Module Descriptions

Master of Science Molecular and Translational Neuroscience

Examination Regulations in the Version of: 2015
Index

Master Thesis

Master's Thesis 1

Compulsory Modules

Advanced Molecular and Translational Neuroscience 3
Molecular and Translational Neuroscience 6
Neurobiology - Master 8
Neurological/Psychiatric Diseases I 10

Advanced Methods

Advanced Methods in Molecular and Translational Neuroscience 13

Optional Modules

Basics of Stress Physiology 15
Biomolecular Systems in Psychiatric Disorders 17
Brain Imaging and Neuroanatomy 19
European Patent Law 21
Introduction to Human Neurophysiology 23
Introduction to Human Neuroanatomy 25
Medical Products 27
Neural Networks in Health and Disease 29

Compulsory Elective Modules I

Advanced Neurobiology

Advanced Neurobiology 31

Medical Neuroscience and European Patent Law

European Patent Law 33
Medical Neuroscience II 35
Medical Products 38

Compulsory Electives Modules II

Translational Neuroscience

From Basic Research to Product 40
Clinical Trials 43
Neurological/Psychiatric Diseases II 46

Behavioral Physiology

Behavioral Physiology 49
**Master's Thesis**  
Modules referring to Master Thesis

<table>
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<td>Duration</td>
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<td>Cycle</td>
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<tr>
<td>Coordinator</td>
<td>Dean of studies</td>
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<td>Instructor(s)</td>
<td>Supervising professor</td>
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<tr>
<td>Allocation of study programmes</td>
<td>Molecular and Translational Neuroscience MSc, start of studies: winter semester, compulsory module, 4th study semester</td>
</tr>
</tbody>
</table>
| Recommended prerequisites | Formally: Refer to the subject-specific examination regulations of the respective study course, in the version effective when taking up the study program.  
Contentually: Corresponding compulsory and compulsory elective modules of the study course. |
| Learning objectives | Students who have successfully completed this module  
- are able to elaborate on a scientific question from the field of biology on the basis of known technologies and document their results (in writing and oral presentation) in accordance with the Guidelines of Research Integrity and Good Scientific Practice.  
- are able to present a research project in the scientific context and to discuss their methods and approaches in the broader scientific community.  
- plan further research and additional investigations on the basis of the results achieved and knowledge gained.  
- act in compliance with the effective health, safety and environmental regulations.  
- have learned common methods of literature research, data administration and data processing.  
- have acquired soft skills like team-work, intercultural capacities and adequate time-management. |
### Syllabus

This module covers the following subject-specific topics:

- Common methods of literature research, data administration and data processing
- Experimental design, setup, documentation
- Interpretation of results in the context of topical scientific literature
- Discussion of results in the broader scientific community
- Implementation of results into new approaches
- Critical analysis of methods
- Guidelines of scientific publishing
- Safety, health and environmental protection, hazard exposure assessment, animal protection
- Time management
- Team work
- Self-organization

### Literature

Subject-specific literature

### Teaching and learning methods

Master thesis (Masterarbeit), 30 credit hours, 30 credit points

### Workload

- Attendance: 450 h
- Private study: 450 h
- Sum: 900 h

### Assessment

*not specified*

### Grading procedure

*not specified*

### Basis for

Graduation master program
## Advanced Molecular and Translational Neuroscience

Modules referring to Compulsory Modules

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<tr>
<td>Cycle</td>
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<tr>
<td>Coordinator</td>
<td>Jun. Prof. Dr. Andreas Grabrucker</td>
</tr>
<tr>
<td>Instructor(s)</td>
<td>Jun. Prof. Dr. Grabrucker, N/A</td>
</tr>
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</table>

### Allocation of study programmes

- Molecular and Translational Neuroscience

### Recommended prerequisites

- Introduction to Molecular and Translational Neuroscience

### Learning objectives

In the lecture, students should get practical information for translational research. Students should understand valuable case studies of translational neuroscience in action, and methods ranging from transcranial magnetic stimulation to neuroimaging and the use of animal models. Furthermore, students should understand how future generations of translational neuroscientists can utilize the full spectrum of techniques at hand.

In the seminar the major focus is to learn and discuss about scientific methods/techniques and new findings in the field of translational neuroscience. Literature will be chosen from scientific journals (mainly Impact factor >10), such as Nature Neuroscience, Science, etc.. The responsible lecturers will provide assistance in understanding the data and offer consultation time.

After the practical training students should summarize their data in a written report and critically discuss published data related to their project. The practical training will enable insights into current methods in translational Neuroscience and provide hands-on experience.

In the excursion, students should get a real life experience of methods, challenges and opportunities for translational Neuroscience in a commercial background. After the excursion, students will give short presentations to selected topics discussed during the excursion with discussion afterwards. No english version available yet.
Syllabus

- Neuroimaging in translational Neuroscience
  - Magnetic Resonance Imaging as a tool for modeling drug treatment of CNS disorders
  - Structural Magnetic Resonance Imaging for diagnoses
  - Positron Emission Tomography in Alzheimer’s Disease
  - Functional Magnetic Resonance Imaging as Biomarker tool

- Animal models for CNS drug discovery
  - Challenges for Psychopharmacology Research
  - Developing new drugs – from animal to the clinic
  - Animal models for brain disorders (Bipolar Disorder, Autism, Alzheimer, ADHD, Epilepsy, Sleep Disorders, etc.)

- Electrophysiology in translational Neuroscience
  - patch clamp recordings
  - magnetoencephalography

- Drug discovery in translational Neuroscience
  - genetic approaches – screenings
  - cellular approaches (cell models and high throughput analysis)

Seminar translational Neuroscience:

This seminar will present current research findings in the field of translational Neuroscience. Students will give Journal Clubs with discussion afterwards.

Practical training translational Neuroscience:

In the practical training students will learn the analysis of various readout systems used in drug screening approaches.

- Cell health analysis (detection of apoptosis)
  - via Western Blot analysis
  - fluorescence microscopy

- gene expression profiling
  - qRT-PCR

- protein expression profiling
- use of cell lines
  - stem cells and cell lines

- application of drugs and establishment of LD50 values
<table>
<thead>
<tr>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Translational Neuroscience: A Guide to a Successful Program von Edgar Garcia-Rill</td>
</tr>
<tr>
<td>• Animal and Translational Models for CNS Drug Discovery von Robert A. McArthur und Franco Borsini</td>
</tr>
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<tr>
<td>Teaching and learning methods</td>
</tr>
<tr>
<td>Lecture, Seminar and practical training</td>
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<tr>
<td>Workload</td>
</tr>
<tr>
<td>2 SWS lecture, 2 SWS Seminar, 12 SWS Practical training, 1 SWS Excursion</td>
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<tr>
<td>Basis for</td>
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# Molecular and Translational Neuroscience

Modules referring to Compulsory Modules

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<td>Language of instruction</td>
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<tr>
<td>Duration</td>
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<td>Cycle</td>
<td>each Winter Semester</td>
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<tr>
<td>Coordinator</td>
<td>Prof. Dr. Leda Dimou</td>
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<tr>
<td>Instructor(s)</td>
<td>Prof. Dr. Leda Dimou</td>
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</table>

## Allocation of study programmes

Molecular and Translational Neuroscience MSc., start of studies: winter semester, compulsory module, 1st semester

## Recommended prerequisites

none

## Learning objectives

Students who have successfully completed this module, will

- understand the major classes of brain disorders
- learn the most common therapeutic approaches
- acquire a comprehensive disorder-focuses perspective of translational Neuroscience, especially on the molecular level

## Syllabus

The module covers the following topics:

- Translational Neuroscience – definition and concept
- Brain disorders – diagnosis
- (Epi)genetic vs. environmental mechanisms in CNS disorders
- Patients studies, patient selection, biomarkers
- In vitro models for translational neuroscience
- In vivo models for translational neuroscience
- Characterization of in vitro and in vivo models for MTN
- Drug development
- Clinical trials
- Translational approaches
<table>
<thead>
<tr>
<th><strong>Literature</strong></th>
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<tbody>
<tr>
<td><strong>Teaching and learning methods</strong></td>
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<td><strong>Workload</strong></td>
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<td>Private study: 62 h</td>
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<td>Sum: 90 h</td>
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<td>The credit points will be awarded once the written or oral exam has been passed (depending on the number of participants). The type of examination will be announced in time - at least 4 weeks prior to the date of the exam. No prerequisites are necessary for exam registration.</td>
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<tr>
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<td>Advanced Molecular and Translational Neuroscience</td>
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Neurobiology - Master
Modules referring to Compulsory Modules

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<td>Duration</td>
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<td>Cycle</td>
<td>each Winter Semester</td>
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<tr>
<td>Coordinator</td>
<td>Prof. Dr. Harald Wolf</td>
</tr>
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<td>Instructor(s)</td>
<td>PD Dr. Stefan Jarau, Prof. Dr. Harald Wolf</td>
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Allocation of study programmes
- Biology MSc, start of studies: winter semester, compulsory module, 1st study semester
- Molecular and Translational Neuroscience MSc, start of studies: winter semester, compulsory elective module, 1st study semester

Recommended prerequisites
Formally: Refer to the subject-specific examination regulations of the respective study course, in the version effective when taking up the study program.
Contentually: None; preferably basic knowledge in neurobiology from bachelor program.

Learning objectives
Students who have successfully completed this module
- have basic knowledge of structural and functional properties of the nervous systems in animals and humans.
- have acquired good knowledge of synaptic processes and their pharmacology, and of neurotransmitters and their receptors.
- have gained an understanding of sensorimotor transitions, general motor control, structure and function of sense organs, neural mechanisms of behavior control, including learning.

Syllabus
This module covers the following subject-specific topics:
- Overview of important structural and functional properties of nervous systems
- Synaptic transmission, effects of neurotransmitters and their receptors, intracellular cascades of signal transduction, synaptic processes of learning
Examples of sensory perception, processing and information representation in brains of different complexity; mechanisms of motor control in pattern generation and reflex regulation

<table>
<thead>
<tr>
<th>Literature</th>
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<tbody>
<tr>
<td>Reichert, H.: <em>Neurobiologie</em>, Thieme-Verlag, Stuttgart</td>
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<td>Modules Behavioral Physiology [Verhaltensphysiologie], Advanced Neurobiology [Spezielle Neurobiologie]</td>
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**Neurological/Psychiatric Diseases I**

**Modules referring to Compulsory Modules**

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<td>Coordinator</td>
<td>Dr. Althaus</td>
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**Instructor(s)**


**Allocation of study programmes**

Molecular and Translational Neuroscience

Students from the following study paths may enroll in this module: biochemistry, molecular biology, physiology and neurobiology, human medicine, pharmaceutical biotechnology

**Recommended prerequisites**

none

**Learning objectives**

This module gives students theoretical insight into current knowledge about principle mechanisms of physiologic function of the nervous system and pathology of neurological and psychiatric human diseases. Students are introduced to techniques of clinical diagnosis, neuropsychological examination and state of the art of neuroimaging.

After successful accomplishment of this module the students have knowledge about

- the functioning and interaction of the central- and peripheral-nervous system
- specific pathophysiological mechanisms involved in the pathogenesis of neurological / neurodegenerative and psychiatric diseases including disorders of the pyramidal motor and extrapyramidal motor system, dementia, neuromuscular diseases, neuroinflammation, networks of locomotion, schizophrenia, depression, stress and affective disorders
Students have the ability to ascribe clinical symptoms to its underlying pathomechanisms.

Syllabus

During the winter semester 32 hours of lectures (2 semester periods per week) will be given comprising:

- Introduction and Neurological Examination
- Peripheral nervous system and Cranial Nerves
- Function of the extrapyramidal and pyramidal motor system
- Brainstem function, coordination and cerebellum
- Mechanisms of neurodegenerative diseases
- Mechanisms of neurovascular diseases and neoplasies of the nervous system
- Mechanisms of neuromuscular disorders
- Mechanisms of neuroinflammation
- Neuroimaging
- Neuropsychology
- Psychiatric disorders and sytems neuroscience
- Neurocognitive Deficits in psychiatric disorders
- Dopamine and reward in schizophrenia
- Stress and affective disorders
- Molecular genetics of personality and psychiatric disorders
- final examination (MC)

Literature


exam relevant content:

Neurology: selected parts of „Oxford Handbook of Neurology“ 2nd revised edition; key slides from each lecture

Teaching and learning methods

lecture

Workload

2 SWS

Assessment

The grade of the module will be the grade of the written exam. No prerequisites are necessary for exam registration.

Grading procedure

The grade of the module will be the grade of the exam.

Basis for

Neurological/Psychiatric Diseases II
Advanced Methods in Molecular and Translational Neuroscience

Modules referring to Advanced Methods

Code 8830074028

ECTS credits 10

Attendance time 10

Language of instruction English

Duration 1 Semester Semester

Cycle each Winter Semester

Coordinator Jun. Prof. Dr. Andreas Grabrucker

Instructor(s) Mentors of the workgroups

Allocation of study programmes MSc Molecular and Translational Neuroscience, 3rd semester

Recommended prerequisites -

Learning objectives Students who have successfully completed this module,

• have detailed knowledge which modern working methods can be applied to the processing of typical questions in biology.

• have insight into current research topics.

• are able to familiarize themselves theoretically and methodologically in scientific issues.

• are able to handle results of the research work, summarize the results in protocols and present them to working group for discussion.

• are able to assess their own actions in the light of any applicable laws and regulations.

• have trained their team spirit.

Syllabus In this module, the following technical contents are conveyed:

• The Advanced Lab is carried out in a working group; the subject and scope of the project are set in consultation with the respective head of the Working
Group and are based on current issues from the research area of the supervising university teacher.

- Instructions for literature, literature management.
- Development of the theory of a scientific theme.
- Incorporation into specifically designed tasks required for resolution of the scientific problem.
- Deepening of already known methods, project-related.
- Resolution of the problem, taking into account any applicable laws, rules and regulations: labor law, environmental law, Ordinance on Hazardous Substances, possibly Laboratory Animal Science.
- The specified task is initially under the guidance, then processed independently.

**Literature**

subject specific literature

**Teaching and learning methods**

Advanced Methods in Molecular and Translational Neuroscience (P), 10 SWS, 10 LP

**Workload**

- Attendance: 150 h
- Preparation: 150 h
- Sum: 300 h

**Assessment**

The award of the credit points in the ungraded module is based on completion of the assignment (presentation). No prerequisites are necessary for exam registration.

**Grading procedure**

The module is not graded.

**Basis for**

MSc thesis
## Basics of Stress Physiology

### Code
- 8830074128

### ECTS credits
- 3

### Attendance time
- 2

### Language of instruction
- English

### Duration
- 1 Semester Semester

### Cycle
- each Summer Semester

### Coordinator
- Prof. Dr. rer. nat. Stefan Reber

### Instructor(s)
- Prof. Dr. rer. nat. Stefan Reber
- Dr. Dominik Langgartner, Sandra Förtsch

### Allocation of study programmes
- Molecular and Translational Neuroscience MSc, start of studies: winter semester, compulsory elective module, 2\textsuperscript{nd} study semester

### Recommended prerequisites
- Basic knowledge in physiology, endocrinology and immunology.

### Learning objectives

After successful completion of this module, students know:

- at least the milestones in the history in stress research
- the difference between stressor, stress perception, stress response and what happens during those procedures on a neuronal, neuroendocrine, physiological and behavioral level
- what the hypothalamus-pituitary-adrenal (HPA) axis and sympathetic nervous system (SNS) is, how those systems are anatomically located within an organism, and what happens during activation of these systems
- the difference between physical, psychological, social, acute, repeated and chronic stressors
- what is happening on a physiological level during stress adaptation
- why a lack of adaptation can be detrimental and how this is mediated
- what stress resilience and vulnerability is and how these are mediated/ influenced
- that stress not only changes physiology but also affect the immune system
- that stress-induced changes in the immune system are involved in development of stress-related somatic and affective disorders and how this is mediated
- how to read and present a scientific paper in front of an audience
<table>
<thead>
<tr>
<th><strong>Syllabus</strong></th>
<th>This module covers the following subject-specific topics: see learning objectives</th>
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</thead>
<tbody>
<tr>
<td><strong>Literature</strong></td>
<td>Literature will be given at the beginning of the lecture.</td>
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<tr>
<td><strong>Teaching and learning methods</strong></td>
<td>Combination of lecture and seminar</td>
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<td>Attendance: 28 h</td>
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<td>Private study: 62 h</td>
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<td>Sum: 90 h</td>
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<td><strong>Assessment</strong></td>
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<td>(depending on the number of participants). The type of examination will be</td>
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<td>announced in time - at least 4 weeks prior to the date of the exam. No</td>
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<tr>
<td><strong>Basis for</strong></td>
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## Biomolecular Systems in Psychiatric Disorders

Modules referring to Optional Modules

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<td>Language of instruction</td>
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<tr>
<td>Duration</td>
<td>1 Semester Semester</td>
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<tr>
<td>Cycle</td>
<td>each Summer Semester</td>
</tr>
<tr>
<td>Coordinator</td>
<td>Agnieszka Molisak, Prof. Iris-Tatjana Kolassa</td>
</tr>
<tr>
<td>Instructor(s)</td>
<td>Agnieszka Molisak, Prof. Iris-Tatjana Kolassa</td>
</tr>
</tbody>
</table>

### Allocation of study programmes

- **Master Psychologie**
- **Molecular and Translational Neuroscience MSc**, start of studies: winter semester, compulsory elective module, 2nd study semester

### Recommended prerequisites

- 

### Learning objectives

This seminar will focus on the biomolecular mechanisms involved in the etiology and pathophysiology of psychiatric disorders: In addition, the role of biological pathways affecting health and disease after chronic or traumatic stress as well as biological pathways underlying and involved in the success of treatments (medication or psychotherapy) will be of major importance

### Syllabus

Besides the discussion of the potential use of novel biomarkers as tools for diagnosis of psychiatric disorders, the methods used for their assessment and future applications such as potential treatment targets will be major topics. The following subjects will be addressed in the seminar:

- The main biological systems that are altered in psychiatric disorders
- Traumatic stress and its consequences on physical health
- Gene x Environment interactions in the etiology, pathophysiology and treatment of psychiatric diseases
- Transgenerational transmission of the consequences of psychological trauma exposure
- Psychoneuroendocrinology and psychoneuroimmunology
- The role of mitochondria in psychiatric diseases
- Biomarkers of premature aging after chronic and traumatic stress
- Mind-microbiota interactions
- Molecular pathways in dementia

In addition, students will improve the following skills:

- using tools for literature research
- critical discussion of research papers
- how to present complex scientific issues
- proper scientific writing

<table>
<thead>
<tr>
<th>Literature</th>
<th>You will be supplied with a list of scientific literature that will introduce you to the matter (research-highlights).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching and learning methods</td>
<td>Oral presentation + written summary</td>
</tr>
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</table>
| Seminar- Schedule | • 40-50 min. presentation of the chosen topic (when 2 students present the same day: each 20 mins)  
• 10-20 min. "active element" with the group  
• 20-30 min. discussion |
| Workload | Attendance: 28 h  
Private study: 62 h  
Sum: 90 h |
| Assessment | The award of the credit points for this ungraded module is based on regular attendance and completion of an assignment (presentation and paper). No prerequisites are necessary for exam registration. |
| Grading procedure | The grade of the module will be the grade of the exam. |
| Basis for | - |
Brain Imaging and Neuroanatomy
Modules referring to Optional Modules

Code 8830074129

ECTS credits 3

Attendance time 2

Language of instruction English

Duration 1 Semester Semester

Cycle each Summer Semester

Coordinator Prof. Dr. rer. nat. Volker Rasche

Instructor(s) Prof. Dr. rer. nat. Volker Rasche et. al.

Allocation of study programmes Molecular and Translational Neuroscience MSc, start of studies: winter semester, compulsory elective module, 2nd study semester

Recommended prerequisites -

Learning objectives Different methods of brain imaging
- PET
- fMRI
- MRT
To understand physiology, pathology and morphology of the brain

Syllabus This module covers the following subject-specific topics:
see Learning objectives

Literature -
<table>
<thead>
<tr>
<th><strong>Teaching and learning methods</strong></th>
<th>Lecture (2 SWS; 3 ECTS)</th>
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<tbody>
<tr>
<td><strong>Workload</strong></td>
<td>Attendance: 28 h</td>
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<tr>
<td></td>
<td>Private study: 62 h</td>
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<tr>
<td></td>
<td>Sum: 90 h</td>
</tr>
<tr>
<td><strong>Assessment</strong></td>
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## European Patent Law

### Modules referring to Optional Modules

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<td>Coordinator</td>
<td>Prof. Dr. Leda Dimou</td>
</tr>
<tr>
<td>Instructor(s)</td>
<td>Dr. Rainer Kränzle, Dr. Christian Beckmann</td>
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### Allocation of study programmes

- Molecular and Translational Neuroscience MSc, start of studies: winter semester, compulsory elective module, 1<sup>st</sup> study semester

### Recommended prerequisites

- Formally: Refer to the subject-specific examination regulations of the respective study course, in the version effective when taking up the study program.
- Contentually: None.

### Learning objectives

- Knowledge of the basics of European Patent Law

### Syllabus

- The module covers the following subject-specific topics:
  - Overview over different right for protecting intellectual property
  - The European Patent Office; Introduction to patents; Inventions and non-Inventions; Requirements for patenting; Biological and medical exceptions from patentability; Novelty and inventive step as conditions for patentability; Procedures at the European Patent Office; Formal structure of a patent application; The granting procedure at European Patent Office; Possible cancellations of a patent; The opposition procedure; The national nullity procedure
  - The right to the patent; The protective effect of a patent; Extend of the patent protection; Exhaustion of the protection; Patent infringement; Exceptions from the patent protection; The employee’s invention act; Protection of medical substances; First and Second Medical Indication; Supplementary Protection Certificate
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## Introduction to Human Neurophysiology

*Modules referring to Optional Modules*

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<td>Prof. Dr. Leda Dimou</td>
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<td>Instructor(s)</td>
<td>Prof. Dr. Leda Dimou</td>
</tr>
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### Allocation of study programmes
- Molecular and Translational Neuroscience MSc., start of studies: winter semester, compulsory module, 1st semester

### Recommended prerequisites
- None

### Learning objectives
- Students who have successfully completed this module, will
  - learn the basics in Human Neurophysiology
  - get the basic knowledge of functional properties of the central nervous system in humans
  - acquire knowledge of ion channels, neuronal properties, synapses, learning and memory, nociception as well as motor and sensory systems

### Syllabus
- The module covers the following topics:
  - ion channels
  - resting membrane potential and action potential
  - excitation of nerve and muscle
  - synapses (electric, chemical, pre-, post-synapse, synaptic cleft)
  - plasticity, learning and memory
  - muscle physiology
  - reflexes
  - autonomic nervous system
  - auditory system
  - visual system
  - nociception
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<tr>
<th><strong>Literature</strong></th>
<th>Several human neurophysiology books.</th>
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<td><strong>Assessment</strong></td>
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Introduction to Human Neuroanatomy
Modules referring to Optional Modules

**Code** 8830074311

**ECTS credits** 3

**Attendance time** 2

**Language of instruction** English

**Duration** 1 Semester

**Cycle** each Summer Semester

**Coordinator** Prof. Dr. Deniz Yilmazer-Hanke

**Instructor(s)** Prof. Dr. Deniz Yilmazer-Hanke

**Allocation of study programmes** Molecular and Translational Neuroscience MSc., start of studies: winter semester, compulsory module, 1st semester

**Recommended prerequisites** Contentually: None
Formally: Refer to the subject-specific examination regulations of the respective study course, in the version effective when taking up the study programme.

**Learning objectives** Students who have successfully completed this module, will
- demonstrate an understanding of fundamental principles in neurobiology and neural development
- have insight into cell types in nervous structures and their function
- be able to identify regions of the nervous system based on their topography
- demonstrate an understanding of neuronal systems and associate them with function

**Syllabus** During the winter semester 28 hours of lectures (2 hours of instruction per week) will be given comprising:
- Introduction to the Nervous System
- Brain development
- Repair and Regeneration
- Molecular Signaling within Neurons
- Spinal cord and nerve
- Brainstem and cranial nerves
- Diencephalic Structures
- Somatic Sensory System
- Acoustic and Vestibular Systems
- Visual System and Overview of Chemical Senses
- Somatic Motor System – Lower and Upper Motor Neuron Circuits
- Modulation of Movement – Basal ganglia and Cerebellum
- Eye Movements and Sensory Motor Integration
- Limbic System and Visceral Motor System
- Cerebral Cortex and Higher Cognitive Functions

**Literature**


**Teaching and learning methods**

Lecture

**Workload**

Attendance: 28 h
Private study: 62 h
Sum: 90 h

**Assessment**

The credit points will be awarded once the written or oral exam has been passed (depending on the number of participants). The type of examination will be announced in time - at least 4 weeks prior to the date of the exam. No prerequisites are necessary for exam registration.

**Grading procedure**

The grade of the module will be the grade of the exam.

**Basis for**

-
**Medical Products**  
*Modules referring to Optional Modules*

**Code**  
8830074026

**ECTS credits**  
3

**Attendance time**  
2

**Language of instruction**  
English

**Duration**  
1 Semester Semester

**Cycle**  
each Semester

**Coordinator**  
N/A

**Instructor(s)**  
Dr. Helmut Reitzle, Dr. Thomas Bräuner, Dr. Dieter Eckhardt, Dr. Karl Heinz Emmert, Dr. Armin Frey, Prof. Dr. Peter Gierschik, Dr. Udo Hartlaub, Dr. Thomas Kammermeier, Dr. Thomas Lamprecht, Dr. Eberhardt Landsbeck, Dr. Rainer Winstel

**Allocation of study programmes**

- Molecular and Translational Neuroscience MSc, start of studies: winter semester, compulsory module, 1st study semester
- Biology MSc, start of studies: winter semester, compulsory module, 1st study semester

**Recommended prerequisites**
none

**Learning objectives**
Arzneimittelseminar (Medical Products): students

- have knowledge of the drug development process generally, as well as chemical-pharmaceutical and pharmacological-toxicological level in particular by reference to appropriate legal regulations.
- have knowledge under what legal conditions new drugs are transferred into clinical adoption.
- have an idea of how clinical trials are constructed and how to interpret resulting data
- have knowledge in the areas of drug safety and authorization of medicines

**Syllabus**
Medical Products:
Introduction, history of drug development, overview of the process of drug development, regulations

Chemical-Pharmaceutical Development I: Drug Discovery

Chemical-Pharmaceutical Development II: Finished product development

Pharmacological-toxicological development I: Drug Discovery and preclinical development to first-in-man

Pharmacological-toxicological development II: Toxicology and safety pharmacology

Pharmacological-toxicological development III: Pharmacokinetics and Metabolism

Clinical examination: first application in humans to prove effectiveness and safety

Planning, implementation, standards and regulations

Drug information and labeling

Drug safety: basics

Drug safety: Structure and Risk Management

Biopharmaceutical medicines: development, manufacture, testing

Generics: quality, substitution

Authorization of medicinal products in Germany

Authorization of medicinal products in the EU

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Neural Networks in Health and Disease
Modules referring to Optional Modules

Code 8830074127

ECTS credits 3

Attendance time 2

Language of instruction English

Duration 1 Semester Semester

Cycle each Summer Semester

Coordinator Dr. Francesco Roselli

Instructor(s) Dr. Francesco Roselli

Allocation of study programmes Molecular and Translational Neuroscience MSc, start of studies: winter semester, compulsory elective module, 2nd study semester

Recommended prerequisites Basic cell biology, biochemistry, pharmacology

Learning objectives After successful completion of this module, students will understand the basic arrangement of local and long-range microcircuitry in brain and spinal cord in physiological conditions and there will be knowledge about the basic and advanced methods for structural (viral tracing, genetic intersectional tracing) and functional (optogenetics, chemogenetics) approaches to neuronal network investigation and manipulation.

Students will know how local microcircuitry in brain and spinal cord changes in pathological conditions such as epilepsy, chronic pain, autism, alzheimer’s disease;

Students will learn how to critically evaluate the new findings in this field

Students will also led to appreciate what are the uncertainty areas in the neuronal network field and which type of information is still missing.

Syllabus The module covers the following subject-specific topics:

- Basic assemblies of neuronal networks and microcircuitry; feed-back and feed-forward inhibition and excitation, basic assembly of recurrent neuronal networks
- Techniques and approaches for neuronal circuitry structural analysis: viral and non-viral tracing, volumetric imaging, genetic intersectional tracing.
• Techniques and approaches for neuronal circuitry manipulation: optogenetics, chemiogenetics, subpopulation ablation
• Structure and function of sensory spinal cord networks in normal and chronic pain conditions
• Structure and function of motor spinal cord networks in traumatic spinal cord injury
• Structure and function of basal ganglia networks
• Structure and function of dopaminergic and serotoninergic networks
• Structure and function of cortical and thalamic networks in epilepsy

Literature
• Kandel-Schwarz-Jessel “Principles of Neuroscience” fifth edition
• Review and original articles from top neuroscience journals

Teaching and learning methods
Lecture series

Workload
Attendance: 28 h
Private study: 62 h
Sum: 90 h

Assessment
The grade of the module will be the grade of the written exam. No prerequisites are necessary for exam registration.

Grading procedure
The grade of the module will be the grade of the exam.

Basis for
-
# Advanced Neurobiology

Modules referring to Advanced Neurobiology

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<td>Coordinator</td>
<td>Prof. Dr. Harald Wolf</td>
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<tr>
<td>Instructor(s)</td>
<td>Dr. Wolfgang Mader, Dr. Andrea Wirmer, PD Dr. Stefan Jarau, Prof. Dr. Harald Wolf</td>
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</table>

## Allocation of study programmes
- Biology MSc, start of studies: winter semester, compulsory elective module, 1st or 3rd study semester recommended
- Master Molecular and Translational Neuroscience MSc, start of studies: winter semester, compulsory elective module, 1st study semester

## Recommended prerequisites
Formally: Refer to the subject-specific examination regulations of the respective study course, in the version effective when taking up the study program.

Contentually: good knowledge in neurobiology and behavioral biology, e.g. bachelor program in animal physiology, neurobiology.

## Learning objectives
Students who have successfully completed this module
- have in-depth knowledge of the energetics and allometry of animal movement, the neural mechanisms of sensorimotor control in invertebrates and vertebrates, of ion channel function, modulation of neuronal activity, cellular plasticity.
- have conceptual and experimental experience in electrophysiological and neuroanatomical methods to functionally characterize neurons and neural systems, in studying learning and memory processes in insects (honey bees as model organism), and in-depth skills in the simulation of neuronal networks.
- are able to carry out scientific experiments largely independently and to process and present data in structured oral presentations and posters, including statistical methods.

## Syllabus
This module covers the following subject-specific topics:
Lectures:

- Energetics and allometry of animal movement
- Properties of ion channels and their contribution to neuronal excitation
- Cellular and neuronal mechanisms of motor and sensorimotor control networks in invertebrates and vertebrates
- Sensory representation in the nervous system

Lab course and seminar Special Neurobiology:

- Experimental und theoretical treatment of the above mentioned topics (selected examples)

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<thead>
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<th>Literature</th>
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<tbody>
<tr>
<td>- Specific literature for laboratory course and seminar topics</td>
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<td>- Sensory Motorsystems and Behavioral Control (lecture), 4 credit hours [SWS], 6 credit points [LP]</td>
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<td>- Advanced Neurobiology (seminar), 2 credit hours [SWS], 3 credit points [LP]</td>
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<td>- Advanced Neurobiology (laboratory course), 12 credit hours [SWS], 12 credit points [LP]</td>
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<td>Master thesis in the area of behavioral biology or neurobiology</td>
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European Patent Law
Modules referring to Medical Neuroscience and European Patent Law

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<td>Dr. Rainer Kränzle, Dr. Christian Beckmann</td>
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<td>Allocation of study programmes</td>
<td>Molecular and Translational Neuroscience MSc, start of studies: winter semester, compulsory elective module, 1st study semester</td>
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Medical Neuroscience II
Modules referring to Medical Neuroscience and European Patent Law

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<td>Coordinator</td>
<td>PD Dr. Petra Steinacker</td>
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<td>PD Dr. Petra Steinacker and further lecturers.</td>
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Allocation of study programmes
Biology MSc, start of studies: winter semester, compulsory elective module, 1\textsuperscript{st} to 2\textsuperscript{nd} study semester recommended

Recommended prerequisites
Formally: Refer to the subject-specific examination regulations of the respective study course, in the version effective when taking up the study program.
Contentually: None.

Learning objectives
Module 1 “Clinical Neurosciences - Basic and special lectures”

This module gives students theoretical insight into current knowledge about principle mechanisms common to neurological and in particular neurodegenerative human diseases. Specific contributing pathomechanisms, recently used therapeutical approaches, and areas of experimental neurology research in Ulm will be main issues.

The lecture block is followed by a written exam which is a prerequisite for the internship of module part 2.

After successful accomplishment of this module the students have knowledge about

- clinical classification of neurological/neurodegenerative diseases.
- basic mechanisms (e.g. excitotoxicity, oxidative and metabolic stress, failure of protein quality control, etc.) contributing to and specific pathophysiological mechanisms involved in the pathogenesis of neurological / neurodegenerative diseases including e.g. Alzheimer’s, Parkinson’s disease, Amyotrophic lateral sclerosis, genetic neurodegenerative diseases, and stroke.
Module part 2

Weekly Seminar “Neurological Diseases” (MEDex22), active participation starting from beginning of winter semester

“Clinical Neurosciences - Practical training” (registration necessary; maximum number of attendees 12)

This module gives students theoretical and practical insight into current methods used in neuroscience research in general and at the various research groups participating in the program in particular. Students will learn how these methods work in principle, what they are used for, what their potential is and what their limitations are. During the practical courses in our laboratories there will be hand on training in selected approaches of the neurobiological and behavioral sciences to study neural function in systems from basic molecular processes to the whole organism. Additionally demonstrations of complex approaches will be given. Opportunities for both basic and clinical research are included.

After successful accomplishment of this module the students have learned

- to interpret and present published data
- to plan own experiments
- to document own experimentally obtained data.
- to present own data in written form (“mini-paper”) and oral presentations.
- to discuss own results in the context of published data

Syllabus

Module 1 - Basic and special lectures:

In the winter semester (December) a 3-day block with 18 hours of lectures will teach the students basics of clinical neuroscience and current knowledge of disease characteristics and recent research on the pathological conditions of the most frequent neurological / neurodegenerative human diseases. Experimental approaches used in this field as biomarker discovery or transgenic animal research will complete the topics listed above. In the second half of January a written exam about the contents of the lecture series will take place.

Module 2 - Practical training:

For this module it is obligatory to pass the written exam mentioned above.

Each student has to complete 4 weeks practical courses in the labs of the neurology department (period: 01.02. – 31.03.). Depending on the lab the spectrum of matters reaches from cell culture / animal models of neurodegenerative diseases, diagnostic analysis of human body fluids, imaging, and behavioral examination. Students have to present their work in lab meetings and write a report about their internship project in form of a minipaper.

Literature

- Additional literature will be provided in the beginning of the semester.

Teaching and learning methods

- From basic to clinical neuroscience (lecture), 2 credit hours [SWS], 3 credit points [LP], winter semester
- Neurological Diseases (seminar), 1 credit hour [SWS], 2 credit points [LP], winter semester
- Clinical neurosciences part 2 - practical training (laboratory course), 11 credit hours [SWS], 10 credit points [LP], winter semester
Workload

- Attendance: 210 h
- Private study: 240 h
- Sum: 450 h

Assessment

Laboratory course report in the form of a mini-paper; oral exam

Grading procedure

Weighing: laboratory course report 1/2 and oral exam 1/2.

Basis for

-
# Medical Products
 Modules referring to Medical Neuroscience and European Patent Law

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**Instructor(s)**
Dr. Helmut Reitzle, Dr. Thomas Bräuner, Dr. Dieter Eckhardt, Dr. Karl Heinz Emmert, Dr. Armin Frey, Prof. Dr. Peter Gierschik, Dr. Udo Hartlaub, Dr. Thomas Kammermeier, Dr. Thomas Lamprecht, Dr. Eberhardt Landsbeck, Dr. Rainer Winstel

**Allocation of study programmes**
- Molecular and Translational Neuroscience MSc, start of studies: winter semester, compulsory module, 1\textsuperscript{st} study semester
- Biology MSc, start of studies: winter semester, compulsory module, 1\textsuperscript{st} study semester

**Recommended prerequisites**
none

**Learning objectives**
Arzneimittelseminar (Medical Products): students
- have knowledge of the drug development process generally, as well as chemical-pharmaceutical and pharmacological-toxicological level in particular by reference to appropriate legal regulations.
- have knowledge under what legal conditions new drugs are transferred into clinical adoption.
- have an idea of how clinical trials are constructed and how to interpret resulting data.
- have knowledge in the areas of drug safety and authorization of medicines.

**Syllabus**
Medical Products:
Introduction, history of drug development, overview of the process of drug development, regulations

Chemical-Pharmaceutical Development I: Drug Discovery

Chemical-Pharmaceutical Development II: Finished product development

Pharmacological-toxicological development I: Drug Discovery and preclinical development to first-in-man

Pharmacological-toxicological development II: Toxicology and safety pharmacology

Pharmacological-toxicological development III: Pharmacokinetics and Metabolism

Clinical examination: first application in humans to prove effectiveness and safety

Planning, implementation, standards and regulations

Drug information and labeling

Drug safety: basics

Drug safety: Structure and Risk Management

Biopharmaceutical medicines: development, manufacture, testing

Generics: quality, substitution

Authorization of medicinal products in Germany

Authorization of medicinal products in the EU

<table>
<thead>
<tr>
<th>Literature</th>
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</thead>
<tbody>
<tr>
<td>Teaching and learning methods</td>
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<td>Workload</td>
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<td>The grade of the module will be the grade of the written exam. No prerequisites are necessary for exam registration.</td>
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<td>The grade of the module will be the grade of the exam.</td>
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<td>Basis for</td>
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</table>
From Basic Research to Product
Modules referring to Translational Neuroscience

Code 8830074040

ECTS credits 6

Attendance time 4

Language of instruction English

Duration 1 Semester Semester

Cycle each Summer Semester

Coordinator Prof. Dr. Bastian Hengerer, Dr. Bernd Sommer

Instructor(s) Lecture series with lecturers from Boehringer Ingelheim

Allocation of study programmes Molecular and Translational Neuroscience MSc., start of studies: winter semester, compulsory elective module, 2nd semester.

Recommended prerequisites None

Learning objectives Students who have successfully completed this module,

• will understand the value creation chain in pharmaceutical research and development
• will have basic knowledge of the processes in pharma research
• will understand the interdependence of the various working packages
• are aware of critical parameters in translating preclinical results to clinical effects

Syllabus

- Basic knowledge of the process for identification and validation of novel target molecules in the context of the unmet medical need
- Genetics of neurodegenerative diseases
- Neuroimmunology
- Neurogenesis
- Neuronal circuits and optogenetics
- Synaptic plasticity, learning and memory
- Role, value and predictive power of animal models in psychiatric diseases
- Generation and application of gene-modified rodents
- Selection and application of suitable in vivo tests and assays
- Non-invasive functional imaging and related methods
  • Methods and processes for compound identification and characterization
- Course of the preclinical research phases
- High throughput screening and automatization
- Biologicals for the treatment of CNS diseases
- Cellular imaging, calcium imaging, high content screening
  • Specific questions at the transition from preclinical to clinical phases
- Properties of drug candidates e.g. DMPK
- Identification and selection of suitable biomarkers
  • Issues and phase transitions in clinical research

**Literature**

Literature will be provided beforehand

**Teaching and learning methods**

- Lecture
- Seminar (Excursion if possible)

**Workload**

Lecture: 2 SWS (3 ECTS)

Seminar (with excursion) 2 SWS (3 ECTS)

**Lecture:**

Attendance: 28 h

Private study: 62 h

Sum: 90 h

**Seminar and Excursion:**

Attendance: 28 h

Private study: 62

Sum: 90 h

**Assessment**

The credit points will be awarded once the module examination and a certificate of achievement have been passed. The type of the module examination is either oral or written (depending on the number of participants) and will be announced in time - at least 4 weeks prior to the date of the exam. No prerequisite(s) are necessary for exam registration. To pass the certificate of achievement it is necessary to complete an assessment (presentation and written report), attend the course regularly and to actively participate in the discussion. No prerequisites are necessary to register for the certificate of achievement.
Grading procedure  The grade of the module will be the grade of the exam.

Basis for  -
# Clinical Trials
Modules referring to Translational Neuroscience

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<tr>
<td>Coordinator</td>
<td>Dr. Schuster</td>
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<tr>
<td>Instructor(s)</td>
<td>Dr. Schuster, Dr. Grabrucker, Members of the Neurocenter Ulm</td>
</tr>
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**Allocation of study programmes**
Molecular and Translational Neuroscience MSc, Studienbeginn WiSe, Wahlpflichtmodul, 2nd semester

**Recommended prerequisites**
- |

**Learning objectives**
Students who have successfully completed this module,

**Lecture:**
- Students will be provided with a comprehensive overview on clinical trials. They will learn about the life cycle of pharmaceutical drugs and the steps needed to come from pre-clinical research to a marketing authorization.

**Seminar:**
- know how to present scientific data in a predetermined time, such as a lecture will be well prepared and presented visually and how to outlining new evidence carefully.
- have language skills in technical English.
- are to be decided in a position as to whether a study was well conducted and scientifically planned carefully.
- know how to discuss new scientific data.

**Practical training:**
The practical training will be held in the center for clinical research of the department Neurologie (University Hospital Ulm). Students will be involved in the setup, management and conduct of clinical trials.

**Syllabus**

**Lecture:**
- History of standards in clinical trials
- Development cycle of pharmaceutical drugs and medicinal products
- Individual steps from first in human to marketing authorization
- Parties involved in clinical trials and their roles and responsibilities
- Regulatory requirements in clinical trials
- Safety and Pharmacovigilance

**Seminar:**
- The focus of this seminar is on learning and discussion of scientific methods / techniques and new findings
- Recent research by research groups of the University of Ulm Neurocenter
- Latest scientific publications in the field of neuroscience

**Practical training:**
- Setup and management of clinical trials
- Roles and responsibilities
- ICH-GCP guidelines
- Source documentation and electronic data capture
- Storage and handling of study drug
- Storage and handling of bio samples
- Management of Serious Adverse Reaction (SAE) and pharmacovigilance

**Literature**

Praxisbuch Klinische Forschung von Michael Herschel

**Teaching and learning methods**

- Seminar Neurological Diseases 1,5 SWS, 2 LP
- Lecture, 2 SWS, 3 LP
- Practical training, 4 SWS, 4 LP

**Workload**

N/A

**Assessment**

The grade of the module will be the grade of the oral exam. No prerequisites are necessary for exam registration.

**Grading procedure**

The grade of the module will be the grade of the exam.

**Basis for**

-
Neurological/Psychiatric Diseases II
Modules referring to Translational Neuroscience

Code 8830072569

ECTS credits 6

Attendance time 4

Language of instruction English

Duration 1 Semester Semester

Cycle each Summer Semester

Coordinator Dr. Althaus


Allocation of study programmes Molecular and Translational Neuroscience MSc, SoSe, Wahlpflichtmodul, 2nd semester

Students from the following study paths may enroll in this module if they have successfully participated in module 3: biochemistry, molecular biology, physiology and neurobiology, human medicine, pharmaceutical biotechnology

Recommended prerequisites Mandatory participation in Neurological/Psychiatric Diseases I (modul 3)

Learning objectives This module builds on the teaching and learning content of “Neurological/Psychiatric Diseases I”. Based on the knowledge about physiologic functioning and principle mechanisms of pathologic changes, the students get insight into the major diseases and syndromes in neurology and psychiatry, complemented by learning contents about clinical studies and the intersection between clinical medicine and research (e.g. neuroimaging, cerebrospinal fluid, brainstimulation) as well as psychosomatic medicine and psychology. Lectures and seminars will include hands-on parts with the presentation of patients and diagnostic procedures of the respective diseases.

After successful accomplishment of this module the students have knowledge about

• syndroms, diagnosis and treatment of the major neurological and psychiatric diseases
• Scopes and conduction of clinical studies
**Syllabus**

*Lectures (2 semester periods per week) & Seminars ( 2 semester periods per week). Thematically corresponding lectures and seminars will be joint within a week.*

- Introduction and neurodegenerative diseases I (motoneuron disease) and myopathies
- Neurodegenerative diseases II (movement disorders)
- Neurodegenerative diseases III (dementia)
- Cerebrovascular diseases
- Epilepsy
- Acute and chronic inflammatory diseases
- liquor cerebrospinalis in clinical diagnosis and research
- Advanced techniques in neuroimaging
- Clinical Studies (from preclinic to drug approval)
- Neuroimaging and affective disorders
- Brainstimulation in affective disorders
- Psychosomatic Medicine
- Psychology
- final examination (MC)

**Literature**


exam relevant content:

Neurology: selected parts of „Oxford Handbook of Neurology“ 2nd revised edition; key slides from each lecture, handouts from seminars if existing


**Teaching and learning methods**

lectures, seminars

**Workload**

Präsenzstudium: 56 h
Selbststudium: 124 h
Summe: 180 h

**Assessment**

No english version available yet.

**Grading procedure**

No english version available yet.
Basis for

-
Behavioral Physiology

Modules referring to Behavioral Physiology

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<tr>
<td>Coordinator</td>
<td>Prof. Dr. Harald Wolf</td>
</tr>
<tr>
<td>Instructor(s)</td>
<td>Dr. Wolfgang Mader, Dr. Andrea Wirmer, PD Dr. Stefan Jarau, Prof. Dr. Harald Wolf</td>
</tr>
</tbody>
</table>

Allocation of study programmes
- Biology MSc, start of studies: winter semester, compulsory elective module, 2nd study semester recommended
- Molecular and Translational Neuroscience MSc, summer semester, compulsory elective module, 2nd study semester

Recommended prerequisites
- Formally: Refer to the subject-specific examination regulations of the respective study course, in the version effective when taking up the study program.
- Contentually: good knowledge in behavioral biology and neurobiology, e.g. bachelor program in animal physiology, neurobiology.

Learning objectives
- Students who have successfully completed this module
  - know the elements and their function in neural control circuits, including efferent and behavioral control.
  - have gained a deeper understanding of the mechanism that elicit and control instinctive and learned behavior in animals.
  - are able to understand the biological basic control principles of, and evolutionary reasons for social behavior in animals.
  - have gained practical experience in handling laboratory animals.
  - are able to create experimental designs for behavioral tests in animals in the laboratory and in the field.
  - have gained competencies to carry out scientific experiments largely independently and to process and present data in structured oral presentations and posters, including good grasp of statistical methods.
Syllabus

This module covers the following subject-specific topics:

Lecture Behavioral Physiology:

- Behavior as systems property (cybernetic approach)
- Reflexes, pattern generation, command systems
- General orientation mechanisms, and in particular in bees, ants, and migratory birds
- Mechanisms that elicit and control instinctive behavior
- Interrelation between inherent and learned behavior
- Different forms of learning
- Introduction to Sociobiology
- Selected topics in Ethology (reproductive strategies, orientation behavior, animal communication)

Lab course and seminar Behavioral Physiology:

- Exemplary investigation of orienting: territorial, courtship, mating and parental behavior, learning behavior and communication in honey bees.

Literature

- Zupanc GKH: Behavioral Neurobiology, Oxford University Press, Oxford

Teaching and learning methods

- Behavioral Physiology (lecture), 4 credit hours [SWS], 6 credit points [LP]
- Behavioral Physiology (seminar), 2 credit hours [SWS], 3 credit points [LP]
- Behavioral Physiology (exercise), 12 credit hours [SWS], 12 credit points [LP]

Workload

- Attendance: 270 h
- Private study: 360 h
- Sum: 630 h

Assessment

The grade of the module will be the grade of the written exam. No prerequisites are necessary for exam registration.

Grading procedure

The grade of the module will be the grade of the exam.

Basis for

Master thesis in the area of neurobiology or behavioral biology