Module Guide for the Study Path

Master MLS

Version from 1. April 2019


1st semester

Module part: Molecular Bioinformatics (CS4440 T, MolBioInfa)  
Module part LS4010 A: Cell Biology (LS4010 A, ViroZB)  
Module part LS4010 B: Molecular Virology (LS4010 B, ViroMV)  
Basics of Cell- and Molecular Biology for Virology (LS4010-KP06, LS4010, Viro)  
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Module part LS4020B: NMR Spectroscopy (LS4020 B, StrAnaNMR)  
Module part LS4020C: Single Molecule Methods (LS4020 C, Einzelstru)  
Module part LS4020D: Microscopy: techniques and applications (LS4020 D, StrAnaMikr)  
Structure Analysis (LS4020-MLS, StrAna)  
Molecular Pathomechanisms and Strategies for Therapy (LS4030-KP06, Pathom)  
General virology and biosafety (LS4040-KP04, AllgeViro)  
Biomathematics / Molecular Bioinformatics (LS4060, BiomaBioIn)  
Module part: Biomathematics (MA3400 T-MLS, Biomathe)  
Medical Cell Biology 1 (MZ5110, MZB1)  
Medical Cell Biology 1: Part A: Immunology (MZ5110 A, MZB1Immu)  
Medical Cell Biology 1: Part B: Neuroscience 1 (MZ5110 B, MZB1Neur1)  
Medical Cell Biology 1: Part C: Frontiers in Metabolic Medicine Research (MZ5110 C, MZCFronMet)  

2nd semester  

Medical Cell Biology 2 (LS4100, MedZB2)  
Medical Cell Biology 2: Part of the module A: Molecular Oncology (LS4100 A, MolOnko)  
Medical Cell Biology 2: Part of the module B: Molecular Endocrinology (LS4100 B, MolEndokr)  
Medical Cell Biology 2: Part of the module C: Molecular biology of the cardiovascular system (LS4100 C, Molkardiov)  
Medical Cell Biology 2: Part of the module D: Tissue regeneration (LS4100 D, Gewebereg)  
Medical Cell Biology 2: Part of the module E: Molecular Neuromedicine (LS4100 E, MolNeurom)  
Medical Cell Biology 2: Part of the module F: Molecular mechanisms in the pathophysiology of pulmonary diseases (LS4100 F, PathoLunge)  
Medical Cell Biology 2: Part of the module G: Neuroendocrinology (LS4100 G, Neuroendo)  
Part F of the module: Clinical Immunology 2 (LS4101 F, FClinIm2)  
Part of the module LS4110A: Pharmacology and Toxicology (LS4110 A, WiFoPharma)  
Part of the module LS4110B: Drug Design (LS4110 B, WiFoDrug)  
Drug Research (LS4110-KP06, WiFo)  
Biophysics 2 (LS4130, Biophy2)  
Module part: Membrane Biophysics (LS4130 A, Biophy2Mem)  
Biophysics 2: Part of the module B: Protein-Biophysics (LS4130 B, Biophy2Pro)  
Module part A: Biology of Infections (MZ4120 A, BiomInfecb)  
Module part MZ4120 B: Neuroscience 2 (MZ4120 B, BiomNeuro2)  
Biomedicine (MZ4120-KP06, MZ4120, Biomed)
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Clinical Immunology 1 (MZ4127-KP06, ClinImmu1)

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arbitrary semester

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## CS4440 T - Module part: Molecular Bioinformatics (MoBioInfa)

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<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>4</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Master Biophysics (module part), advanced curriculum, 1st semester
- Master MLS (module part), interdisciplinary competence, 1st semester
- Master Medical Informatics (module part), module part, arbitrary semester
- Master Computer Science since 2014 (module part), module part, arbitrary semester
- Master Medical Informatics since 2019 in planning (module part), module part, arbitrary semester

### Classes and lectures:
- Molecular Bioinformatics (lecture, 2 SWS)
- Molecular Bioinformatics (exercise, 1 SWS)

### Workload:
- 45 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

### Contents of teaching:
- Methods for fast genome comparison
- Analysis of data describing gene expression profiles and sequence variation
- Advanced usage of biological databases (for sequences, motifs, structures, gene regulation and interactions)

### Qualification-goals/Competencies:
- The students can apply indexing based software to Next Generation sequence data.
- They can use and design databases for molecular biological research.
- They are able to detect statistically significant changes in Microarray data.

### Grading through:
- exam type depends on main module

### Requires:
- Introduction to Bioinformatics (CS1400-KP04, CS1400)

### Responsible for this module:
- Siehe Hauptmodul

### Teacher:
- Institute for Neuro- and Bioinformatics
- Prof. Dr. Bernhard Haubold
- Prof. Dr. rer. nat. Thomas Martinetz
- Dr. rer. nat. Kurt Fellenberg
- MitarbeiterInnen des Instituts

### Literature:
- B. Haubold, T. Wiehe: Introduction to Computational Biology - Birkhäuser 2007
- D. M. Mount: Bioinformatics - Sequence and Genome - New York: Cold Spring Harbor Press

### Language:
- offered only in German

### Notes:
This modul is for Master MLS the Modulpart B of Modul LS4060 with 5 credit points.
### LS4010 A - Module part LS4010 A: Cell Biology (ViroZB)

<table>
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<td>3</td>
</tr>
</tbody>
</table>

#### Course of study, specific field and term:
- Master Biophysics (module part), advanced curriculum, 1st semester
- Master MLS starting 2018 (module part), cell biology, 1st semester
- Master MLS starting 2016 (module part), cell biology, 1st semester
- Master MLS (module part), cell biology, 1st semester

#### Classes and lectures:
- Cell Biology (lecture, 2 SWS)

#### Workload:
- 60 Hours private studies
- 30 Hours in-classroom work

#### Contents of teaching:
- Secretion in pro- and eukaryotes
- Structure and function of membraneous compartments of eukaryotes
- Cellular fusion, cytokinesis and organellar inheritance
- RNA-metabolism

#### Qualification-goals/Competencies:
- Ability, to understand and reproduce detailed knowledge in cell biology in the areas listed under
- Ability, to recognize the connection between the cell biology of hosts and the molecular strategies of viral and other microbiological parasites

#### Grading through:
- written exam

#### Responsible for this module:
- Siehe Hauptmodul

#### Teacher:
- Institute for Biology
- Prof. Dr. rer. nat. Enno Hartmann

#### Literature:
- Lodish: Molecular Cell Biology
- Alberts: Molecular Biology of the Cell

#### Language:
- English, except in case of only German-speaking participants
## LS4010 B - Module part LS4010 B: Molecular Virology (ViroMV)

<table>
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</table>

### Course of study, specific field and term:
- Master Biophysics (module part), advanced curriculum, 1st semester
- Master MLS starting 2018 (module part), cell biology, 1st semester
- Master MLS starting 2016 (module part), cell biology, 1st semester
- Master MLS (module part), cell biology, 1st semester

### Classes and lectures:
- Molecular Virology (lecture, 2 SWS)

### Workload:
- 60 Hours private studies
- 30 Hours in-classroom work

### Contents of teaching:
- Viral and cellular receptors for virus-cell interaction as well as their inhibition by inhibitors
- Detailed molecular mechanisms of genome replication from selected virus families (focussed on RNA viruses)
- Host factors and their function in viral genome replication on the basis of selected examples
- Structural biology of viruses and its application for anti-viral therapy
- Basics of viral pathogenesis
- Viral strategies against the innate immune system

### Qualification-goals/Competencies:
- Detailed knowledge on the interaction between viruses and their host cells
- Details on virus structure and replication mechanisms as well as on derived anti-viral strategies
- Pathogenic processes and virus-host interactions in virus infections

### Grading through:
- written exam
- contributions to the discussion

### Responsible for this module:
- Siehe Hauptmodul

### Teacher:
- Institute of Virology and Cell Biology
- Prof. Dr. rer. nat. Norbert Tautz
- Dr. rer. nat. Olaf Isken

### Literature:
- Grundlagen- und Übersichtsartikel

### Language:
- English, except in case of only German-speaking participants
# LS4010-KP06, LS4010 - Basics of Cell- and Molecular Biology for Virology (Viro)

<table>
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<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>6</td>
</tr>
</tbody>
</table>

## Course of study, specific field and term:
- Master MLS starting 2018 (compulsory), cell biology, 1st semester
- Master MLS starting 2016 (compulsory), cell biology, 1st semester
- Master MLS (compulsory), cell biology, 1st semester

## Classes and lectures:
- Part of the module A: Cell Biology (lecture, 2 SWS)
- Part of the module B: Molecular Virology (lecture, 2 SWS)

## Workload:
- 120 Hours private studies
- 60 Hours in-classroom work

## Contents of teaching:
- See part of the modules A and B

## Qualification-goals/Competencies:
- See part of the modules A and B

## Grading through:
- written exam (test achievement)

## Responsible for this module:
- Prof. Dr. rer. nat. Enno Hartmann

## Teacher:
- Institute of Virology and Cell Biology
- Institute for Biology
- Prof. Dr. rer. nat. Enno Hartmann
- Prof. Dr. rer. nat. Norbert Tautz
- Dr. rer. nat. Olaf Isken

## Language:
- English, except in case of only German-speaking participants

## Notes:
Prerequisites: Bachelor degree in Molecular Life Sciences or in related fields.
One written examination on both parts (Cell Biology and Molecular Virology), each valued 50%.
## LS4020 A - Module part LS4020A: Crystallography (StrAnaKris)

<table>
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<tbody>
<tr>
<td>Turnus of offer:</td>
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</tr>
<tr>
<td>Credit points:</td>
<td>3</td>
</tr>
<tr>
<td>Max. group size:</td>
<td>60</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Master MLS starting 2018 (module part), structure biology, 1st semester
- Master Infection Biology ab 2018 (module part), Interdisciplinary modules, 1st semester
- Master Biophysics (module part), biophysics, 1st semester
- Master CLS starting 2016 (module part), MML with specialization in Life Science, 3rd semester
- Master MLS starting 2016 (module part), structure biology, 1st semester
- Master Infection Biology (module part), Interdisciplinary modules, 1st semester
- Master CLS (module part), computational life science / life sciences, 3rd semester
- Master MLS (module part), structure biology, 1st semester

### Classes and lectures:
- Crystallography (lecture, 2 SWS)

### Workload:
- 60 Hours private studies
- 30 Hours in-classroom work

### Contents of teaching:
- Crystal growth, precipitant and phase diagram, crystal morphology, symmetry and space groups, crystallogenesis
- X-rays, X-ray sources, X-ray diffraction, Bragg's law, reciprocal lattice and Ewald-sphere construction
- X-ray diffraction by electrons, Fourier analysis and synthesis
- Protein structure determination by X-ray diffraction, crystallographic phase problem, Patterson map, molecular replacement (MR), multiple isomorphous replacement (MIR), multi-wavelength anomalous diffraction (MAD)
- Crystallography and the drug discovery process: studying protein-ligand interactions
- Practical exercises employing an X-ray generator (collection of a diffraction image) and the computer (MR; calculation and interpretation of electron density maps)
- Site visit at the Synchrotron DESY (Hamburg)

### Qualification-goals/Competencies:
- They have a general scientific competence in macromolecular X-ray diffraction analysis
- They have the methodological competence to grow protein crystals by hanging or sitting drops
- They have the methodological competence to correctly interpret (salt or protein) the diffraction image of a crystal using the Ewald Sphere construction
- They have the methodological competence to tackle the phase problem either by MR, MIR or MAD
- They can calculate and interpret electron density maps
- They have the methodological competence, to apply structure- or fragment-based techniques for lead compound identification
- They have the communication competency to convey the principles of X-ray diffraction theory

### Grading through:
- see Notes

### Responsible for this module:
- Prof. Dr. rer. nat. Christian Hübner
- Prof. Dr. rer. nat. Thomas Peters

### Teacher:
- Institute of Biochemistry
- Dr. math. et dis. nat. Jeroen Mesters
- Prof. Dr. rer. nat. Rolf Hilgenfeld

### Literature:
- Jan Drenth: Principles of Protein X-ray Crystallography - Science+Business Media, LLC, New York

### Language:
- offered only in English
Notes:

Is part of Module:
- LS4021-KP06 (former LS4020-IB) -> Prof. Hübner
- LS4020-KP06 (former LS4020-MLS) and LS4020-KP12 -> Prof. Peters

4 exercises, 2 hours each, are offered in addition to the lecture. Dates are given at the start of the semester.

For Master MLS with specialization Structure Biology the module is mandatory.
### LS4020 B - Module part LS4020B: NMR Spectroscopy (StrAnaNMR)

<table>
<thead>
<tr>
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<th>3</th>
</tr>
</thead>
</table>

#### Course of study, specific field and term:
- Master Infection Biology ab 2018 (module part), Interdisciplinary modules, 1st semester
- Master Biophysics (module part), biophysics, 1st semester
- Master CLS starting 2016 (module part), MML with specialization in Life Science, 3rd semester
- Master MLS starting 2016 (module part), structure biology, 1st semester
- Master Infection Biology (module part), Interdisciplinary modules, 1st semester
- Master CLS (module part), computational life science / life sciences, 3rd semester
- Master MLS (module part), structure biology, 1st semester
- Master MLS starting 2018 (module part), structure biology, 1st semester

#### Classes and lectures:
- NMR-Spectroscopy (lecture, 2 SWS)

#### Workload:
- 60 Hours private studies
- 30 Hours in-classroom work

#### Contents of teaching:
- Lecture topics:
  - Assignment of NMR spectra
  - Description of the NOESY experiment using the vector model
  - Chemical Exchange and Transfer-NOEs
  - Multidimensional NMR spectroscopy
  - Assignment strategy for peptides
  - Introduction into the product operator formalism (POF)
  - Description of the COSY and of the HSQC experiment using POF
  - NMR experiments for the assignment of proteins
  - NMR structural analysis of proteins
  - Experiments to probe the motions of protein

#### Qualification-goals/Competencies:
- Advanced techniques to assign and analyze NMR spectra
- Understanding of NMR experiments based on the product operator formalism
- Basic knowledge about NMR experiments to analyze structure and dynamics of proteins

#### Grading through:
- see Notes

#### Responsible for this module:
- Prof. Dr. rer. nat. Thomas Peters

#### Teacher:
- Institute of Chemistry and Metabolomics
- Prof. Dr. rer. nat. Thomas Peters
- PD Dr. rer. nat. Karsten Seeger

#### Literature:
- James Keeler: Understanding NMR Spectroscopy - Wiley
- Timothy Claridge: High-Resolution NMR Techniques in Organic Chemistry - Pergamon Press
- Current scientific literature

#### Language:
- offered only in English
Notes:

This lecture is a part of modules:
- LS4021-KP06 (former LS4020-IB) -> Prof. Hübner
- LS4020-KP06 (former LS4020-MLS) and LS4020-KP12 -> Prof. Peters

Exercises are integrated into the lectures.
It is a compulsory module part for the Master MLS with a focus on structural biology.
### LS4020 C - Module part LS4020C: Single Molecule Methods (Einzelstru)

**Duration:** 1 Semester  
**Turnus of offer:** each winter semester  
**Credit points:** 3

**Course of study, specific field and term:**
- Master MLS starting 2018 (module part), structure biology, 1st semester
- Master Infection Biology ab 2018 (module part), Interdisciplinary modules, 1st semester
- Master Biophysics (module part), biophysics, 1st semester
- Master CLS starting 2016 (module part), MML with specialization in Life Science, 3rd semester
- Master MLS starting 2016 (module part), structure biology, 1st semester
- Master Infection Biology (module part), Interdisciplinary modules, 1st semester
- Master CLS (module part), computational life science / life sciences, 3rd semester
- Master MLS (module part), structure biology, 1st semester

**Classes and lectures:**
- Single Molecule Methods (lecture, 2 SWS)

**Workload:**
- 60 Hours private studies
- 30 Hours in-classroom work

**Contents of teaching:**
- Physical basics of fluorescence
- Photo physics
- Microscopy techniques
- Protein labeling
- Fluorescence resonance energy transfer
- Single molecule enzymology
- Single molecule protein folding
- Physical basics of optical tweezers
- Protein folding with optical tweezers

**Qualification-goals/Competencies:**
- Understanding of the physical basics of single molecule methods
- Understanding of the benefits of single molecule methods
- Understanding of the limits of single molecule methods

**Grading through:**
- see Notes

**Responsible for this module:**
- Siehe Hauptmodul

**Teacher:**
- Institute of Physics
- Prof. Dr. rer. nat. Christian Hübner

**Literature:**

**Language:**
- offered only in English

**Notes:**
Is module part of:
- LS4021-KP06 (former LS4020-IB) -> Prof. Hübner
- LS4020-KP06 (former LS4020-MLS) and LS4020-KP12 -> Prof. Peters

This module part is identical to LS4020 C-MIW without seminar.
For Master MLS with specialization in structure biology the module is mandatory.
# LS4020 D - Module part LS4020D: Microscopy: techniques and applications (StrAnaMikr)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>3</td>
</tr>
</tbody>
</table>

## Course of study, specific field and term:
- Master Infection Biology ab 2018 (module part), Interdisciplinary modules, 1st semester
- Master Biophysics (module part), biophysics, 1st semester
- Master CLS starting 2016 (module part), MML with specialization in Life Science, 3rd semester
- Master MLS starting 2016 (module part), structure biology, 1st semester
- Master Infection Biology (module part), Interdisciplinary modules, 1st semester
- Master CLS (module part), computational life science / life sciences, 3rd semester
- Master MLS (module part), structure biology, 1st semester
- Master MLS starting 2018 (module part), structure biology, 1st semester

## Classes and lectures:
- Microscopy: techniques and applications (lecture, 2 SWS)

## Workload:
- 60 Hours private studies
- 30 Hours in-classroom work

## Contents of teaching:
- Light microscopy
- Confocal microscopy
- 2-photon microscopy
- Light sources and detectors
- Fluorescent Dyes; GFP and genetically encoded fluorescence markers; Live Cell/tissue imaging: considerations/limitations
- Labelling/identifying cell components using fluorescence techniques
- Protein-protein Interactions in living cells: FRET, FLIM; Biosensors
- Photo-activatable/-switchable Fluorescent Proteins; Fluorescent Timers
- Advanced 3D-Fluorescence Microscopy, STED, PALM, STORM
- In vivo imaging in tissues and living animals
- Applications of Flow Cytometry & Fluorescence-activated Cell Sorting
- Electron Microscopy: TEM, Immunogold label; Survey of cell ultrastructure; Correlative EM/light microscopy; Scanning Electron Microscopy (SEM)
- Bioluminescence; high-content screening; outlook: emerging technologies
- Data storage/formats; Course discussion; and then: Cinema of the Cell

## Qualification-goals/Competencies:
- Basics of light and fluorescence microscopy and electron microscopy
- Detailed knowledge of methods for labelling and visualization of proteins and subcellular compartments
- Applications of live cell imaging, in vivo imaging and quantitative fluorescence techniques

## Grading through:
- see Notes

## Responsible for this module:
- Siehe Hauptmodul

## Teacher:
- Institute for Biology
- Prof. Dr. rer nat. Rainer Duden

## Literature:
- http://www.microscopyu.com/smallworld/
- http://www.olympusmicro.com/

## Language:
- offered only in English
Notes:

Is module part of:
- LS4021-KP06 (former LS4020-IB) -> Prof. Hübner
- LS4020-KP06 (former LS4020-MLS) and LS4020-KP12 -> Prof. Peters

For Master MLS with specialization in Structure Biology the module is mandatory.

(Contribution to lecture, Biology 60%)
(Contribution to lecture, Biomedical Optics 40%)
# LS4020-MLS - Structure Analysis (StrAna)

<table>
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<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>6</td>
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</tbody>
</table>

## Course of study, specific field and term:
- Master CLS (optional subject), computational life science / life sciences, 3rd semester
- Master MLS (compulsory), structure biology, 1st semester

## Classes and lectures:
- Part of the module A: Crystallography (lecture, 2 SWS)
- Part of the module B: NMR-Spectroscopy (lecture, 2 SWS)
- Part of the module C: Single Molecule Methods (lecture, 2 SWS)
- Part of the module D: Microscopy: techniques and applications (lecture, 2 SWS)

## Workload:
- 120 Hours private studies
- 60 Hours in-classroom work

## Contents of teaching:
- See module parts A to D

## Qualification-goals/Competencies:
- See module parts A to D

## Grading through:
- written exam

## Responsible for this module:
- Prof. Dr. rer. nat. Thomas Peters

## Teacher:
- Institute of Physics
- Institute for Biology
- Institute of Biochemistry
- Institute of Chemistry and Metabolomics
- Prof. Dr. rer. nat. Thomas Peters
- Prof. Dr. rer. nat. Rolf Hilgenfeld
- Dr. math. et dis. nat. Jeroen Mesters
- PD Dr. rer. nat. Karsten Seeger
- Prof. Dr. rer. nat. Christian Hübner
- Prof. Dr. rer. nat. Rainer Duden

## Language:
- English, except in case of only German-speaking participants

## Notes:
- This modul has 4 parts: LS4020A-D.
- BSc in Molecular Life Science or related fields.
- One written examination with all parts, each valued 25%.
# LS4030-KP06 - Molecular Pathomechanisms and Strategies for Therapy (Pathom)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
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<tr>
<td>Credit points:</td>
<td>6</td>
</tr>
</tbody>
</table>

## Course of study, specific field and term:
- Master MLS starting 2016 (compulsory), cell biology, 1st semester
- Master MLS (compulsory), life sciences, 1st semester
- Master MLS starting 2018 (compulsory), cell biology, 1st semester

## Classes and lectures:

<table>
<thead>
<tr>
<th>Course</th>
<th>Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molecular Pathomechanisms and Strategies for Therapy (lecture, 4 SWS)</td>
<td>120 Hours private studies</td>
</tr>
<tr>
<td></td>
<td>60 Hours in-classroom work</td>
</tr>
</tbody>
</table>

## Contents of teaching:
- Oncogenic viruses (selected mammalian RNA and DNA viruses)
- Correlation of tumour development and DNA repair defects
- Pathways, regulation and pathological relevant deregulation of apoptosis
- Mechanisms of tumour development and progression
- microRNA: a new player in cancer development
- Tumour diagnostic
- Therapeutic concepts (chemotherapy, gene therapy, alternative strategies)

## Qualification-goals/Competencies:
- Students are able to list the different general mechanisms of tumorgenesis including mechanisms of viral carcinogenesis (especially retroviruses and DNA tumor viruses), tumor progression, correlation between RNA interference and cancer, and correlation between apoptosis and tumour development. They are able to illustrate in detail afore mentioned terms and definitions with the aid of different examples. They are able to discuss the listed terms and definitions in the general context of tumor biology and to apply it to a given question. They are able to assess which concepts of cancer diagnosis and therapy are realistic in a given situation and can rationalize if alternative therapeutic concepts are applicable and where the limits of such approaches are. Moreover, they are able to judge to what extent ethic aspects limit the application of molecular medicine.

## Grading through:
- written exam

## Responsible for this module:
- Prof. Dr. rer. nat. Tobias Restle

## Teacher:
- Institute of Molecular Medicine
- Prof. Dr. rer. nat. Tobias Restle
- Dr. rer. nat. Rosel Kretschmer-Kazemi Far

## Literature:
- : Current research and review articles

## Languages:
- offered only in German
- English, except in case of only German-speaking participants

## Notes:
- BSc in Molecular Life Science or related fields
## LS4040-KP04 - General virology and biosafety (AllgeViro)

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</tbody>
</table>

### Course of study, specific field and term:
- Master MLS starting 2016 (compulsory), interdisciplinary competence, 1st semester
- Master MLS (compulsory), life sciences, 1st semester
- Master MLS starting 2018 (compulsory), interdisciplinary competence, 1st semester

### Classes and lectures:
- General virology and biosafety (lecture, 2 SWS)
- General virology and biosafety (practical course as compact course, 1 SWS)

### Workload:
- 60 Hours private studies
- 60 Hours in-classroom work

### Contents of teaching:
- Lecture: History of virology
- Virus taxonomy and structure
- Virus morphology in overview
- Viral life cycles (entry, assembly, budding)
- Replication mechanisms
- Viral evolution
- Basic techniques in virology and methods of virus diagnostics
- Blood-borne viruses and safety of blood products
- Biosafety classification of viruses according to □Gentechnikrecht□ and □Biostoffverordnung□
- Exercises with regard to the topics of the lecture

### Qualification-goals/Competencies:
- They can categorize viruses systematically
- They can explain and compare viral life cycles and replication strategies
- They can explain and exercise basic virological techniques in research and virus diagnostics
- They can list basic practices and protocols for the virological safety of blood products
- They can apply basics knowledge according to □Gentechnikrecht□ and □Biostoffverordnung□
- They can use scientific termini of molecular virology in English

### Grading through:
- certificates and protocols
- continuous, successful participation in practical course
- written exam

### Responsible for this module:
- Prof. Dr. rer. nat. Norbert Tautz

### Teacher:
- Institute of Biochemistry
- Institute of Virology and Cell Biology
- Prof. Dr. rer. nat. Norbert Tautz
- Dr. math. et dis. nat. Jeroen Mesters
- Dr. rer. nat. Olaf Isken

### Literature:

### Language:
- English, except in case of only German-speaking participants
Notes:

Requirements: BSc in Molecular Life Science or related fields.
Note: The first written exam takes place after X-mas holiday season.
<table>
<thead>
<tr>
<th><strong>LS4060 - Biomathematics / Molecular Bioinformatics (BiomaBioIn)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration:</strong> 1 Semester</td>
</tr>
<tr>
<td><strong>Course of study, specific field and term:</strong></td>
</tr>
<tr>
<td>● Master MLS (compulsory), interdisciplinary competence, 1st semester</td>
</tr>
<tr>
<td><strong>Classes and lectures:</strong></td>
</tr>
<tr>
<td>● See MA3400 T-MLS: Biomathematics (course, 2 SWS)</td>
</tr>
<tr>
<td>● See CS4440 T: Molecular Bioinformatics (course, 2 SWS)</td>
</tr>
<tr>
<td><strong>Contents of teaching:</strong></td>
</tr>
<tr>
<td>● See module MA3400 T-MLS</td>
</tr>
<tr>
<td>● See module CS4440 T</td>
</tr>
<tr>
<td><strong>Qualification-goals/Competencies:</strong></td>
</tr>
<tr>
<td>● See module MA3400 T-MLS</td>
</tr>
<tr>
<td>● See module CS4440 T</td>
</tr>
<tr>
<td><strong>Grading through:</strong></td>
</tr>
<tr>
<td>● Exercises</td>
</tr>
<tr>
<td>● written exam</td>
</tr>
<tr>
<td><strong>Requires:</strong></td>
</tr>
<tr>
<td>● Bachelor Thesis (LS3990-KP12, LS3990)</td>
</tr>
<tr>
<td><strong>Responsible for this module:</strong></td>
</tr>
<tr>
<td>● Prof. Dr. rer. nat. Thomas Martinetz</td>
</tr>
<tr>
<td><strong>Teacher:</strong></td>
</tr>
<tr>
<td>● Institute for Neuro- and Bioinformatics</td>
</tr>
<tr>
<td>● Institute for Mathematics</td>
</tr>
<tr>
<td>● PD Dr. rer. nat. Hanns-Martin Teichert</td>
</tr>
<tr>
<td>● Prof. Dr. rer. nat. Thomas Martinetz</td>
</tr>
<tr>
<td><strong>Language:</strong></td>
</tr>
<tr>
<td>● offered only in German</td>
</tr>
<tr>
<td><strong>Notes:</strong></td>
</tr>
<tr>
<td>Prerequisite for the certificate LS4060-Biomathematics/Molecular Bioinformatics with 5 credit points is the attendance of either Modulpart A: Biomathematics MA3400-MML T or Modulpart B: Bioinformatics CS4440 T. The attendance of the second course is optional. Students who have successfully attended both courses may choose which one should be taken into the module account.</td>
</tr>
</tbody>
</table>
### MA3400 T-MLS - Module part: Biomathematics (Biomathe)

**Duration:**
1 Semester

<table>
<thead>
<tr>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>each winter semester</td>
<td>5</td>
</tr>
</tbody>
</table>

**Course of study, specific field and term:**
- Master MLS (module part), interdisciplinary competence, 1st semester

**Classes and lectures:**
- Biomathematics (MA3400-MML) (lecture, 2 SWS)
- Biomathematics (exercise, 2 SWS)

**Workload:**
- 70 Hours private studies and exercises
- 60 Hours in-classroom work
- 20 Hours exam preparation

**Contents of teaching:**
- Basics of differential equations
- Differential equations of first order
- Linear differential equations of n-th order
- Systems of linear differential equations with constant coefficients
- Notes on numerics and qualitative analysis; the prey-predator model

**Qualification-goals/Competencies:**
- Learning the basics of ordinary differential equations
- Ability to apply differential equations
- Learning by means of examples how to use differential equations for models in biology, chemistry and medicine
- Basic understanding of simple numerical methods

**Grading through:**
- Exercises
- written exam

**Requires:**
- Bachelor Thesis (LS3990-KP12, LS3990)

**Responsible for this module:**
- Siehe Hauptmodul

**Teacher:**
- Institute for Mathematics
- PD Dr. rer. nat. Hanns-Martin Teichert

**Literature:**
- J. D. Murray: Mathematical Biology - Springer

**Language:**
- offered only in German

**Notes:**
The lecture is identical to MA3400-MML Biomathematics.
# Module Guide

## MZ5110 - Medical Cell Biology 1 (MZB1)

### Duration:
1 Semester

### Turnus of offer:
each winter semester

### Credit points:
6

### Course of study, specific field and term:
- Master MLS (compulsory), cell biology, 1st semester
- Master CLS (optional subject), computational life science/life sciences, 3rd semester

### Classes and lectures:
- See MZ5110 A: Immunology (course, 4 SWS)
- See MZ5110 B: Neuroscience 1 (course, 4 SWS)
- See MZ5110 C: Frontiers in Metabolic Medicine Research (course, 4 SWS)

### Workload:
- 120 Hours in-classroom work
- 60 Hours private studies

### Contents of teaching:
- Lecture MZ5110 A: Immunology, B: Neuroscience 1 and C: Frontiers in Metallic Medicine Research

### Qualification-goals/Competencies:
- see MZ5110 Part A: Immunology, Part B: Neuroscience 1 and C: Frontiers in Metallic Medicine Research

### Grading through:
- presentation
- continuous, successful participation in course
- written exam

### Responsible for this module:
- Prof. Dr. rer. nat. Rudolf Manz

### Teacher:
- Medical Clinic I
- Institut of Physiology
- Institute of Experimental and Clinical Pharmacology and Toxicology
- Institute for Systemic Inflammation Research (ISEF)
- Prof. Dr. rer. nat. Rudolf Manz
- Prof. Dr. med. Jörg Köhl
- Prof. Dr. rer. nat. Marc Ehlers
- Prof. Dr. rer. nat. Olaf Jöhren
- Prof. Dr. med. Sebastian Schmid
- Prof. Dr. Jens Mittag
- Dr. rer. nat. Carla Schulz
- Dr. Stefanie Fiedler
- Prof. Dr. rer. nat. Henrik Oster
- Prof. Dr. med. Christian Sina

### Language:
- offered only in English

### Notes:
- MLS: one of three choices
  (Consists of MZ5110 A, MZ5110 B, MZ5110 C)
### MZ5110 A - Medical Cell Biology 1: Part A: Immunology (MZB1AImmu)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>6</td>
</tr>
</tbody>
</table>

**Course of study, specific field and term:**
- Master MLS (module part), neuroscience, 1st semester
- Master CLS (module part), computational life science / life sciences, 3rd semester

**Classes and lectures:**
- Immunology (lecture, 2 SWS)
- Immunology (seminar, 2 SWS)

**Contents of teaching:**
- Lecture: Introduction to immunology
- Cells of the innate immune system
- Innate immune system: pathogen recognition
- Complement and inflammation
- Introduction into the adaptive immune system
- Antigen-presentation and T cell activation
- Immunological memory
- Immune system and infection I: bacteria, worms, fungi
- Immune system and infection II: Viruses
- Signal transduction in immune cells
- Organs and tissues of the immune system, homing
- Immunopathogenesis I: allergy and asthma
- Immunopathogenesis II: autoimmune diseases
- Immunoprivileged Organs
- Hematopoiesis and hematopoietic stem cells
- Experimental and clinically applied biologicals
- Seminar: PCR
- ELISA/ELISPOT
- Flow cytometry I: FACS-Analysis
- Flow cytometry II: MACS, FACS-Sort
- Flow cytometry III: Practical course at the ISEF (MACS, Analysis, Sort)
- Conventional and confocal microscopy
- Methods in signal transduction
- Migration: transwell assay; adhesion test etc.
- 2-Photon microscopy
- Animal models in life science
- Genetically modified mice I: conventional transgenics and KO mice
- Genetically modified mice II: conditional KO and Knock In Mice

**Qualification-goals/Competencies:**
- Students are able to:
- Name cells of the immune system and allocate their functions
- Name organs that belong to the immune system and allocate their functions
- Name mechanisms, cells and molecules of the innate and adaptive immune system and allocate their functions during bacterial, viral and fungal infections
- Name and allocate functions of molecules important for B cell - T cell co-operation
- Name and allocate the functions of molecules and antigen-presenting cells important for T cell activation and differentiation
- Name molecules of the complement system and allocate their functions for immune protection and immune diseases
- Name structure and function of the distinct antibody classes
- Name and allocate functions of molecules important for homing and migration of immune cells
- Name and allocate functions of molecules important for the initiation and resolution of inflammation
- Name the functions of immunological memory
- Name molecules and mechanisms involved in the development of B cell and T cell memory
- Describe the principal sequence of an immune reaction during infection and after vaccination

**Workload:**
- 120 Hours private studies
- 60 Hours in-classroom work
• Name genetic, molecular and cellular disturbances of the immune system relevant for immune deficiency, autoimmune and allergic diseases
• Describe the basic mechanisms of signal transduction in immune cells
• Name mechanisms and molecules involved in hematopoiesis
• Name and explain immunological methods
• Present and discuss scientific data

Grading through:
• presentation
• continuous, successful participation in course
• written exam

Responsible for this module:
• Prof. Dr. rer. nat. Rudolf Manz

Teacher:
• Institute for Systemic Inflammation Research (ISEF)
• Prof. Dr. rer. nat. Rudolf Manz
• Prof. Dr. med. Jörg Köhl
• Prof. Dr. rer. nat. Marc Ehlers

Literature:
• Janeway, Travers, Walport, Shlomchik: Immunologie - Spektrum Akademischer Verlag
• Original- und Übersichtsartikel

Language:
• offered only in English

Notes:
• (Part of the module MZ5110)
# MZ5110 B - Medical Cell Biology 1: Part B: Neuroscience 1 (MZB1BNeur1)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>6</td>
</tr>
</tbody>
</table>

## Course of study, specific field and term:
- Master MLS (module part), neuroscience, 1st semester
- Master CLS (module part), computational life science / life sciences, 3rd semester
- Master Biophysics (module part), advanced curriculum, 1st semester

## Classes and lectures:
- Neuroscience 1 (lecture, 2 SWS)
- Neuroscience 1 (seminar, 2 SWS)

## Workload:
- 120 Hours private studies
- 60 Hours in-classroom work

## Contents of teaching:
- Micro- and macroscopic anatomy of the CNS
- Electrical activity of neurons
- Channels and transporters in neurons
- Synaptic transmission
- Neurotransmitters and their receptors
- Intracellular signaling in neurons
- Plasticity and memory
- Circadian rhythms and sleep
- The visual system
- Development of the nervous system

## Qualification-goals/Competencies:
- Understanding basics of neuroscience
- Understanding the structure and development of the brain
- Understanding neuronal excitation and signal transmission
- Introduction to examples of behavior and plasticity

## Grading through:
- presentation
- continuous, successful participation in course
- written exam

## Responsible for this module:
- Prof. Dr. rer. nat. Rudolf Manz

## Teacher:
- Medical Clinic I
- Department of Neurosurgery
- Institut of Physiology
- Institute of Experimental and Clinical Pharmacology and Toxicology
- Prof. Dr. rer. nat. Olaf Jöhren
- Prof. Dr. med. Cor de Wit
- Prof. Dr. rer. nat. Henrik Oster
- Prof. Dr. med. Markus Schwaninger
- PD Dr. rer. nat. Christina Zechel

## Literature:
- Original publications and Reviews
Language:
  • offered only in German

Notes:
  Part of the module MZ5110
  MLS: one of two choises
# Module Guide

## MZ5110 C - Medical Cell Biology 1: Part C: Frontiers in Metabolic Medicine Research (MZCFronMet)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
<th>Max. group size:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Master CLS (module part), computational life science / life sciences, 3rd semester
- Master MLS (module part), cell biology, 1st semester

### Classes and lectures:
- Frontiers in Metabolic Medicine Research (lecture, 2 SWS)
- Frontiers in Metabolic Medicine Research (seminar, 2 SWS)

### Contents of teaching:
- Central regulation of adipose tissues
- Thyroid hormones
- Central adipokine action
- Tumor metabolism
- Chronometabolism
- Nutrient barriers

### Qualification-goals/Competencies:
- Know about some current themes in metabolic physiology and medicine
- Know about some experimental paradigms to address metabolism-related problems
- Understand the molecular basis of metabolic disorders and know how to develop strategies for experimentally addressing scientific problems

### Grading through:
- presentation
- continuous, successful participation in course
- written exam

### Requires:
- Module part LS3250 B: Metabolic Medicine (LS3250 B)

### Responsible for this module:
- Prof. Dr. rer. nat. Henrik Oster

### Teacher:
- Institute for Systemic Inflammation Research (ISEF)
- Prof. Dr. med. Sebastian Schmid
- Prof. Dr. Jens Mittag
- Dr. rer. nat. Carla Schulz
- Dr. Stefanie Fliedner
- Prof. Dr. rer. nat. Henrik Oster
- Prof. Dr. med. Christian Sina

### Literature:
- Original- and Übersichtsartikel

### Language:
- German and English skills required

### Notes:
Part of the module MZ5110
If there is space in the course students can participate even if they did not pass module LS3250-B.
MLS: compulsory, 1. Term, either MZ5110 A, MZ5110 B or MZ5110 C needs to be selected.
# LS4100 - Medical Cell Biology 2 (MedZB2)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>8</td>
</tr>
</tbody>
</table>

## Turnus of offer:
- each summer semester

## Course of study, specific field and term:
- Master MLS (compulsory), cell biology, 2nd semester

## Classes and lectures:
- See Medical Cellbiology 2: Part of the modules A to G (lecture, 2 SWS)

## Contents of teaching:
- See part of the modules A to G

## Qualification-goals/Competencies:
- See part of the modules LS4100A to G

## Grading through:
- written exam

## Workload:
- 150 Hours private studies
- 90 Hours in-classroom work

## Requires:
- Bachelor Thesis (LS3990-KP12, LS3990)

## Responsible for this module:
- Prof. Dr. med. Jürgen Brinckmann

## Teacher:
- Research Center Borstel
- Medical Clinic I
- Institut of Physiology
- Department of Pathology
- Department of Neurology
- Medical Clinic II
- Department of Neurosurgery
- Department of Dermatology, Allergology and Venerology
- PD Dr. rer. nat. Christina Zechel
- Prof. Dr. hum. biol. Hans-Werner Stürzbecher
- Prof. Dr. med. Wolfgang Jelkmann
- Prof. Dr. rer. nat. Jeanette Erdmann
- Prof. Dr. rer. nat. Christine Zühike
- Prof. Dr. med. Christine Klein
- Prof. Dr. rer. nat. Heinz Fehrenbach
- Prof. Dr. med. Jürgen Brinckmann
- Dr. rer. nat. Carla Schulz
- Prof. Dr. rer. nat. Henrik Oster

## Language:
- depends on the chosen courses

## Notes:
- Basic requirement:
  - BSc in Molecular Life Science or related study program.
  - Prerequisite for the certificate is the attendance of 3 courses of LS 4100A-G, each part valued 33.33% for the grade; the attendance of further presentations is optional.
- For the focus neuroscience, the courses E and G are mandatory. The choice of the third course is free.
- For the focus of structural biology, the attendance of 2 courses of LS4100A-G is mandatory. The choice of the courses is free.
- For the focus medical cell biology, the choice of the three respective courses is free.
The attendance of further presentations is optional. Four weeks after the start of the semester, the selection of the courses is obligatory. These courses are then subjects of the written test. A written registration is required for the test (type of courses, date of the test (1st or 2nd test).
## LS4100 A - Medical Cell Biology 2: Part of the module A: Molecular Oncology (MolOnko)

| Duration: 1 Semester | Turnus of offer: each summer semester | Credit points: 2.66 |

### Course of study, specific field and term:
- Master MLS (module part), cell biology, 2nd semester

### Classes and lectures:
- Molecular Oncology (lecture, 2 SWS)

### Workload:
- 50 Hours private studies
- 30 Hours in-classroom work

### Contents of teaching:
- Oncology from the view of the pathologist; early and recent concepts in oncology; tumour stem cells; defects in DNA-repair systems as a cause for tumorigenesis
- Biochemical, as well as cellular and molecular characteristics and features of tumours (melanoma, glioma, hematopoetic tumours)
- Concepts of prevention and therapy of tumours (melanoma, glioma, hematopoetic tumours)
- Chromatin: Mutations, translocations, methylation, telomere and mitosis defects
- Epidemiology and Lifestyle in the carcinogenesis of lymphoma

### Qualification-goals/Competencies:
- Understanding the concepts in oncology; principles in tumour initiation, tumour progression and relapse
- Understanding the significance of repair mechanisms for tumour formation and therapy
- Understanding the molecular and cellular features of tumours (selected examples such as glioma, melanoma, leukemia and lymphoma)

### Grading through:
- written exam

### Responsible for this module:
- Siehe Hauptmodul

### Teacher:
- Department of Neurosurgery
- Department of Pathology
- Prof. Dr. hum. biol. Hans-Werner Stürzbecher
- PD Dr. rer. nat. Christina Zechel

### Literature:
- Schlegel et al.: Neuroonkologie
- Aktuelle Forschungs- und Überblickartikel
- Thieme; Knippers: Molekulare Genetik
- Thieme; Passarge und Wirth: Taschenatlas Humangenetik, Thieme

### Language:
- offered only in English

### Notes:
- Part of the module LS4100.
- This is one choice of seven. You have to choose 3
<table>
<thead>
<tr>
<th><strong>LS4100 B - Medical Cell Biology 2: Part of the module B: Molecular Endocrinology (MolEndokr)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration:</strong> 1 Semester</td>
</tr>
<tr>
<td><strong>Course of study, specific field and term:</strong></td>
</tr>
<tr>
<td>● Master MLS (module part), cell biology, 2nd semester</td>
</tr>
<tr>
<td><strong>Classes and lectures:</strong></td>
</tr>
<tr>
<td>● Molecular Endocrinology (lecture, 2 SWS)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Contents of teaching:</strong></td>
</tr>
<tr>
<td>● The hormone-producing organs brain, pancreatic gland, parathyroid gland, thyroid gland, adrenocortical gland and kidney</td>
</tr>
<tr>
<td>● Principles of the structure/function relation of hormones</td>
</tr>
<tr>
<td>● Hormone receptors and signal transduction pathways</td>
</tr>
<tr>
<td>● Diseases and therapeutic options in patients suffering from diabetes mellitus, hypo- or hyperthyroidism, adrenal gland failure, disturbances of calcium homeostasis, renal anemia</td>
</tr>
<tr>
<td><strong>Qualification-goals/Competencies:</strong></td>
</tr>
<tr>
<td>● Understanding the main mechanisms of hormonal actions</td>
</tr>
<tr>
<td>● Knowledge of established and novel strategies for the treatment of diseases of specified hormone producing organs</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Grading through:</strong></td>
</tr>
<tr>
<td>● written exam</td>
</tr>
<tr>
<td><strong>Responsible for this module:</strong></td>
</tr>
<tr>
<td>● Siehe Hauptmodul</td>
</tr>
<tr>
<td><strong>Teacher:</strong></td>
</tr>
<tr>
<td>● Institut of Physiology</td>
</tr>
<tr>
<td>● Prof. Dr. med. Wolfgang Jelkmann</td>
</tr>
<tr>
<td>● Prof. Dr. med. Jürgen Brinckmann</td>
</tr>
<tr>
<td><strong>Literature:</strong></td>
</tr>
<tr>
<td><strong>Language:</strong></td>
</tr>
<tr>
<td>● offered only in German</td>
</tr>
<tr>
<td><strong>Notes:</strong></td>
</tr>
<tr>
<td>MLS: see main module LS4101-KP08 for details.</td>
</tr>
<tr>
<td>Nutritional Medicine: see main module EW4200-KP08 for details.</td>
</tr>
<tr>
<td>Part of LS4101-KP08, EW4200-KP08</td>
</tr>
</tbody>
</table>
LS4100 C - Medical Cell Biology 2: Part of the module C: Molecular biology of the cardiovascular system

(Molkardiov)

Duration: 1 Semester
Turnus of offer: each summer semester
Credit points: 2.66

Course of study, specific field and term:
- Master MLS (module part), cell biology, 2nd semester

Classes and lectures:
- Molecular biology of the cardiovascular system (lecture, 2 SWS)

Workload:
- 50 Hours private studies
- 30 Hours in-classroom work

Contents of teaching:
- Introduction into cardiovascular medicine
- Molecular and genetic changes in chronic heart failure
- Molecular and genetic changes in atherosclerosis
- Molecular and genetic changes in angiogenesis

Qualification-goals/Competencies:
- Understanding the (patho-) physiological mechanisms in cardiovascular diseases
- Understanding molecular and genetic characteristics of selected cases of cardiovascular diseases

Grading through:
- written exam

Responsible for this module:
- Siehe Hauptmodul

Teacher:
- Medical Clinic II
- Prof. Dr. rer. nat. Jeanette Erdmann

Literature:

Language:
- offered only in German

Notes:
- Part of the module LS4100
- One choice of seven. You have to choose 3
## LS4100 D - Medical Cell Biology 2: Part of the module D: Tissue regeneration (Gewebereg)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
<th>Turnus of offer:</th>
<th>each summer semester</th>
<th>Credit points:</th>
<th>2.66</th>
</tr>
</thead>
</table>

**Course of study, specific field and term:**
- Master MLS (module part), cell biology, 2nd semester

**Classes and lectures:**
- Tissue regeneration (lecture, 2 SWS)

**Workload:**
- 50 Hours private studies
- 30 Hours in-classroom work

**Contents of teaching:**
- Introduction / Morphological structures
- Biosynthesis and function of matrix proteins (collagens, non-collagenous proteins)
- Tissue regeneration (embryonic, adult) and fibrosis
- Tissue substitutes

**Qualification-goals/Competencies:**
- Understanding of molecular and morphological entities in the assembly of extracellular matrix of different origins
- Understanding of (patho)physiological mechanisms in tissue regeneration

**Grading through:**
- written exam

**Responsible for this module:**
- Siehe Hauptmodul

**Teacher:**
- Department of Dermatology, Allergology and Venerology
- Prof. Dr. med. Jürgen Brinckmann

**Literature:**
- Edited by P. Royce and B. Steinmann: Connective Tissue and its heritable disorders - Wiley-Liss, 2002
- ed by Brinckmann, Notbohm, Müller: Topics in Current Chemistry, 247, Collagen Primer in Structure, Processing and Assembly - 2005

**Language:**
- offered only in German

**Notes:**
- Part of the module LS4100
- One choice of seven. You have to choose 3
## LS4100 E - Medical Cell Biology 2: Part of the module E: Molecular Neuromedicine (MolNeurom)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turnus of offer:</td>
<td>each summer semester</td>
</tr>
<tr>
<td>Credit points:</td>
<td>2.66</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Master MLS (module part), cell biology, 2nd semester

### Classes and lectures:
- Molecular Neurobiomedicine (lecture, 2 SWS)

### Workload:
- 50 Hours private studies
- 30 Hours in-classroom work

### Contents of teaching:
- Introduction into neuroanatomy
- Modern methods of structural, functional and metabolic neuroimaging
- Electrophysiology in diagnostics of neurological diseases and understanding basic neurobiologic mechanisms (EEG, EMG, TMS)
- Selecting neurogenetic diseases: dystonia-parkinsonism syndromes, repeat disorders
- Linkage analyses, gene cloning, genetic association, molecular neurobiology
- Selecting neurogenetic diseases: dystonia-parkinsonism syndromes, repeat disorders

### Qualification-goals/Competencies:
- Acquiring basic skills in neuroanatomy, neuroimaging, electrophysiology and neurogenetics
- Understanding pathophysiology using select examples of neurogenetic diseases

### Grading through:
- written exam

### Responsible for this module:
- Siehe Hauptmodul

### Teacher:
- Institute of Human Genetics
- Prof. Dr. med. Christine Klein
- Prof. Dr. rer. nat. Christine Zühlke

### Literature:
- : u.a. Lehrbücher

### Language:
- offered only in German

### Notes:
- Part of the module LS4100
- One choice of seven. You have to choose 3
<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
<th>Turnus of offer:</th>
<th>each summer semester</th>
<th>Credit points:</th>
<th>2.66</th>
</tr>
</thead>
</table>

**Course of study, specific field and term:**
- Master MLS (module part), cell biology, 2nd semester

**Classes and lectures:**
- Molecular mechanisms in the pathophysiology of pulmonary diseases (lecture, 2 SWS)

**Workload:**
- 50 Hours private studies
- 30 Hours in-classroom work

**Contents of teaching:**
- Introduction: Lung structure; respiration/ventilation and lung damage; immunological aspects
- Diagnostic methods in clinical pneumology: lung function analysis; bronchoscopy; bronchoalveolar lavage; molecular genetics
- Specific aspects of the pathophysiology of selected pulmonary diseases

**Qualification-goals/Competencies:**
- Understanding the basics of lung structure and function as well as of basic diagnostic methodology
- Understanding the (patho)physiologic and molecular mechanisms involved in the development of selected pulmonary diseases
- Acquiring basic knowledge of disease-specific animal models

**Grading through:**
- written exam

**Responsible for this module:**
- Siehe Hauptmodul

**Teacher:**
- Research Center Borstel
- Prof. Dr. rer. nat. Heinz Fehrenbach

**Literature:**

**Language:**
- offered only in German

**Notes:**
- Part of the module LS4100
- One choice of seven. You have to choose 3
# LS4100 G - Medical Cell Biology 2: Part of the module G: Neuroendocrinology (Neuroendo)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each summer semester</td>
<td>2.66</td>
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</tbody>
</table>

## Course of study, specific field and term:
- Master MLS (module part), cell biology, 2nd semester

## Classes and lectures:
- Neuroendocrinology (seminar, 2 SWS)

## Workload:
- 50 Hours private studies
- 30 Hours in-classroom work

## Contents of teaching:
- Introduction into neuroendocrinology
- Hypothalamo-pituitary-system
- Experimental methodology
- Interactions between central nervous and peripheral endocrine systems
- Examples of neuroendocrine systems
- Central nervous regulation of food intake
- Endocrine rhythms

## Qualification-goals/Competencies:
- Acquisition of basic knowledge of neuroendocrinology
- Comprehension of interactions between central nervous endocrine systems

## Grading through:
- Written exam

## Responsible for this module:
- Siehe Hauptmodul

## Teacher:
- Medical Clinic I
- Dr. rer. nat. Carla Schulz
- Prof. Dr. rer. nat. Henrik Oster

## Literature:
- :

## Language:
- Offered only in German

## Notes:
- Part of the module LS4100
- This is one choice of seven. You have to choose 3
### LS4101 F - Part F of the module: Clinical Immunology 2 (FClinIm2)

<table>
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</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each summer semester</td>
<td>2.66</td>
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</tbody>
</table>

**Course of study, specific field and term:**
- Master MLS starting 2018 (module part), Clinical Immunology, 2nd semester
- Master MLS (module part), cell biology, 2nd semester
- Master MLS starting 2016 (module part), Clinical Immunology, 2nd semester

**Classes and lectures:**
- Special topics of clinical immunology (lecture, 2 SWS)

**Workload:**
- 50 Hours private studies
- 30 Hours in-classroom work

**Contents of teaching:**
- The students get basic knowledge of various branches and aspects of clinical immunology
- The students get an insight into the interdisciplinary clinical-immunological aspects of dermatological and allergological diseases
- The students get to know immunopathogenesis, diagnosis and treatment of selected diseases (contact dermatitis, Hymenoptera allergy, food allergy, psoriasis, atopic dermatitis, lichen planus), in context of the involved immune system (especially immunodeficiencies, allergic diseases and chronic inflammation)

**Qualification-goals/Competencies:**
- Students are able to explain the immune response of the innate and adaptive immune system in the context of diagnostic and therapeutic issues
- The students can describe the current knowledge for the development of different types of allergies, Lichen planus or Psoriasis and can explain the basic mechanisms causing these diseases
- They can provide examples of genetic defects leading to primary immunodeficiencies and allergy

**Grading through:**
- written exam

**Responsible for this module:**
- Prof. Dr. med. Jürgen Brinckmann

**Teacher:**
- Institute of Nutrition Medicine
- LIED | Lübecker Institut für experimentelle Dermatologie (Lübeck Institute of Experimental Dermatology)
- Department of Dermatology, Allergology and Venerology
- Dr. Torsten Schröder
- Dr. med. Andreas Recke
- Prof. Dr. med. Ralf Ludwig
- Dr. rer. physiol. Katja Bieber
- Priv.-Doz. Dr. med. vet. Jennifer Hundt

**Literature:**
- Kenneth M. Murphy, Paul Travers, Mark Walport: Janeway Immunologie

**Language:**
- English, except in case of only German-speaking participants

**Notes:**
- See main module LS4101-KP08 for details.
- Part of the module LS4101-KP08
| Duration: | 1 Semester | Turnus of offer: | each summer semester | Credit points: | 3 |

**Course of study, specific field and term:**
- Master Biophysics (module part), advanced curriculum, 2nd semester
- Master MLS starting 2018 (module part), cell biology, 2nd semester
- Master MLS starting 2016 (module part), cell biology, 2nd semester
- Master MLS (module part), structure biology, 2nd semester

**Classes and lectures:**
- Pharmacology and Toxicology (lecture, 2 SWS)

**Workload:**
- 60 Hours private studies
- 30 Hours in-classroom work

**Contents of teaching:**
- Introduction into Pharmacology
- Pharmacodynamic
- Pharmacokinetics
- Oral Antidiabetics
- Pharmacology of the Renin-Angiotensin-Aldosterone-System
- Cerebrovascular Pharmacology
- Reverse Pharmacology
- Pharmacology of the Blood-Brain-Barrier
- Pharmacology of Thyroid Homones
- Sleep and Hypnotics
- Antiepileptic Drugs
- Gene Therapy
- Pain physiology and analgetics therapies

**Qualification-goals/Competencies:**
- Effects of therapeutic drugs on the organism (Pharmacodynamics)
- Time course of therapeutic drug concentrations in the organism (Pharmacokinetics)
- Mechanisms of action of various substance classes
- Experimental methods in pharmacology

**Grading through:**
- written exam

**Responsible for this module:**
- Siehe Hauptmodul

**Teacher:**
- Institute of Experimental and Clinical Pharmacology and Toxicology
  - Prof. Dr. rer. nat. Olaf Jöhren
  - Prof. Dr. rer. medic. Lisa Marshall
  - Prof. Dr. rer. nat. Walter Raasch
  - Dr. rer. nat. Dipl.-Psych. Sonja Binder
  - Prof. Dr. med. Markus Schwaninger
  - Dr. rer. nat. Jan Wenzel
  - Prof. Dr. rer. nat. Enrico Leipold
  - Dr. rer. nat. Sivaraj Mohana Sundaram
  - Dr. rer. nat. Marietta Zille

**Literature:**
<table>
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<tr>
<th>Language:</th>
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<tr>
<td>● English, except in case of only German-speaking participants</td>
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<thead>
<tr>
<th>Notes:</th>
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<tbody>
<tr>
<td>Part of the module LS4110</td>
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</table>
## LS4110 B - Part of the module LS4110B: Drug Design (WiFoDrug)

<table>
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<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each summer semester</td>
<td>3</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Master MLS starting 2018 (module part), cell biology, 2nd semester
- Master MLS starting 2016 (module part), cell biology, 2nd semester
- Master MLS (module part), structure biology, 2nd semester
- Master Biophysics (module part), advanced curriculum, 2nd semester

### Classes and lectures:
- Drug Design (lecture, 2 SWS)

### Workload:
- 60 Hours private studies
- 30 Hours in-classroom work

### Contents of teaching:
- Concepts in Drug Design
- NMR experiments for Drug Design
- Case Study: Omeprazole vs. Tamiflu
- Chemical Synthesis of Drugs - Combinatorial Approaches
- Drug Discovery - An Overview
- Target Identification and Validation
- X-ray Crystallography in Drug Design
- Structure-based drug design - Principles and Methods

### Qualification-goals/Competencies:
- Basic strategies of Drug Design
- The way from the target discovery to the drug. Techniques of rational Drug Design
- NMR and X-ray Crystallography as important tools for target monitoring and optimization
- The relationship between chemical structure and effect and the techniques for theoretical prognosis and experimental tests, particular x-ray crystallography and NMR-experiments
- The students should know the borders of x-ray crystallography and NMR-experiments

### Grading through:
- written exam

### Responsible for this module:
- Prof. Dr. rer. nat. Thomas Peters

### Teacher:
- Institute of Biochemistry
- Institute of Molecular Medicine
- Institute of Chemistry and Metabolomics
- Prof. Dr. rer. nat. Thomas Peters
- Prof. Dr. rer. nat. Tobias Restle
- Dr. rer. nat Sonja Petkovic
- Prof. Dr. rer. nat. Rolf Hilgenfeld
- Dr. Lars Redecke

### Literature:
- : Grundlagen- und Übersichtsartikel für beide Veranstaltungen

### Language:
- English, except in case of only German-speaking participants

### Notes:
Part of the module LS4110
**LS4110-KP06 - Drug Research (WiFo)**

| Duration: 1 Semester | Turnus of offer: each summer semester | Credit points: 6 |

**Course of study, specific field and term:**
- Master MLS starting 2018 (compulsory), cell biology, 2nd semester
- Master MLS starting 2016 (compulsory), cell biology, 2nd semester
- Master MLS (compulsory), life sciences, 2nd semester

**Classes and lectures:**
- Part of the module A: Pharmacology and Toxicology (lecture, 2 SWS)
- Part of the module B: Rational Drug Design (lecture, 2 SWS)

<table>
<thead>
<tr>
<th>Workload:</th>
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<tbody>
<tr>
<td>120 Hours private studies</td>
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<tr>
<td>60 Hours in-classroom work</td>
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</table>

**Contents of teaching:**
- See part of the modules A and B

**Qualification-goals/Competencies:**
- See part of the modules A and B

**Grading through:**
- written exam

**Responsible for this module:**
- Prof. Dr. rer. nat. Thomas Peters

**Teacher:**
- Institute of Biochemistry
- Institute of Molecular Medicine
- Institute of Experimental and Clinical Pharmacology and Toxicology
- Institute of Chemistry and Metabolomics
- Prof. Dr. rer. nat. Thomas Peters
- Prof. Dr. rer. nat. Olaf Jöhren
- Dr. rer. nat. Sivaraj Mohana Sundaram
- Dr. rer. nat. Jan Wenzel
- Prof. Dr. rer. nat. Tobias Restle
- Dr. rer. nat. Alessandra Mescalchin
- Prof. Dr. rer. nat. Rolf Hilgenfeld
- Prof. Dr. med. Markus Schwaninger
- Prof. Dr. rer. nat. Enrico Leipold
- Prof. Dr. rer. nat. Walter Raasch
- Dr. rer. nat. Marietta Zille

**Language:**
- English, except in case of only German-speaking participants

**Notes:**
- BSc in Molecular Life Science or related fields.
- One written examination with on both parts (Pharmacology and Toxicology, Drug Design), each valued 50%.
# LS4130 - Biophysics 2 (Biophy2)

<table>
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<tr>
<th>Duration:</th>
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<tbody>
<tr>
<td>Turnus of offer:</td>
<td>each summer semester</td>
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<tr>
<td>Credit points:</td>
<td>4</td>
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</table>

**Course of study, specific field and term:**
- Master MLS (compulsory), structure biology, 2nd semester

**Classes and lectures:**
- See LS4130 A: Membranbiophysics (course, 3 SWS)
- See LS4130 B: Proteinbiophysics (course, 3 SWS)

**Workload:**
- 75 Hours private studies
- 45 Hours in-classroom work

**Contents of teaching:**
- See part of the module LS4130 A and B

**Qualification-goals/Competencies:**
- See part of the module LS4130 A and B

**Grading through:**
- written exam

**Responsible for this module:**
- Prof. Dr. rer. nat. Christian Hübner

**Teacher:**
- Research Center Borstel
- Institute of Physics
- Prof. Dr. rer. nat. Christian Hübner
- Prof. Dr. rer. nat. Thomas Gutsmann
- PD Dr. rer. nat. Jörg Andrä
- PD Dr. rer. nat. Andra Schromm

**Language:**
- English, except in case of only German-speaking participants

**Notes:**
- One choise of two.
# LS4130 A - Module part: Membrane Biophysics (Biphy2Mem)

<table>
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<tr>
<th>Duration:</th>
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<tr>
<td>1 Semester</td>
<td>each summer semester</td>
<td>4</td>
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</tbody>
</table>

## Course of study, specific field and term:
- Master Biophysics (module part), biophysics, 2nd semester
- Master Entrepreneurship in Digital Technologies (module part), mathematics / natural sciences, arbitrary semester
- Master MES since 2014 (module part), mathematics / natural sciences, arbitrary semester
- Master MLS (module part), structure biology, 2nd semester

## Classes and lectures:
- Basics of Membrane Biophysics (lecture, 2 SWS)
- Basics of Membrane Biophysics (exercise, 1 SWS)

## Workload:
- 75 Hours private studies
- 45 Hours in-classroom work

## Contents of teaching:
- Importance and function of cell membranes: structure, physical function and dynamic models
- Basics of the membrane components
- Thermodynamic self-assembling of lipids and reconstitution techniques
- Transmembrane and intrinsic membrane potentials
- Mechanical properties of lipid membranes
- Physical basics of membrane transport mechanisms
- Investigations using lipid monolayer
- Electrical and optical experiments using planar lipid bilayers
- Examples for interaction mechanisms between peptides/ proteins and planar membranes
- Spectroscopic methods on membranes and membrane proteins
- Light and force microscopy on membranes and membrane proteins

## Qualification-goals/Competencies:
- Constituents and composition of biological membranes
- Physical role and function of membrane lipids and proteins
- Mechanical and electrical properties of membranes
- Various methods to investigate reconstituted and natural membranes

## Grading through:
- written exam

## Responsible for this module:
- Siehe Hauptmodul

## Teacher:
- Research Center Borstel
- Prof. Dr. rer. nat. Thomas Gutsmann
- PD Dr. rer. nat. Andra Schromm
- Dr. Christian Nehls

## Literature:
- Adam, P. Läuger, G. Stark: Physikalische Chemie und Biophysik - Springer-Verlag, 4. Auflage 2003
- W. Hanke, R. Hanke: Methoden der Membranphysiologie - Spektrum Akademischer Verlag, Auflage 1997

## Language:
- English, except in case of only German-speaking participants

## Notes:
- Part of the module LS4130
- One choise of two.
LS4130 B - Biophysics 2: Part of the module B: Protein-Biophysics (Biophy2Pro)

<table>
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<tr>
<th>Duration:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>each summer semester</td>
<td>4</td>
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</tbody>
</table>

Course of study, specific field and term:
- Master MLS (module part), structure biology, 2nd semester
- Master Biophysics (module part), biophysics, 2nd semester

Classes and lectures:
- Physics of Proteins (lecture, 2 SWS)
- Physics of Proteins (exercise, 1 SWS)

Contents of teaching:
- Protein structure
- Energy landscapes
- Thermodynamics of protein folding
- Kinetics of protein folding
- Thermodynamics of enzymatic reactions
- Kinetics of enzymatic reactions

Workload:
- 60 Hours private studies
- 30 Hours in-classroom work

Qualification-goals/Competencies:
- Understanding of physical principles of:
  - protein folding
  - protein dynamics
  - protein interactions

Grading through:
- written exam

Requires:
- Introduction into Biophysics (LS2200-KP04, LS2200)

Responsible for this module:
- Siehe Hauptmodul

Teacher:
- Institute of Physics
- Prof. Dr. rer. nat. Christian Hübner
- PD Dr. rer. nat. Hauke Paulsen

Literature:

Language:
- offered only in German

Notes:
- Part of the module LS4130
- One choice of two.
### MZ4120 A - Module part A: Biology of Infections (BiomInfecb)

<table>
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<tr>
<th>Duration:</th>
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<th>Credit points:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>each summer semester</td>
<td>6</td>
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</tbody>
</table>

#### Course of study, specific field and term:
- Master Nutritional Medicine in planning (module part), life sciences, 2nd semester
- Master CLS (module part), computational life science / life sciences, 3rd semester
- Master MLS (module part), cell biology, 2nd semester

#### Classes and lectures:
- Specific Topics of Infection Biology (lecture, 2 SWS)
- Specific Topics of Infection Biology (seminar, 2 SWS)

#### Workload:
- 120 Hours private studies
- 60 Hours in-classroom work

#### Contents of teaching:
- Infectious diseases, viral, prokaryotic and eukaryotic infectious agents, parasites, zoonotic diseases
- ...
- ...
- ...
- ...
- ...
- ...
- ...

#### Qualification-goals/Competencies:
- Students will have detailed knowledge of infectious agents, infectious diseases and their pathomechanisms
- They have a detailed understanding of antimicrobial defence mechanisms at the cellular and molecular level. They are able to understand mechanisms of vaccination and immune deficiencies.
- They have knowledge of in vivo and in vitro techniques of infection biology.
- They will improve their ability to present data and to scientific problems in English.

#### Grading through:
- presentation
- written exam

#### Responsible for this module:
- Prof. Ph.D. Tamás Laskay

#### Teacher:
- Research Center Borstel
- Department of Infectious Diseases and Microbiology
- Prof. Ph.D. Tamás Laskay
- Dr. rer. nat. Bianca Schneider
- Dr. rer. nat. Christoph Hölscher
- PD Dr. rer. nat. Norbert Reiling
- Prof. Dr. rer. nat. Stefan Niemann
- Prof. Dr. Ulrich Schaible
- Dr. rer. nat. Tobias Dallenga
- Dr. rer. nat. Matthias Hauptmann
- Dr. rer. nat. Gabi Schramm

#### Literature:
- Books, Original publications and Reviews

#### Language:
- offered only in English
Notes:

- Part of the module MZ4120
- BSc in Molecular Life Science or in related fields
- One choice of two
MZ4120 B - Module part MZ4120 B: Neuroscience 2 (BiomNeuro2)

Duration: 1 Semester
Turnus of offer: each summer semester
Credit points: 6

Course of study, specific field and term:
- Master Nutritional Medicine in planning (module part), life sciences, 2nd semester
- Master CLS (module part), neuroscience, 3rd semester
- Master MLS (module part), cell biology, 2nd semester
- Master Biophysics (module part), advanced curriculum, 2nd semester

Classes and lectures:
- Neuroscience 2 (lecture, 2 SWS)
- Neuroscience 2 (seminar, 2 SWS)

Workload:
- 120 Hours private studies
- 60 Hours in-classroom work

Contents of teaching:
- Stem and progenitor cells
- Alzheimer's disease
- Pathophysiology of cerebrovascular disorders
- Neuroimmunology of Multiple Sclerosis
- Epilepsy
- Pathogens of the brain
- Parkinson's disease and other movement disorders
- Neurogenetic diseases
- Schizophrenia
- Neuropathies
- Neurometabolic diseases

Qualification-goals/Competencies:
- Introduction to neuronal stem cells
- Introduction to various neuropathological diseases
- Understanding molecular mechanisms of neuropathological diseases

Grading through:
- presentation
- continuous, successful participation in course, >80%
- written exam

Responsible for this module:
- Prof. Ph.D. Tamás Laskay

Teacher:
- Department of Neurosurgery
- Department of Neurology
- Institute of Experimental and Clinical Pharmacology and Toxicology

- Prof. Dr. med. Markus Schwaninger
- PD Dr. rer. nat. Christina Zechel
- Prof. Dr. rer. nat. Katja Lohmann
- PD Dr. Sc. Ana Westenberger

Literature:
- : Original publications and Reviews

Language:
- English, except in case of only German-speaking participants

Notes:
Part of the module MZ4120
BSc in Molecular Life Science or in related fields
Choose one Modulpart of two
### MZ4120-KP06, MZ4120 - Biomedicine (Biomed)

**Duration:** 1 Semester  
**Turnus of offer:** each summer semester  
**Credit points:** 6

**Course of study, specific field and term:**
- Master Nutritional Medicine in planning (compulsory), life sciences, 2nd semester
- Master MLS (optional subject), neuroscience, 2nd semester

**Classes and lectures:**
- MZ4120 A: Infection Biology (course, 4 SWS)  
- MZ4120 B: Neuroscience 2 (course, 4 SWS)

**Workload:**
- 120 Hours private studies  
- 60 Hours in-classroom work

**Contents of teaching:**
- see Modulpart A: Infection Biology and Modulpart B Neuroscience 2

**Qualification-goals/Competencies:**
- see Modulpart A: Infection Biology and Modulpart B Neuroscience 2

**Grading through:**
- presentation  
- written exam

**Responsible for this module:**
- Prof. Ph.D. Tamás Laskay

**Teacher:**
- Institut of Physiology  
- Institute of Experimental and Clinical Pharmacology and Toxicology  
- Department of Infectious Diseases and Microbiology  
- Prof. Ph.D. Tamás Laskay  
- Prof. Dr. med. Werner Solbach  
- Dr. rer. nat. Christoph Hölscher  
- PD Dr. rer. nat. Norbert Reiling  
- Prof. Dr. med. Johannes Knobloch  
- Prof. Dr. rer. nat. Ulrike Seitzer  
- Prof. Dr. rer. nat. Stefan Niemann  
- Prof. Dr. Ulrich Schaible

**Literature:**
- Books, Original publications and Reviews

**Language:**
- English, except in case of only German-speaking participants

**Notes:**
- BSc in Molecular Life Science or in related fields  
- Choose one Modulpart of two
# MZ4127-KP06 - Clinical Immunology 1 (ClinImmu1)

<table>
<thead>
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<th><strong>Duration:</strong></th>
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<tr>
<td><strong>Turnus of offer:</strong></td>
<td>each summer semester</td>
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<tr>
<td><strong>Credit points:</strong></td>
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</table>

## Course of study, specific field and term:
- Master MLS (optional subject), Clinical Immunology, 2nd semester
- Master MLS starting 2016 (optional subject), Clinical Immunology, 2nd semester
- Master MLS starting 2018 (optional subject), Clinical Immunology, 2nd semester

## Classes and lectures:
- Special topics of clinical immunology (lecture, 2 SWS)
- Special topics of clinical immunology (seminar, 2 SWS)

## Workload:
- 120 Hours private studies
- 60 Hours in-classroom work

## Contents of teaching:
- The students get advanced knowledge of various branches and aspects of clinical immunology
- The students get an insight into the interdisciplinary clinical-immunological aspects of dermatological, gastroenterological, hematological and rheumatologic disorders
- The students get to know immunopathogenesis, diagnosis and treatment of selected diseases, (pemphigus, pemphigoid, connective tissue diseases, ANCA-associated vasculitis, inflammatory bowel disease, multiple sclerosis), in context of the involved immune system (especially immunodeficiencies, autoimmune diseases and chronic inflammation)
- Gender differences of the immune system
- Epigenetic changes in the context of clinical immunology

## Qualification-goals/Competencies:
- Students are able to explain the immune response of the innate and adaptive immune system in the context of diagnostic and therapeutic issues
- Students are able to explain common features of primary immunodeficiencies affecting humoral immune response or T cell function
- The students can describe the current knowledge for the development of autoimmune diseases like multiple sclerosis, rheumatoid arthritis, systemic lupus erythematosus and bullous autoimmune skin diseases.
- They can provide examples of genetic defects and epigenetic modification leading to primary immunodeficiencies and autoimmunity
- They know gender differences of the immune system
- The students can critically evaluate scientific content of recent scientific publications in the field of clinical immunology
- The students can give didactically good presentations

## Grading through:
- presentation
- written exam

## Responsible for this module:
- Prof. Dr. med. Dr. rer. nat. Enno Schmidt

## Teacher:
- Comprehensive Center for Inflammation Medicine (CCIM)
- Department of Dermatology, Allergology and Venerology
- LIED | Lübecker Institut für experimentelle Dermatologie (Lübeck Institute of Experimental Dermatology)
- Prof. Dr. med. Dr. rer. nat. Enno Schmidt
- Prof. Dr. med. Ralf Ludwig
- Dr. rer. nat. Susanne Lemcke
- Dr. Stephanie Goletz
- Dr. Ingolf Karl
- Prof. Christian Sadik
- PD Michael Kasperkiewicz
- Prof. Diamant Thaci
- Prof. Dr. med. Gabriela Riemekasten
- Prof. Peter Lamprecht
Module Guide

- Prof. Dr. med. Christian Sina
- Dr. med. vet. Jennifer Kloepper

Literature:
- Kenneth M. Murphy, Paul Travers, Mark Walport: Janeway Immunologie

Language:
- English, except in case of only German-speaking participants

Notes:
- MZ4127
  - BSc in Molecular Life Science or in related fields
  - For Master MLS: focus on Clinical Immunology it is a mandatory modul
<table>
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<tr>
<th><strong>LS1100 - Practical Course MLS (BP)</strong></th>
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<tbody>
<tr>
<td><strong>Duration:</strong></td>
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<tr>
<td>1 Semester</td>
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</tbody>
</table>

**Course of study, specific field and term:**
- Master MLS (compulsory), life sciences, 3rd semester

**Classes and lectures:**
- Practical Course (block practical course, 24 SWS)

**Contents of teaching:**
- Two practical courses with 2 different skills of the following list are to acquire. One term must have 3 month (12 weeks) labwork, the other 8 to 12 weeks labwork.
  - Structural biology:
    - S 1: Structure analytics of macromolecules
    - S 2: Proteinexpression- and cleaning
    - S 3: Membranbiophysics
    - S 4: RNA-Technologies
    - S 5: Computer aided methods
  - Cell biology:
    - Z 1: Tissue culture/ Cell culture
    - Z 2: Cellphysiology and Cellbiochemistry
    - Z 3: Classical and moleculare Genetics
    - Z 4: Infection and Immunology
    - Z 5: Microscopic Techniques
    - Z 6: Neuroscience

**Qualification-goals/Competencies:**
- Ability to applicate knowledge of the first ans second semester of the master course in practice
- Absorbing knowledge in documentation and presentation of scientific data (poster presentation and talk)
- Ability to work in a team
- Getting lab experiences by working on real research projects

**Grading through:**
- oral presentation
- practical work, poster and oral presentation of course results, 2 examiners
- Poster

**Requires:**
- Basics of Cell- and Molecular Biology for Virology (LS4010-KP06, LS4010)

**Responsible for this module:**
- Prof. Dr. rer. nat. Enno Hartmann

**Teacher:**
- Institutes and hospitals of the University of Lübeck
- Dozentinnen/Dozenten der UzL

**Language:**
- English, except in case of only German-speaking participants

**Notes:**
- Lehrbücher, Methodenanleitungen, Grundlagen- und Übersichtsartikel
The practical course can run at the University of Lübeck, at other Universities in Germany or foreign countries, at research center or at companies. The Minimum of one of the three courses (PC 1, 2 or Masterthesis) must pass at the University of Lübeck.
## LS200 - Consolidating in MLS (VTMLS)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
<th>Max. group size:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Master MLS (compulsory), advanced curriculum, 3rd semester

### Classes and lectures:
- See the list of 20 different courses on the website (seminar, 4 SWS)

### Workload:
- 120 Hours private studies
- 60 Hours in-classroom work

### Contents of teaching:
- 20 different courses with topics of molecular cellbiology, structure biology, neurosciences or clinical immunology. Everybody has to choose two of it. See special plan of the courses located on the MLS website.

### Qualification-goals/Competencies:
- Extended knowledge in two special topics of molecular cellbiology, structure biology, neurosciences or clinical immunology
- Detailed knowledge of actual research projects
- Working with specialist literature
- Ability, to understand and reproduce the specific knowledge of the topics
- Improving special practical skills

### Grading through:
- as announced by examiner

### Requires:
- Molecular Pathomechanisms and Strategies for Therapy (LS4030-KP06)
- Basics of Cell- and Molecular Biology for Virology (LS4010-KP06, LS4010)

### Responsible for this module:
- Prof. Dr. rer. nat. Enno Hartmann

### Teacher:
- Universitätsklinikum S-H
- Research Center Borstel
- All institutes of the University of Lübeck
- Alle Dozentinnen/Dozenten der UzL

### Literature:
- see special course:

### Language:
- English, except in case of only German-speaking participants

### Notes:
The seminars must run at the University of Lübeck. The list is located on the website of the Master Program MLS. The certificate is without grades.
## LSS200 SC - Module part: Structure-based design and synthesis of an antiviral compound (DDSyn)

<table>
<thead>
<tr>
<th>Duration:</th>
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</thead>
<tbody>
<tr>
<td>Turnus of offer:</td>
<td>each winter semester</td>
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<tr>
<td>Credit points:</td>
<td>3</td>
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<td>Max. group size:</td>
<td>4</td>
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</tbody>
</table>

### Course of study, specific field and term:
- Master MLS (module part), advanced curriculum MLS, 3rd semester

### Classes and lectures:
- Structure-based design and synthesis of an antiviral compound (seminar, 2 SWS)

### Workload:
- 60 Hours private studies
- 30 Hours in-classroom work

### Contents of teaching:
- Experiment 1: Recombinant production of 3C-protease (3Cpro) of Coxsackievirus B3 in E. coli, purification of protein, activity assays
- Experiment 2: Crystallization of 3Cpro. Conditions are chosen allowing for crystal growth in only few hours
- Experiment 3: Collection of diffraction data of these crystals or, in case of not sufficient quality, of primed crystals
- Experiment 4: Interpretation of electron density and modelling of an inhibitor
- Experiment 5: Practical performance of two steps of the synthesis of an inhibitor, determination of the identity of the product via ESI mass spectrometry and NMR spectroscopy
- Experiment 6: Determination of kinetic parameters using FRET: IC50 and kkat/KM
- Experiment 7: Working with replicons, transfection, determination of EC50 - values

### Qualification-goals/Competencies:
- This practical course offers an interdisciplinary insight in design and chemical synthesis of antiviral compounds. All practical work is performed by the students themselves. The course is based on the knowledge of the following courses: virology, biochemistry, structure analysis/crystallography, rational drug design, organic chemistry, biological chemistry

### Grading through:
- protocols

### Responsible for this module:
- Siehe Hauptmodul

### Teacher:
- Institute of Biochemistry
- Prof. Dr. rer. nat. Rolf Hilgenfeld
- MitarbeiterInnen des Instituts

### Language:
- offered only in German

### Notes:
- For MLS.
- Prerequisites: Passed all modules of the 1. and 2. semester MSc
<table>
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<th>Duration:</th>
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<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>3</td>
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</tbody>
</table>

**Course of study, specific field and term:**
- Master MLS (module part), advanced curriculum MLS, 3rd semester

**Classes and lectures:**
- NMR and drug design (seminar, 2 SWS)

**Workload:**
- 60 Hours private studies
- 30 Hours in-classroom work

**Contents of teaching:**
- Basics
- Ligand based techniques
- Protein based techniques
- Expression and purification of isotope labeled proteins
- Examples for the use of NMR in drug design

**Qualification-goals/Competencies:**
- Acquisition of in-depth knowledge of NMR experiments which identify and characterize protein-ligand interactions
- Acquiring knowledge of the use of NMR active isotope labels
- Learning criteria when and where to apply NMR in the drug design process

**Grading through:**
- Oral examination

**Responsible for this module:**
- Siehe Hauptmodul

**Teacher:**
- Institute of Chemistry and Metabolomics
- Dr. rer. nat. Thorsten Biet
- Dr. phil. nat. Hannelore Peters
- PD Dr. phil. nat. Thomas Weimar

**Literature:**
- Aktuelle Forschungsliteratur

**Language:**
- English, except in case of only German-speaking participants

**Notes:**
- Only for MLS.
- Prerequisites: Passed all modules of the 1. and 2. semester MSc
<table>
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<th>Duration:</th>
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</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

**Course of study, specific field and term:**
- Master MLS (module part), advanced curriculum MLS, 3rd semester

**Classes and lectures:**
- Individual molecule therapy: from bench to bedside (seminar, 2 SWS)

**Workload:**
- 60 Hours private studies
- 30 Hours in-classroom work

**Contents of teaching:**
- Design and validation of nucleic acid-based tools and drugs (aptamers, antisense, siRNA and miRNA)
- Nucleic acid delivery
- Pharmacology & toxicology
- Animal models
- Clinical studies in phases I, II and III
- Final stages of drug development

**Qualification-goals/Competencies:**
- Insights into current research on nucleic acid based drugs
- Insights into the mode of action of nucleic acid based drugs
- Analysing relevant publications and introduction to a colloquium with discussion
- Capability to analyse publication in this fields

**Grading through:**
- oral presentation
- Written report
- Oral examination

**Responsible for this module:**
- Siehe Hauptmodul

**Teacher:**
- Institute of Molecular Medicine
- Prof. Dr. rer. nat. Georg Sczakiel
- Prof. Dr. rer. nat. Tobias Restle

**Literature:**
- Aktuelle Forschungs- und Übersichtsartikel

**Language:**
- English, except in case of only German-speaking participants

**Notes:**
- Only for MLS.
- Prerequisites: Passed all modules of the 1. and 2. semester MSc
LS5200 SH - Module part: Microscopic Optical Techniques (OptVerf)

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<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
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<tbody>
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<td>3</td>
<td>4</td>
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</tbody>
</table>

Course of study, specific field and term:
- Master MLS (module part), advanced curriculum MLS, 3rd semester

Classes and lectures:

<table>
<thead>
<tr>
<th>Workload:</th>
</tr>
</thead>
</table>
| • 60 Hours private studies
| • 30 Hours in-classroom work |

Contents of teaching:
- Lecture: Basic concepts of quantum optics, wave optics, geometrical optics. Microscopic imaging in geometric optical and Fourier optical description
- Coherent filtering, phase contrast and differential interference contrast imaging (DIC)
- Modern light sources (lasers, white light sources, LEDs)
- Basics of spectroscopy (absorption, fluorescence, FRET)
- Confocal laser scanning microscopy
- Nonlinear microscopy (multiphoton excitation, 2nd harmonic)
- Flow-cytometry, (fluorescence-activated cell sorting, FACS)
- DNA- and protein chips
- Tissue optics, Interaction of light with cells and tissues
- Optical manipulation of cells (laser tweezers, microdissection, laser-catapulting, nanoparticle-cell surgery, CALI)
- Practical course: Coherence, interference, diffraction, Fourier optics
- Microscopic illumination, imaging, and resolution
- Coherent filtering, phase contrast, DIC
- Fluorescence spectroscopy
- Confocal laser scanning microscopy
- Nonlinear microscopy via multiphoton excitation and 2nd harmonic generation
- FACS
- Laser microdissection, laser-catapulting, and cell surgery

Qualification-goals/Competencies:
- Basic knowledge of modern optical techniques in Biomedicine and Biotechnology
- Practical experience in applying those techniques to problems in Biomedicine and Biotechnology

Grading through:
- Written report

Responsible for this module:
- Siehe Hauptmodul

Teacher:
- Institute of Biomedical Optics
- Prof. Dr. rer. nat. Alfred Vogel

Literature:
- Textbooks, scientific articles

Language:
- offered only in German

Notes:
- Only for MLS.
- Prerequisites: Passed all modules of the 1. and 2. semester MSc
# LS5200 SM - Module part: Economics for MLS (BWL)

<table>
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</thead>
<tbody>
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<td>1 Semester</td>
<td>each winter semester</td>
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**Course of study, specific field and term:**
- Master MLS (module part), advanced curriculum MLS, 3rd semester

**Classes and lectures:**
- Economics for MINT students (seminar / exercises, 2 SWS)

**Workload:**
- 60 Hours private studies
- 30 Hours in-classroom work

**Contents of teaching:**
- Basics of business administration and economics
- A company as a social-economic system
- Organisation of companies and production processes
- Sales/market and price/controlling
- Human Resource Management: leadership
- Macroeconomics: discussions of current problems

**Qualification-goals/Competencies:**
- Knowing of basics of business administration and economics and practice this on a case study
- Understanding of processes and correlations in economics
- Discussing current problems of economics

**Grading through:**
- Oral presentation
- Continuous, successful participation in course

**Responsible for this module:**
- Siehe Hauptmodul

**Teacher:**
- Dipl.-Ökonom Jürgen Spiekermann

**Literature:**
- Scientific articles

**Language:**
- Offered only in German

**Notes:**
- Only for MLS.
- Prerequisites: Passed all modules of the 1. and 2. semester MSc
## LS5200 ZA - Module part: Neurogenetics (Neurogen)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
<th>Turnus of offer:</th>
<th>each winter semester</th>
<th>Credit points:</th>
<th>3</th>
<th>Max. group size:</th>
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</tr>
</thead>
</table>

### Course of study, specific field and term:
- Master MLS (module part), advanced curriculum MLS, 3rd semester

### Classes and lectures:
- **Neurogenetics: Mutations, pathology and diseases (seminar, 2 SWS)**

### Workload:
- 60 Hours private studies
- 30 Hours in-classroom work

### Contents of teaching:
- Study of relevant literature
- Presentation of scientific results
- Correlation mutation to function
- Selected topics: Huntington’s disease, fragile X syndrome, Parkinson’s disease

### Qualification-goals/Competencies:
- Understanding of mutations and resulting diseases, selected examples

### Grading through:
- Presentation

### Responsible for this module:
- Siehe Hauptmodul

### Teacher:
- **Institute of Human Genetics**
  - Prof. Dr. rer. nat. Katja Lohmann
  - PD Dr. Sc. Ana Westenberger

### Literature:
- Selected scientific articles

### Language:
- English, except in case of only German-speaking participants

### Notes:
- Only für MLS.
- Prerequisites: Passed all modules of the 1. and 2. semester MSc
<table>
<thead>
<tr>
<th>Duration:</th>
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<td>each winter semester</td>
<td>3</td>
<td>20</td>
</tr>
</tbody>
</table>

**Course of study, specific field and term:**
- Master MLS (module part), advanced curriculum MLS, 3rd semester

**Classes and lectures:**
- Intracellular Topogenesis of Proteins - Concepts and Experimental Methods (seminar, 2 SWS)
- 60 Hours private studies
- 30 Hours in-classroom work

**Contents of teaching:**
- Starting point is the signal hypothesis of Blobel and Dobberstein
- Milestones and errors as well as misinterpretations in the field of protein transport into the ER of the last 30 years are discussed in detail using original papers
- Focusing on methods used (e.g. translocation assays, ribosome binding assays, chemical and photochemical cross-linking, fluorescence quenching, reconstitution of proteoliposomes, EM, cryo-EM, crystal structure of protein translocation channels, electrophysiology)
- Analyzing the design of the used experiments and critical interpretation of results

**Qualification-goals/Competencies:**
- Improving the knowledge about the protein transport into the endoplasmic reticulum (ER)
- Developing skills in the design of experiments and the use of model organisms, using examples of intracellular protein transport

**Grading through:**
- Oral examination

**Responsible for this module:**
- Siehe Hauptmodul

**Teacher:**
- Institute for Biology
- PD Dr. rer. nat. Kai-Uwe Kalies

**Literature:**
- Originalarbeiten werden am 1. Termin verteilt

**Language:**
- offered only in German

**Notes:**
- Only for MLS.
- Prerequisites: Passed all modules of the 1. and 2. semester MSc
## LS5200 ZG - Module part: Progenitors (Progenitor)

<table>
<thead>
<tr>
<th>Duration: 1 Semester</th>
<th>Turnus of offer: each winter semester</th>
<th>Credit points: 3</th>
<th>Max. group size: 5</th>
</tr>
</thead>
</table>

### Course of study, specific field and term:
- Master MLS (module part), advanced curriculum MLS, 3rd semester

### Classes and lectures:
- Progenitor Cells (seminar / exercises, 2 SWS)

### Workload:
- 60 Hours private studies
- 30 Hours in-classroom work

### Contents of teaching:
- Types of stem cells: (i) embryonic stem cells (ESC), (ii) fetal stem cells (FSC), (iii) adult stem cells (aSC), (iv) tumor stem cells (CSC), (v) induced pluripotent stem cells (IPS)
- Definitions: stem cell/progenitor; features of neural (NSC), mesenchymal (MSC), hematopoietic (HSC) and tumor- (CSC) stem cells
- Characteristics and generation of IPS
- Characteristics of the stem cell niche
- non-neural and neural differentiation
- Neurogenesis: (i) neuro-epithelial cells, (ii) radial glia, (iii) types of neuronal and glial progenitors
- Factors regulating differentiation; factor-cocktails for the induction & differentiation of IPS

### Qualification-goals/Competencies:
- They can explain the features of ESCs, FSCs, aSCs, CSCs and IPS
- They can list the characteristics and significance of NSCs, MSCs, HSCs and CSCs
- They can explain the production and significance of IPS
- They can explain the structure of the stem cell niche and its regulatory role
- They can detail protocols of directed differentiation (e.g. neural versus non-neural)
- Using neurogenesis as an example, they can tell how stem cells differentiate and what the terms cell fate decision and lateral inhibition indicate
- They can name factors which promote the stem cell character and which are used to allow the production of IPS cells or their differentiation, respectively

### Grading through:
- Oral presentation and exercise with written report

### Responsible for this module:
- Siehe Hauptmodul

### Teacher:
- Department of Neurosurgery
- PD Dr. rer. nat. Christina Zechel

### Literature:
- : Originalliteratur und Reviews zu den einzelnen Themenabschnitten

### Language:
- English, except in case of only German-speaking participants

### Notes:
- Only for MLS.
- Prerequisites: Passed all modules of the 1. and 2. semester MSc
# LSS200 ZL - Module part: Animals in experimental neuro- and endocrinopharmacology (TierMeth)

<table>
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<th>Duration:</th>
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</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>3</td>
<td>6</td>
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</tbody>
</table>

**Course of study, specific field and term:**
- Master MLS (module part), advanced curriculum MLS, 3rd semester

**Classes and lectures:**
- Animals in experimental neuro- and endocrinopharmacology (Seminar and practical course, 2 SWS)

**Workload:**
- 60 Hours private studies
- 30 Hours in-classroom work

**Contents of teaching:**
- Introduction to laboratory animal science, animal welfare and animal applications
- Anatomy and handling of rodents
- Anesthesia in rodents
- Transgenic / knockout mice
- Brain histology of rodents

**Qualification-goals/Competencies:**
- Learning of practical use of laboratory animals (rats, mice)
- Introduction to animal models for stroke and diabetes
- Learning of easy behavioral test

**Grading through:**
- evaluated protocol

**Responsible for this module:**
- Siehe Hauptmodul

**Teacher:**
- Institute of Experimental and Clinical Pharmacology and Toxicology
- Prof. Dr. rer. nat. Olaf Jöhren
- Prof. Dr. rer. nat. Walter Raasch
- Dr. med. Dirk Ridder
- Dr. rer. hum. biol. Helge Müller-Fielitz

**Literature:**
- Original publications and Reviews

**Language:**
- English, except in case of only German-speaking participants

**Notes:**
- Only for MLS.
- Prerequisites: Passed all modules of the 1. and 2. semester MSc
### Module Guide

#### LS5200 ZN - Module part: Chronobiology (Chronobio)

<table>
<thead>
<tr>
<th>Duration: 1 Semester</th>
<th>Turnus of offer: each winter semester</th>
<th>Credit points: 3</th>
<th>Max. group size: 6</th>
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</thead>
</table>

**Course of study, specific field and term:**
- Master MLS (module part), advanced curriculum MLS, 3rd semester

**Classes and lectures:**
- Chronobiology (lecture and practical course, 2 SWS)

**Workload:**
- 60 Hours private studies
- 30 Hours in-classroom work

**Contents of teaching:**
- **Lecture:**
  - Introduction
  - Fly clocks
  - Mammalian clocks in the SCN
  - Mammalian clocks in the periphery
  - Evolution of circadian clocks
  - Infra- and ultradian rhythms and clocks
  - Circadian rhythms in humans
  - Clocks and diseases
  - Chronotherapy and -pharmacology
  - From the bench
- **Practical course:**
  - Cellular clocks / luminescence measurements
  - Running-wheel experiments
  - Clock gene expression / realtime PCR, in situ analyses
- **Seminar:**
  - Journal club

**Qualification-goals/Competencies:**
- Understanding the principles of biological timekeeping
- Understanding the importance of time as a factor in biological processes and in the clinics
- Practical experience in the analysis of circadian clock function in vitro and in vivo

**Grading through:**
- evaluated protocol

**Responsible for this module:**
- Siehe Hauptmodul

**Teacher:**
- Medical Clinic I
  - Prof. Dr. rer. nat. Henrik Oster
  - Dr. med. Volker Ott
  - Dr. rer. nat. Christiane Koch

**Literature:**
- P DeCoursey, JC Dunlap, JJ Loros (Hrsg.): Chronobiology - Sinauer (2003)

**Language:**
- English, except in case of only German-speaking participants

**Notes:**
- Only for MLS.
- Prerequisites: Passed all modules of the 1. and 2. semester MSc
### LS5200 ZO - Module part: Neuro-oncology (NeuroOnk)

<table>
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<th>Duration:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>3</td>
<td>4</td>
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</table>

**Course of study, specific field and term:**
- Master MLS (module part), advanced curriculum MLS, 3rd semester

**Classes and lectures:**
- Neuro-oncology (seminar with practical exercises, 2 SWS)

**Workload:**
- 60 Hours private studies
- 30 Hours in-classroom work

**Contents of teaching:**
- Introduction to the histology and etiology of primary and secondary brain tumors
- Differences between neuroepithelial and non-neuroepithelial brain tumors
- Cell types from which brain tumors originate and their relevance for nomenclature
- Clinic of the meningioma, schwannoma, glioblastoma, and tumors of the pituitary; tumor surgery and standard chemo- and radiotherapy of gliomas. Molecular and genetic causes for the development of the respective tumors
- Significance of tumor stem cells for tumor initiation, progression and therapy. Specific features of glioma stem cells and experimental research strategies

**Qualification-goals/Competencies:**
- They can differentiate between primary and secondary brain tumors, as well as between neuroepithelial tumors and brain tumors of different etiology
- They know the cell types from which primary brain tumors may originate and can describe how this is reflected by tumor nomenclature
- They can provide information about the clinic of distinct brain tumors and know how a typical neuro-surgical intervention and standard glioma therapy is performed
- They can list genetic and molecular causes for Meningioma, Schwannoma and Glioblastoma and can name the deregulated signaling cascades
- They can list features of brain tumor stem cells and can describe their significance for the development, progression and therapy resistance of malignant gliomas. They can describe experimental concepts addressing the role of glioma stem cells

**Grading through:**
- Oral presentation and written report

**Responsible for this module:**
- Siehe Hauptmodul

**Teacher:**
- Department of Neurosurgery
- PD Dr. rer. nat. Christina Zechel

**Literature:**
- Schlegel et al.: Neuroonkologie - Thieme Verlag
- Wagner & Müller: Molekulare Onkologie - Thieme Verlag
- Original papers and reviews to the above topics

**Language:**
- English, except in case of only German-speaking participants

**Notes:**
- Only for MLS.
- Prerequisites: Passed all modules of the 1. and 2. semester MSc
- One week in March
### LS5990-KP30 - Master Thesis (MScArbeit)

<table>
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<th>Duration:</th>
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<th>Credit points:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>each semester</td>
<td>30</td>
<td>1</td>
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</tbody>
</table>

#### Course of study, specific field and term:
- Master MLS starting 2016 (compulsory), advanced curriculum, 4th semester
- Master MLS (compulsory), advanced curriculum, 4th semester
- Master MLS starting 2018 (compulsory), advanced curriculum, 4th semester

#### Classes and lectures:
- **Practical work (practical course, 39 SWS)**
- **Authoring of the Master Thesis (self-study, 5 SWS)**
- **Colloquium (presentation (incl. preparation), 1 SWS)**

#### Workload:
- 900 Hours in-classroom work

#### Contents of teaching:
- Scientific project in the field of molecular life sciences

#### Qualification-goals/Competencies:
- Ability to solve a preformulated more complex scientific problem in a defined period of time and to present and defend the experimental results
- Basic skills to design and perform their own experiments

#### Grading through:
- written exam, oral presentation, and defence of the experiment’s results

#### Responsible for this module:
- Studiengangsleitung MLS

#### Teacher:
- Institutes of natural science
- Alle prüfungsberechtigten Dozentinnen/Dozenten des Studienganges

#### Literature:
- : - will be announced by the lecturer

#### Language:
- English, except in case of only German-speaking participants

#### Notes:
- Prerequisites: Minimum of 82 ECTS.
- If the Master thesis is done externally (outside our university) the student has to choose a licensed lecturer (see PO) of our university as a second instructor who will be First Examiner in the examination.
# PS4610 A - Module part: Ethics in Sciences (Ethics)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each summer semester</td>
<td>3</td>
</tr>
</tbody>
</table>

## Course of study, specific field and term:
- Master MLS starting 2018 (module part), interdisciplinary competence, 2nd or 4th semester
- Master MLS starting 2016 (module part), interdisciplinary competence, 2nd or 4th semester
- Master MLS (module part), interdisciplinary competence, 4th semester
- Master Infection Biology (module part), Clinical Aspects, 2nd semester

## Classes and lectures:
- Ethics in Sciences (lecture, 2 SWS)

## Workload:
- 55 Hours private studies
- 30 Hours in-classroom work
- 20 Hours exam preparation

## Contents of teaching:
- Societal and ethical implications of research in biomedical sciences and technologies
- Basics of philosophy and sociology of science
- Good scientific practice
- Basics of bioethics: duties of investigators, obligations to colleagues,
- Use and implications of images in science

## Qualification-goals/Competencies:
- You can explain the methodology of the physical sciences and their philosophical basis
- You can recognize ethical dimensions of practice and deciding
- You can understand relevant laws in Germany
- You can participate in current discussions in bioethics and research ethics
- You can reflect on ethical dimensions of biomedical sciences
- You can write a structured ethics paper about a self-chosen topic

## Grading through:
- see Notes

## Responsible for this module:
- Siehe Hauptmodul

## Teacher:
- Institute for the History of Medicine and Science Studies
- Prof. Dr. phil. Christoph Rehmann-Sutter

## Literature:
- Daniel A. Vallero: Biomedical Ethics for Engineers. Ethics and Decision Making in Biomedical and Biosystem Engineering - Amsterdam: Elsevier 2007
- Sergio Sismondo: An introduction to science and technology studies - Chichester: Wiley-Blackwell 2010

## Language:
- offered only in English

## Notes:
- Part of PS4610-KP07
  - This module part is graded by means of an oral presentation (seminar) including an essay.
PS4610 B - Module part: Scientific Writing (SciWrit)

**Duration:** 1 Semester  
**Turnus of offer:** each winter semester  
**Credit points:** 3

**Course of study, specific field and term:**
- Master MLS starting 2018 (module part), interdisciplinary competence, 2nd or 4th semester
- Master MLS starting 2016 (module part), interdisciplinary competence, 2nd or 4th semester
- Master MLS (module part), interdisciplinary competence, 4th semester
- Master Infection Biology (module part), Clinical Aspects, 2nd semester

**Classes and lectures:**
- Scientific Writing (seminar, 2 SWS)

**Workload:**
- 75 Hours private studies  
- 30 Hours in-classroom work

**Contents of teaching:**
- Basics of ethics and moral philosophy
- The ethical structure of experiments with tissue, animals and human subjects
- Principles of the most important laws and guidelines regulating research
- Basic issues of research ethics and cases from recent debates
- Key topics of research ethics in the biomedical sciences
- Introduction into categories of scientific presentations
- Analysis of scientific manuscripts and rules for their presentation
- Preparation and presentation of scientific posters
- Preparing a project proposal

**Qualification-goals/Competencies:**
- Understanding of basic ethical dimensions of human actions and decisions
- Understanding of ethical implication of experimental scientific research
- Knowledge of relevant legal regulations in Germany and internationally
- Knowledge of key debates in bioethics and research ethics
- Basic skills for an autonomous ethical reflection about issues in biomedical sciences
- Analysis of the logical and formal structure of scientific publications. Analysis of a specific original publication. Introduction into the ‘peer-review process’
- Understanding the criteria underlying scientific posters. Preparation and presentation of a poster based on given experimental data
- Introduction into the writing of ‘grant applications’ and the funding process of research projects. Writing a grant application on the basis of specified prior-work and scientific aims

**Grading through:**
- see Notes

**Responsible for this module:**
- Siehe Hauptmodul

**Teacher:**
- Institute of Molecular Medicine  
- Prof. Dr. rer. nat. Georg Sczakiel

**Literature:**
- : Current scientific literature

**Languages:**
- offered only in English  
- English, except in case of only German-speaking participants

**Notes:**
Module Guide

Is part of PS4610-KP07.

Grading of the module part through
- written exam
- seminar
- regular participation in seminars (85%)

The total amount of time allocated to a written examination is usually between 60 and 180 minutes (Examination Regulations).
# PS4610-KP06 - Ethics in Sciences / Scientific Writing (EthScWr)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each summer semester</td>
<td>6 (Typ B)</td>
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</tbody>
</table>

## Course of study, specific field and term:
- Master MLS starting 2016 (compulsory), interdisciplinary competence, 4th semester
- Master MLS (compulsory), interdisciplinary competence, 4th semester
- Master Infection Biology (compulsory), Interdisciplinary modules, 2nd or 4th semester
- Master MLS starting 2018 (compulsory), interdisciplinary competence, 4th semester

## Classes and lectures:
- Ethics in Sciences (lecture with seminar, 2 SWS)
- Scientific Writing (seminar and project work, 2 SWS)

## Workload:
- 120 Hours private studies
- 60 Hours in-classroom work

## Contents of teaching:
- See module parts

## Qualification-goals/Competencies:
- See module parts

## Grading through:
- Oral presentation and written report
- written exam
- Marked presentation with written report
- B-Certificate (not graded)

## Responsible for this module:
- Prof. Dr. rer. nat. Georg Sczakiel

## Teacher:
- Institute for the History of Medicine and Science Studies
- Institute of Molecular Medicine
- Prof. Dr. rer. nat. Georg Sczakiel
- Prof. Dr. phil. Christoph Rehmann-Sutter

## Language:
- offered only in English

## Notes:
Consists of module parts PS4610 A and PS4610 B.

For the acquisition of the B-certificate both module parts must be successfully passed.

The total amount of time allocated to a written examination is usually between 60 and 180 minutes (Examination Regulations).
Module Guide

PS1030-KP04, PS1030 - English for Bachelor and Master students MLS (Engl)

Duration: 1 Semester  
Turnus of offer: each summer semester  
Credit points: 4

Course of study, specific field and term:
- Bachelor MLS starting 2016 (optional subject), interdisciplinary competence, arbitrary semester
- Bachelor Biophysics (optional subject), no specific field, 6th semester
- Master MES since 2014 (optional subject), no specific field, 2nd semester
- Bachelor MES since 2014 (optional subject), no specific field, 4th or 6th semester
- Master MLS (optional subject), interdisciplinary competence, arbitrary semester
- Bachelor Computer Science before 2014 (optional subject), computer science, arbitrary semester
- Bachelor MES before 2014 (optional subject), Medical Engineering Science, arbitrary semester
- Master CLS (optional subject), interdisciplinary competence, arbitrary semester
- Bachelor MLS (optional subject), interdisciplinary competence, arbitrary semester
- Bachelor MLS starting 2018 (optional subject), interdisciplinary competence, arbitrary semester

Classes and lectures:
- English for Bachelor and Master students MLS (exercise, 4 SWS)
- 60 Hours in-classroom work
- 60 Hours private studies

Contents of teaching:
- Exercise: The content follows a curriculum, modified depending on the given skills and the thematic interests of the participants.
- Creating a CV in English

Qualification-goals/Competencies:
- Acquisition of basic skills in spoken and written English
- Improvement of communication in English
- Improvement of reading and writing of texts in English, including technical literature

Grading through:
- Exercises
- continuous, successful participation in course
- written exam

Responsible for this module:
- B. Sc. Sara Meitner

Teacher:
- B. Sc. Sara Meitner

Literature:
- - Publications and articles

Language:
- offered only in English