tr>
<th>Modulart</th>
<th>Wahlpflicht</th>
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<tbody>
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</tr>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
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</tr>
<tr>
<td>Examination</td>
<td>Prüfungszeiten</td>
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<tr>
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<td>Präsenzzeit Modul insgesamt</td>
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## neu540 - Neural Basis of Perception

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<td>Master Neuroscience &gt; Research Modules</td>
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<tr>
<td>Ansprechpartner/-in</td>
<td>Module responsibility</td>
</tr>
<tr>
<td></td>
<td>- Jutta Kretzberg</td>
</tr>
<tr>
<td></td>
<td>- Prüfungsberechtigt</td>
</tr>
<tr>
<td></td>
<td>- Alle hier genannten</td>
</tr>
<tr>
<td></td>
<td>Module counseling</td>
</tr>
<tr>
<td></td>
<td>- Georg Martin Klump</td>
</tr>
<tr>
<td></td>
<td>- Henrik Mouritsen</td>
</tr>
<tr>
<td></td>
<td>- Michael Winklhofer</td>
</tr>
<tr>
<td>Entry requirements</td>
<td>attendance in pre-meeting, priority is given to students who attended at least one of the background modules listed as &quot;recommended in combination with&quot;</td>
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<tr>
<td>Skills to be acquired in this module</td>
<td>+ Neurosci. knowlg. Expt. methods Independent research Scient. literature + Social skills + Interdiscipl. knowlg. + Maths/Stats/Progr. Data present./disc. + Scientific English + Ethics Students perform individual research projects to learn:</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>
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<td>- oral presentation and discussion of backgrounds and results in the lab seminar</td>
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<td></td>
<td>- write a scientific report</td>
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<td></td>
<td>- prepare and present a scientific poster</td>
</tr>
<tr>
<td>Module contents</td>
<td>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:</td>
</tr>
<tr>
<td></td>
<td>Option 1: Navigation mechanisms in nocturnal bird migration (Mouritsen) comprises (i) lecture &quot;Bird migration&quot;, (ii) participation in group seminar, and (iii) a laboratory project &quot;Navigation mechanisms in nocturnal bird migration&quot; (flexible timing); including participation in investigations of navigation mechanisms in migratory birds (project focussing on behavioural biology, molecular biology or neuroanatomy).</td>
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<td></td>
<td>Option 2: Invertebrate somatosensory system (Kretzberg), includes participation in group seminar, journal club and laboratory project (all flexible timing).</td>
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<td></td>
<td>Option 3: Central auditory mechanisms (Klump), includes introductory block course &quot;Fundamentals of Auditory Physiology&quot; (one week at start of winter semester), participation in group seminar and a laboratory project (flexible timing).</td>
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<tr>
<td></td>
<td>Option 4: Magnetic field perception (Winklhofer), includes participation in group seminar, journal club and laboratory project (all flexible timing).</td>
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<td>Links</td>
<td>English</td>
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<td>Duration (semesters)</td>
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<td>Module frequency</td>
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<td>Module capacity</td>
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<td>Reference text</td>
<td>Please note that different options have mandatory course components at different times.</td>
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<td>Priority for admission is given to students who attended at least one of the background modules listed as &quot;recommended in combination with&quot;</td>
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</table>
- Participation in a joint poster presentation of concurrent research modules is highly recommended.

| Modullevel | MM (Mastermodul) |
| Modulart | Wahlpflicht |

### Lern-Lehrform / Type of program

### Vorkenntnisse / Previous knowledge

<table>
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<th>Examination</th>
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<th>Type of examination</th>
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<td>Final exam of module</td>
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<td>Internship report</td>
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<td>Lecture</td>
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<tr>
<td>Seminar</td>
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<td>14 h</td>
<td></td>
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<tr>
<td>Projektorientiertes Modul</td>
<td>8.00</td>
<td>WiSe</td>
<td>112 h</td>
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**Präsenzzeit Modul insgesamt**

140 h
neu570 - Development and Evolution of the Auditory System

Module label Development and Evolution of the Auditory System
Module code neu570
Credit points 15.0 KP
Workload 450 h
Used in course of study Master Neuroscience > Research Modules

Ansprechpartner/-in
Module responsibility
- Ulrike Sienknecht
Prüfungsberechtigt
- Alle hier genannten
Module counseling
- Hans Gerd Nothwang
- Christine Köppl
- Hubert Löwenheim

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)

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

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 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 MM (Mastermodul)
Modulart Wahlpflicht

Lern-Lehrform / Type of program

Vorkenntnisse / Previous knowledge

<table>
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<th>Examination</th>
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<td>Final exam of module</td>
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<td>Portfolio: 60% presentation, 40% internship report (paper or poster format)</td>
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<th>Workload attendance</th>
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<tr>
<td>Lecture</td>
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<tr>
<td>Seminar</td>
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<td>14 h</td>
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<td>Projektorientiertes Modul</td>
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<td>WiSe</td>
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## neu610 - External Research Project

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<td>● Master Neuroscience &gt; Research Modules</td>
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<td>Ansprechpartner/-in</td>
<td>Module responsibility</td>
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<tr>
<td></td>
<td>● Christine Köppl</td>
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<td>Prüfungsberechtigt</td>
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<tr>
<td></td>
<td>● Christine Köppl</td>
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<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></td>
<td>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)</td>
</tr>
<tr>
<td></td>
<td>Students perform individual research projects to learn:</td>
</tr>
<tr>
<td></td>
<td>● planning and organization of a research project in a group outside of University of Oldenburg</td>
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<tr>
<td></td>
<td>● formulate a scientific hypothesis</td>
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<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>
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<td></td>
<td>● oral presentation and discussion of backgrounds and results in the lab seminar</td>
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<td></td>
<td>● write a scientific report in publication format</td>
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<tr>
<td></td>
<td>● prepare and present a scientific poster</td>
</tr>
<tr>
<td>Module contents</td>
<td>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.</td>
</tr>
<tr>
<td>Literaturempfehlungen</td>
<td>Provided by external and / or local supervisor, depending on the project</td>
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<td>Links</td>
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<td></td>
<td>● all members of the regular Neuroscience faculty at the University of Oldenburg can act as local supervisor, students should contact appropriate supervisors individually</td>
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<tr>
<td></td>
<td>● prior to project start, external and local supervisors must fill the learning agreement form</td>
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<td></td>
<td>● the supervisor at the host institution is invited to submit a short written statement of assessment, final grading is done by the local supervisor</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>
<td>MM (Mastermodul)</td>
</tr>
<tr>
<td>Modulart</td>
<td>Wahlpflicht</td>
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<tr>
<td>Lern-/Lehrform / Type of program</td>
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<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td></td>
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<td>Examination</td>
<td>Prüfungszeiten</td>
</tr>
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<tr>
<td>Final exam of module</td>
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<td>Course type</td>
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**Skills Modules**

**neu710 - Neuroscientific Data Analysis in Matlab**

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**Ansprechpartner/-in**

- Jannis Hildebrandt
- Jannis Hildebrandt

**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 should learn and practice basic programming concepts and apply them to neuroscientific data. Goal of the course is that students can write programs in Matlab to analyze their own data.

**Module contents**

The course is going to introduce the students both to the programming environment Matlab and its application in neuroscience data analysis. We will start with some general programming concepts and then quickly move on to hands-on examples of neuroscientific data. This includes - but is not limited to - the analysis of electrophysiological data, spike train analysis, image processing, statistical analysis and visualisation. The students are encouraged to bring examples of data from experiments they have been involved in or are planning to do.

**Literaturempfehlungen**

Will be available in Stud.IP

**Links**

- Language of instruction: English
- Duration (semesters): 1 Semester
- Module frequency: jährlich
- Module capacity: unlimited
- Modulelevel: MM (Mastermodul)
- Modulart: Wahlpflicht

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

<table>
<thead>
<tr>
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<th>Type of examination</th>
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<td>Prüfungszeiten</td>
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<td>after the course</td>
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<td>Practical exercise</td>
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**Course type**

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**Präsenzzeit Modul insgesamt**

56 h
neu720 -

Module label
Module code  neu720
Credit points  6.0 KP
Workload  180 h
Used in course of study  •  Master Neuroscience > Skills Modules

Ansprechpartner/-in
Module responsibility
  •  Fabian Otto-Sobotka
Prüfungsberechtigt
  •  Fabian Otto-Sobotka

Entry requirements

Skills to be acquired in this module

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

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

Literaturempfehlungen
Uwe Ligges - Programmieren mit R
R Core Team - R: A language and environment for statistical computing
Simon N. Wood - Generalized Additive Models: An Introduction with R

Links

Language of instruction  English
Duration (semesters)  1 Semester
Module frequency  jährlich
Module capacity  unlimited
Modulelevel  MM (Mastermodul)
Modulart  Wahlpflicht

Lern-/Lehrform / Type of program

Vorkenntnisse / Previous knowledge

Examination  Prüfungszeiten  Type of examination
Final exam of module  after the course  practical exercise

Course type  Comment  SWS  Frequency  Workload attendance
Lecture  2.00
Exercises  2.00

Präsenzzeit Modul insgesamt  56 h
neu730 -

Module label
Module code  neu730
Credit points  6.0 KP
Workload  180 h

Used in course of study
- Fach-Bachelor Betriebswirtschaftslehre für Leistungssportlerinnen und Leistungssportler > Fachnahe Angebote Biologie
- Fach-Bachelor Betriebswirtschaftslehre mit juristischem Schwerpunkt > Fachnahe Angebote Biologie
- Fach-Bachelor Biologie > Fachnahe Angebote Biologie
- Fach-Bachelor Business Administration in mittelständischen Unternehmen > Fachnahe Angebote Biologie
- Fach-Bachelor Chemie > Fachnahe Angebote Biologie more...
- Fach-Bachelor Comparative and European Law > Fachnahe Angebote Biologie
- Fach-Bachelor Engineering Physics > Fachnahe Angebote Biologie
- Fach-Bachelor Informatik > Fachnahe Angebote Biologie
- Fach-Bachelor Interkulturelle Bildung und Beratung > Fachnahe Angebote Biologie
- Fach-Bachelor Mathematik > Fachnahe Angebote Biologie
- Fach-Bachelor Nachhaltigkeitsökonomik > Fachnahe Angebote Biologie
- Fach-Bachelor Pädagogik > Fachnahe Angebote Biologie
- Fach-Bachelor Pädagogisches Handeln in der Migrationsgesellschaft > Fachnahe Angebote Biologie
- Fach-Bachelor Physik > Fachnahe Angebote Biologie
- Fach-Bachelor Physik, Technik und Medizin > Fachnahe Angebote Biologie
- Fach-Bachelor Sozialwissenschaften > Fachnahe Angebote Biologie
- Fach-Bachelor Umweltwissenschaften > Fachnahe Angebote Biologie
- Fach-Bachelor Wirtschaftsinformatik > Fachnahe Angebote Biologie
- Fach-Bachelor Wirtschaftswissenschaften > Fachnahe Angebote Biologie
- Master Neuroscience > Skills Modules
- Zwei-Fächer-Bachelor Anglistik > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Biologie > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Chemie > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Elementarmathematik > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Ev. Theologie und Religionspädagogik > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Gender Studies > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Germanistik > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Geschichte > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Informatik > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Interdisziplinäre Sachbildung > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Kunst und Medien > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Materielle Kultur: Textil > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Mathematik > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Musik > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Niederlandistik > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Ökonomische Bildung > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Pädagogik > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Philosophie / Werte u. Normen > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Physik > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Politik-Wirtschaft > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Slavistik > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Sozialpädagogik > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Sozialwissenschaften > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Sportwissenschaft > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Technik > Fachnahe Angebote Biologie
- Zwei-Fächer-Bachelor Wirtschaftswissenschaften > Fachnahe Angebote Biologie

Ansprechpartner/in
Module responsibility
- Christine Köppl
Prüfungsberechtigt
- Alle hier genannten
Module counseling
- Ulrike Sienknecht

Entry requirements
Skills to be acquired in this module
Basic knowledge of non-biological aspects of professional life (e.g., law, management, languages)
Ability to communicate scientific concepts, both orally and in writing
Ability to work in a team
Acquiring an in-depth knowledge of subject-specific concepts and facts
Introduction to non-university workplaces
Knowledge of safety and environmental concerns in bioscientific workplaces
Module contents

Introduction to the legal framework and the application procedures for experimental work with animals, humans and genetically modified organisms.

Critical and evidence-based evaluation of the pros and cons of bioscientific questions of public interest, e.g., the use of genetically modified organisms in food production.

Critical definition and discussion of ethical conflicts in biological research, e.g., stem cell research or data manipulation.

Problem-based, independent research of the scientific background by a team of students is an integral part of this module.

Literatureempfehlungen

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: jährlich

Module capacity: unlimited

Modullevel: PB (Professionalisierungsbereich)

Modulart: Ergänzung/Professionalisierung

Vorkenntnisse / Previous knowledge

Examination: Final exam of module within a few weeks of summer term lecture period

To qualify for the exam, regular participation during the semester is required (no more than 3 days of absence).

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.

Course type

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<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
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<td>Seminar und Übung</td>
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<td>28 h</td>
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Präsenzzeit Modul insgesamt: 56 h
neu740 - Molecular Mechanisms of Ageing

Module label: Molecular Mechanisms of Ageing
Module code: neu740
Credit points: 6.0 KP
Workload: 180 h

Used in course of study

- Fach-Bachelor Betriebswirtschaftslehre für Leistungssportlerinnen und Leistungssportler > Fachnahe Angebote Biologie
- Fach-Bachelor Betriebswirtschaftslehre mit juristischem Schwerpunkt > Fachnahe Angebote Biologie
- Fach-Bachelor Biologie > Fachnahe Angebote Biologie
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- Fach-Bachelor Chemie > Fachnahe Angebote Biologie more...
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- Fach-Bachelor Internationale Bildung und Beratung > Fachnahe Angebote Biologie
- Fach-Bachelor Mathematik > Fachnahe Angebote Biologie
- Fach-Bachelor Nachhaltigkeitsökonomik > Fachnahe Angebote Biologie
- Fach-Bachelor Pädagogik > Fachnahe Angebote Biologie
- Fach-Bachelor Pädagogisches Handeln in der Migrationsgesellschaft > Fachnahe Angebote Biologie
- Fach-Bachelor Physik > Fachnahe Angebote Biologie
- Fach-Bachelor Physik, Technik und Medizin > Fachnahe Angebote Biologie
- Fach-Bachelor Sozialwissenschaften > Fachnahe Angebote Biologie
- Fach-Bachelor Umweltwissenschaften > Fachnahe Angebote Biologie
- Fach-Bachelor Wirtschaftsinformatik > Fachnahe Angebote Biologie
- Fach-Bachelor Wirtschaftswissenschaften > Fachnahe Angebote Biologie
- Master Neuroscience > Skills Modules
- Zwei-Fächers-Bachelor Anglistik > Fachnahe Angebote Biologie
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- Zwei-Fächers-Bachelor Elementarmathematik > Fachnahe Angebote Biologie
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- Zwei-Fächers-Bachelor Sonderpädagogik > Fachnahe Angebote Biologie
- Zwei-Fächers-Bachelor Sozialwissenschaften > Fachnahe Angebote Biologie
- Zwei-Fächers-Bachelor Wirtschaftswissenschaften > Fachnahe Angebote Biologie

Ansprechpartner/-in

Module responsibility
- Kathrin Thedieck

Prüfungsberechtigt
- Kathrin Thedieck

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

- 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 presentation 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 different political systems 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 in during the first meeting.

**Literaturempfehlungen**

will be provided online after the first meeting

**Links**

**Language of instruction**

English

**Duration (semesters)**

1 Semester

**Module frequency**

jährlich

**Module capacity**

unlimited

**Modullevel**

MM (Mastermodul)

**Modulart**

Wahlpflicht

**Vorkenntnisse / Previous knowledge**

**Examination**

**Prüfungszeiten**

Type of examination

Final exam of module: end of semester, portfolio

**Course type**

**Comment**

SWS

Frequency

Workload attendance

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**Präsenzzeit Modul insgesamt**

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 Neuroscience > Skills Modules

Ansprechpartner/-in
Module responsibility
○ Christine Köppl
Prüfungsberechtigt
○ Alle hier genannten
Module counseling
○ Ulrike Langemann
○ Georg Martin Klump
○ Arne Nolte
○ Gabriele Gerlach

Entry requirements

Skills to be acquired in this module
Neurosci. knowlg. Ext. 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

Literaturempfehlungen
“LAS interactive” internet-based learning platform

Links

Language of instruction
English
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<th>Prüfungszeiten</th>
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| Präsenzzeit Modul insgesamt | 70 h |
**neu751 - Laboratory Animal Science**

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<tr>
<td></td>
<td>Christine Köppl</td>
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<td>Ulrike Langemann</td>
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<td>Arne Nolte</td>
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**Entry requirements**

Skills to be acquired in this module

**Module contents**

**Literaturempfehlungen**

**Links**

**Language of instruction** English

**Duration (semesters)** 1 Semester

**Module frequency**

**Module capacity** 15

**Modulart** je nach Studiengang Pflicht oder Wahlpflicht

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

**Vorkenntnisse / Previous knowledge**

<table>
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**Course type**

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**Präsenzzeit Modul insgesamt** 0 h
**neu760 - Scientific English**

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**Ansprechpartner/-in**

- Module responsibility
  - Jannis Hildebrandt
- Prüfungsberechtigt
  - Jannis Hildebrandt

**Entry requirements**

- non-native speakers

**Skills to be acquired in this module**


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.

**Literaturempfehlungen**

http://users.wpi.edu/~nab/sci_eng/ScientificEnglish.pdf

**Links**

- Language of instruction: English
- Duration (semesters): 1 Semester
- Module frequency: jährlich
- Module capacity: unlimited

**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

**Modullevel**

Abschlussmodul (Abschlussmodul)

**Modulart**

Wahlpflicht

**Vorkenntnisse / Previous knowledge**

**Examination**

Prüfungszeiten

- within 2 months of completing the course

Type of examination

- Portfolio: 50% presentation, 50% assignment; bonus
<table>
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<tr>
<th>Course type</th>
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<td>Lecture</td>
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<td>1.00</td>
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Präsenzzeit Modul insgesamt 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

Used in course of study:
- Fach-Bachelor Physik, Technik und Medizin > Aufbaumodule
- Master Neuroscience > Skills Modules

Ansprechpartner/-in:
- Module responsibility: Fabian Otto-Sobotka
- Prüfungsberechtigt: 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

Literaturempfehlungen:
Will be available in Stud.IP

Language of instruction: English

Duration (semesters): 1 Semester

Module frequency: jährlich

Module capacity: unlimited

Modulelevel: MM (Mastermodul)

Modulart: Wahlpflicht

Lern-/Lehrform / Type of program:

Vorkenntnisse / Previous knowledge:

Examination:

<table>
<thead>
<tr>
<th>Final exam of module</th>
<th>Prüfungszeiten</th>
<th>Type of examination</th>
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<tbody>
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<td>after the course</td>
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<td>written exam</td>
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Course type:

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<th>Frequency</th>
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Präsenzzeit Modul insgesamt: 56 h
neu780 - Introduction to Data Analysis with Python

<table>
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<tr>
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<tr>
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<tr>
<td>Workload</td>
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<tr>
<td>Used in course of study</td>
<td>Master Neuroscience &gt; Skills Modules</td>
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<table>
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<tr>
<th>Ansprechpartner/-in</th>
<th>Module responsibility</th>
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<tbody>
<tr>
<td></td>
<td>Michael Winkhofer</td>
</tr>
<tr>
<td></td>
<td>Prüfungsberechtigt</td>
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<tr>
<td></td>
<td>Michael Winkhofer</td>
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**Entry requirements**

**Skills to be acquired in this module**

**Module contents**

**Literaturempfehlungen**

**Links**

**Language of instruction** English

**Duration (semesters)** 1 Semester

**Module frequency**

**Module capacity** 20

**Moduleart** je nach Studiengang Pflicht oder Wahlpflicht

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

**Vorkenntnisse / Previous knowledge**

**Final exam of module**

<table>
<thead>
<tr>
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<th>Frequency</th>
<th>Workload attendance</th>
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<tbody>
<tr>
<td>Lecture</td>
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<tr>
<td>Exercises</td>
<td></td>
<td>2.00</td>
<td>SoSe und WiSe</td>
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<td>Präsenzzeit Modul insgesamt</td>
<td></td>
<td></td>
<td></td>
<td>56 h</td>
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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 Neuroscience > Skills Modules

Ansprechpartner/-in:

Module responsibility:
- Jutta Kretzberg

Prüfungsberechtigt:
- Jutta Kretzberg
- Martin Greschner
- Jannis Hildebrandt

Entry requirements:

Skills to be acquired in this module:
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 weak). 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.
**Literaturempfehlungen**

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

**Links**

<table>
<thead>
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<th>Language of instruction</th>
<th>English</th>
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<td>Duration (semesters)</td>
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<tr>
<td>Module frequency</td>
<td>every semester (seminar during winter semester, other option any time)</td>
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<td>20 (Registration procedure / selection criteria: StudIP)</td>
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<td>Modullevel</td>
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<tr>
<td>Modulart</td>
<td>Pflicht o. Wahlpflicht / compulsory or optional</td>
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<tr>
<td>Lern-Lehrform / Type of program</td>
<td>Master of Science: Neuroscience</td>
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**Vorkenntnisse / Previous knowledge**

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<td>depend on the option chosen (see Module content)</td>
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**Course type**

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**Frequency**

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### neu800 - Introduction to Matlab

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#### Used in course of study
- Master Neuroscience > Skills Modules

#### Entry requirements

#### Skills to be acquired in this module

#### Module contents

#### Literaturempfehlungen

#### Links

#### Language of instruction
German

#### Duration (semesters)
1 Semester

#### Module frequency

#### Module capacity
unlimited

#### Modullevel
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#### Modulart
je nach Studiengang Pflicht oder Wahlpflicht

### Language of instruction

#### Duration (semesters)
1 Semester

#### Module frequency

#### Module capacity
unlimited

#### Modullevel
---

#### Modulart
je nach Studiengang Pflicht oder Wahlpflicht

### Lern-Lehrform / Type of program

#### Vorkenntnisse / Previous knowledge

#### Examination Prüfungszeiten Type of examination

### Final exam of module

<table>
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</tr>
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<td>Exercises</td>
<td>0.00</td>
<td>WiSe</td>
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#### Präsenzzeit Modul insgesamt
0 h