CARL VON OSSIETZKY universität OLDENBURG

Handbook of Modules

Master of

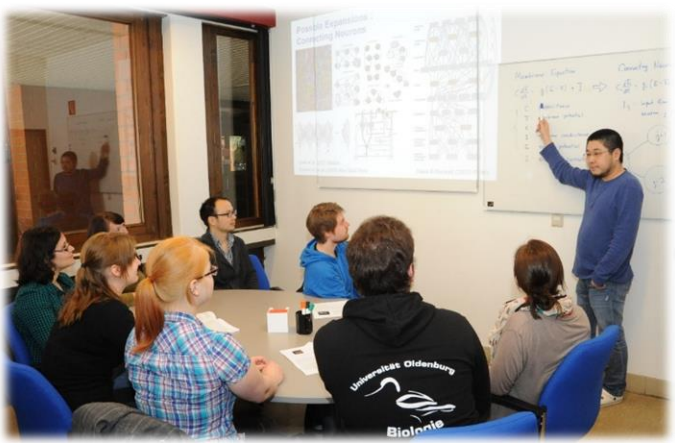
NEUROSCIENCE

Jointly carried by

School of Mathematics and Science (Faculty V)

and School of Medicine and Health Sciences (Faculty VI)

version 19th July 2017



Overview M.Sc. Neuroscience

Compulsory Elective, 60 CP

30 CP

Background Modules

15 CP

Research Module

6 CP

Skills Mod.

9 CP any Neuro Module

Neuroscience

Thesis Module, 30 CP

30 CP

Master Thesis Module

Neuroscience

Elective, 30 CP

30 CP

any Neuroscience Modules, other M.Sc. courses, semester abroad

Interdisciplinary / Neuroscience

M.Sc. Neuroscience (year 2017/2018)

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

	NR	Module	Shared / (similar) Modules	Teachers	Winter Semester 1. Half	Winter Semester 2. Half	Semester break	Summer Semester 1. Half	Summer Semester 2. Half	Semester break
Background Modules	neu280	Research Techniques in Neuroscience		Hartmann, Nothwang, Thiel, Neidhardt, et al	6 CP					
	neu110	Development & Evolution	bio840	Sienknecht, Nothwang, Köppl	9 CP					
	neu120	Lab Exercise in Devo & Evo		Sienknecht, Nothwang, Köppl		6 CP				
	neu170	Molecular Genetics & Cell Biology	bio600	Koch, Neidhardt, Thedieck	15 CP					
	neu305	Essentials fMRI data analysis SPM/FSL	psy275, (neu300)	Wreda, Sörös	6 CP					
	neu320	Introduction to Neurophysics		Anemüller	weekly course 6 CP					
	neu241	Computational Neurosci. - Introduction		Kretzberg, Greschner, Hildebrandt		12 CP				
	neu190	Biochem. Conc. in Signal Transduct.	bio690	Koch, Scholten		15 CP				
	neu210	Neurosensory Science & Behaviour A	bio610	Klump, Hildebrandt, Langemann, Mouritsen		9 CP				
	neu220	Neurosensory Science & Behaviour B	bio610, psy180	Thiel, Giessing		6 CP				
	neu250	Comp. Neurosci. - Statistical Learning	(psy220)	Kretzberg, Rieger, Anemüller				6 CP		
	neu290	Biophysics of sensory reception		Winklhofer					6 CP	
	neu140	Neurophysiology	bio620	Greschner, Dedek				9 CP		
	neu150	Neuroanatomy		Janssen-Bienholdt, Dedek					6 CP	
	neu310	Psychophysics of hearing	bio640	Klump, Langemann					12 CP	
	neu300	Functional MRI data analysis	bio640	Thiel, Gießing					12 CP	
	neuXX	Invertebrate Neurophysiology		Kretzberg					12 CP	
Research Modules	neu410	Auditory Neuroscience		Klump, Köppl, Hildebrandt	15 CP					
	neu470	Molecular Sensory Neuroscience	bio680	Koch, Nothwang, Neidhardt, Thedieck	15 CP			15 CP		
	neu540	Neural Basis of Perception		Kretzberg, Klump, Mouritsen, Winklhofer	15 CP				15 CP	
	neu440	Visual Neuroscience		Janssen-Bienhold, Dedek, Greschner		15 CP			15 CP	
	neu510	Computation in Sensory Systems	(psy260)	Kretzberg, Greschner, Hildebrandt, Rieger		15 CP			15 CP	
	neu570	Develop & Evolution Auditory System	bio850	Sienknecht, Nothwang, Köppl		15 CP				
	neu610	External Research Project		all teachers			15 CP			15 CP
Skills Modules	neu710	Neuroscientific Data Analysis in Matlab	(pb150)	Hildebrandt	6 CP					
	neu770	Basics of Statistical Data Analysis		Sobotka	weekly course 6 CP					
	neu790	Communicating Neuroscience		Kretzberg, Köppl, Hildebrandt	weekly course 3 CP					
	neu720	Statistical Programming in R	(ph050)	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		Köppl, Klump, Langemann			3 CP			3 CP
	neu760	Scientific English		Hildebrandt			6 CP			
	neu780	Introduction Data Analysis with Python		Winklhofer			6 CP			
	neu800	Introduction to Matlab		Gießing					3 CP	
MA	mam	Master Thesis Module		all teachers				30 CP		

fixed time slots, mostly blocked courses

flexible time slots

fixed time slots

flex

Legend:

full-time courses with fixed time slots

part-time courses with fixed time slots

Preferred time slots of projects

Individual project time slots can be discussed with supervisor

CP credit point, ECTS (30h work load)

neuXX new modules, will receive numbers soon.

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 or similar content (see list) cannot be credited twice.

Recommendations:

- For most students, it is recommended to start with Research Techniques (neu280) and Matlab (neu710) in the first half of the first semester.
- Research modules are individual research projects in a neuroscience lab. 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 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

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):

neu110 Development and Evolution

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

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

Module content:

Lectures on the fundamentals and concepts of developmental biology, and introduction to the development of the auditory system, including evolutionary aspects. Parallel seminars matching the topics of the lectures and emphasizing discussion.
Lecture topics:
• Introduction to Developmental Biology
• Cell-Cell Communication
• Early Development of Vertebrates, Gastrulation
• Neurulation
• Neural Crest
• Mesoderm Development
• Limb Development
• Histogenesis Brain
• Genomic Equivalence -Differential Gene Expression
• Medical Implications of Developmental Biology
• Axonal Growth and Target Selection
• Synaptogenesis and Refinement, Natural Apoptosis, Plasticity
• 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

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

Time frame: weeks 1-4 of winter term, full-time

Course components and workload:

3 SWS Lecture (VO)

Total workload 135 h: 40 h contact / 40 h background reading / 55 h exam preparation

3 SWS Seminar (SE)

Total workload 135 h: 40 h contact / 95 h literature reading

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: oral exam of 30 minutes

Examination period: same winter term

In addition, mandatory but ungraded: none

Primary faculty responsible for the module: Dr. Ulrike Sienknecht

Additional teachers in the module: Prof. Hans Gerd Nothwang, Prof. Christine Köppl

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Required reading:

Several selected scientific papers, for the seminar (selection varies)

Recommended textbook(s) or other literature:

Gilbert S.F.: Developmental Biology, Macmillan Publishers Ltd, 10th edition 2014

Maximum number of students: 20 (in total with 5.02.841)

Registration procedure / selection criteria: StudIP, sequence of registration

Required previous credits from: none

Recommended previous knowledge / skills: organismic biology, developmental biology, evolutionary biology, neurobiology, genetics, molecular biology

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Interrelations with other modules:

Recommended in combination with: neu120 "Lab Exercises in Development and Evolution"

Shared course components with (cannot be credited twice):

bio840 (5.02.841 - Einführung in die Entwicklungsbiologie und Evolution)

neu120 Lab Exercises in Development and Evolution

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 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 notebook
• know how to carry out formal laboratory reports (and the anatomy of a scientific paper)

Module content:

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.

Introduction to current methods in biomedical and molecular developmental biology and genetics according to the individual supervisor's actual lab routines (Sienknecht, Nothwang).

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

Time frame: weeks 5-7 of winter term, full-time

Course components and workload:

4 SWS Supervised exercise (UE)

Total workload 180 h: 90 h contact / 40 h background reading / 50 h report writing

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: report

Examination period: same winter term

In addition, mandatory but ungraded:

Primary faculty responsible for the module: Dr. Ulrike Sienknecht

Additional teachers in the module: Prof. Hans Gerd Nothwang

Required reading:

Recommended textbook(s) or other literature:

Gilbert S.F., Development, Macmillan Publishers Ltd, 10th edition 2014; Mathews W.W & Schoenwolf G.C., Atlas of Descriptive Embryology, Prentice-Hall Inc., Simon & Schuster, 5th edition 1998

Maximum number of students: 12

Registration procedure / selection criteria: StudIP; required previous credits, sequence of registration

Required previous credits from: neu110 BM "Development and Evolution"

Recommended previous knowledge / skills: organismic biology, evolutionary biology, neurobiology, genetics, molecular biology, experience with lab work

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Interrelations with other modules:

Recommended in combination with: neu570 RM "Development and Evolution of the Auditory System"

Shared course components with (cannot be credited twice):

bio840 (5.02.842 - Praktische Übungen Entwicklungsbiologie und Evolution)

neu170 Molecular Genetics and Cell Biology

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

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

Module content:

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

Exercises: Learning current methods of human genetics, cellular and molecular neurobiology; introduction to cell cultivation techniques.
- DNA extraction and agarose gel analysis
- Sanger sequencing and sequence analysis
- PCR-based techniques
- bioinformatic analysis of high throughput data
- cell culture
- gene therapy of dominant diseases

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

Time frame: 7 weeks full-time, first half of winter term

Course components and workload:

2 SWS Lecture (VO)

Total workload 90 h: 24 h contact / 66 h exam preparation and backgroud reading

2 SWS Seminar (SE)

Total workload 90 h: 30 h contact / 60 h literature reading and preparation of the presentation

6 SWS Supervised exercise (UE)

Total workload 270 h: 120 h contact / 150 h protocol preparation and background reading

SWS

Total workload 0 h: h contact /

Type of examination: 70% written exam, 30% presentation(s)

Examination period: same winter term

In addition, mandatory but ungraded: Regular active participation, accepted reports and a paper discussion.

Primary faculty responsible for the module: Prof. John Neidhardt

Additional teachers in the module: Prof. Karl-Wilhelm Koch, Prof. Kathrin Thedieck

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Required reading:

Several selected scientific papers for the seminar (selection may vary)

Recommended textbook(s) or other literature:

Textbooks of Molecular Cell Biology; Alberts, Molecular biology of the cell

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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: Basic knowledge of Cell Biology, Genetics, Biochemistry

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Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

bio600 Molekulargenetik und Zellbiologie

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):

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):

neu190 Biochemical concepts in signal transduction

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

Module content:

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

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

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

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

Time frame: 7 weeks full-time, second half of winter term

Course components and workload:

1 SWS Lecture (VO)

Total workload 45 h: 15 h contact / 30 h background reading

1 SWS Seminar (SE)

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

8 SWS Supervised exercise (UE)

Total workload 360 h: 160 h contact / 140 h reading, analysing data and preparing the protocol/ 60 h exam preparation

SWS

Total workload 0 h: h contact /

Type of examination: 50% written exam of 90 min., 50% report(s)

Examination period: within 2 months after the end of the course

In addition, mandatory but ungraded: Regular active participation and seminar presentation(s)

Primary faculty responsible for the module: Prof. Karl-Wilhelm Koch

Additional teachers in the module: Dr. Alexander Scholten

Required reading:

Current reviews on topics of signal transduction as preparation for the presentation in the Seminar; list of reviews will be adjusted every year;

Recommended textbook(s) or other literature:

Textbooks of cell biology and biochemistry.
Alberts et al., Molecular Biology of the Cell, 5th edition or later; Stryer, Biochemistry, 7th edition or later; these textbooks are updated almost every 3 or 4 years.
Current literature on topics of signal transduction (as announced in the preparatory meeting).

Maximum number of students: 20

Registration procedure / selection criteria: StudIP; sequence of registration

Required previous credits from:

Recommended previous knowledge / skills: Basic knowledge of Cell Biology and Biochemistry

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Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

bio690 Biochemische Konzepte der Signaltransduktion

neu210 Neurosensory Science and Behaviour: Part A

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: neu220 BM "Neurosensory Science and Behaviour: Part B" and neu540 RM "Neural Basis of Perception", neu410 RM "Auditory Neuroscience

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 Neurosensory Science and Behaviour: Part B

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: neu210 BM "Neurosensory Science and Behaviour: Part A", neu270 BM "Neurocognition and Psychophysics

Shared course components with (cannot be credited twice):

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

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):

neu140 Neurophysiology

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: 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 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 ion channels, retinal physiology and the invertebrate neuronal system
- have practiced to generate a scientific hypothesis and choose suitable methods
- are able to critically evaluate and discuss experimental results

Module content:

The background module Neurophysiology consists of one week of theoretical introduction and three weeks of hands-on lab exercises on two electrophysiological techniques (intracellular and either patch or extracellular recordings).

The seminars cover the following topics:
- Introduction to electrophysiological methods
- Ion channels and transporters
- Visual system
- Invertebrate neuronal system
- Neural coding
- Analysis of spikes
- Analysis of graded potentials
- Comparison of electrophysiological methods

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

Time frame: First four weeks of summer semester

Course components and workload:

1 SWS Lecture (VO)

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

0,5 SWS Seminar (SE)

Total workload 23 h: 15 h contact / 8 h literature reading and preparation of results presentation

4,5 SWS Supervised exercise (UE)

Total workload 203 h: 150 h contact / 55 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 term, 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. Jutta Kretzberg

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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: 16

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: neu150 BM "Neuroanatomy"

Shared course components with (cannot be credited twice):

bio620 Grundmodul Neurobiologie

neu150 Neuroanatomy

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: 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 fundamental 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 (introduction into the use of FIJI and Photoshop)
+ are able to prepare results in a publishable format
+ are able to critically evaluate, describe and discuss experimental results

Module content:

The background module Neuroanatomy includes 15 h lectures and 15 h seminars covering the following topics:

+ Introduction into morphology of the mammalian brain and retina
+ morphology of chemical and electrical synapses and their function in neurotransmission in the brain and retina
+ retinal circuits important for night-vision and light-adaptation
+ introduction into methods used in neuranatomy and neurochemistry
+ introduction into microscopy and image analysis
+ presentation and discussion of results relating to the literature

and hands-on lab exercises of 3 weeks (24 h each neuroanatomical experiments in small groups on vertebrate retina and brain)

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

Time frame: week 5-7 of summer term, full-time

Course components and workload:

1 SWS Lecture (VO)

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

1 SWS Seminar (SE)

Total workload 45 h: 15 h contact / 30 literature reading, writing short reports

2 SWS Supervised exercise (UE)

Total workload 90 h: 72 h contact / 18 h microscopy, image analysis,

SWS

Total workload 0 h: h contact /

Type of examination: Portfolio consisting of short tests and short reports (75%), report (25%)

Examination period: summer semester, first half

In addition, mandatory but ungraded: Regular active participation and presentation(s) within the scope of the seminar

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Primary faculty responsible for the module: Prof. Dr. Ulrike Janssen-Bienhold

Additional teachers in the module: PD. Dr. Karin Dedek

Required reading:

L. Squire et al. : Fundamental Neuroscience, Fourth Edition, Academic Press, 2012
http://webvision.med.utah.edu/ (H.Kolb et al (2016): The organization of the retina and visual system)
Script, which will be provided in StudIP

Recommended textbook(s) or other literature:

J.L. Wilkinson: Neuroanatomy for medical students, Butterworth-Heinemann, 1998
http://library.med.utah.edu/WebPath/HISTHTML/HISTOTCH/HISTOTCH.html
http://library.med.utah.edu/WebPath/HISTHTML/NEURANAT/NEURANCA.html
http://library.med.utah.edu/WebPath/HISTHTML/MANUALS/MANUALS.html
selected articles: retinal circuitry, gap junctions, ribbon synapses

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Maximum number of students: 16 (in total with bio620)

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

Required previous credits from:

Recommended previous knowledge / skills: cell biology, neurophysiology

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Interrelations with other modules:

Recommended in combination with: neu140 BM Neurophysiology

Shared course components with (cannot be credited twice):

bio620 Grundmodul Neurobiologie

neu310 Psychophysics of Hearing

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 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 8-14 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):

bio640

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

neu410 Auditory Neuroscience

Study program: Master of Science
Subject: Neuroscience
Module category: Research Module
type: compulsory elective
Semester: flexible
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 independent, experimental research in auditory sensory physiology. May serve as preparation for a Master thesis.

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

Module content:

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

The introductory course is followed by 6 weeks of small-group laboratory-based projects, participating in the supervisor's ongoing research. This includes experimental work, data analysis, literature study, participation in the group seminar and in a poster presentation of concurrent Research Modules.
There are three options for the lab projects:
Option 1: Cochlea and auditory brainstem (Köppl)
Option 2: Auditory cortex (Hildebrandt)
Option 3: Central auditory mechanisms (Klump)

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

Time frame: 1 week full-time in summer term + equiv. of 6 weeks full-time with flexible timing

Course components and workload:

1 SWS Lecture (VO) "Fundamentals of Auditory Physiology"

Total workload 45 h: 15 h contact / 30h background reading

1 SWS Seminar (SE) "Fundamentals of Auditory Physiology"

Total workload 45 h: 15 h contact / 15h literature reading / 15h preparation of presentation

8 SWS Research Internship (IFP) Option 1 or 2 or 3

Total workload 360 h: 120 h contact / 130 h indep. lab work / 40 h lit. reading / 30 h group seminar / 40 h internship report, poster

SWS

Total workload 0 h: h contact /

Type of examination: Internship report

Examination period: within two months after completion of experimental work

In addition, mandatory but ungraded: 1 paper pres. in seminar, 1 project pres. in group seminar, 1 poster pres.

Primary faculty responsible for the module: Prof. Christine Köppl

Additional teachers in the module: Prof. Georg Klump, Prof. Jannis Hildebrandt

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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: 6

Registration procedure / selection criteria: StudIP, final acceptance after personal discussion of project

Required previous credits from: none

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

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Interrelations with other modules:

Recommended in combination with: BM neu210 "Introduction to Neurosensory Science and Behaviour: Part A" or BM neu270 "Neurocognition and Psychophysics"

Shared course components with (cannot be credited twice):

neu470 Molecular Sensory Neuroscience

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: 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

For students putting emphasis on cell biological, molecular biological, genetic, biochemical and/or neurobiological fields. The module can serve the purpose of preparing for a Master's thesis.

Upon successful completion of this course, students

have an advanced knowledge in molecular cell biology
have acquired methodological and experimental skills in molecular cell biology
have an advanced knowledge of how to perform research projects
have advanced skills in presenting and discussing scientific data they have obtained, analysed and put in a wider framework of a current scientific topic.

Module content:

Theory and practice of topics related to issues in molecular sensory neuroscience; independent treatment of an individual project; acquiring an advanced theoretical knowledge in selected fields of the molecular biology of the cell (points of emphasis: genetics, biochemistry, cell biology; topics depending on working groups).

There are several options for the lab projects, in the broad categories of:
1. Protein function in neurosensory signaling (Koch)
Heterologous expression in cell cultures of a protein involved in visual transduction or magnetoreception

2. Neurosensory genetics (Nothwang)

3. Metabolic signalling networks (Thediek)

4. Human genetics: mutation identification, pathogenic processes and therapy development (Neidhardt)

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

Time frame: 7 weeks full day; time is flexible and subject to individual arrangement.

Course components and workload:

10 SWS Research Internship (IFP)

Total workload 450 h: 50 h contact / 200 h laboratory work / 100 h background reading / 100 h exam 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: oral exam, 30 min. Cell Biol., Genetics or Biochem., depend. on option chosen

Examination period: as agreed; usually within 2 months of the conclusion of lab work

In addition, mandatory but ungraded: accepted internship report and participation in a joint poster presentation of concurrent research modules

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Primary faculty responsible for the module: Prof. Karl-Wilhelm Koch

Additional teachers in the module: Prof. Hans Gerd Nothwang, Prof. Kathrin Thedieck, Prof. John Neidhardt, Dr. Anna-Maria Hartmann

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Required reading:

Specific literature of the topics indicated above; original papers related to the current research question; will be different for every student and every year.

Recommended textbook(s) or other literature:

Textbooks of Cell Biology, Biochemistry, Genetics:
Alberts et al. Molecular Biology of the Cell (5 th Edition or later); Stryer Biochemistry (7th Edition or later); Lehninger Biochemistry (4th Edition or later). These textbooks are updated almost every 3 or 4 years.

Maximum number of students: 12 (in total with bio680)

Registration procedure / selection criteria: StudIP; sequence of registration

Required previous credits from:

Recommended previous knowledge / skills: Basic knowledge of Cell Biology, Genetics, Biochemistry

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Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):

bio680 Molekulare Neurosensorik

neu540 Neural Basis of Perception

Study program: Master of Science
Subject: Neuroscience
Module category: Research Module
type: compulsory elective
Semester: flexible
Cycle: annually
Teaching language: English
Recommended in semester: 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 presentation and discussion of backgrounds and results in the lab seminar
- write a scientific report
- prepare and present a scientific poster

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

Module content:

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

Comments: - Please note that different options have mandatory course components at different times.
- Priority for admission is given to students who attended at least one of the background modules listed as "recommended in combination with"
- Participation in a joint poster presentation of concurrent research modules is highly recommended.

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

Time frame: equiv. of 7 weeks full-time, flexible timing; !! Options 1 and 3 have non-flexible comp.

Course components and workload:

1 SWS Lecture (VO)

Total workload 45 h: 20 h contact / 25 h individual revision of lecture contents and background reading

1 SWS Seminar (SE)

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

8 SWS Research Internship (IFP)

Total workload 360 h: 210 h contact / 30 h background reading / 90 h written report / 30 h poster preparation

SWS

Total workload 0 h: h contact /

Type of examination: Internship report

Examination period: within 2 months after completion of experimental work

In addition, mandatory but ungraded:

Primary faculty responsible for the module: Prof. Jutta Kretzberg

Additional teachers in the module: Prof. Georg M. Klump, Prof. Henrik Mouritsen, Prof. Michael Winklhofer

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Required reading:

will be given to students depending on project

Recommended textbook(s) or other literature:

Option 1: Berthold P, Gwinner E, Sonnenschein (2003) Avian Migration. Springer.
Option 2: Nichols JG et al. (2001) From Neuron to Brain. Sinauer.
Option 3: Pickles JO (2012) An Introduction to the Physiology of Hearing. Brill.

Maximum number of students: 10

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

Required previous credits from:

Recommended previous knowledge / skills: Fundamentals of Neurosensory Science and Behavioural Biology. Priority for admission is given to students who attended at least one of the background modules listed as "recommended in combination with"

Interrelations with other modules:

Recommended in combination with: neu210 BM "Introduction to Neurosensory Science and Behaviour:Part A", neu220 BM "Introduction to Neurosensory Science and Behaviour: Part B" or neu270 BM "Neurocognition and Psychophysics" or neu140 BM "Neurophysiology" or neu240 BM "Computational Neuroscience - Introduction"

Shared course components with (cannot be credited twice):

5.02.641 "Navigationsmechanismen bei nachtziehenden Zugvögeln" (Option 1)

neu440 Visual Neuroscience

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: 2 / 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

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

Module content:

1. Independent performance of an individual research project in small groups. Dates are individually arranged with the respective supervisor. Available project topics will be presented in the pre-meeting. Methods include:
Option 1: Molecular Neuroscience
Option 2: Neuroanatomy
Option 3: Neurophysiology

2. Participation in the "Journal club" seminar, including presentation of the project and the results obtained.

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

Time frame: equiv. of 7 weeks full-time with flexible timing

Course components and workload:

2 SWS Seminar (SE)

Total workload 90 h: 35 h contact / 55 h literature reading

8 SWS Research Internship (IFP)

Total workload 360 h: 90 h contact / 180h indep. lab work incl data analysis, 30h literature reading, 60h internship report

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: Internship report

Examination period: flexible, after individual project

In addition, mandatory but ungraded: Regular active participation and presentation(s) within the scope of the seminar

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Primary faculty responsible for the module: Prof. Dr. Ulrike Janssen-Bienhold

Additional teachers in the module: PD Dr. Karin Dedek, Prof. Dr. Martin Greschner

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Required reading:

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

Recommended textbook(s) or other literature:

+ J.E. Dowling (2012) The Retina- An approachable Part of the Brain, Revised Edition, Harvard University Press
+ R.W. Rodieck (1998) The first steps in seeing, Sinauer Associates, Inc.

Maximum number of students: 10 (in total with bio630)

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

Required previous credits from:

Recommended previous knowledge / skills: priority is given to students who attended neu140 "Neurophysiology" or neu150 "Neuroanatomy"

Interrelations with other modules:

Recommended in combination with: neu140 BM Neurophysiology and neu150 BM Neuroanatomy

Shared course components with (cannot be credited twice):

neu510 Computation in Sensory Systems

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 presentation and discussion of backgrounds and results in the lab seminar
- write a scientific report
- prepare and present a scientific poster

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

Module content:

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

In options 1-4, depending on the student's interests and background, projects can be focussed on
- experiments (neurophysiology / behavior)
- simulation
- data analysis or
- combinations of these approaches

Comments:
- The timing of individual projects can be discussed with the supervisor. Projects can also be scheduled during semester breaks, part-time options (lasting more than 7 weeks) are available.
- priority for admission to the module is given to students who passed comptuational neuroscience background modules (neu240 / neu250)
- Participation in a joint poster presentation of concurrent research modules is highly recommended.

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

Time frame: flexible timing, part-time options are available

Course components and workload:

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

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

9 SWS Research Internship (IFP)

Total workload 405 h: 245 h contact / 40 h background reading / 90 h written 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: flexible, 6 weeks after individual project

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, Prof. Dr. Jochem Rieger

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Required reading:

Will be given to the students depending on the project

Recommended textbook(s) or other literature:

Will be given to the students depending on the project

Maximum number of students: 12

Registration procedure / selection criteria: StudIP; attendance in pre-meeting, see comments above

Required previous credits from:

Recommended previous knowledge / skills: Programming experience is helpful for many of the projects. Priority for admission is given to students who passed neu240 and/or neu250

Interrelations with other modules:

Recommended in combination with: neu240 BM Computational Neuroscience - Introduction and / or neu250 BM Computational Neuroscience - Statistical Learning

Shared course components with (cannot be credited twice):

psy260 Practical Project (for option 4)

neu570 Development and Evolution of the Auditory System

Study program: Master of Science
Subject: Neuroscience
Module category: Research Module
type: compulsory elective
Semester: winter term, second half
Cycle: annually
Teaching language: English
Recommended in semester: 1 / 2 / 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

Introduction to independent, experimental research in developmental biology and evolution of the auditory system. May serve as preparation for a Master thesis.

Upon successful completion of this course, students
• have a broad knowledge on aspects of comparative developmental biology of the auditory system in vertebrates including: inner ear morphogenesis, histogenesis of the peripheral and central auditory system, and molecular genetic mechanisms of cell fate specification, differentiation, synaptogenesis, and axon guidance
• have basic knowledge of the large range of techniques used in modern developmental biology
• are able to read and critically report to others on an original research paper in auditory system research
• have in-depth knowledge on a specific research question in auditory system development
• are able to discuss current hypotheses and controversies regarding their research question
• are able to identify possible medical implications of their research question
• are able to perform experiments addressing their research topic and can describe the principles and the pros and cons of the experimental technique used
• are able to critically evaluate and discuss experimental results

Module content:

One week introductory block course "Fundamentals of Auditory and Vestibular Development and Evolution", comprised of a lecture series and matching seminar that emphasizes discussion.
Topics:
• Auditory and vestibular sensory organ development in different vertebrate groups, such as birds, mammals, and lizards
• Development of the central auditory system in vertebrates
• Differentiation of hair cell types
• Gene regulatory networks in auditory development
• Comparative aspects of inner ear development, middle ear development, and auditory pathway development - highlighting the deep link between development and evolution
• Medical implications of studies in molecular developmental biology of the auditory and vestibular system

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

There are three options for the lab projects:
Option 1: Molecular development and evolution of the peripheral auditory system (Sienknecht)
Option 2: Molecular development and evolution of the central auditory system (Nothwang)
Option 3: Comparative studies of the peripheral or central auditory system (Köppl)

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

Time frame: 1 week full-time introductory course + 6 weeks full-time lab with flexible timing

Course components and workload:

9 SWS Research Internship (IFP) Option 1 or 2 or 3

Total workload 405 h: 130 h contact / 135 h indep. lab work / 50 h lit. reading / 40 h group seminar / 50 h internship report, poster

0,5 SWS Lecture (VO) "Fundamentals of Auditory Development and Evolution"

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

0,5 SWS Seminar (SE) "Fundamentals of Auditory Development and Evolution"

Total workload 23 h: 10 h contact / 13h literature reading

SWS

Total workload 0 h: h contact /

Type of examination: Portfolio: 60% presentation, 40% internship report (paper or poster format)

Examination period: within 2 months after completion of experimental work

In addition, mandatory but ungraded:

Primary faculty responsible for the module: Dr. Ulrike Sienknecht

Additional teachers in the module: Prof. Hans Gerd Nothwang, Prof. Christine Köppl

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Required reading:

Selected original papers and overview articles (selection varies)

Recommended textbook(s) or other literature:

Springer Handbook of Auditory Research (SHAR) (book series; selected chapters will be indicated); Sanes et al. (eds.) Development of the Nervous System, Academic Press, 2010

Maximum number of students: 6

Registration procedure / selection criteria: StudIP; sequence of registration

Required previous credits from:

Recommended previous knowledge / skills: organismic biology, developmental biology, evolutionary biology, neurobiology, genetics, experience with lab work

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Interrelations with other modules:

Recommended in combination with: neu120 BM "Lab Exercises in Development and Evolution"

Shared course components with (cannot be credited twice):

bio850 Vertiefungsmodul - Entwicklungsbiologie und Evolution des auditorischen Systems

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 joint poster presentation of concurrent research modules is 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:

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: 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

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: Active participation in a scientific conference, workshop, summer school etc:
Participation in a scientific conference, workshop, summer school etc. lasting a minimum of 3 full days can be credited with 3 ECTS, if the student presents own scientific results (poster, talk) obtained, e.g., in a research module or Master thesis.

- Option 4: Participation in at least 20 scientific presentations (e.g. IBU / DfN colloquium, Hanse lecture neuroscience) and submission of a short (1 page) written summary of each talk.

- For other individual options (e.g. teaching in neuroscience) ask the module organizer.

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

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):

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):

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)

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

neu mam Master Thesis

Study program: Master of Science
Subject: Neuroscience
Module category: Thesis Module
type: compulsory
Semester: flexible
Cycle: annually
Teaching language: English
Recommended in semester: 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 final module of their degree, students demonstrate their ability
- to work independently (with guidance from an expert supervisor) on a specific research question
- to explain the background of their research question in written and spoken format
- to present and critically discuss their results in written and spoken format

Module content:

The major part of the module is the thesis work which includes background reading, formulating a hypothesis, carrying out appropriate experiments and/or modelling, and data analysis. Finally, the work is presented as a written thesis, according to international standards in the natural sciences.
The thesis work is accompanied by a colloquium where students present their inital study design and again their results upon completion of the thesis work.

Total credit points: 30 CP (equivalent 20 SWS, 900 hours workload)

Time frame: flexible

Course components and workload:

18 SWS Thesis work

Total workload 810 h: 30 h contact / 620h self-organized thesis work / 160h thesis writing

2 SWS Seminar (SE)

Total workload 90 h: 30 h contact / 60h literature reading and preparation of presentations

SWS

Total workload 0 h: h contact /

SWS

Total workload 0 h: h contact /

Type of examination: Master thesis (90%), Results colloquium (10%)

Examination period: within 3 months of thesis submission

In addition, mandatory but ungraded:

Primary faculty responsible for the module: Prof. Christine Köppl

Additional teachers in the module: all Neuroscience faculty

Required reading:

project-specific

Recommended textbook(s) or other literature:

project-specific

Maximum number of students: individual project

Registration procedure / selection criteria: manual registration through supervisor

Required previous credits from: minimum of 60 CP acquired towards the Master degree in Neuroscience

Recommended previous knowledge / skills:

Interrelations with other modules:

Recommended in combination with:

Shared course components with (cannot be credited twice):