Universität Bremen

Faculty 02:
Biology/Chemistry

Summersemester 24

Module Guide

for the study of

Biochemistry and Molecular Biology

Master of Science

valid in connection with the examination regulations MPO 2021

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Module 02-CHE-MA-BMB-G: Module Master Thesis (incl. Colloquium) in Integrative BMB

Module Master Thesis (incl. Colloquium) in Integrative BMB

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Master Thesis	Minimum of 66 CP acquired in BMB Master programme

Learning content:

Students with MicroSys specialization choose module BMB-G-MicroSys instead

Training on scientific objectives and work techniques of the different laboratories, methods relevant to the respective research questions, practical work, evaluation of data, error analysis, presentation of scientific data.
The module Master Thesis aims at the training and individual independent performance of a research project under supervision of a senior scientist in the framework of inquiry-based learning. The master thesis project is supervised and conducted under the conditions of the respective department at the University of Bremen and the examination regulations of the respective study programme.
The module includes compulsory elective choices (Wahlpflicht WP) of 24 weeks (or upon request 28 weeks):

WP1: The practical work is conducted in a research group at the University of Bremen.

WP2: The practical work is conducted as an internship student integrated in an external national or international research group.

Learning outcomes / competencies / targeted competencies:

Students have increased knowledge of relevant research background, can design and conduct a research project, can evaluate data critically and present their data professionally.

The graduates have a proven level of knowledge and understanding of molecular biosciences and related disciplines, with particular expertise in their specific field of research. They are able to apply their academic knowledge and understanding in a broad and multidisciplinary context and
acquire new knowledge. They know how to approach and to conduct a largely self-directed complex scientific project (including analytical
applications), solve problems and present and defend their data and conclusions to a scientific auditorium.

Calculation of student workload:

30 h Exam preparation
728 h SWS / presence time / working hours
142 h Preparation / follow-up work

Are there optional courses in the modules?

yes

Language(s) of instruction:	**Responsible for the module:**
English	Prof. Dr. Barbara Reinhold-Hurek
Frequency:	**Duration:**
each semester	1 semester[s]

The module is valid since / The module is valid until:	Credit points / Workload:
SoSe 24 / -	30 / 900 hours

Module examinations

Module examination: Thesis and Colloquium	
Type of examination: partial exam	
Form of examination: Master Thesis	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 2 / - / -	
Language(s) of instruction: Englisch	
Description: PL 1: Master thesis, 75% PL 2: Colloquium, 25%	

Module examination: Tutorial	
Type of examination: partial exam	
Form of examination: See free text	**The examination is ungraded?** yes
Number of graded components / ungraded components / prerequisites of the examination: - / 1 / -	
Language(s) of instruction: Englisch	
Description: Attendance of the accompanying seminar	

Module courses

Course: Seminar	
Frequency: each semester	**Are there parallel courses?** no
Contact hours: 1	**University teacher:**
Language(s) of instruction: Englisch	
Teaching method(s): Accompanying seminar (for Bachelor and Master Thesis)	**Associated module examination:**
Associated module courses	

Seminar zur Masterarbeit (Seminar)

Module 02-CHE-MA-BMB-G-MSys: Module Master Thesis (incl. Colloquium) in Microbial Systems

Module Master Thesis (incl. Colloquium) in Microbial Systems

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Master Thesis	Minimum of 66 CP acquired in BMB Master programme

Learning content:

Essential module for MicroSys specialization

Students choose a topic in the field of Microbial Systems for their master thesis.
Training on scientific objectives and work techniques of the different laboratories, methods relevant to the respective research questions, practical work, evaluation of data, error analysis, presentation of scientific data.
The module Master Thesis aims at the training and individual independent performance of a research project under supervision of a senior scientist in the framework of inquiry-based learning. The master thesis project is supervised and conducted under the conditions of the respective department at the University of Bremen and the examination regulations of the respective study programme.

The module includes compulsory elective choices (Wahlpflicht WP) of 24 weeks (or upon request 28 weeks):
WP1: The practical work is conducted in a research group at the University of Bremen.
WP2: The practical work is conducted as an internship student integrated in an external national or international research group.

The presence time in the laboratory can vary. Usually, students spend 18 weeks full-time in the laboratory. Depending on the lab and topic, a varying part of this time can be conducted in self study.

Learning outcomes / competencies / targeted competencies:

Students have increased knowledge of relevant research background, can design and conduct a research project, can evaluate data critically and present their data professionally.

The graduates have a proven level of knowledge and understanding of molecular biosciences and related disciplines, with particular expertise in their specific field of research. They are able to apply their academic knowledge and understanding in a broad and multidisciplinary context including Microbial Systems and

acquire new knowledge. They know how to approach and to conduct a largely self-directed complex scientific project (including analytical

applications), solve problems and present and defend their data and conclusions to a scientific auditorium.

Calculation of student workload:

142 h Preparation / follow-up work
30 h Exam preparation
728 h SWS / presence time / working hours

Are there optional courses in the modules?
yes
The module includes compulsory elective choices (Wahlpflicht WP) of 24 weeks (or upon request 28 weeks):

WP1: The practical work is conducted in a research group at the University of Bremen.

WP2: The practical work is conducted as an internship student integrated in an external national or international research group.

Language(s) of instruction: English	**Responsible for the module:** Prof. Dr. Barbara Reinhold-Hurek
Frequency: each semester	**Duration:** 1 semester[s]
The module is valid since / The module is valid until: SoSe 24 / -	**Credit points / Workload:** 30 / 900 hours

Module examinations

Module examination: Thesis and Colloquium

Type of examination: partial exam

Form of examination: See free text	**The examination is ungraded?** no

Number of graded components / ungraded components / prerequisites of the examination:
2 / - / -

Language(s) of instruction:
Englisch

Description:
PL 1: Master Thesis, 75%

PL 2: Colloquium, 25%

Module examination: Tutorial

Type of examination: partial exam

Form of examination: See free text	**The examination is ungraded?** yes

Number of graded components / ungraded components / prerequisites of the examination:
- / 1 / -

Language(s) of instruction:
Englisch

Description:
Attendance of the accompanying seminar

Module courses

Course: Seminar	
Frequency: each semester	**Are there parallel courses?** no
Contact hours: 1	**University teacher:**
Language(s) of instruction: Englisch	
Teaching method(s): Accompanying seminar (for Bachelor and Master Thesis)	**Associated module examination:**
Associated module courses **Seminar zur Masterarbeit** (Seminar)	

Module 02-CHE-MA-BMB-A: Basics in Biochemistry and Molecular Cell Biology
Basics in Biochemistry and Molecular Cell Biology

Assignment to areas of study:	Content-related prior knowledge or skills:
• Fundamentals and Applications	none

Learning content:

The course provides the essential theoretical knowledge for the specialization for all biological disciplines which deal with biochemical and cell biology topics

The course deals with the following topics:

- Functional groups and their reactions in biochemistry
- Protein structure
- Nucleic acids structure
- Transcription and RNA processing
- Genomics
- Gene regulation in prokaryotes
- DNA replication
- Thermodynamic basics, metabolism
- Protein biosynthesis I (translation)
- Protein biosynthesis II (translocation)
- Protein folding
- Nuclear-cytoplasmic transport of macromolecules
- Redox potential, membrane potential
- Enzymes (regulation)
- Cytoskeleton
- Vesicular transport
- Signal transduction
- Transport of small molecules across membranes
- Methods: Gene transfer
- Methods: Protein purification
- Methods: Nucleic acids
- Methods which are used in the practical part
- Sterile and quantitative work with bacteria
- Work with nucleic acids (Isolation, determination of concentration, restriction digest, agarose gel electrophoresis, ligation, PCR)
- Work with proteins (Affinity chromatography, determination of concentration, SDS-PAGE, protein staining, protein tagging, ELISA; enzyme activity in crude extracts)

Learning outcomes / competencies / targeted competencies:

- Students have a comprehensive understanding of the basics in biochemistry and molecular cell biology of the a.m. topics.
- Students understand laboratory safety regulations, including handling of genetically modified organisms.
- Students can perform basic biochemical and molecular biology experiments.
- Students know how to document experimental work, critically judge and discuss results of experimental work.

Calculation of student workload: 204 h Preparation / follow-up work 64 h Exam preparation 182 h SWS / presence time / working hours

Are there optional courses in the modules? no

Language(s) of instruction: English	**Responsible for the module:** Prof. Dr. Andreas Dotzauer
Frequency: winter semester, yearly	**Duration:** 1 semester[s]
The module is valid since / The module is valid until: SoSe 24 / -	**Credit points / Workload:** 15 / 450 hours

Module examinations

Module examination: Kombinationsprüfung Basics in Biochemistry and Molecular Cell Biology	
Type of examination: combination exam	
Form of examination: Written examination	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 1 / 1 / -	
Language(s) of instruction: Englisch	
Description: SL: protocols (of laboratory work)	

Module courses

Course: Basics in Biochemistry and Molecular Cell Biology I	
Frequency: winter semester, yearly	**Are there parallel courses?** no
Contact hours: 7	**University teacher:** Prof. Dr. Andreas Dotzauer Dr. Annette Peter Dr. Jan-Hendrik Hehemann Dr. Kathrin Mädler Prof. Dr. Michael Friedrich Dr. Thomas Hurek Prof. Dr. Ralf Dringen Prof. Dr. Rita Helene Groß-Hardt Prof. Dr. Barbara Reinhold-Hurek Prof. Dr. Uwe Nehls

Language(s) of instruction: Englisch	
Teaching method(s): Lecture Tutorial	**Associated module examination:** Kombinationsprüfung Basics in Biochemistry and Molecular Cell Biology

Course: Methods in Biochemistry and Molecular Cell Biology II	
Frequency: winter semester, yearly	**Are there parallel courses?** no
Contact hours: 6	**University teacher:** Prof. Dr. Andreas Dotzauer Dr. Frank Dietz Dr. Christian Arend Dr. Andrea Krause Prof. Dr. Ralf Dringen Prof. Dr. Barbara Reinhold-Hurek
Language(s) of instruction: Englisch	
Teaching method(s): Laboratory class	**Associated module examination:** Kombinationsprüfung Basics in Biochemistry and Molecular Cell Biology

Module 02-CHE-MA-BMB-E1: Lab Project 1
BMB-E1 Lab Project 1

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Fundamentals and Applications	Knowledge of the contents of the modules BMB-A (Basics in Biochemistry and Molecular Cell Biology) and BMB-B (Models, Methods and Specialization) is recommended.

Learning content:
Students need to complete one Lab Project 1 (incl. Poster presentation) and one Lab Project 2. Students with MicroSys specialization need to choose a topic related to Microbial Systems in at least one of the lab projects (Module BMB-E1- MSys or Module BMB-E2-MSys)).

Duration: 9 weeks plus BMB Workshop. The presence time in the laboratory can vary. Usually, students spend 6 weeks full-time in the laboratory. Depending on the lab and topic, a varying part of this time can be conducted in self study.

Students will be trained on scientific objectives and work techniques in one of the different laboratories. From a large spectrum of scientific projects students can select their preferred topic and research group. They will get involved in all phases of an experimental research project: Development of working hypotheses, experimental design, method selection, practical work, analysis of the data and relevant statistics. They will write a research report, present and discuss the outcome of their project results in a seminar.
The project will be presented and discussed as a poster in an annual Postersymposium.

The module includes compulsory elective choices (Wahlpflicht WP) of 9 weeks duration:

WP1: Students undertake the practical work integrated in a research group at the University of Bremen.
WP2: Students undertake the practical work as internship students integrated in an external national or international research group.

Learning outcomes / competencies / targeted competencies:
Students have an increased knowledge about relevant research questions. Students can apply general and specific experimental techniques, analyze and interpret the respective data depending on the research areas of their project. Students are able to independently plan, perform and analyze an experiment based on information from the literature.
Students are able to assess the relevance of an experiment with respect to the objective of their project in the current scientific context.
Students are able to summarize the key questions, methodology, outcome and conclusions of their project on a poster and are able to discuss this on basis of the poster. Ability to assess the relevance of an experiment with respect to the objective of a particular work.

Calculation of student workload:
240 h Preparation / follow-up work
28 h Exam preparation
182 h SWS / presence time / working hours

Are there optional courses in the modules?
yes
The module includes compulsory elective choices (Wahlpflicht WP) of 9 weeks duration:

WP1: Students undertake the practical work integrated in a research group at the University of Bremen.

WP2: Students undertake the practical work as internship students integrated in an external national or international research group.

Language(s) of instruction: English	**Responsible for the module:** Prof. Dr. Barbara Reinhold-Hurek
Frequency: each semester	**Duration:** 1 semester[s]
The module is valid since / The module is valid until: SoSe 24 / -	**Credit points / Workload:** 15 / 450 hours

Module examinations

Module examination: Modulprüfung Lab Project 1	
Type of examination: module exam	
Form of examination: See free text	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	
Description: PL = Portfolio, consisting of: project report (lab report) (70%), presentation, oral (30%), scientific poster about the work (ungraded)	

Module courses

Course: Lab Project 1	
Frequency: each semester	**Are there parallel courses?** yes
Contact hours: 12	**University teacher:**
Language(s) of instruction: Englisch	
Teaching method(s): Self-study unit	**Associated module examination:** Modulprüfung Lab Project 1
Associated module courses **Lab Project 1** (Laboratory class)	

Course: Workshop Biochemistry and Molecular Biology	
Frequency: winter semester, yearly	**Are there parallel courses?** no
Contact hours: 1	**University teacher:**
Language(s) of instruction: Englisch	
Teaching method(s): Seminar	**Associated module examination:** Modulprüfung Lab Project 1
Associated module courses **Lab Project 1** (Laboratory class)	

Module 02-CHE-MA-BMB-E1-MSys: Lab Project 1 - Microbial Systems

Lab Project 1 - Microbial Systems

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Fundamentals and Applications	Knowledge of the contents of the modules BMB-A (Basics in Biochemistry and Molecular Cell Biology) and BMB-B (Models, Methods and Specialization) is recommended.

Learning content:

Students need to complete one Lab Project 1 (incl. Poster presentation) and one Lab Project 2. Students with MicroSys specialization need to choose a topic related to Microbial Systems in at least one of the lab projects (Module BMB-E1- MSys or Module BMB-E2-MSys)).

Duration: 9 weeks plus BMB Workshop. The presence time in the laboratory can vary. Usually, students spend 6 weeks full-time in the laboratory. Depending on the lab and topic, a varying part of this time can be conducted in self study.

Students will be trained on scientific objectives and work techniques in the field of Microbial Systems. From a large spectrum of scientific projects students can select their preferred topic and research group. They will get involved in all phases of an experimental research project: Development of working hypotheses, experimental design, method selection, practical work, analysis of the data and relevant statistics. They will write a research report, present and discuss the outcome of their project results in a seminar.

The project will be presented and discussed as a poster in an annual Postersymposium.

The module includes compulsory elective choices (Wahlpflicht WP) of 9 weeks duration:

WP1: Students undertake the practical work integrated in a research group at the University of Bremen.

WP2: Students undertake the practical work as internship students integrated in an external national or international research group.

Learning outcomes / competencies / targeted competencies:

Students have an increased knowledge about relevant research questions. Students can apply general and specific experimental techniques, analyze and interpret the respective data depending on the research areas of their project. Students are able to independently plan, perform and analyze an experiment based on information from the literature.
Students are able to assess the relevance of an experiment with respect to the objective of their project in the current scientific context.
Students are able to summarize the key questions, methodology, outcome and conclusions of their project on a poster and are able to discuss this on basis of the poster. Ability to assess the relevance of an experiment with respect to the objective of a particular work.

Calculation of student workload:

182 h SWS / presence time / working hours
240 h Preparation / follow-up work
28 h Exam preparation

Are there optional courses in the modules?
yes
The module includes compulsory elective choices (Wahlpflicht WP) of 9 weeks duration:
WP1: Students undertake the practical work integrated in a research group at the University of Bremen.
WP2: Students undertake the practical work as internship students integrated in an external national or international research group.

Language(s) of instruction: English	**Responsible for the module:** Prof. Dr. Barbara Reinhold-Hurek
Frequency: each semester	**Duration:** 1 semester[s]
The module is valid since / The module is valid until: SoSe 24 / -	**Credit points / Workload:** 15 / 450 hours

Module examinations

Module examination: Modulprüfung Lab Project 1 - Microbial Systems

Type of examination: module exam

Form of examination: See free text	**The examination is ungraded?** no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
Englisch

Description:
PL = Portfolio, consisting of: project report (lab report) (70%), presentation, oral (30%), scientific poster about the work (ungraded)

Module courses

Course: Lab Project 1-MicroSys

Frequency: each semester	**Are there parallel courses?** yes
Contact hours: 12	**University teacher:**

Language(s) of instruction:
Englisch

Teaching method(s): Self-study unit	**Associated module examination:** Modulprüfung Lab Project 1 - Microbial Systems

Associated module courses

Lab Project 1 (Laboratory class)

Course: Workshop Biochemistry and Molecular Biology

Frequency: winter semester, yearly	**Are there parallel courses?** no
Contact hours: 1	**University teacher:**
Language(s) of instruction: Englisch	
Teaching method(s): Seminar	**Associated module examination:** Modulprüfung Lab Project 1 - Microbial Systems
Associated module courses **Lab Project 1** (Laboratory class)	

Module 02-CHE-MA-BMB-E2: Lab Project 2
Lab Project 2

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Fundamentals and Applications	Knowledge of the contents of the modules BMB-A (Basics in Biochemistry and Molecular Cell Biology) and BMB-B (Models, Methods and Specialization) is recommended.

Learning content:

Students need to complete one Lab Project 1 (incl. Poster presentation) and one Lab Project 2. Students with MicroSys specialization need to choose a topic related to Microbial Systems in at least one of the lab projects (Module BMB-E1- MSys or Module BMB-E2-MSys)).

Duration: 9 weeks. The presence time in the laboratory can vary. Usually, students spend 6 weeks full-time in the laboratory. Depending on the lab and topic, a varying part of this time can be conducted in self study.

Students will be trained on scientific objectives and work techniques in one of the different laboratories. From a large spectrum of scientific projects students can select their preferred topic and research group. They will get involved in all phases of an experimental research project: Development of working hypotheses, experimental design, method selection, practical work, analysis of the data and relevant statistics. They will write a research report, present and discuss the outcome of their project results in a seminar.

The module includes compulsory elective choices (Wahlpflicht WP) of 9 weeks duration:

WP1: Students undertake the practical work integrated in a research group at the University of Bremen.

WP2: Students undertake the practical work as internship students integrated in an external national or international research group.

Learning outcomes / competencies / targeted competencies:

Students have an increased knowledge about relevant research questions. Students can apply general and specific experimental techniques, analyze and interpret the respective data depending on the research areas of their project. Students are able to independently plan, perform and analyze an experiment based on information from the literature.

Students are able to assess the relevance of an experiment with respect to the objective of their project in the current scientific context.

Students have an increased knowledge about relevant research questions. Students can apply general and specific experimental techniques, analyze and interpret the respective data depending on the research areas of their project. Students are able to independently plan, perform and analyze an experiment based on information from the literature.

Students are able to assess the relevance of an experiment with respect to the objective of their project in the current scientific context.

Calculation of student workload:

168 h SWS / presence time / working hours
28 h Exam preparation
254 h Preparation / follow-up work

Are there optional courses in the modules?
yes
The module includes compulsory elective choices (Wahlpflicht WP) of 9 weeks duration:

WP1: Students undertake the practical work integrated in a research group at the University of Bremen.

WP2: Students undertake the practical work as internship students integrated in an external national or international research group.

Language(s) of instruction: English	**Responsible for the module:** Prof. Dr. Barbara Reinhold-Hurek
Frequency: each semester	**Duration:** 1 semester[s]
The module is valid since / The module is valid until: SoSe 24 / -	**Credit points / Workload:** 12 / 360 hours

Module examinations

Module examination: Modulprüfung Lab Project 2	
Type of examination: module exam	
Form of examination: See free text	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	
Description: PL = Portfolio, consisting of: project report (lab report) (70%) and presentation, oral (30%)	

Module courses

Course: Lab Project 2	
Frequency: each semester	**Are there parallel courses?** yes
Contact hours: 12	**University teacher:**
Language(s) of instruction: Englisch	
Teaching method(s): Self-study unit	**Associated module examination:** Modulprüfung Lab Project 2
Associated module courses **Lab Project 2** (Laboratory class)	

Module 02-CHE-MA-BMB-E2-MSys: Lab Project 2 - Microbial Systems

Lab Project 2 - Microbial Systems

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Fundamentals and Applications	Knowledge of the contents of the modules BMB-A (Basics in Biochemistry and Molecular Cell Biology) and BMB-B (Models, Methods and Specialization) is recommended.

Learning content:

Students need to complete one Lab Project 1 (incl. Poster presentation) and one Lab Project 2. Students with MicroSys specialization need to choose a topic related to Microbial Systems in at least one of the lab projects (Module BMB-E1- MSys or Module BMB-E2-MSys)).

Duration: 9 weeks. The presence time in the laboratory can vary. Usually, students spend 6 weeks full-time in the laboratory. Depending on the lab and topic, a varying part of this time can be conducted in self study.

Students will be trained on scientific objectives and work techniques in the field of Microbial Systems. From a large spectrum of scientific projects students can select their preferred topic and research group. They will get involved in all phases of an experimental research project: Development of working hypotheses, experimental design, method selection, practical work, analysis of the data and relevant statistics. They will write a research report, present and discuss the outcome of their project results in a seminar.

The module includes compulsory elective choices (Wahlpflicht WP) of 9 weeks duration:

WP1: Students undertake the practical work integrated in a research group at the University of Bremen.

WP2: Students undertake the practical work as internship students integrated in an external national or international research group.

Learning outcomes / competencies / targeted competencies:

Students have an increased knowledge about relevant research questions. Students can apply general and specific experimental techniques, analyze and interpret the respective data depending on the research areas of their project. Students are able to independently plan, perform and analyze an experiment based on information from the literature.
Students are able to assess the relevance of an experiment with respect to the objective of their project in the current scientific context.

Calculation of student workload:

168 h SWS / presence time / working hours
254 h Preparation / follow-up work
28 h Exam preparation

Are there optional courses in the modules?
yes
The module includes compulsory elective choices (Wahlpflicht WP) of 9 weeks duration:

WP1: Students undertake the practical work integrated in a research group at the University of Bremen.

WP2: Students undertake the practical work as internship students integrated in an external national or international research group.

The module includes compulsory elective choices (Wahlpflicht WP) of 9 weeks duration:

WP1: Students undertake the practical work integrated in a research group at the University of Bremen.

WP2: Students undertake the practical work as internship students integrated in an external national or international research group.

Language(s) of instruction: English	**Responsible for the module:** Prof. Dr. Barbara Reinhold-Hurek
Frequency: each semester	**Duration:** 1 semester[s]
The module is valid since / The module is valid until: SoSe 24 / -	**Credit points / Workload:** 12 / 360 hours

Module examinations

Module examination: Modulprüfung Lab Project 2 - Microbial Systems	
Type of examination: module exam	
Form of examination: See free text	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	
Description: PL = Portfolio, consisting of: project report (lab report) (70%) and presentation, oral (30%)	

Module courses

Course: Lab Project 2 - Microbial Systems	
Frequency: each semester	**Are there parallel courses?** yes
Contact hours: 12	**University teacher:**
Language(s) of instruction: Englisch	

Teaching method(s):	**Associated module examination:**
Self-study unit	Modulprüfung Lab Project 2 - Microbial Systems

Associated module courses

Lab Project 2 (Laboratory class)

Module 02-CHE-MA-BMB-F: Project Proposal
Project Proposal

Assignment to areas of study:	Content-related prior knowledge or skills:
• Fundamentals and Applications	Knowledge of the contents of the modules BMB-A (Basics in Biochemistry and Molecular Cell biology) and BMB-B (Models, Methods and Specializaton) is recommended.

Learning content:

The main part of the module takes place in the summer term, but the symposium where students present their proposal is held in the first half of October.

The module satisfies an increasing demand for interdisciplinary research skills. It is unique as it combines information, expertise, and excellent scientists from three different departments: Biological Sciences and Chemistry (FB 2), Biophysics (FB 1), and Material Sciences and Engineering (FB 4). The module brings students into contact with cutting-edge research and enables them to design their own interdisciplinary project in close collaboration with scientists who are experts in their respective field.
Learning contents:

- Interdisciplinary literacy and out of the box thinking
- Design of interdisciplinary research projects
- Translation of research idea into written project proposal
- Presentation and defence of written project proposal

Learning outcomes / competencies / targeted competencies:

- The students are able to propose an interdisciplinary project that is suitable to answer open questions that have not previously been scientifically addressed.
- Students are able to articulate and develop their research idea with experts in the field.
- Students are able to translate their research idea into a written proposal.
- Students are able to present and discuss their project proposal in front of an interdisciplinary scientific audience.

Calculation of student workload:

90 h Preparation / follow-up work
42 h SWS / presence time / working hours
138 h Exam preparation

Are there optional courses in the modules?

no

Language(s) of instruction:	Responsible for the module:
English	Prof. Dr. Rita Helene Groß-Hardt
Frequency: summer semester, yearly	**Duration:** 2 semester[s]
The module is valid since / The module is valid until: SoSe 24 / -	**Credit points / Workload:** 9 / 270 hours

Module examinations

Module examination: Modulprüfung Project proposal	
Type of examination: module exam	
Form of examination: Presentation and written assignment	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	

Module courses

Course: Seminar 1	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 1	**University teacher:** Prof. Dr. Andreas Dotzauer Dr. Kathrin Mädler Prof. Dr. Barbara Reinhold-Hurek
Language(s) of instruction: Englisch	
Teaching method(s): Seminar	**Associated module examination:** Modulprüfung Project proposal
Associated module courses **Literature Seminar in Biochemistry and Molecular Biology** (Seminar)	

Course: Seminar 2	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 2	**University teacher:** Prof. Dr. Andreas Dotzauer Dr. Kathrin Mädler Prof. Dr. Barbara Reinhold-Hurek
Language(s) of instruction: Englisch	
Teaching method(s): Seminar	**Associated module examination:**
Associated module courses **Project Proposal and Defence** (Seminar)	

Module 02-CHE-MA-BMB-B: Models, Methods and Specialization - Integrative BMB

Models, Methods and Specialization - Integrative BMB

Assignment to areas of study:	Content-related prior knowledge or skills:
• Specialization / Models, Methods and Specialization	Knowledge of the contents of the module BMB-A, basics in cell biology, chemistry and biochemistry is recommended. Students in Microbial Systems specialization study module BMB-B-MSys instead

Learning content:

1) Organismic models for bioscience research (2 SWS lecture)

The lecture course provides an introduction to model systems that are frequently used in biomolecular research as organisms to study modern research questions. For each model system basic information on the structure of the organism, on the handling of the organisms as well as on advantages and disadvantages of the organismic model for various types of biomolecular research will be given. In addition, examples for modern biomolecular research questions that have been addressed or are currently addressed by using the respective model organism will be presented and discussed. The organisms addressed by this lecture course may include (but may be modified according to recent developments): Bacteria, Yeast, C. elegans, Drosophila, Arabidopsis, Poplar, Mouse, Rat, Monkey, Homo sapiens

2) Methods for biomolecular research (2 SWS lecture + 1 SWS seminar)

The lecture course provides an introduction to important methods that are frequently used for biomolecular research to study modern research questions. For each method principles and basic information will be provided as lecture and special aspects will be additionally addressed in the accompanying seminar or exercises. The methods addressed by this course may include (but may be modified according to recent developments): Physicochemical analysis of biomolecules (NMR, mass spectrometry, photometry, fluorometry, ...), Enzymatic methods (coupled enzymatic tests, cycling assays, ...), Immunological test systems (ELISA, immunocytochemistry, ...), Microscopy (light, fluorescence, confocal, atomic force, ...), Centrifugation, Protein purification, Viruses as vectors, Cell cultures, Isotope labeling and radioactivity, Optogenetics, Omic-technologies, Bisulfite sequencing,Chip sequencing

3) Block seminar with excursion

The one week excursion (in February or March) will introduce special research topics to the biochemistry master students, as an example for “field-based molecular research”.

One option is an excursion to List. During the week in List the participants will learn about the mission of the research station. The overall objectives of this course are (1) to provide a basic understanding of concepts in marine (e.g. ecology & physiology) research topics; (2) to develop ideas for biomolecular research projects addressing marine research questions; (3) to develop ideas how to implement biomolecular methodology into this research and (4) how to adapt experimental setups for field research.

4) Specialization in one of the offered research fields (6 CP)

For the tutorial/seminar course of 6 CP in a specialized research field the students can choose between several options, such as:

A) Chemistry of Metabolism

The course covers essential and advanced aspects of the bioorganic chemistry of cellular metabolism. Topics addressed can include for example: Energetics of chemical reactions, Functional groups and bonds of biomolecules, Redox reactions, Mechanisms involved in enzymatic catalysis and transport processes, Chemistry of basic metabolic pathways, Methods and models to study the metabolism and metabolic pathways. The students will decide as team on the aspects and topics of the chemistry of metabolism that will be covered and on strategies that will be applied to improve the basal knowledge of each participating student. Self-structured learning sessions, team discussions and examinations by the team may be considered and tested as learning strategies.

B) Biophysics

The course aims to substantially improve the basic knowledge on the physical principles underlying cellular function. Acquisition of theoretical knowledge in lectures will be accompanied by experimental training in a laboratory course and augmented with a hands-on tutorial.

C) Other courses offered as specialization courses

Learning outcomes / competencies / targeted competencies:

1) Organismic models for bioscience research (2 SWS lecture)

At the end of the course the student will know the organismic models that are frequently used for biomolecular research to study modern research questions. They will be aware of the advantages and disadvantages of these models, will be informed about safety, legal and ethical issues connected with the use of the various organismic models and will be able to choose appropriate organismic models to answer new research questions in biomolecular research.

2) Methods for biomolecular research (2 SWS lecture + 1 SWS seminar)

At the end of the course the student will know the principles and concepts of selected methods and technologies that are frequently used for biomolecular research to study modern research questions. They will be aware of the advantages and disadvantages (such as sensitivities of methods, safety and legal issues, ethical aspects) of the various methods addressed and will be able to choose appropriate methods and technologies to answer new research questions in biomolecular research.

3) Block seminar with excursion (40 h with 8 h per 5 days, 2 h preparation and presentation).

The successful participants will be able (1) to understand basic concepts of a different discipline; (2) to combine concepts of biomolecular research with those of other disciplines; (3) integrate methods and the potential of model systems to address questions derived from other disciplines and (4) to develop ideas how to adapt experimental setups in the field to facilitate biomolecular research.

4) Specialization in one of the offered research fields (6 CP)

A) Chemistry of Metabolism

At the end of this course, the participating students have advanced knowledge on the chemical principles underlying the cell metabolism and on the methods used to study metabolism. In addition, they can communicate and present their work professionally and can work in a team. For example, students…

- know the chemistry that underlies cell metabolism
- can recognise repetitive chemical principles in metabolism
- can work in teams and to present their work
- can ask high quality questions.
- can present and discuss complex scientific topics at the
- white board
- can identify and solve scientific questions

B) Biophysics

At the end of the course, students have advanced knowledge on the physical principles underlying cellular function. Students can think in terms of physics. They can appreciate quantitative approaches and modelling. Students understand the reciprocal flow of knowledge from Biology to Physics and vice versa. In addition, they can communicate and present their work professionally and can work in a team. For example, students…

- know the physics that underlies cellular and molecular processes
- know molecular forces and interactions, principles of thermodynamics and chemical kinetics, pattern formation
- can work in teams and present their work in presentations
- can ask high quality questions.

C) Learning outcomes of other courses offered as specialization courses

Calculation of student workload:
242 h Preparation / follow-up work
40 h Exam preparation
168 h SWS / presence time / working hours

Are there optional courses in the modules?
yes
For the tutorial/seminar course of 6 CP in a specialized research field the students can choose between several optional courses, such as:

A) Chemistry of Metabolism (limited to 10 students per course)
B) Biophysics (limited to 10 students per course
C) Other courses offered as specialization

For more details on the content and the aims of these courses see leraning contents and learning outcomes.

Language(s) of instruction: English	**Responsible for the module:** Prof. Dr. Ralf Dringen
Frequency: winter semester, yearly	**Duration:** 1 semester[s]
The module is valid since / The module is valid until: WiSe 23/24 / -	**Credit points / Workload:** 15 / 450 hours

Module examinations

Module examination: Modulprüfung Models, Methods and Specialization - Integrative BMB

Type of examination: module exam

Form of examination: Oral examination (single)	**The examination is ungraded?** no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
Englisch

Module courses

Course: Organismic models for bioscience research

Frequency: winter semester, yearly	**Are there parallel courses?** no

Contact hours: 2	**University teacher:** Prof. Dr. Marko Rohlfs Prof. Dr. Andreas Dotzauer Dr. Detlef Wegener Dr. Annette Peter Dr. Kathrin Mädler Prof. Dr. Michael Koch Prof. Dr. Ralf Dringen Prof. Dr. Rita Helene Groß-Hardt Prof. Dr. Barbara Reinhold-Hurek Prof. Dr. Tilmann Harder Prof. Dr. Olivia Masseck Prof. Dr. Uwe Nehls
Language(s) of instruction: Englisch	
Teaching method(s): Lecture	**Associated module examination:** Modulprüfung Models, Methods and Specialization - Integrative BMB

Course: Methods for biomolecular research	
Frequency: winter semester, yearly	**Are there parallel courses?** no
Contact hours: 3	**University teacher:** Prof. Dr. Michael W. Friedrich Prof. Dr. Andreas Dotzauer Dr. Kathrin Mädler Dr. Christian Arend Prof. Dr. Ralf Dringen Prof. Dr. Barbara Reinhold-Hurek Prof. Dr. Tilmann Harder Prof. Dr. Olivia Masseck
Language(s) of instruction: Englisch	
Teaching method(s): Lecture Seminar	**Associated module examination:** Modulprüfung Models, Methods and Specialization - Integrative BMB

Course: Block seminar with excursion	
Frequency: winter semester, yearly	**Are there parallel courses?** no
Contact hours: 3	**University teacher:**
Language(s) of instruction: Englisch	

Teaching method(s): Field trip	**Associated module examination:** Modulprüfung Models, Methods and Specialization - Integrative BMB

Course: Specialization in one of the offered research fields	
Frequency: winter semester, yearly	**Are there parallel courses?** yes
Contact hours: 4	**University teacher:**
Language(s) of instruction: Englisch	
Teaching method(s): Seminar	**Associated module examination:** Modulprüfung Models, Methods and Specialization - Integrative BMB

Module 02-CHE-MA-BMB-C: Project Management, Science Communication - From Concept to Implementation - Integrative BMB

Project Management, Science Communication - From Concept to Implementation - Integrative BMB

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Specialization / Project Management	content of the module BMB-A, basics in cell biology, chemistry and biochemistry are recommended

Learning content:

Students in Microbial Systems specialization study module BMB-C-MSys instead

Technology and science are powerful tools for meeting the challenges of the future. It is essential for the understanding of global problems and the acceptance of solution models that knowledge is made comprehensible to a broad public. Accordingly, the communication of science is of immense importance in a highly technologized and rapidly developing society.
Learning contents:

- Goals of science communication (1)
- Target groups and their needs (1)
- Formats of science communication (e.g. lecture for Bachelor students (1), scientific conference (2))
- Communication modules as projects (1+2)
- Professional presentation skills (1+2)
- Project management (1+2):
- Idea generation
- Format definition
- Project design
- Project implementation
- Project maintenance and feedback

Learning contents are organized in 2 parts guided by Prof. Groß-Hardt (1) and by Prof. Nehls (2).
Managing specific example projects will be carried out by students in small groups.

Learning outcomes / competencies / targeted competencies:

Students can design science communication modules according to character and needs of target groups (1)

- Students are able to communicate professionally (1)
- Students can manage small projects (1+2)
- Students can apply project management skills for the design of science communication modules (1+2)
- Students can cope with the logistic and scientific challenges of conference organization (2)

Calculation of student workload:

80 h Preparation / follow-up work
56 h SWS / presence time / working hours
44 h Exam preparation

Are there optional courses in the modules?

no

Language(s) of instruction:	**Responsible for the module:**
English	Prof. Dr. Rita Helene Groß-Hardt

Frequency: summer semester, yearly	**Duration:** 2 semester[s]
The module is valid since / The module is valid until: SoSe 24 / -	**Credit points / Workload:** 6 / 180 hours

Module examinations

Module examination: Modulprüfung Project Management, Science Communication - From Concept to Implementation - Integrative BMB	
Type of examination: module exam	
Form of examination: See free text	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	
Description: PL = Portfolio, consisting of: • graphical abstract (35%) & self assessment (15%), oral presentation (of the project) (ungraded) • documentation of conference preparation (35%) and self assessment (15%)	

Module courses

Course: Project Management, Science Communication - From Concept to Implementation - Integrative BMB	
Frequency: winter semester, yearly	**Are there parallel courses?** no
Contact hours: 4	**University teacher:** Prof. Dr. Rita Helene Groß-Hardt
Language(s) of instruction: Englisch	
Teaching method(s): Lecture Tutorial	**Associated module examination:** Modulprüfung Project Management, Science Communication - From Concept to Implementation - Integrative BMB
Associated module courses **Project Management - from conceptionalization to implementation** (Lecture)	

Module 02-CHE-MA-BMB-B-MSys: Models, Methods and Specialization - Microbial Systems

Models, Methods and Specialization - Microbial Systems

Assignment to areas of study:	Content-related prior knowledge or skills:
• Specialization / Models, Methods and Specialization	Knowledge of the contents of the module BMB-A, basics in cell biology, chemistry and biochemistry is recommended.

Learning content:

Essential module in Microbial Systems specialization

limited to 10 students per course

1) Organismic models for bioscience research (2 SWS lecture)

The lecture course provides an introduction to model systems that are frequently used in biomolecular research as organisms to study modern research questions. For each model system basic information on the structure of the organism, on the handling of the organisms as well as on advantages and disadvantages of the organismic model for various types of biomolecular research will be given. In addition, examples for modern biomolecular research questions that have been addressed or are currently addressed by using the respective model organism will be presented and discussed. The organisms addressed by this lecture course may include (but may be modified according to recent developments): Bacteria, Yeast, C. elegans, Drosophila, Arabidopsis, Poplar, Mouse, Rat, Monkey, Homo sapiens

2) Methods for biomolecular research (2 SWS lecture + 1 SWS seminar)

The lecture course provides an introduction to important methods that are frequently used for biomolecular research to study modern research questions. For each method principles and basic information will be provided as lecture and special aspects will be additionally addressed in the accompanying seminar or exercises. The methods addressed by this course may include (but may be modified according to recent developments): Physicochemical analysis of biomolecules (NMR, mass spectrometry, photometry, fluorometry, ...), Enzymatic methods (coupled enzymatic tests, cycling assays, ...), Immunological test systems (ELISA, immunocytochemistry, ...), Microscopy (light, fluorescence, confocal, atomic force, ...), Centrifugation, Protein purification, Viruses as vectors, Cell cultures, Isotope labeling and radioactivity, Optogenetics, Omic-technologies, Bisulfite sequencing,Chip sequencing

3) Block seminar with excursion

The one week excursion (in February or March) will introduce special research topics to the biochemistry master students, as an example for “field-based molecular research”.

One option is an excursion to List. During the week in List the participants will learn about the mission of the research station. The overall objectives of this course are (1) to provide a basic understanding of concepts in marine (e.g. ecology & physiology) research topics; (2) to develop ideas for biomolecular research projects addressing marine research questions; (3) to develop ideas how to implement biomolecular methodology into this research and (4) how to adapt experimental setups for field research.

4) Specialization in one of the offered research fields (6 CP)

Applied Microbiology

This option addresses only students in the specialization MicroSys (Microbial Systems). In excursions, the students will visit different companies and other institutions of applied sciences. They will discuss practices, application and research challenges. The aspect Food Microbiology will be covered in self-study and seminars and lectures. The students will apply their basal knowledge in self-structured learning sessions to discuss challenges and potential solutions for the respective topics.

Learning outcomes / competencies / targeted competencies:
1) Organismic models for bioscience research (2 SWS lecture)
At the end of the course the student will know the organismic models that are frequently used for biomolecular research to study modern research questions. They will be aware of the advantages and disadvantages of these models, will be informed about safety, legal and ethical
issues connected with the use of the various organismic models and will be able to choose appropriate organismic models to answer new research questions in biomolecular research.
2) Methods for biomolecular research (2 SWS lecture + 1 SWS seminar)
At the end of the course the student will know the principles and concepts of selected methods and technologies that are frequently used for biomolecular research to study modern research questions. They will be aware of the advantages and disadvantages (such as sensitivities of methods, safety and legal issues, ethical aspects) of the various methods addressed and will be able to choose appropriate methods and technologies to answer new research questions in biomolecular research.
3) Block seminar with excursion (40 h with 8 h per 5 days, 2 h preparation and presentation).
The successful participants will be able (1) to understand basic concepts of a different discipline; (2) to combine concepts of biomolecular research with those of other disciplines; (3) integrate methods and the potential of model systems to address questions derived from other disciplines and (4) to develop ideas how to adapt experimental setups in the field to facilitate biomolecular research.
4) Specialization in one of the offered research fields (6 CP)

Applied Microbiology (MicroSys)
At the end of this course, the participating students have advanced knowledge on applied aspects of microbiological and biotechnological research and can solve problems with a scientific approach. In addition, they can communicate and present their work professionally and can work in a team. For example, students:

- can work in a team
- can present in a poster format
- can ask high quality questions
- can identify problems and develop approaches to solve them

C) Learning outcomes of other courses offered as specialization courses

Calculation of student workload:
168 h SWS / presence time / working hours
40 h Exam preparation
242 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction: English	**Responsible for the module:** Prof. Dr. Barbara Reinhold-Hurek
Frequency: winter semester, yearly	**Duration:** 1 semester[s]
The module is valid since / The module is valid until: WiSe 23/24 / -	**Credit points / Workload:** 15 / 450 hours

Module examinations

Module examination: Modulprüfung Models, Methods and Specialization - MicroSys	
Type of examination: module exam	
Form of examination: Oral examination (single)	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	

Module courses

Course: Organismic models for bioscience research	
Frequency: winter semester, yearly	**Are there parallel courses?** no
Contact hours: 2	**University teacher:** Prof. Dr. Marko Rohlfs Prof. Dr. Andreas Dotzauer Dr. Detlef Wegener Dr. Annette Peter Dr. Kathrin Mädler Prof. Dr. Michael Koch Prof. Dr. Ralf Dringen Prof. Dr. Rita Helene Groß-Hardt Prof. Dr. Barbara Reinhold-Hurek Prof. Dr. Tilmann Harder Prof. Dr. Olivia Masseck Prof. Dr. Uwe Nehls
Language(s) of instruction: Englisch	
Teaching method(s): Lecture	**Associated module examination:** Modulprüfung Models, Methods and Specialization - MicroSys

Course: Methods for biomolecular research	
Frequency: winter semester, yearly	**Are there parallel courses?** no

Contact hours: 3	**University teacher:** Prof. Dr. Michael W. Friedrich Prof. Dr. Andreas Dotzauer Dr. Kathrin Mädler Dr. Christian Arend Prof. Dr. Ralf Dringen Prof. Dr. Barbara Reinhold-Hurek Prof. Dr. Tilmann Harder Prof. Dr. Olivia Masseck
Language(s) of instruction: Englisch	
Teaching method(s): Lecture Seminar	**Associated module examination:** Modulprüfung Models, Methods and Specialization - MicroSys

Course: Block seminar with excursion	
Frequency: winter semester, yearly	**Are there parallel courses?** no
Contact hours: 3	**University teacher:**
Language(s) of instruction: Englisch	
Teaching method(s): Field trip	**Associated module examination:** Modulprüfung Models, Methods and Specialization - MicroSys

Course: Specialization in one of the offered research fields	
Frequency: winter semester, yearly	**Are there parallel courses?** yes
Contact hours: 4	**University teacher:**
Language(s) of instruction: Englisch	
Teaching method(s): Seminar	**Associated module examination:** Modulprüfung Models, Methods and Specialization - MicroSys

Module 02-CHE-MA-BMB-C-MSys: Project Management, Science Communication - From Concept to Implementation - Microbial Systems

Project Management, Science Communication - From Concept to Implementation - Microbial Systems

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Specialization / Project Management	Content of the module BMB-A, basics in cell biology, chemistry and biochemistry are recommended. Previous completion of Module BMB-B-MSys is highly recommended.

Learning content:

Essential module for Microbial Systems specialization

Technology and science are powerful tools for meeting the challenges of the future. It is essential for the understanding of global problems and the acceptance of solution models that knowledge is made comprehensible to a broad public. Accordingly, the communication of science is of immense importance in a highly technologized and rapidly developing society. Also knowledge on intellectual property rights is vital for application of novel scientific findings.

Learning contents are organized in 2 parts guided by Prof. Groß-Hardt (1) and by Prof. Reinhold-Hurek with partners IMASA and InnoWi (2).

Learning contents:

- Goals of science communication (1)
- Target groups and their needs (1)
- Formats of science communication (e.g. lecture for Bachelor students (1))
- Communication modules as projects (1+2)
- Professional presentation skills (1+2)
- Project management (1+2):
- Idea generation
- Format definition
- Project design
- Project implementation
- Project maintenance and feedback
- Tools of project management (e.g. project structure plan, Gannt chart, cause-effect plot, FMEA analysis) (2)
- Intellectual property rights and patenting (2)

Managing specific example projects will be carried out by students in small groups.

Learning outcomes / competencies / targeted competencies:

- Students can design science communication modules according to character and needs of target groups (1)
- Students are able to communicate professionally (1)
- Students can manage small projects (1+2)
- Students can apply project management skills for the design of science communication modules (1)
- Students are able to work in teams (2)
- Students can manage complex project tasks (2)
- Students can search for and evaluate patents in life sciences (2)

Calculation of student workload:
56 h SWS / presence time / working hours
44 h Exam preparation
80 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:	**Responsible for the module:**
English	Prof. Dr. Barbara Reinhold-Hurek
Frequency:	**Duration:**
summer semester, yearly	1 semester[s]
The module is valid since / The module is valid until:	**Credit points / Workload:**
SoSe 24 / -	6 / 180 hours

Module examinations

Module examination: Modulprüfung Project Management, Science Communication - From Concept to Implementation - Integrative BMB

Type of examination: module exam

Form of examination:	**The examination is ungraded?**
See free text	no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
Englisch

Description:
PL = Portfolio, consisting of:

- Graphical abstract (35%) & self assessment (15%), oral presentation (of the project) (ungraded)
- Presentation, oral, (50%), consisting of design of a given project including application of the taught project management tools.

Module courses

Course: Project Management, Science Communication - From Concept to Implementation - Integrative BMB	
Frequency: winter semester, yearly	**Are there parallel courses?** no
Contact hours: 4	**University teacher:** Prof. Dr. Barbara Reinhold-Hurek
Language(s) of instruction: Englisch	
Teaching method(s): Lecture Tutorial	**Associated module examination:** Modulprüfung Project Management, Science Communication - From Concept to Implementation - Integrative BMB
Associated module courses **Project Management - from conceptionalization to implementation** (Lecture)	

Module 02-CHE-MA-D-AMB: Atomistic Modelling of Biomacromolecules
Atomistic Modelling of Biomacromolecules

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Tailored Research Portfolio	Fundamental knowledge about structural setup of biomacromolecules is recommended

Learning content:
Limited to 8 students

Lecture:

- 3D visualization of bio-macromolecules like proteins and lipids
- Building protein 3D structures from their amino acid using homology modeling algorithms
- Introduction into statistical mechanics and molecular mechanics
- Basics of molecular dynamics simulations with the usage of force field based methods

Seminar:

- Introduction to basic terminal commands (Linux)
- Guided walk-through through the GROMACS tutorial setting up a protein simulation under physiological conditions
- Calculation of a protein isosurface
- Introduction into common analysis tools for protein structural models (RDF, RMSD, h-bond-, secondary structure-, dipole-, charge distribution analysis etc.

Practical work:

- Reproduction of GROMACS online tutorial with a selected protein:

1. Homology modelling for 3D structure determination
2. setup of simulation cell using GROMACS
3. Performing a molecular dynamics simulation of the protein in aqueous ionic solution using GROMACS
4. Post-processing of obtained trajectories for dynamic characterisation using VMD and processing scripts by GROMACS

Learning outcomes / competencies / targeted competencies:
Students have a detailed understanding of biomacromolecules three-dimensional structure and knowledge that can be derived from the analysis.
Computational Toolbox: Students …

- can construct protein 3D structures based on homology modelling
- understand and are able to visualize macromolecules
- can apply atomistic calculation tools independently to perform molecular dynamics simulation and physiological conditions of thermodynamically stable systems
- have a fundamental theoretical background knowledge about the physical calculations implemented in these algorithms

Calculation of student workload:
30 h Exam preparation
70 h SWS / presence time / working hours
80 h Preparation / follow-up work

Are there optional courses in the modules? no

Language(s) of instruction: English	**Responsible for the module:** Dr. Lucio Colombi Ciacchi
Frequency: summer semester, yearly	**Duration:** 1 semester[s]
The module is valid since / The module is valid until: SoSe 24 / -	**Credit points / Workload:** 6 / 180 hours

Module examinations

Module examination: Modulprüfung Atomistic Modelling of Biomacromolecules	
Type of examination: module exam	
Form of examination: Announcement at the beginning of the semester	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	

Module courses

Course: Lecture	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 2	**University teacher:** M.Sc. Isabell Grothaus Dr. Lucio Colombi Ciacchi
Language(s) of instruction: Englisch	
Teaching method(s): Lecture	**Associated module examination:** Modulprüfung Atomistic Modelling of Biomacromolecules
Associated module courses **Atomistic modelling of biomacromolecules** (Lecture)	

Course: Seminar	
Frequency: summer semester, yearly	**Are there parallel courses?** no

Contact hours: 1	**University teacher:** M.Sc. Isabell Grothaus Dr. Lucio Colombi Ciacchi
Language(s) of instruction: Englisch	
Teaching method(s): Seminar	**Associated module examination:** Modulprüfung Atomistic Modelling of Biomacromolecules
Associated module courses **Atomistic modelling of biomacromolecules** (Lecture)	

Course: Exercise	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 2	**University teacher:** M.Sc. Isabell Grothaus Dr. Lucio Colombi Ciacchi
Language(s) of instruction: Englisch	
Teaching method(s): Tutorial	**Associated module examination:** Modulprüfung Atomistic Modelling of Biomacromolecules
Associated module courses **Atomistic modelling of biomacromolecules** (Lecture)	

Module 02-CHE-MA-D-BG: Bacterial Genomes: Bioinformatics, Mutant Construction and Proteomics

Bacterial Genomes: Bioinformatics, Mutant Construction and Proteomics

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Tailored Research Portfolio	Successful attendance in the mandatory BMB-courses in term 1 is recommended.

Learning content:

Eligible module for Microbial Systems specialization

The course is research-oriented, each student will work on his own construct / gene/ task. Experiments will directly benefit the research of our lab. Bacterial signal transduction cascades, genome analysis, biological nitrogen fixation and principles of mutational analysis will be covered theoretically.
Experiments include:
Mutational analysis: Gene inactivation by insertional mutagenesis in Azoarcus sp. (PCR, cloning, restriction analysis of clones, conjugation), analysis of the mutation (Southern blot analysis), expression analysis using transcriptional reporter gene studies (fluorescence microscopy).
Bioinformatic analysis of putative protein functions.
Protein identification.

Learning outcomes / competencies / targeted competencies:

Students can bioinformatically analyze protein functions, can desing and carry out mutagenesis strategies (directed mutagenesis for gene knockouts) and can desing and construct transcriptional and translational fusions. They are proficient in understanding the principles of the methods used and in identifying necessary experimental controls. They can present and discuss their scientific findings.

Calculation of student workload:

52 h Preparation / follow-up work
98 h SWS / presence time / working hours
30 h Exam preparation

Are there optional courses in the modules?

no

Language(s) of instruction:	**Responsible for the module:**
English	Prof. Dr. Barbara Reinhold-Hurek
Frequency:	**Duration:**
summer semester, yearly	1 semester[s]
The module is valid since / The module is valid until:	**Credit points / Workload:**
SoSe 24 / -	6 / 180 hours

Module examinations

Module examination: Modulprüfung Bacterial Genomes: Bioinformatics, mutant construction and proteomics

Type of examination: module exam

Form of examination: Announcement at the beginning of the semester	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	

Module courses

Course: Lecture	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 3	**University teacher:** Dr. Andrea Krause Prof. Dr. Barbara Reinhold-Hurek
Language(s) of instruction: Englisch	
Teaching method(s): Lecture	**Associated module examination:** Modulprüfung Bacterial Genomes: Bioinformatics, mutant construction and proteomics
Associated module courses **Bacterial Genomes: Bioinformatics, mutant construction and proteomics** (Lecture)	

Course: Laboratory	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 4	**University teacher:** Dr. Andrea Krause Prof. Dr. Barbara Reinhold-Hurek
Language(s) of instruction: Englisch	
Teaching method(s): Laboratory class	**Associated module examination:** Modulprüfung Bacterial Genomes: Bioinformatics, mutant construction and proteomics
Associated module courses **Bacterial Genomes: Bioinformatics, mutant construction and proteomics** (Lecture)	

Module 02-CHE-MA-D-CPMO: Cell Physiology of Marine Organisms: Cellular Energy Budget and Metabolic Fingerprinting

Cell Physiology of Marine Organisms: Cellular Energy Budget and Metabolic Fingerprinting

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Tailored Research Portfolio	A basic understanding of animal physiology and energy metabolism is recommended

Learning content:

limited to 5 students, priority is given to BMB students

Deepening the knowledge of cell physiology of marine ectotherms.
Topics will be:

- Environmental impact on function of cells, mitochondria, enzymes
- Aerobic and anaerobic energy metabolism
- Analytical NMR techniques
- Cellular energy budget and metabolite status

Methods being used:

- Isolation/Preparation of primary cells/tissue extracts
- Respirometry
- Photometry
- Nuclear Magnetic Resonance (NMR) spectroscopy

Learning outcomes / competencies / targeted competencies:

Students understand the principles of cell metabolism under physiological control and stress conditions

- Students are able to conduct and perform scientific experiments
- Students can prepare primary cell/tissue extracts
- Students can conduct NMR spectroscopy, photometric and respiration measurements
- Students can understand, evaluate, present and discuss scientific data

Calculation of student workload:

26 h Preparation / follow-up work
70 h Exam preparation
84 h SWS / presence time / working hours

Are there optional courses in the modules?

no

Language(s) of instruction:	**Responsible for the module:**
English	Dr. Frank Dietz
Frequency:	**Duration:**
summer semester, yearly	1 semester[s]
The module is valid since / The module is valid until:	**Credit points / Workload:**
SoSe 24 / -	6 / 180 hours

Module examinations

Module examination: Modulprüfung Cell Physiology of Marine Organisms: Cellular Energy Budget and Metabolic Fingerprinting	
Type of examination: module exam	
Form of examination: Announcement at the beginning of the semester	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	

Module courses

Course: Lecture	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 0,5	**University teacher:** Dr. Gisela Lannig-Bock
Language(s) of instruction: Englisch	
Teaching method(s): Lecture	**Associated module examination:** Modulprüfung Cell Physiology of Marine Organisms: Cellular Energy Budget and Metabolic Fingerprinting

Course: Seminar	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 1,5	**University teacher:** Dr. Gisela Lannig-Bock
Language(s) of instruction: Englisch	
Teaching method(s): Seminar	**Associated module examination:** Modulprüfung Cell Physiology of Marine Organisms: Cellular Energy Budget and Metabolic Fingerprinting

Course: Laboratory	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 4	**University teacher:** Dr. Gisela Lannig-Bock
Language(s) of instruction: Englisch	

Teaching method(s):	**Associated module examination:**
Laboratory class	Modulprüfung Cell Physiology of Marine Organisms: Cellular Energy Budget and Metabolic Fingerprinting

Module 02-CHE-MA-D-FABPI: Functional Analysis of Bacteriaplant Interactions: Transcriptomics, Advanced PCR Techniques and Bacterial Mutant Assessment

Functional Analysis of Bacteriaplant Interactions: Transcriptomics, Advanced PCR Techniques and Bacterial Mutant Assessment

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Tailored Research Portfolio	Successful attendance in the mandatory BMB-courses in term 1 is recommended

Learning content:

Eligible module for Microbial Systems specialization

The course is research-oriented, each student will work on his own experimental set. Experiments will directly benefit the research of our lab. Molecular principles of plant-microbe interactions, microarray and PCR applications, and RNA analysis will be covered theoretically.
Experiments include:
Gnotobiotic cultivation systems: Inoculation experiments of rice under aseptic conditions (Controlling of bacterial growth, aseptic handling of seedlings).
Optimization of reaction conditions for PCR (effect of variation of different parameters).
Quantitive PCR experiments for quantification of genes by Real-Time PCR.
Extraction of bacterial mRNA and detection of bacterial transcripts (antisense and sense) by RT-PCR, bioinformatic analysis of putative protein function and orientation of transcription.
Competition experiments of bacterial mutants after site-directed mutagenesis (DNA extraction from roots, PCR), evaluated by:
Oligonucleotide-based microarray experiments including controls (Generation of fluorescent target, amplicon purification, hybridization, scanning and statistical evaluation), and by T-RFLP (terminal restriction fragment length polymorphism

Learning outcomes / competencies / targeted competencies:

Students can bioinformatically analyze protein functions and predict sense/antisense transcription. They can optimize PCR reactions and quantify specific DNA molecules by quantitative PCR; students are capable to extract bacterial transcripts and to detect transcription of specific genes, and can set up and evaluate plant-microbe interaction studies in gnotobiotic culture systems, and carry out and analyze diagnostic microarrays. They are proficient in understanding the principles of the methods used and in identifying necessary experimental controls. They can present and discuss their scientific findings.

Calculation of student workload:

52 h Preparation / follow-up work
98 h SWS / presence time / working hours
30 h Exam preparation

Are there optional courses in the modules?

no

Language(s) of instruction:	**Responsible for the module:**
English	Dr. Thomas Hurek
Frequency:	**Duration:**
summer semester, yearly	1 semester[s]

The module is valid since / The module is valid until:	Credit points / Workload:
SoSe 24 / -	6 / 180 hours

Module examinations

Module examination: Modulprüfung Functional Analysis of Bacteriaplant Interactions: Transcriptomics, Advanced PCR Techniques and Bacterial Mutant Assessment	
Type of examination: module exam	
Form of examination: Announcement at the beginning of the semester	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	

Module courses

Course: Lecture	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 3	**University teacher:** Dr. Thomas Hurek Prof. Dr. Barbara Reinhold-Hurek
Language(s) of instruction: Englisch	
Teaching method(s): Lecture	**Associated module examination:** Modulprüfung Functional Analysis of Bacteriaplant Interactions: Transcriptomics, Advanced PCR Techniques and Bacterial Mutant Assessment
Associated module courses **Functional genomics of bacteria: RNA and microarray analysis** (Lecture)	

Course: Laboratory	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 4	**University teacher:** Dr. Thomas Hurek Prof. Dr. Barbara Reinhold-Hurek
Language(s) of instruction: Englisch	

Teaching method(s):	**Associated module examination:**
Laboratory class	Modulprüfung Functional Analysis of Bacteriaplant Interactions: Transcriptomics, Advanced PCR Techniques and Bacterial Mutant Assessment

Associated module courses

Functional genomics of bacteria: RNA and microarray analysis (Lecture)

Module 02-CHE-MA-D-FGME: Functional Genomics of Marine Eukaryotes
Functional Genomics of Marine Eukaryotes

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Tailored Research Portfolio	Basic understanding of molecular biology and genetics is recommended, including laboratory skills for molecular biology such as PCR and gel-electrophoresis, Basic in R and preferable R studio.

Learning content:
Consolidation of the theoretical knowledge and understanding in the field of molecular ecology, functional genomics and genome evolution: Therefore the following topic will be discussed:

- Introduction into the functional genomic
- Application of functional genomics in the field of molecular ecology
- Comparative genomics: Concepts and approaches
- Introduction into Genome evolution
- functional gene annotation
- Theoretical background for functional and statical analyses of RNAseq data

Methodologies, applied in the laboratory and on a computer part:

- Extraction of RNA: Analysis (NanoDrop, Bioanalyser)
- production of cDNA libraries the generation of ESTs with Illumina sequencer
- Gene expression analysis of RNA seq (Illumina) data using R

Learning outcomes / competencies / targeted competencies:
Students have an in-depth theoretical knowledge and understanding in the field of molecular ecology, functional genomics, and environmental genomics

- Students can perform experiments in functional genomics and molecular ecology
- Students understand the principles in genome evolution and bioinformatics
- Students can generate and analyse RNAseq data

Calculation of student workload:
66 h Exam preparation
90 h SWS / presence time / working hours
24 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:	**Responsible for the module:**
English	Dr. Frank Dietz
Frequency:	**Duration:**
summer semester, yearly	1 semester[s]
The module is valid since / The module is valid until:	**Credit points / Workload:**
SoSe 24 / -	6 / 180 hours

Module examinations

Module examination: Modulprüfung Functional Genomics of Marine Eukaryotes	
Type of examination: module exam	
Form of examination: Announcement at the beginning of the semester	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	

Module courses

Course: Lecture	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 2	**University teacher:** Dr. Uwe John
Language(s) of instruction: Englisch	
Teaching method(s): Lecture	**Associated module examination:** Modulprüfung Functional Genomics of Marine Eukaryotes
Associated module courses **Functional Genomics** (Lecture)	

Course: Seminar	
Frequency: winter semester, yearly	**Are there parallel courses?** no
Contact hours: 0,4	**University teacher:** Dr. Uwe John
Language(s) of instruction: Englisch	
Teaching method(s): Seminar	**Associated module examination:** Modulprüfung Functional Genomics of Marine Eukaryotes
Associated module courses **Functional Genomics** (Lecture)	

Course: Laboratory	
Frequency: summer semester, yearly	**Are there parallel courses?** no

Contact hours: 4	**University teacher:** Dr. Uwe John
Language(s) of instruction: Englisch	
Teaching method(s): Laboratory class	**Associated module examination:** Modulprüfung Functional Genomics of Marine Eukaryotes
Associated module courses **Functional Genomics** (Lecture)	

Module 02-CHE-MA-D-IEPR: Investigation and Engineering of Plant Reproduction Using State of the Art Gene Editing Tools

Investigation and Engineering of Plant Reproduction Using State of the Art Gene Editing Tools

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Tailored Research Portfolio	N.A.

Learning content:

Plants play key role in sustaining life on earth as source of food, shelter and energy. Polyploidization, an increase in genome copies, has been a major driving force for the increase in performance of crop plants and continues to be important breeding goal. We recently discovered that polyspermy, the fusion of an egg with two sperm, is route towards polyploidization. However, polyspermy barriers are in place making this a rare event. To tackle the bottleneck of polyspermy block, the students will target potential polyspermy regulating molecular factors making use of CRISPR/Cas9 based gene editing tool.

Learning contents:
Master students will have the opportunity to develop and realize their own research idea with the support of experts in the field.

As part of the holistic concept the students will generate CRISPR/Cas9 genome editing construct to then follow the approach up until the generation and identification of the mutant. Special attention is given to the conceptualization and design of experiments. In addition, students will learn basic techniques for science communication, professional presentation, and poster design.

Learning outcomes / competencies / targeted competencies:

- Students can design and implement CRISPR/Cas9 based genome editing
- Students have the ability to conceive and develop their own research project
- Students can apply their conceptional knowledge to design experiments
- Students can communicate and present scientific findings professionally
- Student have in-depth knowledge regarding the mechanism of plant reproduction

Calculation of student workload:

60 h Exam preparation
98 h SWS / presence time / working hours
22 h Preparation / follow-up work

Are there optional courses in the modules?

no

Language(s) of instruction:	**Responsible for the module:**
English	Prof. Dr. Rita Helene Groß-Hardt
Frequency:	**Duration:**
summer semester, yearly	1 semester[s]
The module is valid since / The module is valid until:	**Credit points / Workload:**
SoSe 24 / -	6 / 180 hours

Module examinations

Module examination: Modulprüfung Investigation and Engineering of Plant Reproduction Using State of the Art Gene Editing Tools	
Type of examination: module exam	
Form of examination: Announcement at the beginning of the semester	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	

Module courses

Course: Lecture	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 1	**University teacher:** Prof. Dr. Rita Helene Groß-Hardt
Language(s) of instruction: Englisch	
Teaching method(s): Lecture	**Associated module examination:** Modulprüfung Investigation and Engineering of Plant Reproduction Using State of the Art Gene Editing Tools
Associated module courses **Analyzing sexual reproduction in plants using state of the art gene editing tools** (Lecture)	

Course: Seminar	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 2	**University teacher:** Prof. Dr. Rita Helene Groß-Hardt
Language(s) of instruction: Englisch	
Teaching method(s): Seminar	**Associated module examination:** Modulprüfung Investigation and Engineering of Plant Reproduction Using State of the Art Gene Editing Tools
Associated module courses **Analyzing sexual reproduction in plants using state of the art gene editing tools** (Lecture)	

Course: Laboratory

Frequency: winter semester, yearly	**Are there parallel courses?** no
Contact hours: 4	**University teacher:** Prof. Dr. Rita Helene Groß-Hardt
Language(s) of instruction: Englisch	
Teaching method(s): Laboratory class	**Associated module examination:** Modulprüfung Investigation and Engineering of Plant Reproduction Using State of the Art Gene Editing Tools
Associated module courses **Analyzing sexual reproduction in plants using state of the art gene editing tools** (Lecture)	

Module 02-CHE-MA-D-MolViro: Molecular Virology
Molecular Virology

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Tailored Research Portfolio	Successful attendance in the module BMB-A Basics in Biochemistry and Molecular Cell Biology is recommended.

Learning content:
Eligible module for Microbial Systems specialization

Topics:

- Laboratory techniques in virology
- Diagnosis and Therapy of viral diseases

Practical course:

- Propagation of viruses (embryonated eggs and cell cultures)
- Virus harvest
- Virus purification
- Quantification of viruses (hemagglutination assay, tissue culture infectious dose (TCID50) determination)
- Detection of viral proteins by indirect immunofluorescence assay
- Proof of interferon: induction of synthesis, RNA extraction and detection by RT-PCR, detection by plaque reduction assay (Bioassay)

Viruses used:
Influenza A virus, Newcastle disease virus (NDV), Hepatitis A virus (HAV), Vesicular stomatitis virus (VSV)

Learning outcomes / competencies / targeted competencies:
Students have an in-depth knowledge of fundamental and advanced virological laboratory techniques including cell culture methodologies, clinical virology and diagnostic methods Students can apply and perform specific standard methods required for virological experiments, like virus propagation and virus analysis. They are able to evaluate and assess the results obtained from virological investigations.

Calculation of student workload:
50 h Preparation / follow-up work
84 h SWS / presence time / working hours
46 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:	**Responsible for the module:**
English	Prof. Dr. Andreas Dotzauer
Frequency:	**Duration:**
summer semester, yearly	1 semester[s]
The module is valid since / The module is valid until:	**Credit points / Workload:**
SoSe 24 / -	6 / 180 hours

Module examinations

Module examination: Kombinationsprüfung Molecular Virology	
Type of examination: combination exam	
Form of examination: Announcement at the beginning of the semester	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 1 / 1 / -	
Language(s) of instruction: Englisch	

Module courses

Course: Lecture	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 1	**University teacher:** Prof. Dr. Andreas Dotzauer
Language(s) of instruction: Englisch	
Teaching method(s): Lecture	**Associated module examination:** Kombinationsprüfung Molecular Virology
Associated module courses **Molecular Virology** (Seminar)	

Course: Seminar	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 1	**University teacher:** Prof. Dr. Andreas Dotzauer Dr. Oliver Janssen-Weets
Language(s) of instruction: Englisch	
Teaching method(s): Seminar	**Associated module examination:** Kombinationsprüfung Molecular Virology
Associated module courses **Molecular Virology** (Seminar)	

Course: Laboratory	
Frequency: summer semester, yearly	**Are there parallel courses?** no

Contact hours: 4	**University teacher:** Prof. Dr. Andreas Dotzauer Dr. Oliver Janssen-Weets
Language(s) of instruction: Englisch	
Teaching method(s): Laboratory class	**Associated module examination:** Kombinationsprüfung Molecular Virology
Associated module courses **Molecular Virology** (Seminar)	

Module 02-CHE-MA-D-MRI-MRS: MRI and MRS in Biomedical Research
MRI and MRS in Biomedical Research

Assignment to areas of study:	Content-related prior knowledge or skills:
• Tailored Research Portfolio	none

Learning content:
Eligible module for Microbial Systems specialization

Lectures:

· the fundamental MR effect

· basic principles of signal detection and image formation

· relaxation phenomena

· in vivo MR Spectroscopy

· MR image contrast and contrast agents

· basic and advanced MRI methods: (Spin Echo/Gradient Echo/Echo Planar, Flow/DIffusion / Susceptibility, fMRI; parallel imaging)

· applications in biological and preclinical research, plant MRI

· MR hardware incl. coil design

Lab course I: MR imaging at 7T

· safety instructions, sample handling

· basic MR imaging, relaxation and contrast formation, artefacts

· MRI / MRS measurements following students choice

samples (fruits, phantoms, plants etc)

methods (parameter optimization)

coils (sensitivity)

Lab course II: Data analysis

· basics of signal processing (octave/matlab)

· basic image reconstruction (octave/matlab)

· image analysis of data acquired by students (octave/matlab/ImageJ)

· analysis of own measurements

presentation of results

Learning outcomes / competencies / targeted competencies:
Comprehensive knowledge of basic MR and MRS methodology, data reconstruction and artifacts. Introduction into state-of-the-art methods used in biological and preclinical research. Practical experience with MR measurements and comprehensive analysis of acquired data.

Calculation of student workload:
84 h SWS / presence time / working hours
96 h Self-study

Are there optional courses in the modules? no

Language(s) of instruction: English	**Responsible for the module:** Dr. Ekkehard Küstermann
Frequency: summer semester, yearly	**Duration:** 1 semester[s]
The module is valid since / The module is valid until: SoSe 24 / -	**Credit points / Workload:** 6 / 180 hours

Module examinations

Module examination: Modulprüfung MRI and MRS in Biomedical Research	
Type of examination: module exam	
Form of examination: Announcement at the beginning of the semester	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	

Module courses

Course: Lecture	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 2	**University teacher:** Dr. Ekkehard Küstermann
Language(s) of instruction: Englisch	
Teaching method(s): Lecture	**Associated module examination:** Modulprüfung MRI and MRS in Biomedical Research
Associated module courses **Magnetic Resonance Imaging (MRI) in biological research** (Lecture)	

Course: Laboratory	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 4	**University teacher:** Dr. Ekkehard Küstermann
Language(s) of instruction: Englisch	

Teaching method(s):	**Associated module examination:**
Laboratory class	Modulprüfung MRI and MRS in Biomedical Research

Associated module courses

Magnetic Resonance Imaging (MRI) in biological research (Lecture)

Module 02-CHE-MA-D-PFT: Plant and Fungal Transformation as Tool for Functional Analysis and In Vivo Visualization

Plant and Fungal Transformation as Tool for Functional Analysis and In Vivo Visualization

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Tailored Research Portfolio	Basic knowledge in genetics and first experience with axenic culture is recommended.

Learning content:

Eligible module for Microbial Systems specialization

The courses take place during the spring break, usually starting at the end of the winter semester and ending at the beginning of the summer semester.

Theoretical part of the course (lectures and seminars):

- Principles of plant and fungal transformation and their application
- Visual markers in plant and fungal biology
- Principles of fluorescence and confocal laser scanning microscopy
- Tissue culture techniques for plant and fungal propagation
- Theoretical basic for the genetic manipulation of lower (fungi) and higher (plants) eukaryotes
- Theoretical basic for in vivo visualization of physiological and developmental processes in lower (fungi) and higher (plants) eukaryotes.

Methods applied in the practical training:

- Development of practical skills for generation of transgenic (plant and fungi). Stable and transient transformation via Agrobacterium, protoplast formation, ballistic techniques, and chemical approaches.
- Tissue culture
- Transient gene expression in tobacco leaves
- Stable gene expression in poplar
- First impressions of the use of visual markers in plant and fungal development
- Fluorescence microscopy and confocal laser scanning microscopy
- Yeast transformation
- Functional analysis of heterologous expressed proteins

Learning outcomes / competencies / targeted competencies:

- Students have a comprehensive knowledge of techniques and strategies suitable to manipulate plants and fungi
- Students can perform selected approaches to generate (stable and transient) transgenics (fungi and plants)
- Students can perform functional characterization of selected proteins using yeast as a toolbox Students have the competence to develop strategies for functional gene expression in plants and fungi.
- Students can perform in vivo visualization of plant function
- Students have the competence to present and discuss projects addressing in vivo visualization of physiological and developmental processes in plants and fungi.

Calculation of student workload: 68 h Preparation / follow-up work 28 h Exam preparation 84 h SWS / presence time / working hours

Are there optional courses in the modules? no

Language(s) of instruction: English	**Responsible for the module:** Prof. Dr. Uwe Nehls
Frequency: summer semester, yearly	**Duration:** 2 semester[s]
The module is valid since / The module is valid until: SoSe 24 / -	**Credit points / Workload:** 6 / 180 hours

Module examinations

Module examination: Modulprüfung Plant and Fungal Transformation as Tool for Functional Analysis and In Vivo Visualization	
Type of examination: module exam	
Form of examination: Announcement at the beginning of the semester	**The examination is ungraded?** no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	

Module courses

Course: Lecture	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 0,5	**University teacher:** Prof. Dr. Uwe Nehls
Language(s) of instruction: Englisch	
Teaching method(s): Lecture	**Associated module examination:** Modulprüfung Plant and Fungal Transformation as Tool for Functional Analysis and In Vivo Visualization

Course: Seminar	
Frequency: summer semester, yearly	**Are there parallel courses?** no

Contact hours: 1	**University teacher:** Prof. Dr. Uwe Nehls
Language(s) of instruction: Englisch	
Teaching method(s): Seminar	**Associated module examination:** Modulprüfung Plant and Fungal Transformation as Tool for Functional Analysis and In Vivo Visualization

Course: Laboratory	
Frequency: summer semester, yearly	**Are there parallel courses?** no
Contact hours: 4,5	**University teacher:** Prof. Dr. Uwe Nehls
Language(s) of instruction: Englisch	
Teaching method(s): Laboratory class	**Associated module examination:** Modulprüfung Plant and Fungal Transformation as Tool for Functional Analysis and In Vivo Visualization

Module 02-CHE-MA-0-BMB: Supplementary Courses in the Master Biochemistry and Molecular Biology

Supplementary Courses in the Master Biochemistry and Molecular Biology

Assignment to areas of study:	**Content-related prior knowledge or skills:**
• Supplementary Courses	none

Learning content:

Learning outcomes / competencies / targeted competencies:

Calculation of student workload:

Are there optional courses in the modules?
no

Language(s) of instruction:	**Responsible for the module:**
English	N.N.
Frequency:	**Duration:**
(depending on capacity) winter or summer semester	1 semester[s]
The module is valid since / The module is valid until:	**Credit points / Workload:**
SoSe 24 / -	0 / 0 hours

This module is ungraded!

Module examinations

Module examination: with examination or without examination

Type of examination: module exam

Form of examination:	**The examination is ungraded?**
See free text	yes

Number of graded components / ungraded components / prerequisites of the examination:
- / 1 / -

Language(s) of instruction:
Englisch

Module courses

Course: Supplementary Courses in the Master BMB

Frequency:	**Are there parallel courses?**
(depending on capacity) winter or summer semester	no
Contact hours:	**University teacher:**
	N. N.

Language(s) of instruction:
Englisch

Teaching method(s): Lecture Tutorial Seminar Self-study unit	**Associated module examination:** with examination or without examination

Course: Lab Safety and Fire Prevention Workshop (in English)	
Frequency: (depending on capacity) winter or summer semester	**Are there parallel courses?** no
Contact hours:	**University teacher:** N. N.
Language(s) of instruction: Englisch	
Teaching method(s): Lecture Tutorial	**Associated module examination:** with examination or without examination
Associated module courses **Lab Safety and Fire Prevention Workshop (in English)** (Lecture)	

Course: Supplementary Courses in the Master Biochemistry and Molecular Biology	
Frequency: (depending on capacity) winter or summer semester	**Are there parallel courses?** no
Contact hours:	**University teacher:** N. N.
Language(s) of instruction: Englisch	
Teaching method(s): Tutorial Seminar Field trip	**Associated module examination:** with examination or without examination