CARL VON OSSIETZKY universität OLDENBURG

HANDBOOK OF MODULES

Master of Neuroscience

Jointly carried by
School of Mathematics and Science (Faculty V)
School of Medicine and Health Sciences (Faculty VI)

MASTER PROGRAM NEUROSCIENCE
UNIVERSITY OF OLDENBURG

www.uni-oldenburg.de/en/master-neuroscience

version 20 | June 2018

Compulsory Elective, **60 ECTS**

30 ECTS
Background Modules

15 ECTS
Research Module

6 ECTS
Skills Mod

9 ECTS
any Neuro Module

Neuroscience

Thesis Module, **30 ECTS**

30 ECTS
Master Thesis Module

Neuroscience

Elective, **30 ECTS**

30 ECTS
any Neuroscience Modules, other MSc. courses, Semester abroad

Interdisciplinary/Neuroscience

List of all M.Sc. Neuroscience Modules (year 2018/19) http://www.uni-oldenburg.de/en/master-neuroscience.de

	NR	Module	Shared / similar previous Module	Teachers	Winter Semester 1. Half	Winter Semester 2. Half	Semester break	Summer Semester 1. Half	Summer Semester 2. Half	Semester break
Background Modules	neu350	Biological Foundations of Neuroscience		Puller, Greschner, Hartmann, Koch et al	6 CP					
	neu305	Essentials fMRI data analysis SPM/FSL	psy275, neu300	Wreda, Sörös	6 CP					
	bio845	Introduction Development & Evolution	bio840, neu110	Sienknecht, Nothwang, Köppl	6 CP					
	bio846	Lab Exercise in Devo & Evo	bio840, neu120	Sienknecht, Nothwang, Köppl		6 CP				
	bio605	Molecular Genetics & Cell Biology	bio600, neu170	Koch, Neidhardt, Thedieck	12 CP					
	neu320	Introduction to Neurophysics		Anemüller	weekly course 6 CP					
	neu241	Computational Neurosci. - Introduction	neu240	Kretzberg, Greschner, Hildebrandt		12 CP				
	bio695	Biochem. Conc. in Signal Transduct.	bio690, neu190	Koch, Scholten		12 CP				
	neu210	Neurosensory Science & Behaviour	bio610	Klump, Hildebrandt, Langemann, Mouritsen		9 CP				
	neu220	Neurocognition & Psychopharmacology	bio610, psy180	Thiel, Giessing		6 CP				
	neu280	Research Techniques in Neuroscience		Hartmann, Nothwang, Thiel, Neidhardt, et al			6 CP			
	neu141	Visual Neurosci. - Physiology & Anatomy	bio620, neu140/15	Greschner, Dedek, Janssen-Bienhold, Puller				12 CP		
	neu150	Visual Neurosci.: Anatomy	bio620, neu141	Janssen-Bienhold, Puller				6 CP		
	neu250	Comp. Neurosci. - Statistical Learning	(sy220	Anemüller, Rieger				6 CP		
	neu290	Biophysics of Sensory Reception		Winklhofer					6 CP	
	neu360	Auditory Neuroscience		Klump, Köppl					6 CP	
	neu310	Psychophysics of Hearing	bio640, neu270	Klump, Langemann					12 CP	
	neu300	Functional MRI Data Analysis	psy270, neu305	Thiel, Gießing					12 CP	
	neu340	Invertebrate Neuroscience		Kretzberg					6 CP	
	neu345	Neural Computation in Invertebrates		Kretzberg						6 CP
Skills Modules	neu710	Neuroscientific Data Analysis in Matlab	neu800	Hildebrandt	6 CP					
	neu770	Basics of Statistical Data Analysis		Sobotka	weekly course 6 CP					
	neu790	Communicating Neuroscience		Kretzberg, Köppl, Hildebrandt	weekly course 3 CP			weekly course 3 CP		
	neu720	Statistical Programming in R		Sobotka				weekly course 6 CP		
	neu730	Biowiss. i. d. gesellschaftl. Debatte	pb227	Köppl, Sienknecht				weekly course 6 CP		
	neu740	Molecular Mechanisms of Ageing	pb193	Thedieck				irregular meetings 6 CP		
	neu751	Laboratory Animal Science	neu150	Köppl, Klump, Langemann			3 CP			3 CP
	neu780	Introduction Data Analysis with Python		Winklhofer			6 CP			
	neu760	Scientific English		Manley, Köppl, Hildebrandt				6 CP		
	neu800	Introduction to Matlab	neu710, neu270	Gießing					3 CP	
	neu810	International Meeting Contribution		Kretzberg, Köppl, Hildebrandt	3 CP flexible timing					
Res.	neu600	Neuroscience Research Project (see list)		all teachers	15 CP flexible timing					
	neu610	External Research Module		all teachers	15 CP flexible timing					
MT	mam	Master Thesis Module		all teachers	30 CP flexible timing					

Legend:

full-time courses with fixed time slots

part-time courses with fixed time slots

CP credit point, ECTS (30h work load)

Program requirements:

- 30 CP Master Thesis Module
- 30 CP Background Modules
- 15 CP Research Modules
- 6 CP Skills Modules
- 9 CP any further module(s) from Neuroscience curriculum
- 30 CP free choice: any further Neuroscience module(s) or (subject to approval) courses from other M.Sc. programs, from other universities, or from abroad.

Modules with shared course components, similar content or previous versions (see list) cannot be credited twice.

Modules neu600 and neu610 offer several project options and can be credited up to three times for different projects.

Recommendations:

- For students with neuroscience course requirement or with little biological background, it is recommended to start with 'biological foundations' (neu350) in the first half of the first semester.
- For students with mathematics course requirement or with little programming experience, it is recommended to start with Matlab (neu710) in the first half of the first semester.
- The combination of 'biological foundations' (neu350) and Matlab (neu710) provides a good starting point for many students.
- Research modules are individual research projects in a neuroscience lab. Please find the separate list of project options for each semester in Stud.IP.
- Before joining the group of a supervisor for a research module, it is recommended to take at least one of the background modules this supervisor teaches.
- In many groups, research modules are flexible in time, e.g. allowing combination with semester-long courses, including courses from other Master's programs.
- Please find a list of approved free choice courses from other M.Sc. programs at our homepage http://www.uni-oldenburg.de/en/master-neuroscience.de
- For more information please contact the program directors master-neuroscience@uni-oldenburg.de or the student body fachschaft-neuroscience@uni-oldenburg.de

neu350 Biological Foundations of Neuroscience

Study program: Master of Science
Subject: Neuroscience
Module category: Background Module
type: compulsory elective
Semester: winter term, first half
Cycle: annually
Teaching language: English
Recommended in semester: first

Objectives and skills taught in the 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 have acquired basic knowledge of fundamental principles of neurobiology. The aim of this background module is to provide a solid biological knowledge base required for studying advanced neuroscientific topics. It is designed in particular, but not exclusively, for students joining the local M.Sc. Neuroscience program from previous study paths with little (neuro)biological background.

Module content:

The background module consists of a lecture series and an associated seminar.

The following topics are covered:
• Biochemistry
• Genetics
• Electrophysiology
• Cell biology
• Systems Neuroscience

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame: First half of winter semester, full-time

Course components and workload:

2 SWS Lecture (VO)

Total workload 90 h: 28 h contact / 14 h tutorial, 48 h self-study and preparation for exam

2 SWS Seminar (SE)

Total workload 90 h: 28 h contact / 62 h self-study and preparation for exam

SWS

Total workload h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: written exam

Examination period: at the end of the course

In addition, mandatory but ungraded:

Primary faculty responsible for the module: Dr. Christian Puller

Additional teachers in the module: Prof. Dr. Karl-Wilhelm Koch, Prof. Dr. John Neidhardt, Dr. Anna-Maria Hartmann, Prof. Dr. Martin Greschner, Prof. Dr. Georg Klump, Dr. Marta Owczarek-Lipska

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Required reading:

Neuroscience, newest edition; Purves; Sinauer Accociates
Stryer Biochemistry and Alberts et al. Molecular Biology of the Cell, several editions
Molecular Biology of the Gene, Watson (Pearson Verlag)

Recommended textbook(s) or other literature:

Maximum number of students:

Registration procedure / selection criteria: StudIP

Required previous credits from:

Recommended previous knowledge / skills:

Interrelations with other modules:

Recommended in combination with: Research Techniques in Neuroscience

Shared course components with (cannot be credited twice):

neu305 Essentials of fMRI Data Analysis with SPM and FSL

Study program: Master of Science
Subject: Neuroscience
Module category: Research Module
type: compulsory elective
Semester: winter term, first half
Cycle: annually
Teaching language: English
Recommended in semester: 3

Objectives and skills taught in the module:

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

This module offers a concise introduction to the basic principles of functional magnetic resonance imaging (fMRI). Students will gain essential knowledge about experimental design, data collection and analysis. Special emphasis will be laid on the statistical background of fMRI data analysis and a hands-on introduction to SPM and FSL, two widely-used and free software packages for fMRI data analysis and results visualisation.

Module content:

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

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame: Mo and We, 16.00 to 18.00; Fr, 14.00 to 18.00 (first seven weeks of the winter term)

Course components and workload:

1 SWS Seminar (SE) fMRI: Experimental Design, Data Collection and Analysis

Total workload 45 h: 14 h contact / 31 h literature work

3 SWS Supervised exercise (UE) Statistical Analysis of fMRI Data with SPM and FSL

Total workload 135 h: 42 h contact / 93 h practice with sample fMRI data sets

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: written exam (multiple choice)

Examination period: Friday, December 1st 2017

In addition, mandatory but ungraded: continuous active participation

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Primary faculty responsible for the module: Riklef Weerda, Dr. Peter Sörös

Additional teachers in the module: two student tutors

Required reading:

Recommended textbook(s) or other literature:

Huettel, S.A., Song, A.W., McCarthy, G. (3rd ed., 2014). Functional Magnetic Resonance Imaging. Sunderland, MA: Sinauer.

Friston, K.J., Ashburner, J.T., Kiebel, S. (Ed., 2006). Statistical Parametric Mapping: The Analysis of Functional Brain Images. Amsterdam etc.: Elsevier, Academic Press.

Maximum number of students: 40

Registration procedure / selection criteria: Stud.IP

Required previous credits from:

Recommended previous knowledge / skills: statistics, MATLAB

Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

Joint Module of M.Sc. Biology and M.Sc. Neuroscience

Faculty of Mathematics and Science - Department of Biology and Environmental Sciences *Semester:* winter term, first half	*Degree: Master of Science Biology*
Emphasis: Developmental Biology	*Sections:* Background Module, compulsory elective
Module Code/Titel: **bio845 Introduction to Development and Evolution**	
Duration: 4 weeks *Cycle: annually* *Type of module: Background Module* *Level: Master* *This module should be performed in the* 1 or 3 semester	*Type of programme*: 2 hrs/w lecture 2 hrs/w seminare hrs/w *Language of programme: English* *Attainable credit points:* 6 cp
Person responsible for the programme: Dr. Ulrike Sienknecht	*Person responsible for this module (only **one** response):* Dr. Ulrike Sienknecht
Deputy person responsible for this module: Dr. Maike Claußen	*Further persons responsible for this module:*

Objective of the module/skills:
Upon successful completion of this course, students

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

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

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

Literature:
Gilbert S.F.: Developmental Biology, Macmillan Publishers Ltd, 11th edition 2016

Comment:

Weblink:

Conditions of admission:

Useful previous knowledge:
organismic biology, developmental biology, evolutionary biology, neurobiology, genetics, molecular biology

Associated with the module:
bio846 (neu120) "Lab Exercises in Development and Evolution"

Maximum number of students/selection criteria: 20 in total with neu110 (sequence of registration)

Type of examination: oral exam of 30 minutes

Examination periods: same winter term

Registration proceedings: StudIP

Joint Module of M.Sc. Biology and M.Sc. Neuroscience

Faculty of Mathematics and Science - Department of Biology and Environmental Sciences *Semester:* winter term, first half	*Degree: Master of Science Biology*
Emphasis: Developmental Biology	*Sections:*

Module Code/Titel:

bio846 Lab Exercises in Development and Evolution

Duration: 3 weeks, full time *Cycle: annually* *Type of module: Background Module* *Level: Master* *This module should be performed in the* 1 or 3 semester	*Type of programme*: 3 hrs/w supervised exercise 1 hrs/w lecture & seminar hrs/w *Language of programme:* English *Attainable credit points:* 6 cp
Person responsible for the programme: Dr. Ulrike Sienknecht	*Person responsible for this module (only **one** response):* Dr. Ulrike Sienknecht
Deputy person responsible for this module: Prof. Dr. Hans Gerd Nothwang	*Further persons responsible for this module:*

Objective of the module/skills:

Upon successful completion of this course, students have skills in methods of developmental biology:
• are capable of performing live embryo husbandry
• are able to carry out in-ovo stainings
• are familiar with the use of embryonic stage discrimination standards for model organisms
• document the observed embryonic stages by drawings with anatomical labelling
• are familiar with embryo handling, tissue preparation (including cryosectioning), dissection of inner ears, and the use of different histological staining methods
• microscopy, data analysis, and photographic data documentation
• know the standards of proper documentation of research data and the universal format of a lab note-book
• know how to carry out formal laboratory reports (and the anatomy of a scientific paper)

and in addition, have basic knowledge in the field of auditory system development
• have basic knowledge of the organisation of the auditory system across vertebrate groups
• have basic knowledge of the development of the middle and inner ear, as well as selected auditory brain centres
• are able to summarize current hypotheses about the evolution of the auditory system in vertebrates

skills:
++ deepened biological expertise
++ deepened knowledge of biological working methods
++ data analysis skills
++ critical and analytical thinking
+ independent searching and knowledge of scientific literature
++ ability to perform independent biological research
++ data presentation and discussion in German and English (written and spoken)
++ teamwork
+ ethics and professional behaviour
++ project and time management

Content of the module:
Lab exercises in comparative developmental biology on chicken and mouse embryos.

Practical introduction to methods, such as in-ovo live observation; developmental stage discrimination and description, tissue preparation for histology, sectioning, staining, and microscopy, including data analyses.

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

Literature:
Gilbert S.F., Development, Macmillan Publishers Ltd, 11th edition 2016; Mathews W.W & Schoenwolf G.C., Atlas of Descriptive Embryology, Prentice-Hall Inc., Simon & Schuster, 5th edition 1998

Comment: *Weblink:* *Conditions of admission:*	*Useful previous knowledge:* organismic biology, evolutionary biology, neurobiology, genetics, molecular biology, experience with lab work *Associated with the module:* bio845 (neu110) Introduction to Development and Evolution

Maximum number of students/selection criteria: 6 in total with neu120 (sequence of registration)

Type of examination: report (50%) and presentation (50%)

Examination periods: same winter term

Registration proceedings: StudIP

Joint Module of M.Sc. Biology and M.Sc. Neuroscience

Faculty of Mathematics and Science - Department of Biology and Environmental Sciences *Semester:* Winter semester	 *Degree:* Master
Emphasis: molecular biology, molecular genetics, biochemistry, cell biology, neurobiology	*Sections:* molecular neurobiology and human genetics
Module Code/Titel: Bio605 Molecular Genetics and Cell Biology	
Duration: ☒ 1 ☐ 2 ☐ 3 Semester *Cycle:* annually *Type of module:* compulsory *Level:* Master module *This module should be performed in the* 1 semester	*Type of programme*: 2 hrs/w lecture 1 hrs/w seminar 5 hrs/w exercise *Language of programme:* english *Attainable credit points:* 12 cp
Person responsible for the programme: Prof. Dr. John Neidhardt	*Person responsible for this module (only **one** response):* Prof. Dr. John Neidhardt
Deputy person responsible for this module: Prof. Dr. Karl Koch, Prof. Dr. Kathrin Thedieck	*Further persons responsible for this module:* all
Objective of the module/skills: ++ deepened biological expertise ++ deepened knowledge of biological working methods + data analysis skills ++ interdisciplinary thinking + critical and analytical thinking + independent searching and knowledge of scientific literature + data presentation and discussion in German and English (written and spoken) + teamwork + ethics and professional behaviour + project and time management Addressing students with an emphasis on molecular biology, molecular genetics, cell biology, and neurobiology	
Content of the module: Lecture: To improve knowledge in molecular genetics, molecular biology and cell biology in correlation with human diseases. Exercise: Learn to transfer the theoretical knowledge to experiments. Gaining methodological knowledge in molecular genetics, cell biology and therapeutic approaches. Initial training on how to perform research projects. Subjects of the lecture and seminar: Molecular bases of neurodegenerative diseases, structure and function of DNA/RNA/proteins/membranes, cytoskeleton, cell cycle, programmed cell death, cells in the social structure. Exercises: Learning current methods of molecular biology and human genetics; high throughput technologies, introduction to cell cultivation techniques.	
Literature:	

Literature:
Textbooks of Cell Biology

Comment:

Weblink:

Conditions of admission:
BSc (Biology, Biochemistry)

Useful previous knowledge:
Basic knowledge of Cell Biology, Genetics, Biochemistry

Associated with the module:
bio685, bio900

Maximum number of students/selection criteria: 15

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

Examination periods:

neu320 Introduction to Neurophysics

Study program: Master of Science
Subject: Neuroscience
Module category: Background Module
type: compulsory elective
Semester: winter term
Cycle: annually
Teaching language: English
Recommended in semester: 3 (with matlab prereq.: 1)

Objectives and skills taught in the module:

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

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 content:

- 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 measurments: from single-cell recordings to EEG, MEG and fMRI
- Functional description of small neuronal networks: Receptive fields and their description with linear and non-linear models
- The neuronal code: Spikes, spike trains, population coding, time- vs. rate-code
- Decoding neuronal activity and its applications
- Simulation of artificial neural networks as a functional model, Hopfield network, Boltzmann machine, Perceptron and deep networks
- Informationtheoretic approaches, stimulus statistics, entropy, mutual information
- Learning and plasticity, conditioning and reinforcement learning, Hebbian learning, long-term potentiation and long-term depression

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame: winter term, 2h lecture and 2h supervised exercise throughout semester

Course components and workload:

2 SWS Lecture (VO)

Total workload 90 h: 28 h contact / 62 h background reading / exam preparation

2 SWS Supervised exercise (Ul

Total workload 90 h: 28 h contact / 62 h self-conducted exercise work / literature reading

SWS

Total workload h: h contact /

SWS

Total workload h: h contact /

Type of examination: 80% oral exam or written exam, 20% exercise work and presentation

Examination period: End of winter term

In addition, mandatory but ungraded:

Primary faculty responsible for the module: Dr. Jörn Anemüller

Additional teachers in the module:

Required reading:

Recommended textbook(s) or other literature:

- Chow, Gutkin, Hansel, Meunier, Dalibard (Eds.): Methods and Models in Neurophysics (2003)
- Dayan, Abbott: Theoretical Neuroscience (2005)
- Galizia, Lledo (Eds.): Neurosciences, from molecule to behauvior (2013)

Maximum number of students: 30

Registration procedure / selection criteria: StudIP

Required previous credits from:

Recommended previous knowledge / skills: Computer programming (preferably Matlab), basic mathematics (statistics, analysis, linear algebra)

Interrelations with other modules:

Recommended in combination with: 5.04.4012 Informationsverarbeitung und Kommunikation (phy350)

Shared course components with (cannot be credited twice):

will also be offered in "M.Sc. Physik, Technik, Medizin" (Studiengang in preparation)

neu241 Computational Neuroscience - Introduction

Study program: Master of Science
Subject: Neuroscience
Module category: Background Module
type: compulsory elective
Semester: winter term, second half
Cycle: annually
Teaching language: English
Recommended in semester: 1 / 3

Objectives and skills taught in the 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

- 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 analyis 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 content:

This course consists of six weeks with different topics, which are introdiced 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 differerential 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)

Total credit points: 12 CP (equivalent 8 SWS, 360 hours workload)

Time frame: Second half of winter semester, full time

Course components and workload:

1 SWS Lecture (VO)

Total workload 45 h: 20 h contact / 25 h individual revision of lecture contents, test preparation

1 SWS Seminar (SE)

Total workload 45 h: 20 h contact / 25 h individual reading and test preparation

6 SWS Supervised exercise (UE)

Total workload 270 h: 135 h contact / 135 h individual work on portfolio tasks (programming, interpretation of simulation results)

SWS

Total workload 0 h: h contact /

Type of examination: Portfolio, consisting of daily short tests, programming exercises, short reports

Examination period: during the course

In addition, mandatory but ungraded:

Primary faculty responsible for the module: Prof. Dr. Jutta Kretzberg

Additional teachers in the module: Prof. Dr. Martin Greschner, Prof. Dr. Jannis Hildebrandt

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Required reading:

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 textbook(s) 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

Maximum number of students: 18

Registration procedure / selection criteria: StudIP; sequence of registration, attendance in pre-meeting

Required previous credits from:

Recommended previous knowledge / skills: Programming experience, preferably in Matlab (e.g. acquired by a 6 ECTS programming course)

Interrelations with other modules:

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

Shared course components with (cannot be credited twice):

Joint Module of M.Sc. Biology and M.Sc. Neuroscience

Faculty of Mathematics and Science - Department of Biology and Environmental Sciences *Semester:* Winter semester	*Degree:* Master
Emphasis: Biochemistry / Molecular Neurobiology	*Sections:*
Module Code/Titel: **bio695** – Biochemical concepts in signal transduction	
Duration: ☒ 1 ☐ 2 ☐ 3 Semester *Cycle:* annually *Type of module:* required elective *Level:* please select... *This module should be performed in the* 1/3semester	*Type of programme*: 1 hrs/w lecture 1 hrs/w seminar 6 hrs/w exercise *Language of programme:* english *Attainable credit points:* 12 cp
Person responsible for the programme:	*Person responsible for this module (only **one** response):* Prof. Dr. Karl-Wilhelm Koch
Deputy person responsible for this module: Dr. Alexander Scholten	*Further persons responsible for this module:*
Objective of the module/skills: ++ deepened biological expertise ++ deepened knowledge of biological working methods ++ data analysis skills + interdisciplinary thinking ++ critical and analytical thinking + independent searching and knowledge of scientific literature ++ data presentation and discussion in German and English (written and spoken) + teamwork + project and time management	
Content of the module: Lecture: Molecular fundamentals of cellular signal processes Seminar: Signal transduction Exercises: Experiments on cellular signal transduction and enzymology Mechanisms of biochemical signal transduction are imparted theoretically and experimentally	
Literature: Textbooks of cell biology and biochemistry. Current literature on topics of signal transduction (as announced in the preparatory meeting).	
Comment: *Weblink:* *Conditions of admission:*	*Useful previous knowledge:* *Associated with the module:*
Maximum number of students/selection criteria: 20	

Type of examination: written examinaton (50%), protocolls (50%)

Examination periods: 90 minutes written exam

Registration proceedings: StudIP

neu210 Neurosensory Science and Behaviour

Study program: Master of Science
Subject: Neuroscience
Module category: Background Module
type: compulsory elective
Semester: winter term, second half
Cycle: annually
Teaching language: English
Recommended in semester: 1 or 3

Objectives and skills taught in the 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 content:

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.

Total credit points: 9 CP (equivalent 6 SWS, 270 hours workload)

Time frame: weeks 8-11 of winter term, full-time

Course components and workload:

4 SWS Lecture (VO) "Neuroethology" and "Behavioural ecology"

Total workload 180 h: 56 h contact / 60 h background reading / 64 h exam preparation

2 SWS Seminar (SE) "Current issues of ethology"

Total workload 90 h: 28 h contact / 30 h literature reading / 32 h preparation of presentation

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: 80% written exam (content of the two lecture series), 20% presentation(s)

Examination period: as agreed, usually in the break after the winter term

In addition, mandatory but ungraded: Regular active participation

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Primary faculty responsible for the module: Prof. Georg M. Klump

Additional teachers in the module: Prof. Dr. Jannis Hildebrandt, Dr. Ulrike Langemann, Prof. Dr. Henrik Mouritsen

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Required reading:

Recommended textbook(s) or other literature:

Carew TJ (2004) Behavioral Neurobiology: The Cellular Organization of Natural Behavior. Sinauer
Davis NB, Krebs JR, West SA (2012) An Introduction to Behavioural Ecology. Wiley Blackwell

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Maximum number of students: 30

Registration procedure / selection criteria: StudIP

Required previous credits from:

Recommended previous knowledge / skills: Fundamentals of Neurobiology, Behavioural Biology, Evolution, Ecology

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Interrelations with other modules:

Recommended in combination with: neu221 BM "Neurocognition and Psychopharmacology"

Shared course components with (cannot be credited twice):

bio610 (5.02.611 "Neuroethologie", 5.02.612 "Verhaltensökologie", 5.02.613 "Aktuelle Themen der Ethologie")

neu220 Neurocognition and Psychopharmacology

Study program: Master of Science
Subject: Neuroscience
Module category: Background Module
type: compulsory elective
Semester: winter term, second half
Cycle: annually
Teaching language: English
Recommended in semester: 1 or 3

Objectives and skills taught in the module:

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

Upon successful completion of this course, students
know the fundamentals of neurotransmission
know the basic neural mechanisms underlying attention, learning, emotion, language and executive functions
understand the relationship between disturbances in neurotransmitter systems, cognitive functions and psychiatric disease
know the priniciples of drug treatement 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 neurosciene

Module content:

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 excersise either deepens that knowledge by excersises or discussions of recent papers/ talks on the respective topic covered during that week.

The lecture "Psychopharmacology" illustrates the connection between neurotransmitters and behaviour and its links to psychiatric disease.The lecture contains several interactive parts to consolidate and critically evaluate the acquired knowledge.
Lecture topics:
Introduction to Terms and Definitions in Drug Research
Dopaminergic and Noradrenergic System
Cholinergic and Serotonergic System
GABAergic and Glutamatergic System
Addiction
Depression
Schizophrenia
Anxiety
Alzheimer's Disease

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame: weeks 12-14 of winter term, full-time

Course components and workload:

3 SWS Lecture (VO) "Introd. to Cognitive Neuroscience" and "Psychopharmacol."

Total workload 135 h: 45 h contact / 45 h background reading / 45 h exam preparation

1 SWS Supervised exercise (UE)

Total workload 45 h: 14 h contact / 31 h paper reading

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: 100% written exam (content of the lectures)

Examination period: as agreed, usually in the break after the winter term

In addition, mandatory but ungraded: Regular active participation is required to pass the module.

Primary faculty responsible for the module: Prof. Dr. Christiane Thiel

Additional teachers in the module: Dr. Carsten Giessing

Required reading:

Recommended textbook(s) or other literature:

Ward J (2015) The Student's Guide to Cognitive Neuroscience. Psychology Press
Meyer JS and Quenzer LF (2013) Psychopharmacology. Sinauer

Maximum number of students: 30

Registration procedure / selection criteria: StudIP

Required previous credits from:

Recommended previous knowledge / skills: Fundamentals of Neurobiology, Behavioural Biology

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Interrelations with other modules:

Recommended in combination with: neu211 "Neurosensory Science and Behaviour", neu300 "Functional MRI data analysis"

Shared course components with (cannot be credited twice):

bio610 and psy181 and psy150 (5.02.614 "Introduction to Cognitive Neuroscience", 5.02.615 "Psychopharmacology")

neu280 'Research techniques in Neuroscience'

Study program: Master of Science

Subject: Neuroscience

Module category: Background Module

type: compulsory elective

Semester: summer term

Cycle: annually

Teaching language: English

Recommended in semester:

Objectives and skills taught in the module:

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

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

Module content:

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

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

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame:

Course components and workload:

2 SWS Lecture (VO)

Total workload 90 h: h contact / 35 h contact; 45 h background reading; 10 h examen preparation

2 SWS Practical (PR)

Total workload 90 h: h contact / 50 h contact; 30 h protocol preparation, 10 h examen preparation

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: written examen

Examination period: end of semester

In addition, mandatory but ungraded:

Primary faculty responsible for the module: Dr. Anna-Maria Hartmann

Additional teachers in the module: Prof. Dr. Hans Gerd Nothwang, Prof. Dr. Christiane Thiel, Prof. Dr. John Neidhardt, Prof. Dr. Martin Greschner, Dr. Carsten Bantel...

Required reading:

Recommended textbook(s) or other literature:

Guide to Research Techniques in Neuroscience, 2nd EditionAuthor(s) : Carter & Shieh
Print Book ISBN : 9780128005118
eBook ISBN : 9780128005972

Maximum number of students: 20

Registration procedure / selection criteria: StudIP

Required previous credits from: none

Recommended previous knowledge / skills: none

Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

neu141 Visual Neuroscience - Physiology and Anatomy

Study program: Master of Science
Subject: Neuroscience
Module category: Background Module
type: compulsory elective
Semester: summer term, first half
Cycle: annually
Teaching language: English
Recommended in semester: all

Objectives and skills taught in the 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

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

Module content:

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

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

Total credit points: 12 CP (equivalent 8 SWS, 360 hours workload)

Time frame: First half of summer semester, full-time

Course components and workload:

3 SWS Lecture (VO)

Total workload 90 h: 30 h contact / 60 h background literature reading and preparation for sh

1 SWS Seminar (SE)

Total workload 30 h: 10 h contact / 20 h literature reading and preparation of results presenta

8 SWS Supervised exercise (UE)

Total workload 240 h: 200 h contact / 40 h results analysis, writing of short reports for portfolio

SWS

Total workload 0 h: h contact /

Type of examination: Portfolio consisting of short tests and short reports

Examination period: during the course (summer semester, first half)

In addition, mandatory but ungraded: seminar presentation

Primary faculty responsible for the module: Prof. Dr. Martin Greschner

Additional teachers in the module: apl. Prof. Dr. Karin Dedek, Prof. Dr. Ulrike Janssen-Bienhold, Dr. Christian Puller

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Required reading:

Course scripts and mandatory scientific literature discussed in the seminar will be available in Stud.IP

Recommended textbook(s) or other literature:

Background and seminar literature will be available in Stud.IP

Maximum number of students: 12 - with Visual Neuroscience: Anatomy

Registration procedure / selection criteria: StudIP, attendance in pre-meeting

Required previous credits from:

Recommended previous knowledge / skills: Basic knowledge of neurobiology

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Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

neu151 BM Visual Neuroscience: Anatomy

neu150 Visual Neuroscience - Anatomy

Study program: Master of Science
Subject: Neuroscience
Module category: Background Module
type: compulsory elective
Semester: summer term, first half
Cycle: annually
Teaching language: English
Recommended in semester: all

Objectives and skills taught in the 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

+ have basic knowledge of brain structures and their function
+ have profound knowledge of the architecture and circuits of the vertebrate retina
+ have aquired basic skills in histological techniques (tissue fixation, embedding, sectioning, staining procedures, immunohistochemistry)
+ have aquired fundamental skills in microscopy (differential interference contrast microscopy, phase-contrast microscopy, confocal microscopy)
+ have aquired fundamental skills in image aquisition and analysis
+ are able to prepare results in a publishable format
+ are able to critically evaluate, describe and discuss experimental results

Module content:

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

The lectures cover the following topics:

+ Visual System
+ Introduction into morphology of the mammalian brain and retina
+ introduction into methods used in neuranatomy and neurochemistry
+ introduction into microscopy and image analysis
+ presentation and discussion of results relating to the literature

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame: First 4 weeks of summer semester, full-time

Course components and workload:

2 SWS Lecture (VO)

Total workload 60 h: 30 h contact / 30 h background reading and exam preparation

1 SWS Seminar (SE)

Total workload 30 h: 10 h contact / 20 literature reading and preparation of presentation

3 SWS Supervised exercise (UE)

Total workload 90 h: 80 h contact / 10 h short report for portfolio

SWS

Total workload 0 h: h contact /

Type of examination: Portfolio consisting of short tests and short reports

Examination period: during the course (summer semester, first half)

In addition, mandatory but ungraded: seminar presentation

Primary faculty responsible for the module: Prof. Dr. Martin Greschner

Additional teachers in the module: Prof. Dr. Ulrike Janssen-Bienhold, Dr. Christian Puller

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Required reading:

Course scripts and mandatory scientific literature discussed in the seminar will be available in Stud.IP

Recommended textbook(s) or other literature:

Background and seminar literature will be available in Stud.IP

Maximum number of students: 12 - with Visual Nueroscience: Physiology and Anatomy

Registration procedure / selection criteria: StudIP, attendance in pre-meeting

Required previous credits from:

Recommended previous knowledge / skills: Basic knowledge of neurobiology

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Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

neu141 BM Visual Neuroscience: Physiology and Anatomy

neu250 Computational Neuroscience - Statistical Learning

Study program: Master of Science
Subject: Neuroscience
Module category: Background Module
type: compulsory elective
Semester: winter term, first half
Cycle: annually
Teaching language: English
Recommended in semester: 1 or 3

Objectives and skills taught in the 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

• 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 content:

• 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

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame: weeks 5-7 in winter semester

Course components and workload:

1 SWS Lecture (VO)

Total workload 45 h: 20 h contact / 25 individual revision of lecture contents, test preparation

1 SWS Seminar (SE)

Total workload 45 h: 20 h contact / 25 h individual reading and test preparation

2 SWS Supervised exercise (UE)

Total workload 90 h: 60 h contact / 30 h individual work on portfolio tasks (interpretation of simulation results)

SWS

Total workload 0 h: h contact /

Type of examination: Portfolio, consisting of daily short tests, programming exercises, short reports

Examination period: during the course

In addition, mandatory but ungraded:

Primary faculty responsible for the module: Prof. Dr. Jutta Kretzberg

Additional teachers in the module: Prof. Dr. Jochem Rieger, Dr. Jörn Anemüller

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Required reading:

Scientific articles: Copies of scientific articles for the seminar will be provided prior to the course

Recommended textbook(s) or other literature:

Wallisch et al.: MATLAB for Neuroscientists, 2nd Ed. Academic Press.
More text books will be suggested prior to the course.

Maximum number of students: 18

Registration procedure / selection criteria: StudIP; sequence of registration, attendance in pre-meeting

Required previous credits from:

Recommended previous knowledge / skills: Programming experience is highly recommended, preferably in Matlab

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Interrelations with other modules:

Recommended in combination with: neu240 BM Computational Neuroscience - Introduction

Shared course components with (cannot be credited twice):

psy220: Human Computer Interaction

neu290 Biophysics of Sensory Reception

Study program: Master of Science
Subject: Neuroscience
Module category: Background Module
type: compulsory elective
Semester: summer term, second half
Cycle: annually
Teaching language: English
Recommended in semester: any

Objectives and skills taught in the module:

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

- to gain a general understanding of sensory reception
- to acquire specific knowledge of sensory reception at the molecular and cellular level, with focus on the relationship between structure and function of sensory molecules
- to be able to perform simple quantitative assessments of detection sensitivity to physical stimuli
- to understand common features in transduction pathways among various senses

Module content:

General aspects of sensory reception and signal transduction: adequate stimulus, threshold sensitivity and signal-to-noise limitations, activation of receptor proteins
Evolutionary and ecological aspects of sensory reception

The senses:
Chemoreception in the gustatory cells and olfactory sensory neurons
Thermoreception in the skin
Infrared reception in the pit organ
Mechanoreception - auditory hair cells, somatosensory neurons in the skin, lateral line, proprioceptors, baroceptors
Photoreception - ciliary and rhabdomeric photoreceptor cells;
Electroreception in Lorenzini ampullae of elasmobranch fish and in tuberous receptors of mormyrid fish; derived electroreceptors in acquatic mammals
Magnetoreception - candidate structural correlates of magnetoreceptors

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame: Summer term

Course components and workload:

2 SWS Lecture (VO)

Total workload 90 h: 30 h contact / 60 h individual reading

2 SWS Seminar (SE)

Total workload 90 h: 30 h contact / 60 h individual reading

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: written exam (75%), presentation in the seminar (25%)

Examination period: ca. one week after the last lecture

In addition, mandatory but ungraded: presentation on seminar

Primary faculty responsible for the module: Prof. Dr. Michael Winklhofer

Additional teachers in the module:

Required reading:

The reading list will be updated on an annual basis to include new developments. The current reading list can be found on StudIP.

Recommended textbook(s) or other literature:

e.g., Kaupp (2010) Nat. Rev. Neurosc. 11:188-200; Palkar et al. (2015) Curr. Opinion Neurobiol. 34:14-19; Pan & Holt (2015) Curr. Opinion Neurobiol. 34:165-171; Lumpkin & Caterina (2007) Nature 445: 858-865; Lamb (2013) Progr. Retinal Eye Res. 36: 52e119; Progress in Retinal and Eye Research 20: 49-94; Baker et al. (2013) J. Exp. Biol. 216:2515-2522; Czech-Damal et al (2013) J. Comp. Physiol. 199:555-563; Hore & Mouritsen (2016) Ann. Rev. Biophys. 45: 299–344; Julius & Nathans (2012) Cold Spring Harbour Perspect Biol 2012;4:a005991;

Maximum number of students: 20

Registration procedure / selection criteria: StudIP

Required previous credits from:

Recommended previous knowledge / skills: cell biology of neurons

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Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

neu360 Auditory Neuroscience

Study program: Master of Science
Subject: Neuroscience
Module category: Background Module
type: compulsory elective
Semester: summer term, second half
Cycle: annually
Teaching language: English
Recommended in semester: 2

Objectives and skills taught in the module:

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

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

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

Module content:

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

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

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame: first 3 weeks of the second half of summer term + individual essay writing

Course components and workload:

1 SWS Lecture (VO)

Total workload 45 h: 14 h contact / 31h background reading

1 SWS Seminar (SE)

Total workload 45 h: 14 h contact / 15h background reading / 16h preparation of presentation

2 SWS Supervised exercise (UE)

Total workload 90 h: 10 h contact / 20h literature search / 60h work on essay paper

SWS

Total workload 0 h: h contact /

Type of examination: term paper

Examination period: within a few weeks of the end of summer term lecture period

In addition, mandatory but ungraded: 1 paper presentation in seminar, active participation in discussions

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Primary faculty responsible for the module: Prof. Christine Köppl

Additional teachers in the module: Prof. Georg Klump

Required reading:

About 20 selected original papers (selection varies)

Recommended textbook(s) or other literature:

Pickles JO (2012) An Introduction to the Physiology of Hearing. Brill, Netherlands

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Maximum number of students: 15

Registration procedure / selection criteria: StudIP, final acceptance after assignment of seminar presentation

Required previous credits from: none

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

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Interrelations with other modules:

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

Shared course components with (cannot be credited twice):

neu310 Psychophysics of Hearing

Study program: Master of Science
Subject: Neuroscience
Module category: Background Module
type: compulsory elective
Semester: winter term, first half
Cycle: annually
Teaching language: English
Recommended in semester: 2

Objectives and skills taught in the module:

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

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

Module content:

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

Total credit points: 12 CP (equivalent 8 SWS, 360 hours workload)

Time frame: weeks 1-7 of summer term, full-time

Course components and workload:

5 SWS Practical (PR) "Experiments in Hearing"

Total workload 225 h: 70 h contact / 110 h experimental work / 45 h exam preparation

1 SWS Supervised exercise (UE) "Fundamentals in psychoacoustic data analysis"

Total workload 45 h: 15 h contact / 30 h practising data analysis (incl. SPSS)

2 SWS Seminar (SE) "Hearing"

Total workload 90 h: 30 h contact / 60 h background reading

SWS Seminar (SE)

Total workload 0 h: 0 h contact /

Type of examination: 70% report or oral exam, 30% presentations

Examination period: end of summer term

In addition, mandatory but ungraded: Regular active participation

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Primary faculty responsible for the module: Prof. Dr. Georg Klump

Additional teachers in the module: Dr. Ulrike Langemann

Required reading:

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

Recommended textbook(s) or other literature:

Maximum number of students: 6 (in total with bio640)

Registration procedure / selection criteria: StudIP; sequence of registration

Required previous credits from:

Recommended previous knowledge / skills:

Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

neu300 Functional MRI data analysis

Study program: Master of Science

Subject: Neuroscience

Module category: Background Module

type: compulsory elective

Semester: summer term, second half

Cycle: annually

Teaching language: English

Recommended in semester: 2

Objectives and skills taught in the module:

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

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

Module content:

The modul comprises (i) a lecture “Functional MRI data analysis” [2 SWS], and (ii) a practical course [5 SWS] and (iii) a seminar “Experiments on Neurocognition” [1 SWS] including aspects of planning, performance and analysis of functional neuro-imaging studies using MATLAB based software.

Total credit points: 12 CP (equivalent 8 SWS, 360 hours workload)

Time frame: weeks 9-14 of summer term, full-time

Course components and workload:

5 SWS Practical (PR)

Total workload 225 h: 70 h contact / 100 h experimental work / 55 h exam preparation

2 SWS Lecture (VO) "Functional MRI data analysis"

Total workload 90 h: 28 h contact / 30 h background reading / 32 h exam preparation

1 SWS Seminar (SE) "Experiments on Neurocognition"

Total workload 45 h: 15 h contact / 30 h preparation of presentation

SWS

Total workload 0 h: h contact /

Type of examination: 70% oral exam or written exam, 30% presentations

Examination period: end of summer term

In addition, mandatory but ungraded: Regular active participation

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Primary faculty responsible for the module: Dr. Carsten Gießing

Additional teachers in the module: Prof. Dr. Christiane Thiel

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Required reading:

Recommended textbook(s) or other literature:

Frackowiak RSJ, Friston KJ, Frith C, Dolan R, Price CJ, Zeki S, Ashburner J, and Penny WD (2003). Human Brain Function. Academic Press, 2nd edition. San Diego, USA.
Huettel, SA, Song, AW, & McCarthy, G (2009). Functional Magnetic Resonance Imaging (2nd Edition). Sinauer Associates. Sunderland, MA, USA.
Poldrack RA, Mumford JA, & Nichols TE (2011). Handbook of Functional MRI Data Analysis. Cambridge University Press. New York, USA.

Maximum number of students: 12 (in total with bio640)

Registration procedure / selection criteria: StudIP

Required previous credits from:

Recommended previous knowledge / skills:

Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

bio640

neu340 Invertebrate Neuroscience

Study program: Master of Science
Subject: Neuroscience
Module category: Background Module
type: compulsory elective
Semester: summer term, second half
Cycle: annually
Teaching language: English
Recommended in semester: 2

Objectives and skills taught in the 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

• have knowledge on invertebrate neuronal systems in comparison to vertebrate systems
• have discussed an overview of experimental and theoretical methods of invertebrate neuroscience
• have acquired first practical skills in intracellular recordings from invertebrate neurons
• have acquired basic skills in data analysis
• have acquired an intuitive understanding of membrane potential and action potential generation based on computer simulations

Module content:

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

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

In the practical exercises, portfolio assignments will be performed on:
• Qualitative electrophysiological classification of different cell types in the leech nervous system
• Quantitative analysis (stimulus - response relationship) of at least one cell type
• Action potential generation: Comparison of model simulations and experiments

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame: Weeks 8-10 in summer semester

Course components and workload:

1 SWS Seminar (SE)

Total workload 45 h: 15 h contact / 30h background literature reading, preparation for short tests and results presentation

3 SWS Supervised exercise (UE)

Total workload 135 h: 70 h contact / 65 h data analysis and preparation of portfolio assignments

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: Portfolio consisting of short tests and short reports

Examination period: during the course (summer term, second half)

In addition, mandatory but ungraded: seminar presentation

Primary faculty responsible for the module: Prof. Dr. Jutta Kretzberg

Additional teachers in the module:

Required reading:

Course scripts and mandatory scientific literature (3 review articles) discussed in the seminar will be available in Stud.IP

Recommended textbook(s) or other literature:

Background and seminar literature will be available in Stud.IP

Maximum number of students: 12

Registration procedure / selection criteria: StudIP; attendance in pre-meeting

Required previous credits from:

Recommended previous knowledge / skills: Basic knowledge of neurobiology, basic Matlab programming skills

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Interrelations with other modules:

Recommended in combination with: this module provides the background for neu145 Computation in invertebrate systems

Shared course components with (cannot be credited twice):

neu345 Neural Computation in Invertebrate Systems

Study program: Master of Science
Subject: Neuroscience
Module category: Background Module
type: compulsory elective
Semester: summer term, second half
Cycle: annually
Teaching language: English
Recommended in semester: 2

Objectives and skills taught in the 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

• have knowledge on some examples of invertebrate neuronal system
• have knowledge on neural coding and corresponding data analysis techniques
• have acquired skills in data analysis
• have practiced to generate a scientific hypothesis and choose suitable experimental or modeling methods
• are able to critically evaluate and discuss experimental results

Module content:

This module builds up on the knowledge and methods acquired in the module neu340 Invertebrate Neuroscience.
In the seminar, the knowledge on invertebrate systems and neural coding in general is deepened based on scientific literature.
In the practical exercise of the module, students can choose one topic from a list of different research questions on computation in the leech nervous system (e.g. comparison of differnt cell types, electrical and chemical synpatic connections, exact meaurement of spike threshold, phase locking). Small groups (2-3) of students plan, perform and analyze experiments (intracellular recordings) or model simulations (model framework will be provided or can be self-written based on module neu241 computational neuroscience - Introduction) to tackle their topic.
The portfolio consists of assignments covering the planing, analysis, interpretation and presentation of the results with feedback given during the course on each project stage.

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame: Weeks 11-13 of summer semester

Course components and workload:

1 SWS Seminar (SE)

Total workload 45 h: 15 h contact / 30 h background literature reading and preparation of results presentation

3 SWS Supervised exercise (UE)

Total workload 135 h: 70 h contact / 65 h data analysis and preparation of portfolio assignments

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: Portfolio consisting of short reports

Examination period: during the course (summer term, second half)

In addition, mandatory but ungraded: seminar presentation

Primary faculty responsible for the module: Prof. Dr. Jutta Kretzberg

Additional teachers in the module:

Required reading:

Course scripts and mandatory scientific literature (3 articles) discussed in the seminar will be available in Stud.IP

Recommended textbook(s) or other literature:

Background and seminar literature will be available in Stud.IP

Maximum number of students: 12 (but only 6 for experimental projects)

Registration procedure / selection criteria: StudIP; attendance in pre-meeting

Required previous credits from: neu340 invertebrate neuroscience

Recommended previous knowledge / skills:

Interrelations with other modules:

Recommended in combination with: neu340 invertebrate neuroscience (mandatory), neu241 computational neuroscience - Introduction (recommended for modeling projects)

Shared course components with (cannot be credited twice):

neu710 Neuroscientific Data Analysis in Matlab

Study program: Master of Science
Subject: Neuroscience
Module category: Skills Module
type: compulsory elective
Semester: summer term
Cycle: annually
Teaching language: English
Recommended in semester: 2 or 4

Objectives and skills taught in the module:

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

Upon succesfful completion of this course, students

- understand basic programming concepts.

- have good knowledge about the most imporant aspects of the programming language Matlab.

- are able to use the programming environment for Matlab.

- are able to write their own programs in Matlab.

- know how to use Matlab to specifically analyze neuroscientific data, including:
> electrophysiogical data (continuous and spike trains)
> basic image processing
>basic statistical testing.

Module content:

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

During the seminar, we will discuss strategies for analysis and coding for specific relevant examples of neuroscientific data. The examples are prepared and presented by the students. Students will also present some of the work they did during the excercises. If students bring their own data or plan experiments for a research modul or their thesis project, there will be the oppurtunity to discuss both analysis strategies and possible implementation in Matlab.

Exercise:
- Students will get coding exercises, where they will use the knowledge gained from the lecture. The excercises are a mix of short excercises and longer projects. Projects will be done in small groups (2-3 students).
- The students are encouraged to bring examples of data from experiments they have been involved in or are planning to do.

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame: During summer term

Course components and workload:

1 SWS Lecture (VO)

Total workload 45 h: 10 h contact / 20h background reading / 15h exam preparation

1 SWS Seminar (SE)

Total workload 45 h: 10 h contact / 20h background reading /15h preparation of presentation

2 SWS Supervised exercise (UE)

Total workload 90 h: 20 h contact / 70h home work

SWS

Total workload 0 h: h contact /

Type of examination: practical exercise - hand in code each week

Examination period: during the course

In addition, mandatory but ungraded: presentation during seminar

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Primary faculty responsible for the module: Prof. Jannis Hildebrandt

Additional teachers in the module:

Required reading:

Pascal Wallisch: MATLAB for Neuroscientists, Elsevier, Oxford

Recommended textbook(s) or other literature:

Maximum number of students: 24

Registration procedure / selection criteria: StudIP; sequence of registration

Required previous credits from:

Recommended previous knowledge / skills: basic knowledge of math and statistics

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Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

PB150 Einführung in die Datenanlyse mit Matlab

neu770 Basics of Statistical Data Analysis

Study program: Master of Science
Subject: Neuroscience
Module category: Skills Module
type: compulsory elective
Semester: winter term
Cycle: annually
Teaching language: English
Recommended in semester: 1

Objectives and skills taught in the 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

- 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 content:

- 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

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame: lecture period

Course components and workload:

1,5 SWS Lecture (VO)

Total workload 68 h: 28 h contact / 20 h background reading / 20 h exam preparation

2,5 SWS Seminar (SE)

Total workload 113 h: 28 h contact / 20 h background reading / 65 h exercise solving

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: written exam, 2 h

Examination period: after the course

In addition, mandatory but ungraded:

Primary faculty responsible for the module: Dr. Fabian Sobotka

Additional teachers in the module:

Required reading:

Recommended textbook(s) or other literature:

Will be available in Stud.IP

Maximum number of students: no maximum

Registration procedure / selection criteria: StudIP; sequence of registration

Required previous credits from:

Recommended previous knowledge / skills: basic mathematical knowledge; use of probabilities

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Interrelations with other modules:

Recommended in combination with: neu720 Statistical Programming with R

Shared course components with (cannot be credited twice):

neu790 Communicating Neuroscience

Study program: Master of Science
Subject: Neuroscience
Module category: Skills Module
type: compulsory elective
Semester: flexible
Cycle: every semester
Teaching language: English
Recommended in semester: any

Objectives and skills taught in the 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 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 content:

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 acitvely 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: 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.

Total credit points: 3 CP (equivalent 2 SWS, 90 hours workload)

Time frame: seminar during winter term; other options any time

Course components and workload:

2 SWS Seminar (SE)

Total workload 90 h: 28 h contact / 62 h individual reading and preparing discussion questions

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: none (only pass / fail)

Examination period:

In addition, mandatory but ungraded: dependent on the option chosen (see Module content)

Primary faculty responsible for the module: Prof. Dr. Jutta Kretzberg

Additional teachers in the module: Prof. Dr. Christine Köppl, Prof. Dr. Jannis Hildebrandt

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Required reading:

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

Recommended textbook(s) or other literature:

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
Kandel et al. 'Principles of Neural Science', 5th Edition 2013, McGraw-Hill Comp.

Maximum number of students: 20 (for option 1)

Registration procedure / selection criteria: StudIP

Required previous credits from:

Recommended previous knowledge / skills:

Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

neu720 Statistical Programming with R

Study program: Master of Science

Subject: Neuroscience

Module category: Skills Module

type: compulsory elective

Semester: summer term

Cycle: annually

Teaching language: English

Recommended in semester: 2 or 4

Objectives and skills taught in the 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
- learn the use of the software R in application scenarios
- learn to actively "speak" the programming language R
- know how to practice statistical data analysis with R

Module content:

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.

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame: during summer term

Course components and workload:

1,5 SWS Lecture (VO)

Total workload 68 h: 28 h contact / 20h background reading / 20h exam preparation

2,5 SWS Supervised exercise (UE)

Total workload 113 h: 28 h contact / 20h background reading / 65h exercise solving

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: practical exercise

Examination period: after the course

In addition, mandatory but ungraded:

Primary faculty responsible for the module: Dr. Fabian Sobotka

Additional teachers in the module:

Required reading:

Recommended textbook(s) or other literature:

Uwe Ligges - Programmieren mit R (2008) Springer.
R Core Team - R: A language and environment for statistical computing (Reference Manual)
Simon N. Wood - Generalized Additive Models: An Introduction with R (2006) Chapman & Hall

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Maximum number of students: 24

Registration procedure / selection criteria: StudIP; sequence of registration

Required previous credits from:

Recommended previous knowledge / skills: basical statistical knowledge including regression analysis

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Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

6.03.103 "Statistical Programming with R"

neu730 Biosciences in the public eye and in our laws

Study program: Master of Science
Subject: Neuroscience
Module category: Skills Module
type: compulsory elective
Semester: summer term
Cycle: annually
Teaching language: German
Recommended in semester: 2 or 4

Objectives and skills taught in the module:

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

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

Module content:

Lectures introduce the legal framework and the application procedures for experimental work with animals, humans and genetically modified organisms.
In supervised exercises, students research the ethical aspects and controversial issues of about 10 particular topics in the biosciences. They take turns in summarizing and presenting each topic in small teams, and leading a critical discussion of each topic. Problem-based, independent research of the scientific background by the students is an integral part of this module.

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

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

Total credit points: CP (equivalent 0 SWS, 0 hours workload)

Time frame: during summer term

Course components and workload:

3,5 SWS Supervised exercise (UE)

Total workload 158 h: 48 h contact / 40h preparation of presentation / 70h term paper

0,5 SWS Lecture (VO)

Total workload 23 h: 10 h contact / 13h background research

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: Term paper

Examination period: within a few weeks of summer term lecture period

In addition, mandatory but ungraded: Regular participation during the semester is required (max 3 days of absence)

Primary faculty responsible for the module: Prof. Christine Köppl

Additional teachers in the module: Dr. Ulrike Sienknecht

Required reading:

Up-to-date introductory opinion pieces, e.g. from "The Scientist" or widely respected newspapers, are provided for each topic.

Recommended textbook(s) or other literature:

Current law and interpretative commentaries, e.g., by the German Research Council (DFG), Office of Research Integrity (ORI) or the German Ethics Panel.

Maximum number of students: 18

Registration procedure / selection criteria: StudIP; sequence of registration, plus attendance at first meeting

Required previous credits from:

Recommended previous knowledge / skills: Fundamentals of genetics, physiology, ecology and biological systematics

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Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

neu740 Molecular mechanisms of ageing

Study program: Master of Science
Subject: Neuroscience
Module category: Skills Module
type: compulsory elective
Semester: summer term
Cycle: annually
Teaching language: English
Recommended in semester: 2 or 4

Objectives and skills taught in the module:

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

In this module the participants gain an overview of arguments and experimental strategies in ageing research. We will focus on the fields of medicine/epidemiology, biochemistry/ cell biology, physiology, and genetics. In addition, the main ageing theories will be covered. The participants work throughout the semester in project groups and present their results at a conference at the end of the course. Ethicists and philosphers from Germany and The Netherlands accompany the course, and chair at the conference a session on ethical aspects of ageing research. Under their moderation, the participants derive joint standpoints and policy recommendations.
At the end of this course the participants can
- understand, analyse, and present scientific articles from ageing research
- present the results of their studies and analyses using different presentation techniques
- apply the learned contents in novel contexts (ethics in ageing research)

Topics
- Major ageing theories
- arguments and experimental strategies in the fields of medicine/epidemiology, biochemistry/ cell biology, physiology, genetics in ageing research
- application of the learned contents in novel contexts (ethics in ageing research)
- understanding, analysing, and presentation of scientific articles
- presentation of results with different presentation techniques

Module content:

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 resentation and group poster
7) Presentation at 1 day conference
8) Dutch and German ethics experts present bioethics and lobby work in German and Dutch political gremia
9) The students develop a comparative view on medical ethics in different countries and derive own standpoints and policy recommendations for the ethical assessment of metabolic and ageing research.
The project work runs independently in the different expert groups throughout the semester and is organised via StudIP. The students and groups receive regular feedback and guidance in presence meetings.

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

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame: across the semester

Course components and workload:

4 SWS Supervised exercise (UE)

Total workload 180 h: 26 h contact / 50 h group work / 50 h prep. of thesis, presentations / 54 h recap., literature

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: portfolio: thesis paper, oral presentation, poster presentation

Examination period: end of semester

In addition, mandatory but ungraded: questionnaire on ageing theories, meeting protocols

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Primary faculty responsible for the module: Prof. Kathrin Thedieck

Additional teachers in the module:

Required reading:

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

Recommended textbook(s) or other literature:

Roger B. McDonald, Biologyof aging, Garland Science
http://www.garlandscience.com/garlandscience_resources/book_resources.jsf?isbn=9780815342137&landing=student

Altern : Zelluläre und molekulare Grundlagen, körperliche Veränderungen und Erkrankungen, Therapieansätze
Ludger Rensing ; Volkhard Rippe
Berlin u.a. : Springer Spektrum, 2014,
http://link.springer.com/book/10.1007%2F978-3-642-37733-4

Maximum number of students: 16

Registration procedure / selection criteria: StudIP; sequence of registration

Required previous credits from:

Recommended previous knowledge / skills:

Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

5.02.903 "Metabolische Signaltransduktion und Alterungsprozesse"

neu751 Laboratory Animal Science

Study program: Master of Science
Subject: Neuroscience
Module category: Skills Module
type: compulsory elective
Semester: semester break
Cycle: every semester
Teaching language: English
Recommended in semester: any

Objectives and skills taught in the module:

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

Upon successful completion of this course, students

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

NOTE: These objectives aim to satisfy the requirements for EU directive A „Persons carrying out animal experiments“ and EU directive D „Persons killing animals”. We aim to obtain accreditation by the Federation of European Laboratory Animal Science Associations (FeLaSa) by 2018.

Module content:

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

Practical procedures will first be demonstrated, important aspects will then be practiced under supervision by every partipant, on an animal model of their choice (rodents, birds or fish):
• Handling and external examination
• Administration of substances, blood sampling
• Euthanasia and dissection
• Transcardial perfusion
• Anaesthesia and surgery

Total credit points: 3 CP (equivalent 2 SWS, 90 hours workload)

Time frame: 1 week full-time in semester break + flexible time for studying and exam preparation

Course components and workload:

1 SWS Lecture (VO)

Total workload 45 h: 2 h contact / 20 h background reading / 23 h exam preparation

1 SWS Supervised exercise (UE)

Total workload 45 h: 35 h contact / 10 h background reading

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: written exam of 90 minutes

Examination period: immediately before the practical part

In addition, mandatory but ungraded: ----

Primary faculty responsible for the module: Prof. Christine Köppl

Additional teachers in the module: Prof. Georg Klump, Dr. Ulrike Langemann, Prof. Arne Nolte

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Required reading:

"LAS interactive" internet-based learning platform

Recommended textbook(s) or other literature:

Wolfensohn and Lloyd (2013) Handbook of Laboratory Animal Management and Welfare. Wiley-Blackwell

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Maximum number of students: 15

Registration procedure / selection criteria: StudIP, sequence of registration

Required previous credits from: none

Recommended previous knowledge / skills:

Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

neu780 Introduction in Data Analysis with Python.

Study program: Master of Science
Subject: Neuroscience
Module category: Skills Module
type: compulsory elective
Semester: semester break
Cycle: annually
Teaching language: English
Recommended in semester: any

Objectives and skills taught in the module:

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

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

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

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

Module content:

Data types and data structures, control structures, functions, modules, file input/output

Standard libraries and SciPy libraries (Matplotlib, NumPy,...), scikit-image, VPython, ...

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame: Introduction into Data Analysis with Python

Course components and workload:

2 SWS Lecture (VO)

Total workload 90 h: 30 h contact / 60 h individual reading

2 SWS Supervised exercise (UE)

Total workload 90 h: 45 h contact / 45 h solving programming exercises

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: assignment of programming exercises, 4 out of 5 exercises to be assessed.

Examination period: term break, immediately after the course (2 weeks in February).

In addition, mandatory but ungraded:

Primary faculty responsible for the module: Prof. Dr. Michael Winklhofer

Additional teachers in the module:

Required reading:

Recommended textbook(s) or other literature:

open access
http://www.swaroopch.com/notes/python/
http://docs.python.org/3/tutorial/index.html

Maximum number of students: 20

Registration procedure / selection criteria: StudIP

Required previous credits from:

Recommended previous knowledge / skills: No prior knowledge in programming required, but useful.

Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

Einführung in Datenanalyse mit Python (Professionalisierungsmodul im Bacherlorstudiengang)

neu760 Scientific English

Study program: Master of Science
Subject: Neuroscience
Module category: Skills Module
type: compulsory elective
Semester: semester break
Cycle: annually
Teaching language: English
Recommended in semester: 2 or 4

Objectives and skills taught in the module:

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

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 pronounciation
- 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 content:

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 pronounciation and language use errors.

Total credit points: 6 CP (equivalent 4 SWS, 180 hours workload)

Time frame: usually held in the break before summer term

Course components and workload:

0,5 SWS Lecture (VO)

Total workload 23 h: 8 h contact / 15 research for term paper

3,5 SWS Supervised exercise (UE)

Total workload 158 h: 46 h contact / 46h preparation of texts and presentations / 66h term paper

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: Portfolio: 50% presentation, 50% term paper

Examination period: within 2 months of completing the course

In addition, mandatory but ungraded: bonus system for active participation

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Primary faculty responsible for the module: Prof. Jannis Hildebrandt

Additional teachers in the module: outsourced to STELS-OL (Scientific and Technical English Language Service); native English speaker with in-depth neuroscience knowlg.

Required reading:

Recommended textbook(s) or other literature:

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

Maximum number of students: 12

Registration procedure / selection criteria: StudIP; non-native speakers, sequence of registration

Required previous credits from:

Recommended previous knowledge / skills: English level B2 according to Common European Framework of Reference for Languages (CEFR)

Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

neu800 Introduction to Matlab

Study program: Master of Science

Subject: Neuroscience

Module category: Skills Module

type: compulsory elective

Semester: summer term, second half

Cycle: annually

Teaching language: English

Recommended in semester: 2

Objectives and skills taught in the module:

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

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

Module content:

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

Total credit points: 3 CP (equivalent 2 SWS, 90 hours workload)

Time frame: within the frist week of the second half of the summer term, full-time

Course components and workload:

2 SWS Supervised exercise (UE) "Introduction to MATLAB"

Total workload 90 h: 28 h contact / 62 h practising learned programming skills

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: Working on exercises (Bearbeitung der Übungsaufgaben)

Examination period: end of summer term

In addition, mandatory but ungraded: Regular active participation

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Primary faculty responsible for the module: Dr. Carsten Gießing

Additional teachers in the module:

Required reading:

Recommended textbook(s) or other literature:

Wallisch, Pascal (2014) MATLAB for neuroscientists: an introduction to scientific computing in MATLAB. 2. ed., Amsterdam: Elsevier.

Maximum number of students: 12 (in total with bio640)

Registration procedure / selection criteria: StudIP

Required previous credits from:

Recommended previous knowledge / skills:

Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

bio640

neu810 International Meeting Contribution

Study program: Master of Science
Subject: Neuroscience
Module category: Skills Module
type: compulsory elective
Semester: flexible
Cycle: every semester
Teaching language: English
Recommended in semester: any

Objectives and skills taught in the module:

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

Presentation and critical discussion of own studies in front of an international audience:
- participate in an international meeting
- prepare a poster or talk for an international meeting
- present own results in a way that is appropriate for the target audience
- put own studies into the context of scientific literature
- acquire additional knowledge about a broader field of research

Module content:

Active participation in a scientific conference, workshop, summer school etc, lasting a minimum of 3 full days. Student must be the presenter (poster or talk) and an author of the presented work, typically carried out in the context of a research module or the Master thesis.

Total credit points: 3 CP (equivalent 2 SWS, 90 hours workload)

Time frame: any time

Course components and workload:

SWS Seminar (SE)

Total workload 0 h: 0 h contact / 90 h individual preparation of poster or talk, meeting participation

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: none (only pass / fail)

Examination period:

In addition, mandatory but ungraded:

Primary faculty responsible for the module: Prof. Dr. Jutta Kretzberg

Additional teachers in the module: Prof. Dr. Christine Köppl, Prof. Dr. Jannis Hildebrandt

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Required reading:

dependent on the scientific topic

Recommended textbook(s) or other literature:

Maximum number of students: no restriction

Registration procedure / selection criteria: please contact module organizer individually

Required previous credits from:

Recommended previous knowledge / skills:

Interrelations with other modules:

Recommended in combination with: any research module or MSc thesis

Shared course components with (cannot be credited twice):

neu600 Neuroscience Research Project

Study program: Master of Science
Subject: Neuroscience
Module category: Research Module
type: compulsory elective
Semester: flexible
Cycle: every semester
Teaching language: English
Recommended in semester: 1 or 2 or 3

Objectives and skills taught in the module:

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

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

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

Module content:

The Research Module is carried out under the guidance and supervision of a member of the Neuroscience faculty at the University of Oldenburg.
It comprises approximately 7 (minimum 5) weeks of experimental or theoretical work, individually or in small groups, and, usually, participation in a regular group seminar during that time.

Students can choose between many options of individual projects, offered by the different groups involved in the MSc Neuroscience study program.
Research questions, methods and approaches differ between individual projects
Please refer to the list of options in Stud.IP and contact potential supervisors directly.

The timing of projects is by individual arrangement with the supervisor. Many, but not all, project options can also be scheduled during semester breaks, and / or as part-time options (lasting more than 7 weeks).
Note that, for some options, priority for admission to the project is given to students who passed a background module offered by the supervisor
Participation in a poster presentation at the neuroscience career day (in March) is not mandatory but highly recommended.

Total credit points: 15 CP (equivalent 10 SWS, 450 hours workload)

Time frame: flexible, by individual arrangement with the supervisor

Course components and workload:

1 SWS Seminar (SE) Lab seminars of chosen working group

Total workload 45 h: 15 h contact / 30 h reading and presentation preparation

9 SWS Research Internship (IFP)

Total workload 405 h: 120 h contact / 125 h independent lab work / 40 h background reading / 90 h internship report / 30 h poster preparation

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: Internship report

Examination period: within 2 months after conclusion of lab work

In addition, mandatory but ungraded: presentation at lab seminar

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Primary faculty responsible for the module: Prof. Dr. Jutta Kretzberg

Additional teachers in the module: All MSc Neuroscience teachers

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Required reading:

Provided by the supervisor, depending on the project

Recommended textbook(s) or other literature:

Provided by the supervisor, depending on the project

Maximum number of students: no restriction

Registration procedure / selection criteria: see comments

Required previous credits from:

Recommended previous knowledge / skills: Depending on project choice, please check Stud.IP and ask the supervisor

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Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

Module can be taken multiple times, however, supervision of individual projects is limited to 45 ECTS for the same combination of student and supervisor (1 research module + Master thesis OR up to 3 research modules, including external research projects)

neu610 External Research Module

Study program: Master of Science
Subject: Neuroscience
Module category: Research Module
type: compulsory elective
Semester: flexible
Cycle: every semester
Teaching language: English
Recommended in semester: any

Objectives and skills taught in the module:

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

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

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

Module content:

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.

Comments:
- all members of the regular Neuroscience faculty at the University of Oldenburg can act as local supervisor, students should contact appropriate supervisors individually
- prior to project start, external and local supervisors must fill the learning agreement form
- the supervisor at the host institution is invited to submit a short written statement of assessment, final grading is done by the local supervisor
- Participation in a poster presentation at the neuroscience career day (in March) is not mandatory but highly recommended.

Total credit points: 15 CP (equivalent 10 SWS, 450 hours workload)

Time frame: flexible, depending on availability of external research options

Course components and workload:

10 SWS Research Internship (IFP)

Total workload 450 h: 260 h contact / 40 h background reading / 90 h written report / 60 h talk and poster preparation

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: internship report

Examination period: within 2 months after conclusion of lab work

In addition, mandatory but ungraded:

Primary faculty responsible for the module: All members of the Neuroscience faculty

Additional teachers in the module:

Required reading:

Provided by external and / or local supervisor, depending on the project

Recommended textbook(s) or other literature:

Provided by external and / or local supervisor, depending on the project

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Maximum number of students: no restriction

Registration procedure / selection criteria: see "Comments"

Required previous credits from:

Recommended previous knowledge / skills:

Interrelations with other modules:

Recommended in combination with: Module can be taken multiple times, if project options are sufficiently different (decision of the examining board needed).

Shared course components with (cannot be credited twice):

Supervision of individual projects is limited to 45 ECTS for the same combination of student and supervisor (1 research module + Master thesis OR up to 3 research modules, including external research module)