Karlsruher Institut für Technologie

Module Handbook
Biology Master 2014 (Master of Science (M.Sc.))

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KIT DEPARTMENT OF CHEMISTRY AND BIOSCIENCES

Table Of Contents

The Master's Program in Biology at KIT

About KIT

KIT was founded in October 2009 through the merger of the University of Karlsruhe (Campus South) and the Karlsruhe Research Center (Campus North). This unique integration of research and education provides an excellent opportunity for modern and research-oriented teaching in biology. Founded in 1825 as a polytechnic school, KIT is centrally located next to Karlsruhe Palace. The tradition of biology at KIT dates back even further: in 1800, Joseph Gottlieb Kölreuter laid the foundation for plant genetics here.

The City of Karlsruhe

With a population of 300,000, Karlsruhe is one of Germany's smaller major cities but has much to offer:

- With 1,800 hours of sunshine per year, it is one of the warmest cities in Germany.
- A diverse cultural scene, from the Baden State Theatre to the Center for Art and Media (ZKM).
- Large recreational areas, including city forests, numerous green spaces, two botanical gardens, and a zoological garden.

Biology at KIT

The biology program at KIT allows students to engage in cutting-edge international research. Internships are available in areas such as developmental biology, signal transduction, and genome editing. The integration with large-scale research at Campus North also offers additional opportunities in cancer research and interdisciplinary projects.

Objectives of the Master's Program in Biology at KIT

- Professional and interdisciplinary training in all key disciplines of biology
- Research-oriented learning objectives
- Understanding of biological concepts and principles

This program provides students with the opportunity to further specialize in biology according to their interests. Given the vast scope of the field, we believe that students should have the freedom to shape their academic path. Therefore, the program offers a wide range of elective options, allowing students to develop a personalized academic profile.

With so many choices, making a decision can be challenging, but we are here to support and guide you throughout the process.

Our Profile

- Focus on molecular methods and research questions
- Integration with applied research (collaborations with non-university research institutions)
- Interdisciplinary approach (including Chemical Biology, Technical Biology, Geoecology, Toxicology, Food Chemistry, and Materials Science)

Use of Animals in Teaching and Research

Some courses involve the use of animals for teaching and examination purposes, in accordance with § 30a of the LHG. Details are provided in the module descriptions. However, all listed modules are elective, and alternative courses are available. We continuously evaluate alternative teaching methods and materials to reduce and replace the use of animals where possible. If feasible, these alternatives are incorporated into the module descriptions.

Research Modules:

- M-CHEMBIO-100249 Neurodevelopmental Biology
- M-CHEMBIO-100248 Microscopy Techniques
- M-CHEMBIO-100276 Integrated Thinking – Major Excursion to Giglio and Helgoland
- M-CHEMBIO-100251 Methods in Developmental Biology
- M-CHEMBIO-103095 Methods in Developmental Genetics
- M-CHEMBIO-103501 Pathophysiology – Fundamentals of Diseases

Project Modules:

- M-CHEMBIO-100258 Molecular Neurodevelopmental Biology
- M-CHEMBIO-100234 Molecular Cell Biology
- M-CHEMBIO-100265 Methods in Developmental Biology
- M-CHEMBIO-105600 Pathophysiology – Fundamentals of Diseases
- M-CHEMBIO-103942 Molecular Biology of the Cell

Structure of the Master's Program in Biology

In biological research, it is important to stay engaged in experiments over several hours or even multiple consecutive days. Therefore, the Master's program in Biology at KIT is structured in a block format. The semester is divided into three four-week blocks. Additionally, there is another block after the lecture period of the winter and summer semesters and before the lecture period of the winter semester.

At the beginning of the program, you choose three equally weighted subjects. Currently, the following subjects are available: the traditional fields of Botany, Genetics, Microbiology, and Zoology, as well as interdisciplinary fields such as Developmental Biology, Molecular Biology, Cell Biology, and Biochemistry. Additional subjects imported from other degree programs include Chemical Biology, Technical Biology/Biotechnology, Toxicology, and Geoecology. More information can be found on the **program's elective area webpages**.

Within each subject, you typically select two **research modules (F2)**, which are four-week block internships accompanied by a lecture. At the end of a research module, a graded exam is conducted (written exam or other type of assessment, in some cases an oral exam). In each of the three subjects, you will also complete a so-called **project module (F3)**. These are also four-week internships in which you work on a small independent research project. The assessment is an ungraded academic requirement, which includes writing a report and usually giving an internal institute presentation and/or documenting the results through status meetings. The project internships are arranged individually with supervisors and are not bound to specific module schedules.

In addition to the internships, you will also complete a total of four seminars:
This includes two **interdisciplinary seminars** (also known as networking seminars). One of these networking seminars can be substituted with a doctoral seminar (covering current topics) or an alternative course at the HOC, the Language Center, or ZAK.
You will also take two additional seminars under the title ***"Developing Concepts"***, one on ***"Advanced Research Methods"*** and one on ***"Advanced Presentation Techniques."***
Furthermore, you will participate in a one-week **Major Excursion** as part of the *"Integrated Thinking"* module. A corresponding lecture, ***"Integrated Analysis of Ecosystems,"*** takes place in the preceding semester. You can choose from four excursions:

- ***Integrated Analysis of Ecosystems – Alpine Habitat*** (lecture in the winter semester) with either the **Alpine excursion** or the **local excursion exploring the vegetation history of Baden** in the following summer semester.
- ***Integrated Analysis of Marine Ecosystems – Giglio or Helgoland*** (lecture in the winter semester) with the **major excursion to Giglio** or, alternately, **to Helgoland** following the summer semester.

All research and project modules, seminars, and excursions can be freely selected from a predefined catalog, depending on available spots (elective area). This flexibility allows students to tailor their interdisciplinary studies both in terms of content and schedule to fit their personal needs, interests, and career aspirations.

The module handbook provides an overview, with individual courses linked to the course catalog and exam registration system. Additionally, the **central websites for biology education** and the ILIAS learning platform are essential resources. They provide up-to-date information each semester on variable course details (e.g., time and location) and any short-term changes.

Placement for research modules, excursions, and seminars is determined through the **module selection** process, which takes place before each semester (September for the winter semester and March for the summer semester). Therefore, it is important to check your emails regularly at least two months before the semester starts to stay informed about the module selection process.

Qualification Goals of the Master's Program in Biology

The four-semester Master's program in Biology allows students to develop an individual scientific profile in great depth. By combining the conceptual and methodological breadth acquired during their Bachelor's studies with specialization at the Master's level, students gain the academic qualification required for subsequent doctoral studies in the life sciences. Additionally, they expand their ability for interconnected thinking by integrating interdisciplinary elements.

Together with a high level of scientific rigor, independence throughout all phases of the Master's program, experience in an international research environment, and an understanding of complex biological and ecological systems, graduates are well-prepared to take on leadership roles in industrial settings. They will be able to act responsibly, integratively, and sustainably in such positions.

The central qualification goals of the Master's program are:

- Students develop an individual academic profile
- They gain in-depth expertise in selected fields of choice.
- They enhance their scientific independence.
- They practice and internalize scientific methodology.

Interdisciplinary Thinking and Communication

Individual specialization should not lead to narrow expertise without broader context. Therefore, the Master's program builds upon the Bachelor's goals of **interconnected thinking** and **understanding different systems and levels of complexity**. These skills are further developed through key qualification modules (structured as interdisciplinary seminars) and the major biological field excursion.

Additionally, the Master's program places great emphasis on the ability to **navigate interdisciplinary contexts with confidence and communicate clearly and effectively**. In addition to the previously mentioned objectives, students will also develop the ability to:

- Connect different system and complexity levels.
- Critically read and evaluate scientific literature.
- Deepen their understanding of sustainability and ecological relationships.
- Analyze and interpret complex information, including from interdisciplinary fields, in a targeted and critical manner.
- Clearly and confidently present complex scientific content, including interdisciplinary topics.
- Operate effectively and assertively in an international academic environment.

Curriculum

3 subjects, selectable from: Botany, Genetics, Microbiology, Zoology, Developmental Biology, Molecular Biology, Cell Biology, Biochemistry, Biotechnology, Technical Biology, Toxicology, Life Science Engineering, Taxonomy, and Geoecology

1st Semester							
Compulsory Elective Area	**Module Name**	**Course**	**Type**	**CP**	**CP**	**Exam**	**Grade**
Subject 1	Research Module Subject 1A	Concepts for Research Module 1A	V	1	**8**	SP or PA	yes
		Practice in Research Module 1A	P	7			
	Research Module Subject 1B	Concepts for Research Module 1B	V	1	**8**	SP or PA	yes
		Practice in Research Module 1B	P	7			
	Project Module Subject 1	Research Project in Subject 1	P	7	**7**	SL	no
Integrative Biology	Developing Concepts	Advanced Research Skills	S	3	**6**	PA	yes
		Advanced Presentation Skills	S	3		PA	yes
Integrative Biology	Integrated Thinking	Integrated Analysis of Ecosystems	V	2	**2 of 9**	SP	yes
					31		
2nd Semester							
Compulsory Elective Area	**Module Name**	**Course**	**Type**	**CP**	**CP**	**Exam**	**Grade**
Subject 2	Research Module Subject 2A	Concepts for Research Module 2A	V	1	**8**	SP or PA	yes
		Practice in Research Module 2A	P	7			
	Research Module Subject 2B	Concepts for Research Module 2B	V	1	**8**	SP or PA	yes
		Practice in Research Module 2B	P	7			
	Project Module Subject 2	Research Project in Subject 2	P	7	**7**	SL	no
Integrative Biology	Integrated Thinking	Major Excursion	E	7	**7 of 9**	SL	no
					30		
3rd Semester							
Compulsory Elective Area	**Module Name**	**Course**	**Type**	**CP**	**CP**	**Exam**	**Grade**
Subject 3	Research Module Subject 3A	Concepts for Research Module 3A	V	1	**8**	SP or PA	yes
		Practice in Research Module 3A	P	7			
	Research Module Subject 3B	Concepts for Research Module 3B	V	1	**8**	SP or PA	yes
		Practice in Research Module 3B	P	7			
	Project Module Subject 3	Research Project in Subject 3	P	7	**7**	SL	no
Integrative Biology	Interdisciplinary Thinking	Interdisciplinary Seminar A	S/M	3	**6**	SL oral	no
		Interdisciplinary Seminar B *	S/M	3		SL oral	no
					29		
4th Semester							
Master's Thesis			A	30	**30**	A	yes
					120		

* Alternatively, freely selectable offerings at the HOC/Language Center/FORUM

V = Lecture; P = Practical; S = Seminar; M = Mentorship; SP = Written Exam; SL = Ungraded Coursework; PA = Other Type of Exam; A = Thesis

The chronological order of the modules can be freely combined and may deviate from the number of semesters stated above

Example Selection for Orientation – Master's Program in Biology SER14

The order in which the completed modules are taken does not matter, so they are not listed according to the study plan here either

3 subjects, selectable from: Botany, Genetics, Microbiology, Zoology, Developmental Biology, Molecular Biology, Cell Biology, Biochemistry, Biotechnology, Technical Biology, Toxicology, Life Science Engineering, Taxonomy, and Geoecology

Compulsory Elective Area	Module Number	Module Name	Semester	Block/Time/Info	CP	Exam	Grade
Microbiology	**M3206**	Research Module Biomolecular Microanalysis	2nd SuSe	1st Block	**8**	SP or PA	yes
	M4202	Research Module Cellular Microbiology	2nd SuSe	2nd Block	**8**	SP or PA	yes
	M4302	Project Module Cellular Microbiology	2nd SuSe	3rd Block	**7**	SL	no
Integrative Biology	**Developing**	Botanical Seminar 1	1st WiSe	Presentation Techniques	**6**	PA	yes
	Concepts	Microbiological Seminar	2nd SuSe	ResearchTechniques		PA	yes
				Sum	**29**		

Compulsory Elective Area	Module Number	Module Name	Semester	Block/Time/Info	CP	Exam	Grade
Zoology	**M5204**	Research Module Anatomy of Vertebrates	1st WiSe	2nd Block	**8**	SP or PA	yes
	M5207	Research Module Neurodevelopmental Biology	3rd WiSe	1st Block	**8**	SP or PA	yes
	M5307	Project Module Molecular Neurodevelopmental Biology	3rd WiSe	2nd Block	**7**	SL	no
Integrative Biology	**Integrated**	Major Excursion	1st WiSe	Lecture Habitat Alps	**9**	SP	yes
	Thinking		2nd SuSe	Excursion Habitat Alps		SL	no
				Sum	**32**		

Compulsory Elective Area	Module Number	Module Name	Semester	Block/Time/Info	CP	Exam	Grade
Botany	**M1201**	Research Module Plant Cell Biology	1st WiSe	1st Block	**8**	SP or PA	yes
	FOR-C2	Research Module Molecular Plant-Microbe Interaction	3rd WiSe	3rd Block	**8**	SP or PA	yes
	M1301	Project Module Plant Cell Biology	1st WiSe	3rd Block	**7**	SL	no
Integrative Biology	**Interdisciplinary**	Networking Seminar	2nd SuSe	Cell Biology	**6**	SL oral	no
	Thinking		3rd WiSe	Molecular Biology		SL oral	no
				Sum	**29**		

4th Semester							
Master's Thesis					**30**	A	yes
				Overal	**120**		

* Alternatively, freely selectable offerings at the HOC/Language Center/FORUM

V = Lecture; P = Practical; S = Seminar; M = Mentorship; SP = Written Exam; SL = Study Performance; PA = Exam Performance of Another Type; A = Thesis

Important Information on Participating in All Types of Assessments

Assessments include written exams, oral exams, other types of examination performances, and coursework. In order to participate, students must register online in the student portal within the deadlines set by the examiners. If participation in a registered assessment becomes impossible, students must withdraw from the respective assessment within the designated deadline. The following must be observed:

Written Examinations:

A failed examination may be re-examined once. If the re-examination is also failed, an oral re-examination will follow. Withdrawals without providing a reason are permitted up until the exam papers are handed out. Withdrawal can be made (1) **via the student portal** (CMS) until 24:00 (midnight) on the day before the exam, or (2) **directly before the exam,** either in person with the examiner or via the student email address (**xxxx@student.kit.edu**). If option (1) and/or (2) are not met, a medical certificate may be required (e.g., in the cases of illness of the student, a child under the student's sole care, or a dependent in need of care).

Withdrawal from a scheduled oral re-examination must be **submitted in writing** to the examination board and must be properly substantiated.

Oral Examinations:

A failed oral examination may be re-examined once. Withdrawals without providing a reason must be made at least three working days in advance via the student portal (CMS). If the three-day deadline is not met, the reason must be submitted to the examination board immediately in writing and credibly substantiated. In the cases of illness of the student, a child under the student's sole care, or a dependent in need of care, a medical certificate may be required.

Other Types of Examinations:

An examination of another type may only be repeated once. Such examinations can consist of multiple components. The overall grade is calculated based on the performance in each individual component (see modules and partial assessments). If the examination consists of several components, it is considered passed if the **overall grade** is at least "sufficient" (4.0). This means that the examination must be passed as a whole, and not necessarily in each individual component. Withdrawals without providing a reason must be made at least three working days in advance via the student portal (CMS). If the three-day deadline is not met, the reason must be submitted to the examination board immediately in writing and credibly substantiated. In cases of illness of the student, a child under their sole care, or a dependent in need of care, a medical certificate may be required.

Coursework:

Coursework may be repeated multiple times. Withdrawals without providing a reason must be made at least three working days in advance via the student portal. If the three-day deadline is not met, the reason must be submitted to the examination board immediately in writing and credibly substantiated. In cases of illness of the student, a child under their sole care, or a dependent in need of care, a medical certificate may be required.

Applies to All Types of Assessments:

If it is not possible to withdraw in due time via the student portal or directly before a written exam with the examiner, withdrawal may be made in justified cases via the student email address (xxxx@student.kit.edu) by contacting the examiner.

If the withdrawal is made directly through the examiner, it is the examiner's responsibility to carry out the deregistration in the student portal (CMS).

Summary:

Types of Assessment	Re-examination	Withdrawal
Written Examination	A written re-examination	- Until the exam papers are handed out by the examiner. - Online via the student portal until 24:00 (midnight) on the day before the exam.
	Oral re-examination	Withdrawal via the student portal is not possible. A justified withdrawal must be requested through a written application.
Oral Examination	An oral re-examination	At least 3 working days before the exam date via the student portal.
Other Types of Examination	One re-examination allowed (under the same conditions as the first attempt)	At least 3 working days before the exam date via the student portal.
Coursework	Until passed	At least 3 working days before the exam date via the student portal.

7 Field of study structure

Mandatory	
Master's Thesis	30 CR
Required Electives (Election: 3 items)	
Botany	23 CR
Zoology	23 CR
Microbiology	23 CR
Genetics	23 CR
Molecular Biology	23 CR
Cell Biology	23 CR
Developmental Biology	23 CR
Biotechnology	23 CR
Biophysics	23 CR
Biochemistry	23 CR
Technical Biology	23 CR
Toxicology	23 CR
Taxonomy and Geoecology	23 CR
Life Science Engineering	23 CR
Mandatory	
Integrative Biology	21 CR
Voluntary	
Additional Examinations *This field will not influence the calculated grade of its parent.*	

7.1 Master's Thesis

Credits
30

Mandatory		
M-CHEMBIO-100178	Master's Thesis	30 CR

7.2 Botany

Credits
23

Compulsory Elective Subject - Research (Election: 2 items)		
M-CHEMBIO-100191	Research Module: Plant Cell Biology	8 CR
M-CHEMBIO-100192	Research Module: Plant Evolution: Methods and Concepts	8 CR
M-CHEMBIO-100194	Research Module: Seed Technology	8 CR
M-CHEMBIO-100195	Research Module: Photoreceptors in Plants and Microorganisms	8 CR
M-CHEMBIO-100197	Research Module: Protein Crystallization	8 CR
M-CHEMBIO-100198	Research Module: Plant Gene Technology - Precise Genome Engineering	8 CR
M-CHEMBIO-100200	Research Module: Molecular and Cell Biology of Mycorrhiza	8 CR
M-CHEMBIO-100201	Research Module: Molecular Plant-Microbe Interactions	8 CR
M-CHEMBIO-106694	Research Module: Quantitative Phenotyping in Breeding	8 CR
M-CHEMBIO-106787	Research Module: Resilience - Plants Conquer Land	8 CR
M-CHEMBIO-106908	Research Module: Ecology of City Trees under Global Change	8 CR
M-CHEMBIO-106909	Research Module: Plant Developmental Biology	8 CR
Compulsory Elective Subject - Project (Election: 1 item)		
M-CHEMBIO-106596	Project Module: Flower Ecology	7 CR
M-CHEMBIO-100202	Project Module: Plant Cell Biology	7 CR
M-CHEMBIO-100203	Project Module: Plant Evolution: Methods and Concepts	7 CR
M-CHEMBIO-100206	Project Module: Photoreceptors in Plants and Microorganisms	7 CR
M-CHEMBIO-100211	Project Module: Bioinformatics	7 CR
M-CHEMBIO-100214	Project Module: Plant Molecular Biology	7 CR
M-CHEMBIO-100218	Project Module: Molecular and Cell Biology of Mycorrhiza	7 CR
M-CHEMBIO-100219	Project Module: Molecular Plant-Microbe Interactions	7 CR
M-CHEMBIO-100228	Project Module: Plant Gene Technology - Precise Genome Engineering	7 CR

7.3 Zoology

Credits
23

Compulsory Elective Subject - Research (Election: 2 items)		
M-CHEMBIO-100248	Research Module: Techniques in Microscopy	8 CR
M-CHEMBIO-100249	Research Module: Developmental Neurobiology	8 CR
M-CHEMBIO-100251	Research Module: Methods of Developmental Biology	8 CR
M-CHEMBIO-103501	Research Module: Pathophysiology, Molecular Basis of Diseases	8 CR
M-CHEMBIO-103530	Research Module: Molecular Biology of the Cell	8 CR
M-CHEMBIO-103298	Research Module: Phenomics and Chemomics	8 CR
M-CHEMBIO-103095	Research Module: Methods of Developmental Genetics	8 CR
M-CHEMBIO-105669	Research Module: Epigenetics	8 CR
M-CHEMBIO-105842	Research Module: Chromatin Structures in Cell Division and Development	8 CR
M-CHEMBIO-106907	Research Module: Transcriptomic Analysis	8 CR
M-CHEMBIO-107269	Research Module: Diversity, Systematics and Evolution of Insects neu	8 CR
Compulsory Elective Subject - Project (Election: 1 item)		
M-CHEMBIO-100257	Project Module: Advanced Light Microscopy	7 CR
M-CHEMBIO-100258	Project Module: Molecular Developmental Neurobiology	7 CR
M-CHEMBIO-100234	Project Module: Molecular Cell Biology	7 CR
M-CHEMBIO-100265	Project Module: Methods of Developmental Biology	7 CR
M-CHEMBIO-103942	Project Module: Molecular Biology of the Cell	7 CR
M-CHEMBIO-105305	Project Module: Systems Biology & Biophysics	7 CR
M-CHEMBIO-105600	Project Module: Pathophysiology, Molecular Basis of Diseases	7 CR
M-CHEMBIO-105678	Project Module: Epigenetics	7 CR
M-CHEMBIO-106307	Project Module: Chromatin Structures in Cell Division and Development	7 CR
M-CHEMBIO-106854	Project module: Systemic Cellular Neurobiology	7 CR
M-CHEMBIO-106861	Project Module: Biophotonics in Life Sciences	7 CR

7.4 Microbiology

Credits
23

Compulsory Elective Subject - Research (Election: 2 items)		
M-CHEMBIO-100195	Research Module: Photoreceptors in Plants and Microorganisms	8 CR
M-CHEMBIO-100197	Research Module: Protein Crystallization	8 CR
M-CHEMBIO-100200	Research Module: Molecular and Cell Biology of Mycorrhiza	8 CR
M-CHEMBIO-100201	Research Module: Molecular Plant-Microbe Interactions	8 CR
M-CHEMBIO-100224	Research Module: Genetics of Lower Eukaryotes	8 CR
M-CHEMBIO-100225	Research Module: Microbiology of Eukaryotes	8 CR
M-CHEMBIO-105294	Research Module: Cellular and Medicinal Microbiology	8 CR
M-CHEMBIO-105666	Research Module: From Samples to Sequences	8 CR
M-CHEMBIO-106206	Research Module: Bioinformatics	8 CR
M-CHEMBIO-106787	Research Module: Resilience - Plants Conquer Land	8 CR
Compulsory Elective Subject - Project (Election: 1 item)		
M-CHEMBIO-100206	Project Module: Photoreceptors in Plants and Microorganisms	7 CR
M-CHEMBIO-100211	Project Module: Bioinformatics	7 CR
M-CHEMBIO-105603	Project Module:Productive Biofilms	7 CR
M-CHEMBIO-100233	Project Module: Microbiology of Eukaryotes	7 CR
M-CHEMBIO-100218	Project Module: Molecular and Cell Biology of Mycorrhiza	7 CR
M-CHEMBIO-100219	Project Module: Molecular Plant-Microbe Interactions	7 CR
M-CHEMBIO-104785	Project Module: Bacterial Genomic & Computational Biology	7 CR
M-CHEMBIO-105304	Project Module: Cellular and Medicinal Microbiology	7 CR
M-CIWVT-100307	Project Module: Project in Technical Biology	7 CR
M-CHEMBIO-106863	Project Module: Molecular and Cell Biology in Plant/Pathogen Interactions	7 CR
M-CHEMBIO-107084	Project Module: Molecular Mechanism of Bacterial Secretion Systems neu	7 CR
M-CHEMBIO-107086	Project Module: Application of Bacterial Secretion Systems in Biotechnology, Healthcare and Plant Sciences neu	7 CR

7.5 Genetics

Credits
23

Compulsory Elective Subject - Research (Election: 2 items)		
M-CHEMBIO-100192	Research Module: Plant Evolution: Methods and Concepts	8 CR
M-CHEMBIO-100194	Research Module: Seed Technology	8 CR
M-CHEMBIO-100198	Research Module: Plant Gene Technology - Precise Genome Engineering	8 CR
M-CHEMBIO-100200	Research Module: Molecular and Cell Biology of Mycorrhiza	8 CR
M-CHEMBIO-100201	Research Module: Molecular Plant-Microbe Interactions	8 CR
M-CHEMBIO-100222	Research Module: Signal Transduction and Gene Regulation I	8 CR
M-CHEMBIO-100223	Research Module: Signal Transduction and Gene Regulation II	8 CR
M-CHEMBIO-100224	Research Module: Genetics of Lower Eukaryotes	8 CR
M-CHEMBIO-100225	Research Module: Microbiology of Eukaryotes	8 CR
M-CHEMBIO-100226	Research Module: Molecular Cell Biology	8 CR
M-CHEMBIO-101596	Research Module: Tissue Engineering and 3D Cell Culture	8 CR
M-CHEMBIO-103095	Research Module: Methods of Developmental Genetics	8 CR
M-CHEMBIO-103298	Research Module: Phenomics and Chemomics	8 CR
M-CHEMBIO-103501	Research Module: Pathophysiology, Molecular Basis of Diseases	8 CR
M-CHEMBIO-105666	Research Module: From Samples to Sequences	8 CR
M-CHEMBIO-105669	Research Module: Epigenetics	8 CR
M-CHEMBIO-105842	Research Module: Chromatin Structures in Cell Division and Development	8 CR
M-CHEMBIO-106206	Research Module: Bioinformatics	8 CR
M-CHEMBIO-106694	Research Module: Quantitative Phenotyping in Breeding	8 CR
Compulsory Elective Subject - Project (Election: 1 item)		
M-CHEMBIO-100203	Project Module: Plant Evolution: Methods and Concepts	7 CR
M-CHEMBIO-100211	Project Module: Bioinformatics	7 CR
M-CHEMBIO-100218	Project Module: Molecular and Cell Biology of Mycorrhiza	7 CR
M-CHEMBIO-100219	Project Module: Molecular Plant-Microbe Interactions	7 CR
M-CHEMBIO-100228	Project Module: Plant Gene Technology - Precise Genome Engineering	7 CR
M-CHEMBIO-100229	Project Module: Signal Transduction in Eukaryotic Systems	7 CR
M-CHEMBIO-100231	Project Module: Molecular Methods in Higher Eukaryotes	7 CR
M-CHEMBIO-100232	Project Module: Genetics of Lower Eukaryotes	7 CR
M-CHEMBIO-100233	Project Module: Microbiology of Eukaryotes	7 CR
M-CHEMBIO-100234	Project Module: Molecular Cell Biology	7 CR
M-CHEMBIO-101597	Project Module: Tissue Engineering and 3D Cell Culture	7 CR
M-CHEMBIO-103096	Project Module: Methods of Developmental Genetics	7 CR
M-CHEMBIO-104785	Project Module: Bacterial Genomic & Computational Biology	7 CR
M-CHEMBIO-105678	Project Module: Epigenetics	7 CR
M-CHEMBIO-105603	Project Module:Productive Biofilms	7 CR
M-CHEMBIO-106307	Project Module: Chromatin Structures in Cell Division and Development	7 CR
M-CHEMBIO-106841	Project Module: Phenomics and Chemomics	7 CR
M-CHEMBIO-106863	Project Module: Molecular and Cell Biology in Plant/Pathogen Interactions	7 CR
M-CHEMBIO-107084	Project Module: Molecular Mechanism of Bacterial Secretion Systems neu	7 CR
M-CHEMBIO-107086	Project Module: Application of Bacterial Secretion Systems in Biotechnology, Healthcare and Plant Sciences neu	7 CR

7.6 Molecular Biology

Credits
23

Compulsory Elective Subject - Research (Election: 2 items)		
M-CHEMBIO-100191	Research Module: Plant Cell Biology	8 CR
M-CHEMBIO-100192	Research Module: Plant Evolution: Methods and Concepts	8 CR
M-CHEMBIO-100195	Research Module: Photoreceptors in Plants and Microorganisms	8 CR
M-CHEMBIO-100197	Research Module: Protein Crystallization	8 CR
M-CHEMBIO-100198	Research Module: Plant Gene Technology - Precise Genome Engineering	8 CR
M-CHEMBIO-100200	Research Module: Molecular and Cell Biology of Mycorrhiza	8 CR
M-CHEMBIO-100201	Research Module: Molecular Plant-Microbe Interactions	8 CR
M-CHEMBIO-100222	Research Module: Signal Transduction and Gene Regulation I	8 CR
M-CHEMBIO-100223	Research Module: Signal Transduction and Gene Regulation II	8 CR
M-CHEMBIO-100267	Research Module: Biomolecular Microanalytics	8 CR
M-CHEMBIO-100224	Research Module: Genetics of Lower Eukaryotes	8 CR
M-CHEMBIO-100225	Research Module: Microbiology of Eukaryotes	8 CR
M-CHEMBIO-100249	Research Module: Developmental Neurobiology	8 CR
M-CHEMBIO-100226	Research Module: Molecular Cell Biology	8 CR
M-CHEMBIO-101596	Research Module: Tissue Engineering and 3D Cell Culture	8 CR
M-CHEMBIO-103095	Research Module: Methods of Developmental Genetics	8 CR
M-CHEMBIO-103501	Research Module: Pathophysiology, Molecular Basis of Diseases	8 CR
M-CHEMBIO-103298	Research Module: Phenomics and Chemomics	8 CR
M-CHEMBIO-103530	Research Module: Molecular Biology of the Cell	8 CR
M-CHEMBIO-105294	Research Module: Cellular and Medicinal Microbiology	8 CR
M-CHEMBIO-105666	Research Module: From Samples to Sequences	8 CR
M-CHEMBIO-105669	Research Module: Epigenetics	8 CR
M-CHEMBIO-105842	Research Module: Chromatin Structures in Cell Division and Development	8 CR
M-CHEMBIO-106206	Research Module: Bioinformatics	8 CR
M-CHEMBIO-106694	Research Module: Quantitative Phenotyping in Breeding	8 CR
M-CHEMBIO-106907	Research Module: Transcriptomic Analysis	8 CR
M-CHEMBIO-106787	Research Module: Resilience - Plants Conquer Land neu	8 CR
Compulsory Elective Subject - Project (Election: 1 item)		
M-CHEMBIO-100202	Project Module: Plant Cell Biology	7 CR
M-CHEMBIO-100203	Project Module: Plant Evolution: Methods and Concepts	7 CR
M-CHEMBIO-100206	Project Module: Photoreceptors in Plants and Microorganisms	7 CR
M-CHEMBIO-100211	Project Module: Bioinformatics	7 CR
M-CHEMBIO-100214	Project Module: Plant Molecular Biology	7 CR
M-CHEMBIO-100228	Project Module: Plant Gene Technology - Precise Genome Engineering	7 CR
M-CHEMBIO-100218	Project Module: Molecular and Cell Biology of Mycorrhiza	7 CR
M-CHEMBIO-100219	Project Module: Molecular Plant-Microbe Interactions	7 CR
M-CHEMBIO-100268	Project Module: Biomolecular Microanalytics	7 CR
M-CHEMBIO-100229	Project Module: Signal Transduction in Eukaryotic Systems	7 CR
M-CHEMBIO-100231	Project Module: Molecular Methods in Higher Eukaryotes	7 CR
M-CHEMBIO-100232	Project Module: Genetics of Lower Eukaryotes	7 CR
M-CHEMBIO-100233	Project Module: Microbiology of Eukaryotes	7 CR
M-CHEMBIO-100258	Project Module: Molecular Developmental Neurobiology	7 CR
M-CHEMBIO-100234	Project Module: Molecular Cell Biology	7 CR
M-CHEMBIO-105603	Project Module:Productive Biofilms	7 CR
M-CHEMBIO-101597	Project Module: Tissue Engineering and 3D Cell Culture	7 CR
M-CHEMBIO-103096	Project Module: Methods of Developmental Genetics	7 CR
M-CHEMBIO-103942	Project Module: Molecular Biology of the Cell	7 CR
M-CHEMBIO-104785	Project Module: Bacterial Genomic & Computational Biology	7 CR
M-CIWVT-100307	Project Module: Project in Technical Biology	7 CR
M-CHEMBIO-105304	Project Module: Cellular and Medicinal Microbiology	7 CR
M-CHEMBIO-105600	Project Module: Pathophysiology, Molecular Basis of Diseases	7 CR

M-CHEMBIO-105678	Project Module: Epigenetics	7 CR
M-CHEMBIO-106307	Project Module: Chromatin Structures in Cell Division and Development	7 CR
M-CHEMBIO-106854	Project module: Systemic Cellular Neurobiology	7 CR
M-CHEMBIO-106841	Project Module: Phenomics and Chemomics	7 CR
M-CHEMBIO-106862	Project Module: Innovative Microscopy	7 CR
M-CHEMBIO-106863	Project Module: Molecular and Cell Biology in Plant/Pathogen Interactions	7 CR
M-CHEMBIO-107084	Project Module: Molecular Mechanism of Bacterial Secretion Systems neu	7 CR
M-CHEMBIO-107086	Project Module: Application of Bacterial Secretion Systems in Biotechnology, Healthcare and Plant Sciences neu	7 CR

7.7 Cell Biology

Credits
23

Compulsory Elective Subject - Research (Election: 2 items)		
M-CHEMBIO-100191	Research Module: Plant Cell Biology	8 CR
M-CHEMBIO-100197	Research Module: Protein Crystallization	8 CR
M-CHEMBIO-100200	Research Module: Molecular and Cell Biology of Mycorrhiza	8 CR
M-CHEMBIO-100222	Research Module: Signal Transduction and Gene Regulation I	8 CR
M-CHEMBIO-100223	Research Module: Signal Transduction and Gene Regulation II	8 CR
M-CHEMBIO-100225	Research Module: Microbiology of Eukaryotes	8 CR
M-CHEMBIO-100226	Research Module: Molecular Cell Biology	8 CR
M-CHEMBIO-100248	Research Module: Techniques in Microscopy	8 CR
M-CHEMBIO-100249	Research Module: Developmental Neurobiology	8 CR
M-CHEMBIO-101596	Research Module: Tissue Engineering and 3D Cell Culture	8 CR
M-CHEMBIO-103530	Research Module: Molecular Biology of the Cell	8 CR
M-CHEMBIO-103501	Research Module: Pathophysiology, Molecular Basis of Diseases	8 CR
M-CHEMBIO-105294	Research Module: Cellular and Medicinal Microbiology	8 CR
M-CHEMBIO-105669	Research Module: Epigenetics	8 CR
M-CHEMBIO-105842	Research Module: Chromatin Structures in Cell Division and Development	8 CR
M-CHEMBIO-106787	Research Module: Resilience - Plants Conquer Land	8 CR
M-CHEMBIO-106907	Research Module: Transcriptomic Analysis	8 CR
Compulsory Elective Subject - Project (Election: 1 item)		
M-CHEMBIO-100202	Project Module: Plant Cell Biology	7 CR
M-CHEMBIO-100218	Project Module: Molecular and Cell Biology of Mycorrhiza	7 CR
M-CHEMBIO-100233	Project Module: Microbiology of Eukaryotes	7 CR
M-CHEMBIO-100234	Project Module: Molecular Cell Biology	7 CR
M-CHEMBIO-100257	Project Module: Advanced Light Microscopy	7 CR
M-CHEMBIO-100258	Project Module: Molecular Developmental Neurobiology	7 CR
M-CHEMBIO-101597	Project Module: Tissue Engineering and 3D Cell Culture	7 CR
M-CHEMBIO-103942	Project Module: Molecular Biology of the Cell	7 CR
M-CHEMBIO-105304	Project Module: Cellular and Medicinal Microbiology	7 CR
M-CHEMBIO-105305	Project Module: Systems Biology & Biophysics	7 CR
M-CHEMBIO-105600	Project Module: Pathophysiology, Molecular Basis of Diseases	7 CR
M-CHEMBIO-105678	Project Module: Epigenetics	7 CR
M-CHEMBIO-100219	Project Module: Molecular Plant-Microbe Interactions	7 CR
M-CHEMBIO-106854	Project module: Systemic Cellular Neurobiology	7 CR
M-CHEMBIO-106861	Project Module: Biophotonics in Life Sciences	7 CR
M-CHEMBIO-106862	Project Module: Innovative Microscopy	7 CR
M-CHEMBIO-107084	Project Module: Molecular Mechanism of Bacterial Secretion Systems neu	7 CR
M-CHEMBIO-107086	Project Module: Application of Bacterial Secretion Systems in Biotechnology, Healthcare and Plant Sciences neu	7 CR

7.8 Developmental Biology

Credits
23

Compulsory Elective Subject - Research (Election: 2 items)		
M-CHEMBIO-100191	Research Module: Plant Cell Biology	8 CR
M-CHEMBIO-100248	Research Module: Techniques in Microscopy	8 CR
M-CHEMBIO-100249	Research Module: Developmental Neurobiology	8 CR
M-CHEMBIO-103530	Research Module: Molecular Biology of the Cell	8 CR
M-CHEMBIO-100226	Research Module: Molecular Cell Biology	8 CR
M-CHEMBIO-103501	Research Module: Pathophysiology, Molecular Basis of Diseases	8 CR
M-CHEMBIO-100251	Research Module: Methods of Developmental Biology	8 CR
M-CHEMBIO-103095	Research Module: Methods of Developmental Genetics	8 CR
M-CHEMBIO-105842	Research Module: Chromatin Structures in Cell Division and Development	8 CR
M-CHEMBIO-106907	Research Module: Transcriptomic Analysis	8 CR
M-CHEMBIO-106909	Research Module: Plant Developmental Biology	8 CR
Compulsory Elective Subject - Project (Election: 1 item)		
M-CHEMBIO-100202	Project Module: Plant Cell Biology	7 CR
M-CHEMBIO-100258	Project Module: Molecular Developmental Neurobiology	7 CR
M-CHEMBIO-100234	Project Module: Molecular Cell Biology	7 CR
M-CHEMBIO-100265	Project Module: Methods of Developmental Biology	7 CR
M-CHEMBIO-103942	Project Module: Molecular Biology of the Cell	7 CR
M-CHEMBIO-105600	Project Module: Pathophysiology, Molecular Basis of Diseases	7 CR
M-CHEMBIO-103096	Project Module: Methods of Developmental Genetics	7 CR
M-CHEMBIO-106307	Project Module: Chromatin Structures in Cell Division and Development	7 CR
M-CHEMBIO-106854	Project module: Systemic Cellular Neurobiology	7 CR
M-CHEMBIO-106861	Project Module: Biophotonics in Life Sciences	7 CR

7.9 Biotechnology

Credits
23

Compulsory Elective Subject - Research (Election: 2 items)		
M-CHEMBIO-100192	Research Module: Plant Evolution: Methods and Concepts	8 CR
M-CHEMBIO-100197	Research Module: Protein Crystallization	8 CR
M-CHEMBIO-100198	Research Module: Plant Gene Technology - Precise Genome Engineering	8 CR
M-CHEMBIO-100267	Research Module: Biomolecular Microanalytics	8 CR
M-CHEMBIO-100200	Research Module: Molecular and Cell Biology of Mycorrhiza	8 CR
M-CHEMBIO-100201	Research Module: Molecular Plant-Microbe Interactions	8 CR
M-CHEMBIO-101596	Research Module: Tissue Engineering and 3D Cell Culture	8 CR
M-CHEMBIO-103298	Research Module: Phenomics and Chemomics	8 CR
M-CHEMBIO-105666	Research Module: From Samples to Sequences	8 CR
M-CHEMBIO-106907	Research Module: Transcriptomic Analysis	8 CR
Compulsory Elective Subject - Project (Election: 1 item)		
M-CHEMBIO-100203	Project Module: Plant Evolution: Methods and Concepts	7 CR
M-CHEMBIO-100228	Project Module: Plant Gene Technology - Precise Genome Engineering	7 CR
M-CHEMBIO-100268	Project Module: Biomolecular Microanalytics	7 CR
M-CHEMBIO-105603	Project Module:Productive Biofilms	7 CR
M-CHEMBIO-100218	Project Module: Molecular and Cell Biology of Mycorrhiza	7 CR
M-CHEMBIO-100219	Project Module: Molecular Plant-Microbe Interactions	7 CR
M-CHEMBIO-101597	Project Module: Tissue Engineering and 3D Cell Culture	7 CR
M-CHEMBIO-104785	Project Module: Bacterial Genomic & Computational Biology	7 CR
M-CHEMBIO-106307	Project Module: Chromatin Structures in Cell Division and Development	7 CR
M-CHEMBIO-106854	Project module: Systemic Cellular Neurobiology	7 CR
M-CHEMBIO-106841	Project Module: Phenomics and Chemomics	7 CR
M-CHEMBIO-106862	Project Module: Innovative Microscopy	7 CR
M-CHEMBIO-107086	Project Module: Application of Bacterial Secretion Systems in Biotechnology, Healthcare and Plant Sciences neu	7 CR

7.10 Biophysics

Credits
23

Compulsory Elective Subject - Research (Election: 2 items)		
M-CHEMBIO-100226	Research Module: Molecular Cell Biology	8 CR
M-CHEMBIO-100248	Research Module: Techniques in Microscopy	8 CR
M-CHEMBIO-100249	Research Module: Developmental Neurobiology	8 CR
M-CHEMBIO-103530	Research Module: Molecular Biology of the Cell	8 CR
Compulsory Elective Subject - Project (Election: 1 item)		
M-CHEMBIO-100234	Project Module: Molecular Cell Biology	7 CR
M-CHEMBIO-100257	Project Module: Advanced Light Microscopy	7 CR
M-CHEMBIO-100258	Project Module: Molecular Developmental Neurobiology	7 CR
M-CHEMBIO-103942	Project Module: Molecular Biology of the Cell	7 CR
M-CHEMBIO-105305	Project Module: Systems Biology & Biophysics	7 CR
M-CHEMBIO-106862	Project Module: Innovative Microscopy	7 CR

7.11 Biochemistry

Credits 23

Compulsory Elective Subject - Research (Election: 2 items)		
M-CHEMBIO-100197	Research Module: Protein Crystallization	8 CR
M-CHEMBIO-100267	Research Module: Biomolecular Microanalytics	8 CR
M-CHEMBIO-100269	Research Module: Genetics and Protein Chemistry	8 CR
M-CHEMBIO-100270	Research Module: Protein Isolation and Kinetics	8 CR
M-CHEMBIO-101596	Research Module: Tissue Engineering and 3D Cell Culture	8 CR
M-CHEMBIO-103298	Research Module: Phenomics and Chemomics	8 CR
Compulsory Elective Subject - Project (Election: 1 item)		
M-CHEMBIO-100268	Project Module: Biomolecular Microanalytics	7 CR
M-CHEMBIO-100271	Project Module: Structure and Function of Peptides	7 CR
M-CHEMBIO-101597	Project Module: Tissue Engineering and 3D Cell Culture	7 CR
M-CHEMBIO-105305	Project Module: Systems Biology & Biophysics	7 CR
M-CHEMBIO-106854	Project module: Systemic Cellular Neurobiology	7 CR
M-CHEMBIO-106841	Project Module: Phenomics and Chemomics	7 CR

7.12 Technical Biology

Credits 23

Compulsory Elective Subject - Research (Election: 2 items)		
M-CIWVT-106416	Intensification of Bioprocesses neu	9 CR
Compulsory Elective Subject - Project (Election: 1 item)		
M-CIWVT-107275	Project Module: Intensification of Bioprocesses neu	14 CR

7.13 Toxicology

Credits 23

Mandatory		
M-CHEMBIO-105673	Research and Project Module: Toxicology and Food Toxicology	17 CR
M-CHEMBIO-105674	General and Food Toxicology for Biology Students	6 CR

7.14 Taxonomy and Geoecology

Credits 23

Mandatory		
M-CHEMBIO-105576	Advanced Module Integrative Thinking	8 CR
Taxonomy and Geoecology (Election: between 1 and 2 items as well as 15 credits)		
M-BGU-105575	Ecology	16 CR
M-CHEMBIO-100192	Research Module: Plant Evolution: Methods and Concepts	8 CR
M-CHEMBIO-106596	Project Module: Flower Ecology	7 CR
M-CHEMBIO-100203	Project Module: Plant Evolution: Methods and Concepts	7 CR
M-CHEMBIO-107269	Research Module: Diversity, Systematics and Evolution of Insects neu	8 CR

7.15 Life Science Engineering

Credits
23

Compulsory Elective Subject - Research (Election: 2 items)		
M-CHEMBIO-100191	Research Module: Plant Cell Biology	8 CR
M-CHEMBIO-100198	Research Module: Plant Gene Technology - Precise Genome Engineering	8 CR
M-CHEMBIO-100200	Research Module: Molecular and Cell Biology of Mycorrhiza	8 CR
M-CHEMBIO-100201	Research Module: Molecular Plant-Microbe Interactions	8 CR
M-CHEMBIO-100195	Research Module: Photoreceptors in Plants and Microorganisms	8 CR
M-CHEMBIO-100267	Research Module: Biomolecular Microanalytics	8 CR
M-CHEMBIO-101596	Research Module: Tissue Engineering and 3D Cell Culture	8 CR
M-CHEMBIO-100269	Research Module: Genetics and Protein Chemistry	8 CR
M-CHEMBIO-100270	Research Module: Protein Isolation and Kinetics	8 CR
M-CHEMBIO-100222	Research Module: Signal Transduction and Gene Regulation I	8 CR
M-CHEMBIO-100223	Research Module: Signal Transduction and Gene Regulation II	8 CR
M-CHEMBIO-100224	Research Module: Genetics of Lower Eukaryotes	8 CR
M-CHEMBIO-103298	Research Module: Phenomics and Chemomics	8 CR
M-CHEMBIO-103095	Research Module: Methods of Developmental Genetics	8 CR
M-CHEMBIO-100225	Research Module: Microbiology of Eukaryotes	8 CR
M-CHEMBIO-105294	Research Module: Cellular and Medicinal Microbiology	8 CR
M-CHEMBIO-100249	Research Module: Developmental Neurobiology	8 CR
M-CHEMBIO-103530	Research Module: Molecular Biology of the Cell	8 CR
M-CHEMBIO-100248	Research Module: Techniques in Microscopy	8 CR
M-CHEMBIO-105669	Research Module: Epigenetics	8 CR
M-CHEMBIO-105666	Research Module: From Samples to Sequences	8 CR
M-CHEMBIO-103501	Research Module: Pathophysiology, Molecular Basis of Diseases	8 CR
M-CHEMBIO-105842	Research Module: Chromatin Structures in Cell Division and Development	8 CR
M-CHEMBIO-106787	Research Module: Resilience - Plants Conquer Land	8 CR
Compulsory Elective Subject - Project (Election: 1 item)		
M-CHEMBIO-100202	Project Module: Plant Cell Biology	7 CR
M-CHEMBIO-100203	Project Module: Plant Evolution: Methods and Concepts	7 CR
M-CHEMBIO-100206	Project Module: Photoreceptors in Plants and Microorganisms	7 CR
M-CHEMBIO-100214	Project Module: Plant Molecular Biology	7 CR
M-CHEMBIO-100218	Project Module: Molecular and Cell Biology of Mycorrhiza	7 CR
M-CHEMBIO-100219	Project Module: Molecular Plant-Microbe Interactions	7 CR
M-CHEMBIO-100228	Project Module: Plant Gene Technology - Precise Genome Engineering	7 CR
M-CHEMBIO-100211	Project Module: Bioinformatics	7 CR
M-CHEMBIO-100268	Project Module: Biomolecular Microanalytics	7 CR
M-CHEMBIO-101597	Project Module: Tissue Engineering and 3D Cell Culture	7 CR
M-CHEMBIO-100271	Project Module: Structure and Function of Peptides	7 CR
M-CHEMBIO-103096	Project Module: Methods of Developmental Genetics	7 CR
M-CHEMBIO-100231	Project Module: Molecular Methods in Higher Eukaryotes	7 CR
M-CHEMBIO-100232	Project Module: Genetics of Lower Eukaryotes	7 CR
M-CHEMBIO-104785	Project Module: Bacterial Genomic & Computational Biology	7 CR
M-CHEMBIO-100229	Project Module: Signal Transduction in Eukaryotic Systems	7 CR
M-CHEMBIO-100233	Project Module: Microbiology of Eukaryotes	7 CR
M-CHEMBIO-100257	Project Module: Advanced Light Microscopy	7 CR
M-CHEMBIO-100258	Project Module: Molecular Developmental Neurobiology	7 CR
M-CHEMBIO-103942	Project Module: Molecular Biology of the Cell	7 CR
M-CHEMBIO-105678	Project Module: Epigenetics	7 CR
M-CHEMBIO-105305	Project Module: Systems Biology & Biophysics	7 CR
M-CHEMBIO-100265	Project Module: Methods of Developmental Biology	7 CR
M-CHEMBIO-105600	Project Module: Pathophysiology, Molecular Basis of Diseases	7 CR
M-CHEMBIO-106307	Project Module: Chromatin Structures in Cell Division and Development	7 CR
M-CHEMBIO-106841	Project Module: Phenomics and Chemomics	7 CR

M-CHEMBIO-106861	Project Module: Biophotonics in Life Sciences	7 CR
M-CHEMBIO-106862	Project Module: Innovative Microscopy	7 CR
M-CHEMBIO-106863	Project Module: Molecular and Cell Biology in Plant/Pathogen Interactions	7 CR
M-CHEMBIO-107084	Project Module: Molecular Mechanism of Bacterial Secretion Systems neu	7 CR
M-CHEMBIO-107086	Project Module: Application of Bacterial Secretion Systems in Biotechnology, Healthcare and Plant Sciences neu	7 CR

7.16 Integrative Biology

Credits
21

Mandatory		
M-CHEMBIO-100275	Concept Development	6 CR
M-CHEMBIO-100276	Integrative Thinking	9 CR
M-CHEMBIO-100277	Interdisciplinary Thinking	6 CR

7.17 Additional Examinations

Additional Examinations (Election: at most 30 credits)		
M-FORUM-106753	Supplementary Studies on Science, Technology and Society	16 CR

8 Modules

M 8.1 Module: Advanced Module Integrative Thinking [M-CHEMBIO-105576]

Organisation: KIT Department of Chemistry and Biosciences
Part of: Taxonomy and Geoecology (mandatory)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	2 terms	German	4	1

Advanced Excursion (Election: 1 item as well as 6 credits)			
T-CHEMBIO-111181	Advanced Module Large Excursion Helgoland	6 CR	Lamparter
T-CHEMBIO-111182	Advanced Module Large Excursion Southern Alps	6 CR	Riemann
T-CHEMBIO-111183	Advanced Module Large Excursion Giglio	6 CR	Bentrop
Lecture (Election: 1 item as well as 2 credits)			
T-CHEMBIO-111034	Integrated Analysis of Ecosystems - Southern Alps	2 CR	Riemann
T-CHEMBIO-100542	Integrated Analysis of Ecosystems - Helgoland	2 CR	Lamparter
T-CHEMBIO-100544	Integrated Analysis of Ecosystems - Giglio	2 CR	Bentrop

M 8.2 Module: Concept Development [M-CHEMBIO-100275]

Responsible: Prof. Dr. Jörg Kämper
Organisation: KIT Department of Chemistry and Biosciences
Part of: Integrative Biology

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each term	1 term	German	4	4

Advanced Literature Research (Election: 1 item as well as 3 credits)			
T-CHEMBIO-100503	Botanical Seminar 1 - Techniques of Information Management	3 CR	
T-CHEMBIO-100490	Theory of Science and Ethics - Presentation Skills	3 CR	Nick
T-CHEMBIO-100504	Botanical Seminar 3 - Techniques of Information Management	3 CR	
T-CHEMBIO-100506	Microbiological Seminar 2 - Techniques of Information Management	3 CR	
T-CHEMBIO-100508	Biochemical Seminar 2 - Techniques of Information Management	3 CR	
T-CHEMBIO-100510	Botanical Seminar 4 - Techniques of Information Management	3 CR	
T-CHEMBIO-100514	Seminar Molecular Genetics - Techniques of Information Management	3 CR	
T-CHEMBIO-103071	Signaling in Cancer - Techniques of Information Management	3 CR	
T-CHEMBIO-106145	Seminar Food Chemistry - Techniques of Information Management	3 CR	Hartwig
T-CHEMBIO-113222	Seminar Epigenetics and Genomics - Techniques of Information Management	3 CR	Erhardt, Kämper
Advanced Presentation Techniques (Election: 1 item as well as 3 credits)			
T-CHEMBIO-100489	Botanical Seminar 1 - Presentation Skills	3 CR	Nick
T-CHEMBIO-100490	Theory of Science and Ethics - Presentation Skills	3 CR	Nick
T-CHEMBIO-100495	Microbiological Seminar - Presentation Skills	3 CR	
T-CHEMBIO-100498	Current Topics in Cellular Neurobiology - Presentation Skills	3 CR	
T-CHEMBIO-100499	Biochemical Seminar 1 - Presentation Skills	3 CR	
T-CHEMBIO-100500	Seminar Replication, Recombination & Reparation - Presentation Skills	3 CR	
T-CHEMBIO-100501	Current Topics in Molecular Genetics - Presentation Skills	3 CR	
T-CHEMBIO-106144	Seminar Food Chemistry - Presentation Skills	3 CR	Hartwig
T-CHEMBIO-105810	Wildcard	3 CR	
T-CHEMBIO-113223	Seminar Epigenetics and Genomics - Advanced Presentation Techniques	3 CR	Erhardt, Kämper
T-CHEMBIO-114330	Current Topics Stem Cell Biology: Gene Regulation Programs Driving Stemness and Differentiation - Presentation Skills	3 CR	Erhardt, Mayer

Competence Certificate
The aim of this course is to enable the students to understand a research field to a level that allows them to present it in a lecture or scientific talk in a professional way. The comprehension of the research field should reach a level that allows the students to ask questions as directory for a theoretical further development of the research field. Besides the oral presentation, the results of the work are supposed to be presented in the form of a written synopsis. Both parts will be used to decide on the final grade.

Prerequisites
none

Competence Goal
The students will gain a deep insight into the current conceptional discussion within two different seminars.
• They learn to develop a question pattern
• They exercise to identify the original literature which is therefore necessary
• They exercise to read the original literature independently and critically questioning
• The learn to develop important concepts
• They learn to present their literature research clearly and distinctly
• They exercise to keep the balance between detail and overview

Content
The students will present in this module current topics of research in the form of scientific talks or lectures. All research topics are represented by two seminars, one in advanced presentation and one in advanced literature research. Another important component of this module is to teach the students to understand a scietific talk in a way that allows to ask specific questions. Thereby, the students are supposed to understand lissening as an active exercise

Module grade calculation
The note results from the talk an the following discussion about it: other forms of evalutation (§4 Abs. 2 Nr. 3)

Annotation
There are two types of seminars - one is **Advanced Presenting** and the other is **Advanced Researching**. You have to complete one seminar of each type. There are different topics in different working groups to choose from, these are selected within the module selection in August and March respectively.

http://www.biologie.kit.edu/143.php

For the seminars a time slot is kept free in the morning from 8:00-10:00 and in the afternoon at 17:15.

Student teachers (Master of Education Biology) may simply choose one of the seminars, the type does not matter.

Workload
for each of the both seminars

Presence time:22 h
preparation and follow-up time:68 h
total workload: 90 h

Recommendation
Informations on:

http://www.biologie.kit.edu/248.php

Learning type
Criticial reading of current publications in Biology and presenting the contens if it.

Literature
Current journals which are provided from the working group

Base for
The preparation and writing of the master thesis

M 8.3 Module: Ecology [M-BGU-105575]

Responsible: Prof. Dr. Sebastian Schmidtlein
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Taxonomy and Geoecology (Taxonomy and Geoecology)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
16	Grade to a tenth	Each term	2 terms	German	4	3

Mandatory			
T-BGU-109123	Vegetation Science	3 CR	Schmidtlein
T-BGU-107481	Introduction to R	3 CR	Schmidtlein
T-BGU-112637	Vegetation Survey and Mapping	4 CR	Ewald
T-BGU-102982	Vegetation Ecology	3 CR	Lewerentz, Schmidtlein
T-BGU-112640	Numerical Ecology and Macroecology	3 CR	Schmidtlein

Prerequisites
None

M 8.4 Module: General and Food Toxicology for Biology Students (M8202) [M-CHEMBIO-105674]

Responsible: Prof. Dr. Andrea Hartwig
Dr. Beate Monika Köberle
Organisation: KIT Department of Chemistry and Biosciences
Part of: Toxicology

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CHEMBIO-104464	Food Toxicology	6 CR	Hartwig

M 8.5 Module: Integrative Thinking [M-CHEMBIO-100276]

Responsible: Maren Riemann
Dr. Urszula Weclawski
Organisation: KIT Department of Chemistry and Biosciences
Part of: Integrative Biology

Credits	Grading scale	Duration	Language	Level	Version
9	Grade to a tenth	2 terms	German	4	8

Election notes
The excursion is already determined at the beginning of the winter semester

Lecture (Election: 1 item as well as 2 credits)			
T-CHEMBIO-111696	Integrated Analysis of Ecosystems - Living Environment Alpes	2 CR	Riemann
T-CHEMBIO-100542	Integrated Analysis of Ecosystems - Helgoland	2 CR	Lamparter
T-CHEMBIO-100544	Integrated Analysis of Ecosystems - Giglio	2 CR	Bentrop
Excursion (Election: 1 item as well as 7 credits)			
T-CHEMBIO-111699	Large Excursion Alpine Habitat	7 CR	Riemann
T-CHEMBIO-100543	Large Excursion Giglio	7 CR	Bentrop
T-CHEMBIO-100541	Large Excursion Helgoland	7 CR	Lamparter
T-CHEMBIO-113851	Local excursion with exploration of the vegetation history of Baden	7 CR	Riemann

Competence Certificate
The module contains two performance assessments:

The details of the graded performance review for the lecture are given in the respective partial performance.

Performance review of the excursion is done in the form of an ungraded course work, where minutes are expected on the main topic worked on.

Prerequisites
for the alpes-excursion:
Average condition for hikes up to 10km and 600hm; sturdy hiking boots

for the marine-biology-excursion:

The participants should be able to take part in the common snorkeling. They should be able to swim. There will be no diving during the excursion.

Participants should be able to walk short to medium distances with some steep passages.

Competence Goal
Students penetrate an ecosystem of their choice (temperate marine ecosystem, subtropical marine ecosystem, alpine ecosystem) in a networked fashion.

- They expand their knowledge of biological life forms
- They practice correctly identifying unknown animals and plants
- They investigate the effect of abiotic factors on ecological relationships
- They investigate biotic interactions within an ecosystem
- You develop sensitivity with regard to threats to and conservation of biodiversity
- You develop a deeper understanding of technical influences on natural resources
- You will develop sensitivity for the importance of sustainability
- You will learn about cultural and historical contexts and their influences on the ecosystem of a place.

Content
Excursion Habitat Alps:

Lecture Habitat Alps:

The living conditions in the Alps are a very special challenge for plants that cannot pack up or run away. Nevertheless, during the excursion we find ourselves in one of the areas of highest biodiversity in Europe.
This lecture presents the relationship between the Alpine flora and its habitat.
This includes, in particular, adaptation strategies to the different climatic and edaphic conditions. Different flora elements meet in the Alps, which makes them particularly interesting from a botanical point of view. In addition, basic geological and climatic as well as cultural backgrounds are discussed.

Central Alps excursion (all-day excursions and vegetation surveys)

During various hikes and practical vegetation surveys you will get to know the Central Alps, a hotspot of biodiversity. Special attention is paid to the flora, its site gradients and site conditions. You will get to know extreme and impressive plant habitats from the montane to the alpine level, from bare rock faces and various grassland communities to glacier forelands.
We will also get to know the Alps as a cultural landscape and look at the history of the Alpine region. The excursion will also show us the drastic effects of climate change. Furthermore, you will learn how to use digital mapping methods and professional vegetation surveys and how to use identification literature and apps professionally.

Local excursion with exploration of the vegetation history of Baden

Not everyone has the opportunity to go on an excursion for a whole week and for various reasons not everyone is able to walk 600 m and 12 km.

If you are nevertheless interested in botany, you can take part in the project to explore the vegetation of Baden. You will independently organize an excursion in the region on a specific topic. You will work closely with the herbarium of the Natural History Museum to help process local vegetation history.
This also includes everyday herbarium work such as sorting herbarium specimens. The main component will be excursions in the Black Forest, the Kraichgau or the Baar.

Marine biology excursions

Lecture:

The lecture deals with the formation and biology of the marine habitat. One focus is on the ecology and diversity of marine habitats. The morphology, physiology and lifestyle of marine protozoa, metazoans and algae are also discussed. Priority is given to groups that are not yet known from the courses of the Bachelor's degree program.

Aspects covered:

-basics of marine biology, marine ecology

-Helgoland/Giglio: geology, history

-cyanobacteria, diatoms

-Green algae, red algae, brown algae: Systematics, ecology

-Physiology of algae

-seaweed

-Protozoa, Porifera, Coelenterata

-Nemathelminthes, Annelida

-Crustacea, Gastropoda

-Echinodermata, Hemichordata

-Littoral zonation

-Plankton

-marine parasites

Excursion:

During the excursion, students learn about the diversity and way of life of marine animals and plants. Important aspects are the organisms of the phyto- and zooplankton, the benthos and also highly mobile animals of the pelagic (nekton) are part of the course program. The marine biotopes are considered in their entirety: Sand and mud bottoms, marine rock littoral, rock pools, seagrass meadows, the fish as a biotope for parasites, etc..

Students carry out field studies and laboratory experiments on topics from the ecology, physiology, developmental biology and behavioral biology of marine organisms.

Students also acquire knowledge of the typical land-dwelling animals and plants of the Mediterranean region.

The students present the topics they have worked on in seminar presentations.

Annotation
Module duration for 2024/2025

depending on choice:

- **zoological excursion Giglio (one week in August)**
- **botanical excursion Central Alps (one week 27.07.25-02.08.2025)**
- **Local excursion with exploration of the vegetation history of Baden (individual dates by individual arrangement)**
- for each excursion: a longitudinal lecture in the winter semester, depending on choice: lecture on marine biology excursions or on the Alpine habitat

Information on the animals and their use for the Giglio excursion

Thismodule works with animals. Individual animals are taken from marine or terrestrial biotopes in order to identify or examine them in the laboratory. These are invertebrates. Vertebrates are not taken.

Reasons why the use of animals cannot be dispensed with in this module

The aim of the module is to explore the ecology and biodiversity of different biotopes. This cannot be done using simulated models; it requires on-site investigation. It is not always possible to make determinations only by observation in water or in the air.

Information on the courses or performance assessments to which students can alternatively switch

This is an elective course; students can choose a botanical excursion as an alternative.

Workload

- Lecture: 14 hours
- Follow-up time and preparation for the exam: 42 hours
- Excursion: approx. 42 hours (without overnight stay)
- Preparation of the seminars and preparation of minutes and preparation for the excursion: 168 hours

Learning type
Lecture, seminar, excursion

Literature
Marine biology excursions

Textbooks of marine biology

Habitat Alps:

- Christian Körner; Alpine Plant Life: Functional Plant Ecology of High Mountain Ecosystem; Springer-Verlag; 2021.
- Lecture notes

M 8.6 Module: Intensification of Bioprocesses [M-CIWVT-106416]

Responsible: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Biology (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
9	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-112998	Intensification of Bioprocesses - Written Exam	6 CR	Holtmann
T-CIWVT-112999	Intensivication of Bioprocesses - Lab	3 CR	Holtmann, Neumann

Competence Certificate
The learing control consists of two partial achievements:

- Written examination, duration: 90 minutes
- Laboratory work: Examination of anaother type

Prerequisites
None

Competence Goal
Technical and methodological competencies

Students will be able to:

- explain the concepts of process intensification
- describe different intensified processes quantitatively
- design and evaluate bioprocess engineering processes on the basis of PI
- analyse interdisciplinary problems at the interface of technology and biological systems and develop solutions to problems
- develop processes with optimal productivities using as little energy and raw materials as possible by combining the advantages of individual disciplines

Social and personal competence

The students will be able to:

- analyse the framework conditions for innovative processes and identify the essential aspects
- identify and evaluate (interdisciplinary) process options
- become independently familiar with new topics
- summarize complex scientific processes

Content
Companies in the chemical and biotechnology industries face particular challenges in times of rising raw material costs, increased competition, and shorter product life cycles.

Process-intensified operations offer great potential for resource efficiency by helping to save materials and energy. According to a generally accepted definition, "Process Intensification (PI) is a collection of revolutionary innovative principles (paradigm shifts) for equipment and processes that can lead to significant improvements in process or process chain efficiency, investment and operating costs, quality, waste, process safety (and other aspects)".

In recent years, process intensification methods have been increasingly used in bioprocess engineering (USP and DSP). These methods are the focus of this module. The following topics are covered in the module:

- Definition of PI, distinction between process optimization and PI.
- Examples from chemical engineering
- Intensified bioreactors and reactor selection (e.g., single-use technologies, rotating bed reactors, enzyme membrane reactors, biofilm reactors)
- PI through adapted operating modes (e.g., repeated fed-batch, perfusion, continuous processes, in situ product removal)
- Process intensification through immobilized enzymes and microorganisms
- Integration of chemo- and biocatalysis
- Electro biotechnological processes
- Photo biotechnological processes
- Use of ultrasound and microwaves for bioprocess intensification
- Bioprocesses in alternative reaction media
- Use of extremophilic organisms / unconventional production organisms

In all sub-areas, the focus is on the quantitative description of the intensified processes.

Module grade calculation
The module grade is the CP-weighted average of the two partial achievements.

Workload
Lectures and exercises:

- Attendance time: 60 hrs
- Preparation and wrap-up lectures: 80 hrs
- Exam preparation: 40 hrs

Lab course (90 hrs in total)

- Preparation
- Experiments
- Experimental protocols

Recommendation
Fundamentals in bioprocess engineering are required.

Literature

- Frerich J. Keil (2017) Process intensification, doi.org/10.1515/revce-2017-0085
- Andrzej Stankiewicz, Tom van Gerven, Georgios Stefanidis (2019) The Fundamentals of Process Intensification, Wiley-VCH, Weinheim, ISBN: 978-3-527-32783-6
- VDI ZRE Publikationen: Kurzanalyse Nr. 24, Ressourceneffizienz durch Prozessintensivierung
- Burek et al (2022) Process Intensification as Game Changer in Enzyme Catalysis, https://doi.org/10.3389/fctls.2022.858706

Further literature recommendations will be announced.

M 8.7 Module: Interdisciplinary Thinking [M-CHEMBIO-100277]

Responsible: Prof. Dr. Reinhard Fischer
Organisation: KIT Department of Chemistry and Biosciences
Part of: Integrative Biology

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	pass/fail	Each term	2 terms	German/English	4	3

Election notes
Please select any placeholder when self-booking key qualifications. The CP will be adjusted automatically.

Interdisciplinary Seminar A (Election: between 1 and 2 items as well as at least 3 credits)			
T-CHEMBIO-100551	Interdisciplinary Seminar Developmental Biology	3 CR	Gradl
T-CHEMBIO-100552	Interdisciplinary Seminar Molecular Biology	3 CR	Kämper
Interdisciplinary Seminar B (Election: at most 2 items as well as at least 3 credits)			
T-CHEMBIO-100554	Current Topics in the Life Science	3 CR	Orian-Rousseau
T-CHEMBIO-111744	ExperiMentoring - The Mentoring-Program	3 CR	Sturm-Richter
T-CHEMBIO-113901	Self Assignment - Interdisciplinary Seminar 1 (ungraded)	1 CR	Weclawski
T-CHEMBIO-111731	Self Assignment - Interdisciplinary Seminar 2 (ungraded)	2 CR	
T-CHEMBIO-113902	Self Assignment - Interdisciplinary Seminar 3 (ungraded)	3 CR	Weclawski

M 8.8 Module: Master's Thesis [M-CHEMBIO-100178]

Responsible: Prof. Dr. Johannes Gescher
Organisation: KIT Department of Chemistry and Biosciences
Part of: Master's Thesis

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
30	Grade to a tenth	Each term	1 term	German	4	1

Mandatory			
T-CHEMBIO-100150	Master's Thesis	30 CR	

Competence Certificate
The control of success is the master thesis and a presentation. The presentation is to be made latest 14 days after delivery of the work. The maximum processing time for the module is 6 month. The theme and the task are adapted to the intended extent. The final document of the module is the master thesis. This document has to be created according to strict scientific rules. Important content-related and formal assistance to write the final thesis can be find on the web page of Biology Teaching of the KIT (http://www.biologie.kit.edu/406.php).

Prerequisites
None

Modeled Conditions
The following conditions have to be fulfilled:

1. You need to have earned at least 90 credits in the following fields:
   - Biochemistry
   - Biophysics
   - Biotechnology
   - Botany
   - Developmental Biology
   - Genetics
   - Integrative Biology
   - Life Science Engineering
   - Microbiology
   - Molecular Biology
   - Taxonomy and Geoecology
   - Technical Biology
   - Toxicology
   - Toxicology
   - Cell Biology
   - Zoology

Module grade calculation
The master thesis is evaluated from at least one university lecturer, a principal scientist in accordance with section 14 subsection 3 no. 1 KITG or a postdoctoral member of the KIT Faculty and one further examiner.
In case of disaccording Evaluations of the two examiners, the audit committee has to fix the mark of the thesis. In addition a further examiner can be ordered. The evaluation has to be made within 6 weeks after the submission date. The presentation is ungraded.

M 8.9 Module: Project Module: Advanced Light Microscopy (M5306) [M-CHEMBIO-100257]

Responsible: Prof. Dr. Martin Bastmeyer
Organisation: KIT Department of Chemistry and Biosciences
Part of: Zoology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Biophysics (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Irregular	1 term	German	4	1

Mandatory			
T-CHEMBIO-100483	Advanced Light Microscopy (Practical Project)	7 CR	

Prerequisites
none

M 8.10 Module: Project Module: Application of Bacterial Secretion Systems in Biotechnology, Healthcare and Plant Sciences (MPRO3302) [M-CHEMBIO-107086]

Responsible: Prof. Dr. Andreas Diepold
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Project)
Microbiology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Biotechnology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Each term	1 term	German/English	4	1

Mandatory			
T-CHEMBIO-114127	Application of Bacterial Secretion Systems in Biotechnology, Healthcare and Plant Sciences (Project Module)	7 CR	Diepold

Competence Certificate
The project module is not graded. A qualitative assessment of success takes place in the form of a final presentation.

The success of the internship is reviewed through individual status discussions with the students and inspection of the results of the experiments.

Competence Goal

- Carry out an independent research project in close collaboration with the researchers in the working group.
- You will read original scientific literature, evaluate it critically and use it specifically for your project.
- You will learn how to carry out a project successfully by planning the individual work steps systematically and purposefully.
- You will deepen your skills in all areas of scientific work and documentation.
- You will work in an international scientific team and actively exchange ideas with colleagues.
- You will present your experiments and ideas clearly, precisely and at a scientific level.

Content
You will work full-time over a period of 4 weeks in a current research project on the application and use of bacterial secretion systems in biotechnology, medicine or plant biology. This may include the following questions:

- What opportunities for targeted control and use of bacterial secretion systems arise from current research findings?

- How can we efficiently inject proteins and other molecules into plant and animal cells?

- How can this injection be efficiently controlled, e.g. via external signals such as light (use of optogenetics)?

In the project, current research methods from the fields of bacterial genetics, infection experiments and fluorescence microscopy, especially of living cells, and synthetic microbiology will be learned and used.

Annotation
4 weeks, full day

In each block by arrangement

Workload
Attendance time:
Internship: 90 h

Preparation and follow-up time:
Internship: 120 h

Literature
Lindner, ..., Diepold, LITESEC-T3SS - Light-controlled protein delivery into eukaryotic cells with high spatial and temporal resolution, Nature Communications, doi: 10.1038/s41467-020-16169-w

Bai, ..., Jin, Bacterial type III secretion system as a protein delivery tool for a broad range of biomedical applications, Biotechnol Advanc, doi: 10.1016/j.biotechadv.2018.01.016

Publications of the working group at https://www.iab.kit.edu/angbiol/1277.php

M 8.11 Module: Project Module: Bacterial Genomic & Computational Biology (MPRO-4311) [M-CHEMBIO-104785]

Responsible: Dr. John Vollmers
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Project)
Microbiology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Biotechnology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Each term	1 term	German	4	1

Mandatory			
T-CHEMBIO-109787	Bacterial Genomic & Computational Biology (Pactical Project)	7 CR	Vollmers

M 8.12 Module: Project Module: Bioinformatics (M1310) [M-CHEMBIO-100211]

Responsible: Prof. Dr. Tilman Lamparter
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Project)
Genetics (Compulsory Elective Subject - Project)
Microbiology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Irregular	1 term	German	4	1

Mandatory			
T-CHEMBIO-100418	Bioinformatics (Practical Project)	7 CR	

Competence Certificate
The project module is an ungraded coursework

Prerequisites
none

M 8.13 Module: Project Module: Biomolecular Microanalytics (M3306) [M-CHEMBIO-100268]

Responsible: Prof. Dr. Christof Niemeyer
Dr. Tim Scharnweber

Organisation: KIT Department of Chemistry and Biosciences

Part of: Molecular Biology (Compulsory Elective Subject - Project)
Biochemistry (Compulsory Elective Subject - Project)
Biotechnology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Each term	1 term	German	4	1

Mandatory			
T-CHEMBIO-100512	Biomolecular Microanalytics (Practical Project)	7 CR	

M 8.14 Module: Project Module: Biophotonics in Life Sciences (MPRO8310) [M-CHEMBIO-106861]

Responsible: Prof. Dr. Moritz Kreysing
Organisation: KIT Department of Chemistry and Biosciences
Part of: Zoology (Compulsory Elective Subject - Project)
Developmental Biology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Each term	1 term	German/English	4	1

Mandatory			
T-CHEMBIO-113751	Biophotonics in Life Sciences (Practical Project)	7 CR	Kreysing

Competence Certificate
The project module is not graded. A qualitative success control takes place in the form of a protocol. The success of the internship is checked through individual discussions with the students while considering the results of the experiments

Competence Goal

- You will delve into a current scientific issue and acquire basic knowledge in the field of biophotonics and modern microscopy
- You are interested in optical methods and participate in optical micromanipulation experiments
- You will apply microscopic and cell biology techniques or programming techniques (Python)
- You document your results
- You discuss your results with your colleagues and supervisors
- You research literature to solve problems
- You write a protocol that presents your results and methods

Content

- Development of a scientific project together with a doctoral student or postdoc as supervisor
- Teaching and acquisition of quantitative methods in the life sciences
- The project will be selected from the current scientific problems of the working group in order to have a direct impact on the research of your supervisor.
- Developing the necessary theoretical scientific background.
  Planning, execution, documentation of the experiments under supervision and discussion in the working group

Annotation
Individual appointment

Workload
90 hours attendance and 120 hours preparation and follow-up time

Learning type
Practical training

Literature
1.) Erben, Elena, et al. “Opto-fluidically multiplexed assembly and micro-robotics.” Light: Science & Applications, vol. 13, Article 59, 2024.
2.) McKinney, Wes. Python for Data Analysis. O’Reilly Media, 2012.
Nelson, Philip. Biological Physics. W. H. Freeman, 2003.

M 8.15 Module: Project Module: Cellular and Medicinal Microbiology (M4305) [M-CHEMBIO-105304]

Responsible: Prof. Dr. Reinhard Fischer
PD Dr. Markus Schmidt-Heydt

Organisation: KIT Department of Chemistry and Biosciences

Part of: Microbiology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Irregular	1 term	German	4	1

Mandatory			
T-CHEMBIO-110792	Cellular and Medicinal Microbiology (Practical Project)	7 CR	Fischer, Schmidt-Heydt

Prerequisites
none

M 8.16 Module: Project Module: Chromatin Structures in Cell Division and Development (M7302) [M-CHEMBIO-106307]

Responsible: Prof. Dr. Sylvia Erhardt
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Project)
Zoology (Compulsory Elective Subject - Project)
Developmental Biology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Biotechnology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Each term	1 term	English	4	1

Mandatory			
T-CHEMBIO-112786	Chromatin Structures in Cell Division and Development (Practical Project)	7 CR	Erhardt

Competence Certificate

- The project module is an ungraded
- A protocol on the contents of the internship must be prepared
- The qualitative performance review takes place in the form of a presentation.
- During the internship the performance is checked by individual status talks with the students and inspection of the results of their experiments.

Competence Goal
The following learning objectives are to be achieved by the students:

- They will be able to develop their own scientific questions and delve deeper into a topic area.
- They can organize themselves independently, plan experiments and document and interpret them in a scientifically valid manner.
- You will be able to achieve reliable experimental results independently and on your own responsibility.
- They can learn new molecular biology techniques and carry them out and evaluate them.
- They can professionally present their results in the form of a final presentation in English.

Content
At the beginning, the students are introduced to topics of the working group in order to then develop their own scientific question and a time schedule, on the basis of which they subsequently carry out their experiments. They will be supported and accompanied by the course supervisors at all stages and will thus have the opportunity to deepen their knowledge of methods in the field of chromatin biology, genome organization, cell division and development. Students are instructed to always check experiments for validity and to record all experiments and results in a comprehensible and correct manner. At the end of the internship, students present their results in the lab seminar of the working group and receive feedback on their presentation and internship performance. A protocol is to be prepared after completion of the internship.

Workload
Attendance time:

- Internship: 90 h

Preparation and follow-up time:

- Internship: 120 h

M 8.17 Module: Project Module: Epigenetics (M7301) [M-CHEMBIO-105678]

Responsible: Prof. Dr. Sylvia Erhardt
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Project)
Zoology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Each term	1 term	English	4	1

Mandatory			
T-CHEMBIO-111333	Epigenetics (Practical Project)	7 CR	Erhardt

Competence Certificate

- The project module is an ungraded course achievement.
- A protocol on the contents of the internship must be prepared.
- The qualitative performance review takes place in the form of a presentation.
- During the internship, the performance is checked by individual status discussions with the students and inspection of the results of their experiments.

Competence Goal
The following learning objectives are to be achieved by the students:

- They will be able to develop their own scientific questions and delve deeper into a topic area.
- They can organize themselves independently, plan series of experiments and document them in a scientifically valid manner.
- They can apply biological methods for the cultivation and analysis of productive biofilms in a goal-oriented manner.
- You will be able to achieve reliable experimental results independently and on your own responsibility.
- They can acquire new analytical methods and carry them out and evaluate them robotically.
- They can present their results professionally in the form of a final presentation.

Content
At the beginning, the students are expected to develop their own scientific question and a time schedule, on the basis of which they will subsequently carry out their experiments. They will be supported, guided and accompanied at all stages by the course supervisors and will thus have the opportunity to deepen their knowledge of methods in the field of epigenetics, epitranscriptomics and chromatin biology. Students will be instructed to always check experiments for validity and to record all experiments and results in a comprehensible and correct way. At the end of the internship, students present their results in the laboratory seminar of the working group and receive feedback on their presentation and internship performance.

Workload
Attendance time:

- Internship: 90 h

Preparation and follow-up time:

- Internship: 120 h

M 8.18 Module: Project Module: Flower Ecology (M1307) [M-CHEMBIO-106596]

Responsible: Dr. Heiko Hentrich
Prof. Dr. Peter Nick
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Project)
Taxonomy and Geoecology (Taxonomy and Geoecology)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Irregular	1 term	German	4	1

Mandatory			
T-CHEMBIO-113285	Flower Ecology (Practical Project)	7 CR	Hentrich, Nick

Competence Certificate
The project module is not graded. A qualitative performance review takes place in the form of an accepted protocol and a final presentation (30 min).

Prerequisites
none

Competence Goal
They will achieve the following learning objectives:

- They will acquire knowledge of the theoretical basis of flower ecology (evolution of the flower, flower morphology, sexual reproductive systems, attractors, co-evolution between flowers and their pollinators).
- They acquire knowledge to classify the pollinator syndrome of a flower.
- They will be able to create floral formulas and floral diagrams.
- They will be able to carry out a simple floral ecology research work (floral ecology fieldwork techniques: nectar sampling, scent sampling, flower color determination, visualization of UV stains, observation and marking of flower visitors, stigma receptivity determination, reproductive system determination; floral ecology laboratory work techniques: Nectar analysis, scent analysis, Cruden's determination of pollen to ovule ratio, staining of glandular tissue, pollen viability tests, determination of reproductive success).
- You will practice experimental design and independent documentation of experimental data.
- You will learn to present your results in the form of a final presentation.

Content
Floral ecology is concerned with the interactions between flowers, animals and their environment. It is a multidisciplinary research field that combines disciplines such as taxonomy, genetics, (bio)chemistry, physiology, ethology, etc.. Accordingly, the content with which floral ecologists deal is also broadly diversified. These range from environmental protection and biodiversity to food security.

In the first block, the course teaches the theoretical basics of floral ecology and provides an insight into basic methods for conducting research in this field. In the second block, participants conduct an independent research project in which they put the theoretical content from the first block into practice by studying the floral ecology of a plant.

Module grade calculation
The module is not graded.

Annotation
Module rotation: WS theory part in post-block, in SS 2. block

Learning type
Internship

M 8.19 Module: Project Module: Genetics of Lower Eukaryotes (M4301) [M-CHEMBIO-100232]

Responsible: Prof. Dr. Jörg Kämper
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Irregular	1 term	German	4	1

Mandatory			
T-CHEMBIO-100442	Molecular Genetics of Lower Eukaryotes (Practical Project)	7 CR	

Prerequisites
none

Literature
Praktikum

M 8.20 Module: Project Module: Innovative Microscopy (MPRO8311) [M-CHEMBIO-106862]

Responsible: Prof. Dr. Moritz Kreysing
Organisation: KIT Department of Chemistry and Biosciences
Part of: Molecular Biology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Biophysics (Compulsory Elective Subject - Project)
Biotechnology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Each term	1 term	German/English	4	1

Mandatory			
T-CHEMBIO-113752	Innovative Microscopy (Practical Project)	7 CR	Kreysing

Competence Certificate
The project module is not graded. A qualitative success control takes place in the form of a protocol. The success of the internship is checked through individual discussions with the students while considering the results of the experiments.

Competence Goal

- You will delve deeper into a current scientific issue and acquire basic knowledge in the field of quantitative biology and imaging methods of biological samples
- You will apply microscopic and cell biology techniques (e.g. confocal microscopy, FACS, tissue culture, etc.)
- You are interested in data analysis and will expand your knowledge of data processing with Python
- You document your results
- discuss your results with your colleagues and supervisors
- You will research literature to solve problems
  You will write a protocol presenting your results and methods

Content

- Development of a scientific project together with a doctoral student or postdoc as supervisor
- Teaching and acquisition of quantitative methods in the life sciences
- The project will be selected from the current scientific problems of the working group in order to have a direct impact on the research of your supervisor.
- Developing the necessary theoretical scientific background.
- Planning, execution, documentation of the experiments under supervision and discussion in the working group.
  Writing a protocol that meets the formal requirements of a scientific paper

Annotation
individual appointment

Workload
90 hours attendance and 120 hours preparation and follow-up time

Learning type
Practical training

Literature
1) Nelson, Philip. Biological Physics. W. H. Freeman, 2003.
2) McKinney, Wes. Python for Data Analysis. O'Reilly Media, 2012.

M 8.21 Module: Project Module: Intensification of Bioprocesses [M-CIWVT-107275]

Responsible: Dr. Anke Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Biology (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
14	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-114319	Practical Project Intensification of Bioprocesses	14 CR	Neumann

M 8.22 Module: Project Module: Methods of Developmental Biology (M6302) [M-CHEMBIO-100265]

Responsible: Dr. habil. Dietmar Gradl
Prof. Dr. Ferdinand le Noble

Organisation: KIT Department of Chemistry and Biosciences

Part of: Zoology (Compulsory Elective Subject - Project)
Developmental Biology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Irregular	1 term	German/English	4	1

Mandatory			
T-CHEMBIO-100494	Methods of Developmental Biology (Practical Project)	7 CR	

Prerequisites
none

Competence Goal
The practical course is embedded in our actual research.

The topics include (1) migration of neural crest cells (J. Kashef), (2) regulation of signal transduction (from binding of a ligand to its receptor to target gene regulation (D. Gradl) and regulation of vasculogenesis (F. le Noble).

You learn to present your own results in a professional manner.

Content
The focus of the course is on selected aspects of the actual research. An overwiew is found at: http://zebio.zoo.kit.edu/64.php

The methods include the generation of new constructs for injection experiments and the characterization of the phenotypes of injected Xenopus embryos (gain of function and loss of function experiments). For the analysis of signal transduction pathways we will make use of „animal cap explants“, „Keller-explants“ and/or GFP stained transplants. For a more detailed analysis we will make use of Western-Blot, RT-PCR, immuno-fluorescence, in situ hybridisation and reporter gene assays.

Literature
•Scott F. Gilbert, Developmental Biology, 7th ed., Sinauer, 2006

•Lewis Wolpert, Entwicklungsbiologie, Spektrum Verlag, 2007

•http://zebio.zoo.kit.edu/index.php

M 8.23 Module: Project Module: Methods of Developmental Genetics (M3308) [M-CHEMBIO-103096]

Responsible: Prof. Dr. Lennart Hilbert
Prof.Dr. Uwe Strähle

Organisation: KIT Department of Chemistry and Biosciences

Part of: Genetics (Compulsory Elective Subject - Project)
Developmental Biology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Each winter term	1 term	English	4	1

Mandatory			
T-CHEMBIO-106140	Methods of Developmental Genetics (Advanced Practical Course)	7 CR	

Prerequisites
None

Competence Goal
They should achieve the following learning objectives

- You will deepen the conceptual discussion for the selected area
- You will read original literature and practise evaluating it critically
- Carry out a research project lasting approximately four weeks
- Practice and deepen all aspects of scientific work and documentation
- You will develop fluency in teamwork and practice organizing yourself
- You will practise presenting clearly, comprehensibly and scientifically
- You will practise being fluent and confident in an international context

Content
In the project module "Methods of Developmental Genetics", they are carrying out work on the investigation of molecular and cellular processes in embryos and larvae of the zebrafish as a developmental biology model. The methods include the observation and analysis of biological processes as well as the use and production of genetically modified fish lines. Molecular biology and light microscopy techniques play a central role in all projects.

Literature
Gilbert Developmental Biology (Tenth edition)

M 8.24 Module: Project Module: Microbiology of Eukaryotes (M4306) [M-CHEMBIO-100233]

Responsible: Prof. Dr. Reinhard Fischer
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Project)
Microbiology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Irregular	1 term	German	4	1

Mandatory			
T-CHEMBIO-100443	Microbiology of Eukaryotes (Practical Project)	7 CR	

Prerequisites
none

M 8.25 Module: Project Module: Molecular and Cell Biology in Plant/Pathogen Interactions (MPRO3320) [M-CHEMBIO-106863]

Responsible: Prof. Dr. Jörg Kämper
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Project)
Microbiology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Each term	1 term	German	4	1

Mandatory			
T-CHEMBIO-113753	Molecular and Cell Biology in Plant/Pathogen Interactions (Practical Project)	7 CR	Kämper

M 8.26 Module: Project Module: Molecular and Cell Biology of Mycorrhiza (M2307) [M-CHEMBIO-100218]

Responsible: Prof. Dr. Natalia Requena Sanchez
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Project)
Genetics (Compulsory Elective Subject - Project)
Microbiology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Biotechnology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Irregular	1 term	English	4	1

Mandatory			
T-CHEMBIO-100437	Molecular and Cell Biology of Mycorrhiza (Practical Project)	7 CR	

Prerequisites
none

Literature
http://www.iab.kit.edu/heisenberg/Publications.php

M 8.27 Module: Project Module: Molecular Biology of the Cell (M5308) [M-CHEMBIO-103942]

Responsible: Prof. Dr. Martin Bastmeyer
Organisation: KIT Department of Chemistry and Biosciences
Part of: Zoology (Compulsory Elective Subject - Project)
Developmental Biology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Biophysics (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Irregular	1 term	German/English	4	1

Mandatory			
T-CHEMBIO-108075	Molecular Biology of the Cell (Practical Project)	7 CR	Bastmeyer

M 8.28 Module: Project Module: Molecular Cell Biology (M6301) [M-CHEMBIO-100234]

Responsible: Dr. habil. Dietmar Gradl
Prof. Dr. Ferdinand le Noble

Organisation: KIT Department of Chemistry and Biosciences

Part of: Genetics (Compulsory Elective Subject - Project)
Zoology (Compulsory Elective Subject - Project)
Developmental Biology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Biophysics (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Irregular	1 term	German/English	4	1

Mandatory			
T-CHEMBIO-100444	Molecular Cell Biology (Practical Project)	7 CR	

Prerequisites
none

Competence Goal
The practical course is embedded in our actual research.

The topics include

(1) migration of neural crest cells (J. Kashef),

(2) regulation of signal transduction (from binding of a ligand to its receptor to target gene regulation (D. Gradl) and

(3) regulation of vasculogenesis (F. le Noble).

You learn to present your own results in a professional manner.

Content
The focus of the course is on selected aspects of the actual research. An overwiew is found at: http://zebio.zoo.kit.edu/64.php

The methods include generation of new constructs for transfection- and injection experiments, transfection and analyses of the transfectants via Western-Blot, RT-PCR immunofluorescence staining, reporter gene assays and live-cell imaging.

In some oft he practical courses we will also use tissue explants of Xenopus embryos for live-cell imaging, immunostaining and expression analyses.

M 8.29 Module: Project Module: Molecular Developmental Neurobiology (M5307) [M-CHEMBIO-100258]

Responsible: Prof. Dr. Martin Bastmeyer
Dr. Joachim Bentrop

Organisation: KIT Department of Chemistry and Biosciences

Part of: Zoology (Compulsory Elective Subject - Project)
Developmental Biology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Biophysics (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Irregular	1 term	German	4	1

Mandatory			
T-CHEMBIO-100484	Molecular Developmental Neurobiology (Practical Project)	7 CR	

Prerequisites
none

M 8.30 Module: Project Module: Molecular Mechanism of Bacterial Secretion Systems (MPRO3301) [M-CHEMBIO-107084]

Responsible: Prof. Dr. Andreas Diepold
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Project)
Microbiology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Each term	1 term	German/English	4	2

Mandatory			
T-CHEMBIO-114126	Molecular Mechanism of Bacterial Secretion Systems (Project Module)	7 CR	Diepold

Competence Certificate
The project module is not graded. A qualitative assessment of success takes place in the form of a final presentation.

The success of the internship is reviewed through individual status discussions with the students and inspection of the results of the experiments.

Competence Goal

- Carry out an independent research project in close collaboration with the researchers in the working group.
- You will read original scientific literature, evaluate it critically and use it specifically for your project.
- You will learn how to carry out a project successfully by planning the individual work steps systematically and purposefully.
- You will deepen your skills in all areas of scientific work and documentation.
- You will work in an international scientific team and actively exchange ideas with colleagues.
- You will present your experiments and ideas clearly, precisely and at a scientific level.

Content
You will work full-time over a period of 4 weeks on a current research project to elucidate the molecular function and utilization of bacterial secretion systems. This may include the following questions:

- How do bacterial secretion systems function at the molecular level?
- How do bacteria utilize these secretion systems during infection?
- How is the utilization of secretion systems controlled?
- How can we use this knowledge to prevent disease and target secretion systems?
- In the project, current research methods from the field of bacterial genetics, interaction studies, infection experiments and fluorescence microscopy, especially on living cells, will be learned and applied.

Annotation
4 weeks, full day

In each block by arrangement

Workload
Attendance time:
Internship: 90 h

Preparation and follow-up time:
Internship: 120 h

Literature
Costa et al, Secretion systems in Gram-negative bacteria: structural and mechanistic insights, Nat Rev Microbiol, doi: 10.1038/nrmicro3456
Publications of the working group at https://www.iab.kit.edu/angbiol/1277.php

M 8.31 Module: Project Module: Molecular Methods in Higher Eukaryotes (M3311) [M-CHEMBIO-100231]

Responsible: Prof. Dr. Ute Schepers
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Each term	1 term	German	4	1

Mandatory			
T-CHEMBIO-100441	Molecular Methods in Higher Eukaryotes (Practical Project)	7 CR	

M 8.32 Module: Project Module: Molecular Plant-Microbe Interactions (M2307) [M-CHEMBIO-100219]

Responsible: Prof. Dr. Natalia Requena Sanchez
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Project)
Genetics (Compulsory Elective Subject - Project)
Microbiology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Biotechnology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Irregular	1 term	English	4	1

Mandatory			
T-CHEMBIO-100438	Molecular Plant-Microbe Interactions (Practical Project)	7 CR	

Competence Certificate
This module is not graded. A short presentation about the conducted research will be used as a qualitative tool for the evaluation of successful participation.

Prerequisites
none

Literature
http://www.iab.kit.edu/heisenberg/Publications.php

M 8.33 Module: Project Module: Pathophysiology, Molecular Basis of Diseases (M6305) [M-CHEMBIO-105600]

Responsible: Dr. habil. Dietmar Gradl
Prof. Dr. Ferdinand le Noble

Organisation: KIT Department of Chemistry and Biosciences

Part of: Zoology (Compulsory Elective Subject - Project)
Developmental Biology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Irregular	1 term	German/English	4	1

Mandatory			
T-CHEMBIO-111223	Pathophysiology, Molecular Basis of Diseases (Practical Project)	7 CR	

Prerequisites
none

Competence Goal
In the practical course, students work independently on aspects of ongoing research projects.

The background is to investigate the pathophysiology of human cardiovascular diseases using zebrafish as a model organism and to open up new possibilities for future therapeutic approaches. The focus is on the basics of:

(1) Regeneration of the nervous tissue.

(2) The reciprocal influence of neural development and vascular development.

(3) Regulation of the development of a blood vessel system.

They learn to present their results professionally in the form of a final presentation.

Content
The content is based on the current research priorities. These can be found at: http://zebio.zoo.kit.edu/64.php

The range of methods includes :

- the creation of new constructs for transfection and/or injection experiments,
- live-cell analysis of transgenic zebrafish embryos
- gene knock-out and/or knockdown
- gene expression analysis
- injections into zebrafish oocytes

Annotation
Module frequency: In each block by arrangement

Module duration: 4 weeks, full-time

Declaration according to § 30a LHG

Information on the animals and their use.

This module**involves**working with animals. Zebrafish from the laboratory's own husbandry are mated to obtain embryos. Studies are carried out on these embryos up to an age of 5 dpf. Fin-clips of adult animals can also be produced All husbandry and procedures are approved by the responsible regional council.

Reasons why the use of animals cannot be dispensed with in this module

The development of the vertebrate vascular system is based on complex interactions between the cell types involved. Often only some of the cell types or proteins involved have been identified. Consequently, these questions cannot be fully investigated in *in vitro culture systems*, as not all molecular parameters are known that would have to be reconstructed in these systems. Furthermore, the complex spatial environment into which the developing vessel grows cannot be fully simulated in culture.

Information on the courses and performance assessments to which students can alternatively switch

This is an elective course; students can alternatively take other FOR/PRO modules that do not involve working with animals.

Learning type
Practical course

Literature

-Scott F. Gilbert, Developmental Biology, 7th ed., Sinauer, 2006

-Lewis Wolpert, Developmental Biology, Spektrum Verlag, 2007

-Internet materials at http://www.zi2.uni-karlsruhe.de/hauptstudium_ss.html

M 8.34 Module: Project Module: Phenomics and Chemomics (M5314) [M-CHEMBIO-106841]

Responsible: Dr. Thomas Dickmeis
Prof. Dr. Lennart Hilbert

Organisation: KIT Department of Chemistry and Biosciences

Part of: Genetics (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Biochemistry (Compulsory Elective Subject - Project)
Biotechnology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Each term	1 term	German	4	1

Mandatory			
T-CHEMBIO-113722	Phenomics and Chemomics (Practical Project)	7 CR	Dickmeis, Hilbert

M 8.35 Module: Project Module: Photoreceptors in Plants and Microorganisms (M1305) [M-CHEMBIO-100206]

Responsible: Prof. Dr. Tilman Lamparter
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Project)
Microbiology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Irregular	1 term	German	4	1

Mandatory			
T-CHEMBIO-100413	Photoreceptors (Practical Project)	7 CR	

Competence Certificate
The project module is an ungraded coursework

Prerequisites
none

M 8.36 Module: Project Module: Plant Cell Biology (M1301) [M-CHEMBIO-100202]

Responsible: Prof. Dr. Peter Nick
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Project)
Developmental Biology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Irregular	1 term	English	4	1

Mandatory			
T-CHEMBIO-100410	Research Projects in Plant Cell Biology (Practical Project)	7 CR	

Competence Certificate
Examination is an ungraded coursework.

Prerequisites
none

M 8.37 Module: Project Module: Plant Evolution: Methods and Concepts (M1302) [M-CHEMBIO-100203]

Responsible: Prof. Dr. Peter Nick
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Project)
Genetics (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Biotechnology (Compulsory Elective Subject - Project)
Taxonomy and Geoecology (Taxonomy and Geoecology)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Language	Level	Version
7	pass/fail	Irregular	English	4	1

Mandatory			
T-CHEMBIO-100411	Research Projects in Plant Evolution (Practical Project)	7 CR	

Prerequisites
none

Literature
http://www.botanik.kit.edu/botzell/579.php
andhttp://www.botanik.kit.edu/botzell/english/26.php

M 8.38 Module: Project Module: Plant Gene Technology - Precise Genome Engineering (M2301) [M-CHEMBIO-100228]

Responsible: Prof. Dr. Holger Puchta
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Project)
Genetics (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Biotechnology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Irregular	1 term	German	4	1

Mandatory			
T-CHEMBIO-100435	Practical in Gene Technology (Practical Project)	7 CR	

Competence Certificate
The project module is an ungraded coursework

Prerequisites
none

Literature
Gentechnik bei Pflanzen (F. u. R. Kempken), Springer, 2012

Lewin's Genes XI (Krebs, Goldstein und Kilpatrick), Jones and Barlett, 2013

Molecular Biology of the Gene (Watson et al.), Cummings, 2013

Molekulare Genetik (Nordheim und Knippers), Thieme Verlag, 2015

Genome und Gene (T.A. Brown), Spektrum Akademischer Verlag, 2007

Der Experimentator: Molekularbiologie / Genomics (Mülhardt), Spektrum Akademischer Verlag, 2013

M 8.39 Module: Project Module: Plant Molecular Biology (M2300) [M-CHEMBIO-100214]

Responsible: Prof. Dr. Holger Puchta
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Each term	1 term	German/English	4	2

Mandatory			
T-CHEMBIO-100420	Plant Molecular Biology (Practical Project)	7 CR	

Competence Certificate
The examination an ungraded coursework.

Prerequisites
none

Competence Goal
The following teaching goals are supposed to be reached:

- You learn to work on a current scientific question
- You apply plant molecular biology methods
- You document your results in a lab journal
- You discuss your results with your colleagues/supervisors
- You search for literature to solve problems
- You write a scientific report in which the methods and your results are presented

Content
Supervised by a doctoral student or a postdoc you will work on a small scientific project. This project will be taken from current scientific problems at the institute and might therefore directly influence the research of your supervisor. You will theoretically prepare the necessary scientific background. You design and carry out your experiments with the help of the supervisor, write down your results, and discuss your results with the team. At the end you write a report that fulfills the requirements of a scientific text.

Recommendation
Assignment of M2201

M 8.40 Module: Project Module: Project in Technical Biology (M9304) [M-CIWVT-100307]

Responsible: Dr. Anke Neumann
Prof. Dr. Christoph Syldatk
Organisation: KIT Department of Chemical and Process Engineering
Part of: Microbiology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Irregular	1 term	German	4	2

Mandatory			
T-CIWVT-100560	Project in Technical Biology (Practical Projekt)	7 CR	Neumann, Syldatk

Prerequisites
none

M 8.41 Module: Project Module: Signal Transduction in Eukaryotic Systems (M3309) [M-CHEMBIO-100229]

Responsible: Prof. Dr. Véronique Orian-Rousseau
Dr. Carsten Weiss

Organisation: KIT Department of Chemistry and Biosciences

Part of: Genetics (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Irregular	1 term	German	4	1

Mandatory			
T-CHEMBIO-100439	Signal Transduction in Eukaryotic Systems (Practical Project)	7 CR	

Prerequisites
none

M 8.42 Module: Project Module: Structure and Function of Peptides (M7301) [M-CHEMBIO-100271]

Responsible: Prof. Dr. Anne Ulrich
Organisation: KIT Department of Chemistry and Biosciences
Part of: Biochemistry (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	Grade to a tenth	Irregular	1 term	German	4	1

Mandatory			
T-CHEMBIO-100519	Biochemistry - Peptide Structure and Function (Practical Project)	7 CR	

M 8.43 Module: Project module: Systemic Cellular Neurobiology (MPRO5320) [M-CHEMBIO-106854]

Responsible: Prof. Dr. Simone Mayer
Organisation: KIT Department of Chemistry and Biosciences
Part of: Zoology (Compulsory Elective Subject - Project)
Developmental Biology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Biochemistry (Compulsory Elective Subject - Project)
Biotechnology (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Each term	1 term	English	4	1

Mandatory			
T-CHEMBIO-113738	Systemic cellular neurobiology (Practical Project)	7 CR	Mayer

Competence Certificate
Study Achievment: practical work, literature research, presentation, report

Competence Goal
Scientific thinking, laboratory or bioinformatic methods

Content
Insights into neurobiology: to generate and analyze cell culture models of brain development

Annotation
Please get in touch at least 8 weeks before the desired start of the module

Workload
175

Recommendation
Knowledge in neurobiology and developmental biology

Learning type
Practical Work

Literature
Review Paper: Khakipoor S, Crouch EE, Mayer S. Human organoids to model the developing human neocortex in health and disease. Brain Res. 2020 Sep 1;1742:146803. doi: 10.1016/j.brainres.2020.146803. Epub 2020 Mar 30. PMID: 32240655; PMCID: PMC7352040.

Base for
Master thesis in Systemic Cellular Neurobiology

M 8.44 Module: Project Module: Systems Biology & Biophysics (M5308) [M-CHEMBIO-105305]

Responsible: Prof. Dr. Lennart Hilbert
Organisation: KIT Department of Chemistry and Biosciences
Part of: Zoology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Biophysics (Compulsory Elective Subject - Project)
Biochemistry (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Irregular	1 term	German	4	1

Mandatory			
T-CHEMBIO-110791	Systems Biology & Biophysics (Practical Project)	7 CR	Hilbert

Competence Certificate
The project module is an ungraded coursework. Control of Success is a written Protocol or a presentation in the working group

Prerequisites
none

M 8.45 Module: Project Module: Tissue Engineering and 3D Cell Culture (M3307) [M-CHEMBIO-101597]

Responsible: Prof. Dr. Ute Schepers
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Cell Biology (Compulsory Elective Subject - Project)
Biochemistry (Compulsory Elective Subject - Project)
Biotechnology (Compulsory Elective Subject - Project)
Life Science Engineering (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Irregular	1 term	German	4	1

Mandatory			
T-CHEMBIO-103059	Tissue Engineering and 3D Cell Culture (Practical Project)	7 CR	

Prerequisites
None

Competence Goal
The students get an overview of the chemical and biological basics of tissue engineering. This includes: Chemical synthesis of hydrogels for cell culture, chemical analysis of synthesized gels, basics of 2D and 3D cell culture of human cells, formation of spheroids, embedding of cells in hydrogels and microscopic analysis of the formed structures.

Content

- Techniques in 2D cell culture
- Techniques in 3D cell culture
- Formation of spheroids
- Viability assay
- Fluorescence staining
- Toxicity screening of nanoparticles on spheroids
- Microscopy/Fluorescence Microscopy
- Chemical synthesis of hydrogels for application in 3D cell culture
- Chemical characterization of hydrogels
- Physical characterization of photoinitiators for application in 3D cell culture

M 8.46 Module: Project Module:Productive Biofilms (M4310) [M-CHEMBIO-105603]

Responsible: Dr. Gunnar Sturm
Dr. Katrin Sturm-Richter

Organisation: KIT Department of Chemistry and Biosciences

Part of: Genetics (Compulsory Elective Subject - Project)
Microbiology (Compulsory Elective Subject - Project)
Molecular Biology (Compulsory Elective Subject - Project)
Biotechnology (Compulsory Elective Subject - Project)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
7	pass/fail	Each term	1 term	German	4	1

Mandatory			
T-CHEMBIO-111231	Productive Biofilms (Practical Project)	7 CR	Sturm

Prerequisites
Research module **Productive Biofilms** (M4209)

M 8.47 Module: Research and Project Module: Toxicology and Food Toxicology (M8201) [M-CHEMBIO-105673]

Responsible: Prof. Dr. Andrea Hartwig
Dr. Beate Monika Köberle
Dr. Carsten Weiss

Organisation: KIT Department of Chemistry and Biosciences

Part of: Toxicology

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
17	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CHEMBIO-111325	Toxicology and Food Toxicology	7 CR	Köberle, Weiss
T-CHEMBIO-111326	Toxicology (Laboratory Practical Course)	10 CR	Köberle, Weiss

Prerequisites
keine

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CHEMBIO-104464 - Food Toxicology must have been started.

Competence Goal
Different methods of toxicity testing will be used

M 8.48 Module: Research Module: Bioinformatics (M4211) [M-CHEMBIO-106206]

Responsible: Prof. Dr. Lennart Hilbert
Prof. Dr. Anne-Kristin Kaster
Prof. Dr. Tilman Lamparter
Dr. John Vollmers

Organisation: KIT Department of Chemistry and Biosciences

Part of: Genetics (Compulsory Elective Subject - Research)
Microbiology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	German/English	4	1

Mandatory			
T-CHEMBIO-112608	Bioinformatics	8 CR	Hilbert, Kaster, Lamparter, Sturm

Competence Certificate
The performance review is a written exam over 120 minutes

Prerequisites
No existing programming skills are required to participate.

Competence Goal
First experiences in automized processing of digital microscopic images using MatLab. Interpretation of the hereby produced quantative results with regard to cellular and subcellular structures

Experiences in processing and analyses of next generation sequencing (NGS) data in the context of microbial genomics and metagenomics, using open-source UNIX command line tools

Knowledge and application of advanced phylogenetic methods based on protein sequences as well as learning computer based prediction of protein 3D structures using AI.

Content
The module is divided into three parts:

Starting with image data from scientific work at the Institute of Biological and Chemical Systems (IBCS), example analysis scripts are used to adapt analysis pipelines to new image data. Different forms of graphical and statistical acquisition of the acquired data will then be presented and applied to answer cell biological questions on a quantitative basis.

Furthermore, (mainly metagenomic) sequence data obtained at the Institute of Biological Interfaces 5 (IBG-5) will be processed, assembled and analyzed with the aim of reconstructing genomes of individual microorganisms that can provide insights into the lifestyle of these organisms. Within this framework, the necessary basic experience in working at the UNIX command line level will also be imparted.

Subsequently, photolyase and cyptochrome sequences will be phylogenetically analyzed using various programs (NJ ML ME Parsymony MrBayes) and parameters. One goal is to demonstrate the evolution of the different groups of photolyases and cryptochromes from their origin.
Gabriel, Krauß, Lamparter (2022); Evidence for evolutionary relationship between archaeplastidal and cyanobacterial phytochromes based on their chromophore pockets, Photochemical & Photobiological Sciences.

The last part will deal with protein sequence comparison, advanced phylogenetic tree analysis and protein modeling using the new AI program Alphafold.

Contents will be taught in a combination of lectures, seminars, and supervised work ("hackathon").

Learning type
Lecture, practical course, presentation

M 8.49 Module: Research Module: From Samples to Sequences (M4212) [M-CHEMBIO-105666]

Responsible: Prof. Dr. Anne-Kristin Kaster
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Research)
Microbiology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Biotechnology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	German/English	4	1

Mandatory			
T-CHEMBIO-111319	From Samples to Sequences	8 CR	

Competence Certificate
Examination performance of a different kind consisting of:

- written test of 120 minutes, on the lecture and the contents of the internship. 80 points of the total score can be achieved.
- a report on the internship must be prepared, which must meet scientific standards. 20 points can be obtained.

Prerequisites
none

Competence Goal
The learning objective is to provide the participants with the necessary practical knowledge and theoretical basis to take samples in the environment, extract DNA and prepare it for sequencing. Furthermore, to independently use a processing, assembly and analysis pipelines for sequence data analysis to determine the microbial composition of the sample (metagenomics).

Content
Lecture (1SWS) and practical course (7SWS)

-Sample collection
-DNA extraction
-DNA quantitation and quality determination
-PCR
-Library prep
-Bioinformatic data analysis

Learning type
Lecture, practical course, presentation

M 8.50 Module: Research Module: Biomolecular Microanalytics (M3206) [M-CHEMBIO-100267]

Responsible: Prof. Dr. Christof Niemeyer
Dr. Tim Scharnweber

Organisation: KIT Department of Chemistry and Biosciences

Part of: Molecular Biology (Compulsory Elective Subject - Research)
Biochemistry (Compulsory Elective Subject - Research)
Biotechnology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	German/English	4	2

Mandatory			
T-CHEMBIO-108707	Biomolecular Microanalytics	8 CR	Niemeyer, Scharnweber

Competence Goal
Basic knowledge of miniaturized analytical methods, in particular the production and application of microarrays, as well as selected current application examples in the fields of biochemistry, microbiology and chemical biology

Content
Miniaturized analytical methods play a central role in the high-throughput analysis of biomacromolecules for applications in biochemistry, pharmaceutical research and medicine. Of particular importance are so-called "microarrays" with which many different biomolecular interactions can be characterized in parallel. This course teaches methods and applications of miniaturized analytical procedures.

- Bioconjugation: Chemical coupling of oligonucleotides, proteins and low-molecular probes.
- Surface chemistry: Immobilization of DNA, proteins and low-molecular components on glass substrates.
- Microstructuring: Piezodispensing for lateral structuring of probe molecules on activated glass substrates.
- Microanalysis: Fluorescence microscopy and densitometry to quantify biomolecular interactions..;
- Fluorescence and enzyme-enhanced detection techniques as analytical methods for microarray experiments

Annotation
only in the summer semester

M 8.51 Module: Research Module: Cellular and Medicinal Microbiology (M4205) [M-CHEMBIO-105294]

Responsible: Prof. Dr. Reinhard Fischer
PD Dr. Markus Schmidt-Heydt

Organisation: KIT Department of Chemistry and Biosciences

Part of: Microbiology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CHEMBIO-110761	Cellular and Medicinal Microbiology	8 CR	

Competence Certificate
The control of success is an examination of another type. The Maximum 100 points can be reached. These points consits the following components:

- On examination is an oral part,with this performance 90 points can be reached.
- Beside this written test, a protocol of the practical part must be written. This protocol must be in accordance with scientific requirements.
  For this protocol 10 points can be reached.

Prerequisites
none

Competence Goal
You will improve the following qualifications

- You will broaden your understanding of the concepts and actual scientific questions in the field
- You will read original papers and improve in understanding and evaluating their content
- You will work practically in the lab for about 4 weeks
- You will improve your skills for scientific working
- You will be working in small teams
- You will improve your oral and written scientific presentation skills
- You will be exposed to an international atmosphere and learn how to work in an international team

Content
Course I, Cellular Microbiology (2 weeks):

In this course we are going to analyze the role of the microtubule and the actin cytoskeleton in the filamentous fungus *Aspergillus nidulans*. We will study the role of cell end marker and motor proteins. The interaction of the components will be studied by microscopic, genetic and biochemical methods.

Practical part:

- Generation of transgenic *Aspergillus nidulans* strains
- Characterization by Southern blot
- Fluorescence microscopy to detect specific proteins and to proof the interaction of two proteins of interest
- Confocal Laser microscopy
- Yeast-Two-Hybrid analysis, generation of transgenic *Saccharomyces cerevisiae* strains, Westernblot to quantify the proteins in yeast
- Co-Immunoprecipitation
- Purification of a kinesin motor protein from *coli*
- Nanotechnology: *In vitro* assay for the analysis of the motor activity

Lectures:

- The eukaryotic Cytoskeleton
- The discovery of cell end marker proteins
- Polarized growth in fungi
- Organelle movement
- Nanotechnology

Course II, Medical Microbiology (2 weeks):

The prerequisite for an adequate microbiological risk analysis in medical and food-related areas, is the analysis of involved microorganisms. In this course, you will learn how to isolate and enrich microorganisms of medical and food toxicological relevance from environmental samples (e.g. skin, hair, soil, food). With modern analytical and molecular biological methods, you will further investigate and characterize these self-enriched pure cultures.

By participating in this course, you will be able to professionally isolate microorganisms, produce pure cultures and characterize them chemically-morphologically and molecular biologically.

Practical part:

- Production of selective growth media
- Cultivation of microorganisms from environmental samples (skin, hair, soil, food); Preparation of dilution series and pure cultures
- Staining methods (e.g. Calcofluor-white)
- Binocular and microscopic examination of the preparations; morphological analysis of microorganisms, identification of important filamentous fungi at genus level
- Chemical extraction of secondary metabolites from mycotoxigenic filamentous fungi, thin layer chromatographic separation, chemotype-fingerprinting, analysis and identification of metabolites with reference standard
- Isolation of genomic DNA, creation of DNA primers for PCR analysis
- Perform RAPD-PCR, gel electrophoresis, evaluation and characterization
- PCR-fragment tree analysis

Lectures:

- Basics and definitions of medical mycology
- Occurrence and significance of pathogenic and mycotoxigenic fungi
- Important fungal genera and species
- Economic and ecological relevance of filamentous fungi
- Classification of pathogenic yeasts / fungi according to DHS scheme
- Dimorphisms in fungi as an adaptation to the host
- Diseases: mycoses, mycotoxicoses, mycogenic allergies
- Regulation of secondary metabolite biosynthesis at the molecular level, involved signal cascades
- Therapy and prevention of contamination / infection by filamentous fungi

M 8.52 Module: Research Module: Chromatin Structures in Cell Division and Development (M7202) [M-CHEMBIO-105842]

Responsible: Prof. Dr. Sylvia Erhardt
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Research)
Zoology (Compulsory Elective Subject - Research)
Developmental Biology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Duration	Language	Level	Version
8	Grade to a tenth	1 term	English	4	2

Mandatory			
T-CHEMBIO-111754	Chromatin Structures in Cell Division and Development	8 CR	Erhardt

Competence Certificate
The control of success takes place in the form of an **examination of a different kind**.

One part of the performance review takes the form of a written test of approx. 90 minutes on the lecture and the contents of the internship. About this part of the examination 80% of the points can be reached. In addition to this written test, a protocol for the practical course must be prepared, which must meet scientific standards. Additionally, a method of chromatin research has to be presented as a short lecture (topics will be assigned). By protocol and short presentation 20% of the points can be reached.

Competence Goal
They should achieve the following learning objectives:

Basic understanding of chromatin structures and how they change during cell division.
You will acquire the basics of research with the fruit fly Drosophila melanogaster.
You will acquire methods to specifically visualize chromatin structures in cells.
You will acquire methods to specifically characterize chromatin structures at the molecular level.
You will be able to understand results from these experiments and
You will be able to present and discuss theoretical and practical details of these experiments orally and in writing (partly also in English).

Content
The module is designed to provide an in-depth look at current research directions in chromatin biology. We will incorporate current aspects of our research group to teach you about the molecular biology of chromatin and how it affects the cell cycle. Experiments, which include current research topics of the group, will introduce current techniques and questions to the participating students. Under guidance, experiments will be performed, evaluated and interpreted independently. This also includes the theoretical follow-up of the experiments and the writing of a detailed protocol.

Annotation
A large part of the internship is held in English

Workload
Attendance time:

- Lecture: 15 h; 1 SWS; 1 LP
- Practical course: 90 h; 6 SWS; 7 LP

Preparation and wrap-up time:

- Lecture: 15 h
- Practical course: 120 h

Learning type
Lecture, practical course, presentation

Literature

- Paro, Grossniklaus, Santoro: Introduction to Epigenetics (open access) Springer. ISBN 978-3-030-68669-7, available April 2021
- Nordheim, Knippers et al: Molecular Genetics ISBN 9783132426375
- Duffy JB: GAL4 system in Drosophila: a fly geneticist's Swiss army knife DOI: 1002/gene.10150
- Martire, Banaszynki: The roles of histone variants in fine-tuning chromatin organization and function https:// nature.com/articles/s41580-020-0262-8

M 8.53 Module: Research Module: Developmental Neurobiology (M5207) [M-CHEMBIO-100249]

Responsible: Prof. Dr. Martin Bastmeyer
Dr. Joachim Bentrop
Prof. Dr. Simone Mayer
Dr. Sepand Rastegar
Dr. Franco Weth

Organisation: KIT Department of Chemistry and Biosciences

Part of: Zoology (Compulsory Elective Subject - Research)
Developmental Biology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Biophysics (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	German	4	2

Mandatory			
T-CHEMBIO-108677	Developmental Neurobiology	8 CR	Bastmeyer, Bentrop

Competence Certificate
The control of success takes place in the form of an examination performance of a different kind.
A total of 100 points can be acquired.

- The first part of the examination is a written exam of 120 minutes on the lecture and the contents of the internship. Up to 90 points can be achieved via this part of the examination.
- In addition to this written test, a protocol on the internship must be prepared, which must meet scientific standards. Up to 10 points are awarded for this protocol.

Prerequisites
none

Competence Goal
Students will.

-Know and understand the conceptual subject matter in the field of neurodevelopmental biology,

-can critically read and evaluate relevant literature,

-know, understand, and master current experimental methods in neurobiology,

-are able to investigate scientific questions in teamwork,

-can professionally document experimental results through reliable laboratory record keeping,

-Will be able to present and analyze the problem of an experiment and its execution, the results and their interpretations in a protocol,

-can present a scientific project in a clear, understandable and reflective manner.

Content
Lecture:

This lecture introduces concepts and methods of modern neurodevelopmental biology.

Aspects covered:

-molecular organization, structure, and function of the vertebrate nervous system.

-axonal growth and axonal pathfinding

-neuronal development and regeneration

Model systems: Cell culture, zebrafish, mouse

Practicum:

Students complete small scientific projects based on current research priorities. They read original literature, write a final protocol in the form of a short scientific publication, and present their project in an oral presentation.

Possible areas of focus:

-Neurodevelopmental biology of mouse and zebrafish.

-RNA antisense techniques, manipulation of protein expression

-Establishment of neuronal cell cultures

-Retinal explants

-Biofunctionalization of surfaces

-In situ hybridization, cloning, qPCR

-immunostaining, digital fluorescence microscopy. quantitative image analysis

Annotation
Module rotation: WS: 1st block period

Module duration: 4 weeks, full day

Declaration according to § 30a LHG

Information about animals and their use.

Inthis module work is done with animals. Zebrafish from the laboratory's own husbandry are mated to obtain embryos. Studies on these embryos will take place up to 5 dpf of age. Fin clips from adults can also be made. Molecular biology and histology studies are performed on organs from laboratory-bred mice. Chicken eggs for embryo collection (E6 of 21) are obtained from a commercial breeding operation. All husbandry and interventions are approved by the responsible regional council.

Reasons why the use of animals in this module cannot be dispensed with

The development of the nervous system in vertebrates is based on complex interactions between the cell types involved. Often, only some of the cell types or proteins involved have been identified. Consequently, these issues cannot be fully investigated in *in vitro culture systems*, because not all molecular parameters are known that would need to be reconstructed in these systems. Also, the complex spatial environment in which neurons differentiate cannot be fully simulated in culture.

Information about the courses or performance assessments students can alternatively take

This is an elective course; students may alternatively take other FOR/PRO modules that do not involve animals.

Workload
Attendance time:

- Lecture: 15 h; 1 SWS; 1 LP
- Practical course: 90 h; 6 SWS; 7 LP

Preparation and wrap-up time:

- Lecture: 15 h
- Practical course: 120 h

Learning type
Lecture, seminar, practical course

Literature
Lecture notes

Brown, Keynes, Lumsden: The developing brain

Sanes, Reh, Harris: Development of the nervous system

Purves et al.: Neuroscience

Alberts et al.: Molecular Biology of the Cell

Lodish et al.: Molecular Cell Biology

Karp: Molecular Cell Biology

Pollard; Cell Biology

M 8.54 Module: Research Module: Diversity, Systematics and Evolution of Insects (MFOR8203) [M-CHEMBIO-107269]

Responsible: Prof. Dr. Martin Husemann
Organisation: KIT Department of Chemistry and Biosciences
Part of: Zoology (Compulsory Elective Subject - Research)
Taxonomy and Geoecology (Taxonomy and Geoecology)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-CHEMBIO-114315	Diversity, Systematics and Evolution of Insects	8 CR	Husemann

Competence Goal
Understanding the diversity and systematics of insects, evolutionary biology basics, writing scientific articles, project planning and implementation, molecular and ecological methods, writing a scientific article, scientific presentation with discussion.

Content
Insects are the most species-rich group of animals on earth. They have conquered almost all habitats and are adapted in many ways. In the course, the diversity and systematics of insects are taught in a lecture and various methods of studying insect diversity are described. In the seminar, current studies on insect systematics and their evolution are presented by the students. In the practical course, students investigate specific topics on the taxonomy, systematics or ecology of this fascinating group of animals in small projects of their own design. The results are presented in a lecture and summarized in a scientific study.

Learning type
Lecture, seminar and practical course

M 8.55 Module: Research Module: Ecology of City Trees under Global Change (MFOR1220) [M-CHEMBIO-106908]

Responsible: Dr. Somidh Saha
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-CHEMBIO-113844	Ecology of City Trees under Global Change	8 CR	Saha

Competence Certificate
Testing of a different kind

Prerequisites
Students should be open to data collection and excursion from outdoor trees (near streets, parks, cemeteries, etc.) during the module from mid-January to mid-February.

Competence Goal

- Students will learn stress ecology (e.g., drought's impact on city trees), dendroecology (e.g., tree ring and climate), ecophysiology (transpiration, photosynthesis, sap flow), and the growth pattern of city trees growing in contrasting conditions, such as parks and streets. They will also be introduced to ongoing field experiments on city trees in Karlsruhe.
- The students will be presented with the differences in tree morphology (crown volume, leaf area) and roots (fine roots) between parks and streets and their implications for ecosystem services and relation to arboriculture/tree care.
- Students will learn about internal trunk damage and the variation between tree species and growing habitats (e.g., parks and streets).
- Students will be introduced to the habitat diversity potentials of large trees growing in parks and cemeteries in Karlsruhe, with particular emphasis on tree-related microhabitats.
- Concentrations of metallic pollutants in soils, twigs, leaves, and barks will be discussed and shown to students, emphasizing its ecotoxicological implication.
- Students will know how to develop experiments in controlled and field conditions in urban ecology and botany of city trees.
- Students will learn the following techniques: sonic tomography for internal trunk damage assessment, fine-root analysis using the WinRHIZO scanning system, heavy metal pollution analysis using handheld X-ray spectrometers, field tree inventory, and microhabitat assessment.
- Students will learn how people in Karlsruhe, as well as in cities countries like Ghana, India, South Korea, and Indonesia, perceive the importance of city trees.

Content

- Life of a city tree (nursery development, site preparation, planting, development stages, senescence, death and removal).
- Crown morphology and size allometry of city trees and their variations between growing habitats.
- Production and stress ecology of city trees (light, water, and nutrients use efficiency, supply, and uptake with emphasis on drought) .
- Root ecology of city trees.
- City trees as toxicological bioindicators with a focus on fruit and nut trees in cities.
- Microhabitat and biodiversity values of city trees.
- Provisioning, regulating, supporting and cultural ecosystem services of trees.

Module grade calculation

- Each student needs to write a written exam of 90 minutes to get 50% of the total notes
- Students should form a group, select a topic for research, and write a short report.(maximum ten pages) on a selected practical research topic to get 50% of the notes. Based on enrollment number of groups and topics will be decided. In each group maximum 4 students are expected.

Annotation
The module can serve as a starting point if students wish to write their Master's thesis in the field of urban ecology and botany of urban trees. A project module is possible by arrangement.

Workload

- Total: 240 hours
- Lecture by teachers: 20 hours
- Practical and field course under the supervision of instructors/teachers: 20 hours
- Study: 40 hours
- Independent practical and field course: 150 hours

Learning type
Classroom lecture, laboratory, outdoor lecture, excursions, field data collections from trees growing near streets, parks, and cemeteries.

Base for
Master thesis

M 8.56 Module: Research Module: Epigenetics (M7201) [M-CHEMBIO-105669]

Responsible: Prof. Dr. Sylvia Erhardt
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Research)
Zoology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Duration	Language	Level	Version
8	Grade to a tenth	1 term	English	4	1

Mandatory			
T-CHEMBIO-111322	Epigenetics	8 CR	Erhardt

Competence Goal
They should achieve the following learning objectives

- Basic understanding of epigenetics and chromatin biology.
- You will be able to carry out molecular and cell biology research with transgenic Drosophila melanogaster and/or culture cells in basic research.
- You will acquire methods to specifically generate and analyze expression changes.
- You will be able to understand and interpret the results of these experiments.
- You will be able to present and discuss theoretical and practical details of these experiments orally and in writing in English.

Content
The module aims to provide an in-depth insight into current research directions in epigenetics. Various aspects of epigenetics, epitranscriptomics and chromatin biology will be discussed. Novel methods for analyzing epigenetic phenomena will also be discussed on the basis of current research questions. The participating students will be introduced to current techniques and questions by means of experiments that include current research focuses of the chair. Experiments will be carried out, evaluated and interpreted independently under supervision. This also includes the theoretical follow-up of the experiments and the writing of a detailed protocol.

Annotation
A large part of the internship is held in English

Learning type
Lecture, practical course, presentation

Literature

- Paro, Grossniklaus, Santoro: Introduction to Epigenetics (open access) Springer. ISBN 978-3-030-68669-7, available April 2021
- Nordheim, Knippers et al: Molecular Genetics ISBN 9783132426375
- Duffy JB: GAL4 system in Drosophila: a fly geneticist's Swiss army knife DOI: 10.1002/gene.10150
- Martire, Banaszynki: The roles of histone variants in fine-tuning chromatin organization and function https://www.nature.com/articles/s41580-020-0262-8

M 8.57 Module: Research Module: Genetics and Protein Chemistry (M7201) [M-CHEMBIO-100269]

Responsible: Prof. Dr. Anne Ulrich
Organisation: KIT Department of Chemistry and Biosciences
Part of: Biochemistry (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CHEMBIO-100515	Biochemistry II - Genetics (Lecture)	1 CR	Ulrich
T-CHEMBIO-100516	Biochemistry - Genetics, Protein Chemical Methods (Practical Research Course)	7 CR	

Competence Goal
After completing the module, students will be able to apply their specialist knowledge and modern biochemistry methods to simple scientific questions, as they will have acquired a broad knowledge of the structure and function of proteins, lipids, carbohydrates and nucleic acids in the two lectures and the subsequent practical course. They know the mechanisms of enzymatic reactions and how these are regulated. They know how biomembranes are composed and how signals and substances are transported through them. They know the different strategies a cell can use to generate energy and are familiar with the metabolic pathways of sugars, fats and amino acids. They have developed an understanding of how genes are read to produce proteins and how this process can be regulated and influenced both in the organism and in the laboratory. They will then be able to apply this specialist and methodological knowledge to questions of protein research (cloning of genes and expression, purification and characterization of proteins) and the characterization of enzymes (enzyme kinetics) during the practical course. They are able to evaluate and interpret the data obtained in the experiments and then present and discuss them controversially in German or English during the seminar accompanying the practical course, taking into account the specialist literature.

Content
Biochemistry of carbohydrates and nucleic acidsCarbohydrates: glycolysis, citrate cycle, respiratory chain, gluconeogenesisMetabolism of fatty acids, urea cycleNucleic acids: transcription, translation, protein biosynthesisDNA replication, genetic engineering

Literature

- Müller-Esterl "Biochemistry - An introduction for physicians and scientists"
- Stryer "Biochemistry"
- Voet/Voet/Pratt "Textbook of Biochemistry" (Ed. Beck-Sickinger & Hahn,Wiley-CH)Munk
- "Biochemistry, Cell Biology, Ecology, Evolution" (Grundstudium Biologie, Spektrum Verlag)-
- Horn/Lindenmeier/Moc/Grilhösl/Berghold/Schneider/Münster "Biochemie des Menschen" (Thieme Verlag)Skri
- Script with pictures from Müller-Esterl (on biochemistry homepage)

M 8.58 Module: Research Module: Genetics of Lower Eukaryotes (M4201) [M-CHEMBIO-100224]

Responsible: Prof. Dr. Jörg Kämper
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Research)
Microbiology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	German	4	2

Mandatory			
T-CHEMBIO-108661	Genetics of Lower Eukaryotes	8 CR	Kämper

Competence Certificate
The control of success of this module is one marked performance of different types of examination
Maximum 100 points can be reached. These points consits the following components:

- On examination is a written part, with duration of 120 minutes, about the contents of the lecture and the practical part. With this performance 80 points can be reached.
- Beside this written test, a protocol of the practical part must be written. This protocol must be in accordance with scientific requirements.
  For this protocol 10 points can be reached.
- Furthermore, 10 points can be achieved by giving a talk about methods, techniques and subjects conveyed by the practical course.

Prerequisites
none

Competence Goal
They should achieve the following learning objectives

-Planning and execution of experiments for the modification of genomes of lower eukaryotes

-conceptual understanding of analysis methods for targeted genome modifications

-Use of programs for planning cloning, implementation of experimental designs in experiments

-molecular phenotyping of lower eukaryotes

-Application of the yeast two hybrid system (and corresponding controls) for the study of protein interactions

-Application of techniques for the expression analysis of genes and proteins

Content
Lecture:

Concepts and mechanisms of regulatory processes in lower eukaryotes(yeasts and hyphal fungi).

Mechanistic focus:

Signal perception: function of receptors; 2-component systems, signal transduction: G-proteins, cAMP; MAPK cascades, mechanisms of gene regulation: transcription factors, chromatin structure, DNA modification, complex regulatory mechanisms, systems biology.

Organismic focus:

Function of cross-type loci; cross-type switching; silencing; osmoregulation; regulation of sugar metabolism and amino acid metabolism; regulation of gene clusters

Analytical focus:

Reverse genetics; screening methods, reporter systems; tagging mutagenesis techniques; global gene expression analysis; analysis of protein interactions (two-hybrid systems, BIACORE, protein chips, methods for purification of native complexes)

Practical course:

Introduction of genetic systems for the analysis of molecular regulatory processes.

Independent planning and execution of molecular biological work with lower eukaryotes.

Transformation and targeted gene alterations in Ustilago maydis (transformation, analytical PCR and Southern analysis to verify homologous recombination events); phenotypic and molecular analysis of the effects of gene alterations (crossover assays, plant infection, RFLP analysis), analysis of protein-protein interactions in the yeast two-hybrid system (cloning of altered genes from U. maydis in yeast vectors, transformation of yeast, interaction assays); sequencing of mutated genes; sequence analysis.

Annotation
Module cycle: SS: 1st block period

Module duration: 4 weeks, full day

Learning type
Lecture, seminar, practical course

Literature
Practical course script, original literature related to the experiment

M 8.59 Module: Research Module: Methods of Developmental Biology (M6202) [M-CHEMBIO-100251]

Responsible: Dr. habil. Dietmar Gradl
Prof. Dr. Ferdinand le Noble
Organisation: KIT Department of Chemistry and Biosciences
Part of: Zoology (Compulsory Elective Subject - Research)
Developmental Biology (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each term	1 term	German/English	4	2

Mandatory			
T-CHEMBIO-108975	Methods of Developmental Biology	8 CR	Gradl, le Noble

Prerequisites
none

Competence Goal
Understanding the molecular mechanisms regulating early embryogenesis in vertebrates and invertebrates.

Content
•Determinantes und morphogenes
•Cleavage types
•Organization centers and induction of cell fate
•Signal transduction pathways
•Determination of body axes
•Gastrulation
•Neurulation
•Neural crest cells
•Handling of Xenopus embryos
•Comparative morphology with different histological methods, including Gryosections and microtome sections
•Staining of germ layers via in situ hybridisation and antibody staining in Xenopus, hydra, zebrafish and mouse.
•Tissue explantations
Axis induction assays

Literature
•Scott F. Gilbert, Developmental Biology, 7th ed., Sinauer, 2006
•Lewis Wolpert, Entwicklungsbiologie, Spektrum Verlag, 2007
•Internetmaterialien unter http://www.zi2.uni-karlsruhe.de/hauptstudium_ss.html

M 8.60 Module: Research Module: Methods of Developmental Genetics (M3208) [M-CHEMBIO-103095]

Responsible: Prof. Dr. Lennart Hilbert
Prof.Dr. Uwe Strähle

Organisation: KIT Department of Chemistry and Biosciences

Part of: Genetics (Compulsory Elective Subject - Research)
Zoology (Compulsory Elective Subject - Research)
Developmental Biology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	English	4	2

Mandatory			
T-CHEMBIO-108671	Methods of Developmental Genetics	8 CR	Hilbert, Strähle

Competence Certificate
Knowledge acquisition will be assessed by a written examinations (one examination for each module) and the absolvation of the practical course

Prerequisites
None

Competence Goal
You are expected to achieve the following learning objectives:

- Be familiar with the early stages of embryonic development, namely embryonic genome activation and differentiation of stem cells into spatially ordered and molecularly defined tissue precursor cells (germ layers).
- You are familiar with the main processes of molecular control of early developmental stages and can explain them in the context of general mechanisms of chromatin establishment and transcriptional control.
- In the practical course, you will work with zebrafish eggs and primary cell cultures obtained from these eggs, which are used as laboratory model systems of early embryonic development. You will perform fluorescence staining, microinjections, and various methods of high-resolution fluorescence microscopy on these eggs.
- They will be able to use the different methods as well as recent original scientific literature in theory and practice to answer questions in developmental biology and cell biology
- In the form of short review lectures, you will learn the ability to communicate your results to your audience in a condensed and appealing form

Content
The Methods of Developmental Genetics module focuses on the range of methods for developmental biology and genetics, specifically in the zebrafish model system. We aim to teach you molecular biology and microscopic techniques that can be used to detect and induce changes in genome organization, transcription, and the cell cycle during development. These techniques have numerous applications in research, as well as in industrial biotechnology and medicine. We will continue to teach you how to observe phenotypes in the development of fish eggs and young larvae, which you can use to determine the effects of perturbations in transcription and its control. You will work in a team on your own project and learn how to apply the techniques practically.

The course will be accompanied by lectures and seminars in which the main concepts of early embryonic development, relevant molecular biology and genetic methods and tools and their application, as well as work on primary literature will be covered in more depth.

Workload
Attendance time:

- Lecture: 15 h; 1 SWS; 1 LP
- Practical course: 90 h; 6 SWS; 7 LP

Preparation and wrap-up time:

- Lecture: 15 h
- Practical course: 120 h

Learning type
Lecture and practical course

M 8.61 Module: Research Module: Microbiology of Eukaryotes (M4206) [M-CHEMBIO-100225]

Responsible: Prof. Dr. Reinhard Fischer
Dr. Maria Cristina Stroe

Organisation: KIT Department of Chemistry and Biosciences

Part of: Genetics (Compulsory Elective Subject - Research)
Microbiology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	German	4	2

Mandatory			
T-CHEMBIO-108663	Microbiology of Eukaryotes	8 CR	Fischer, Stroe

Competence Certificate
The examination is a written examination with a duration of 120 minutes
Examnined are the contents of the lecture and the practical course.

Prerequisites
none

Competence Goal
They should achieve the following learning objectives

-deepen the conceptual discussion for the chosen area

-read original literature and practise evaluating it critically

-carry out a research project lasting approximately four weeks

-Practice and deepen all aspects of scientific work and documentation

-You develop fluency in teamwork and practice organizing yourself

-practise presenting clearly, comprehensibly and scientifically

-You will practise being fluent and confident in an international context

Content
In this course we deal with applied aspects of molecular mycology. Fungi play a major role in food and modern biotechnology. We will learn methods for analyzing secondary metabolism and isolating exoenzymes.

Topics of the accompanying lecture:

-Molecular biology of fungi

-Developmental biology

-molecular biology of light regulation in fungi

-Circadian rhythms

-Secondary metabolites - Toxins and antibiotics

-Biotechnology - Fungi as cell factories

Topics of the practical part

Diversity of fungi: Isolation and molecular characterization

Investigation of the light dependence of sterigmatocystin and penicillin synthesis in A. nidulans and alternariol formation in Alternaria alternata (thin-layer chromatography, HPLC and inhibition test)

Investigation of the light induction of a gene using a reporter

Detection of the binding of light regulators to the promoters of light-regulated genes

Isolation of a laccase from a basidiomycete using FPLC

Use of the enzyme in a biological fuel cell

Annotation
Module cycle: WS: 3rd block period

Module duration: 4 weeks, full day

Learning type
Lecture, seminar, practical course

Literature
Textbook "General Microbiology", Ed. Munk, Thieme Verlag, chapter "Fungi"

Papers on secondary metabolites and laccase from the working group (can be downloaded here: http://www.iab.kit.edu/microbio/490.php)

M 8.62 Module: Research Module: Molecular and Cell Biology of Mycorrhiza (M2207) [M-CHEMBIO-100200]

Responsible: Prof. Dr. Natalia Requena Sanchez
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Research)
Genetics (Compulsory Elective Subject - Research)
Microbiology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Biotechnology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	English	4	2

Mandatory			
T-CHEMBIO-108653	Molecular and Cell Biology of Mycorrhiza	8 CR	Requena Sanchez

Competence Certificate
The control of success of this module is one marked performance of different types of examination
Maximum 100 points can be reached. These points consits the following components:

- On examination is a written part, with duration of 120 minutes, about the contents of the lecture and the practical part. With this performance 90 points can be reached.
- Beside this written test, a protocol of the practical part must be written. This protocol must be in accordance with scientific requirements.
  For this protocol 10 points can be reached.

Prerequisites
none

Competence Goal
The following teaching goals are supposed to be reached:

•You will achieve a full understanding of the molecular and cellular mechanisms underlying the symbiotic interaction between arbuscular mycorrhizal fungi and their host plants.

•You will be able to carry out experiment in order to manipulate plant or fungal genes to analyze their putative role in the symbiosis

•You will be able to plan and carry out complex molecular biological experiments involving arbuscular mycorrhizal fungi and plants.

Content
The majority of plants in the terrestrial ecosystem (80%) are colonized by arbuscular mycorrhizal fungi. They are key to the plants to grow under poor nutrient conditions and thus are key for the sustainability of plant growth and future agricultural programs. However, these symbiotic microorganisms are still a mystery in many aspects given their complex biology. The modern biological methods have allowed us to know much more of them and provided tools to manipulate the symbiosis. In this couse, the following related topics will be extensively studied:

•Plant reprogramming during mycorrhiza symbiosis: from the cellular to the molecular level

•Molecular analysis of nutrient exhange between symbionts

•Secretion and function of mycorrhizal fungal effectors in plant cells

Learning type
Lecture, seminar, practical course

Literature
Lecture slides and original key articles will be given during the course.

See also: http://www.iab.kit.edu/heisenberg/Publications.php

M 8.63 Module: Research Module: Molecular Biology of the Cell (M5208) [M-CHEMBIO-103530]

Responsible: Prof. Dr. Martin Bastmeyer
Dr. Joachim Bentrop

Organisation: KIT Department of Chemistry and Biosciences

Part of: Zoology (Compulsory Elective Subject - Research)
Developmental Biology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Biophysics (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	German	4	4

Mandatory			
T-CHEMBIO-107046	Molecular Biology of the Cell	8 CR	

Competence Certificate
Control of success within this module is a graded exam consisting of the folllowing parts. A maximum 100 points can be reached.

- Part one is a written exam of 120 minutes duration. It covers the contents of the lecture and of the practical course. 80 points can be acquired here.
- In addition, a protocol of the practical part must be written. This protocol has to be in accordance with scientific requirements.
  For this protocol up to 10 points can be aquired .
- Furthermore, up to 10 points can be aquired from oral knowledge checks during the during the practical couse.

Prerequisites
none

Competence Goal
The students

-learn and understand essential content in the field of cell biology,

-are able to comprehend and master current experimental methods in cell biology,

-read original scientific literature and are able to evaluate it critically,

-develop and solve scientific problems in a team,

-document the motivation, execution and results of their experiment in a protocol and analyze or discuss them on a scientific basis

-are able to present their results clearly, confidently and in an appealing form.

Content
Lecture:

In the lecture, conceptual contents from cell biology and current focal points in cell biology research are presented.

Contents:

-Structure, function, regulation and dynamics of the cytoskeleton

-Cellular receptors and extracellular matrix

-Molecular building blocks and function of focal contacts

-Signal transduction

-Cell polarization and cell migration

-Cell mechanics / mechanobiology

-Biofunctionalized surfaces in research and regenerative medicine

Practical course:

Students work in teams to carry out small scientific projects based on current research topics. For this purpose, they read original scientific literature, write a final report in the form of a short scientific publication and present their project in an oral presentation.

-Possible focus areas:

-Cell culture (permanent, stem cell or primary cell culture) and sterile work

-Production of structured growth substrates

-biofunctionalization of surfaces

-Cell adhesion, migration and differentiation on artificial substrates

-Cellular manipulation by transfection or pharmacological inhibition

-Immunohistochemical staining of cell cultures

-Living cell microscopy, epifluorescence microscopy, high-resolution microscopy

-Quantitative image analysis

Annotation
Module cycle: WS; 2nd block period

Module duration: 4 weeks, full-time

Learning type
Lecture, seminar, practical course

Literature
Lecture notes

Alberts et al.: Molecular Biology of the Cell

Lodish et al: Molecular Cell Biology

Pollard: Cell Biology

M 8.64 Module: Research Module: Molecular Cell Biology (M6201) [M-CHEMBIO-100226]

Responsible: Dr. habil. Dietmar Gradl
Prof. Dr. Ferdinand le Noble

Organisation: KIT Department of Chemistry and Biosciences

Part of: Genetics (Compulsory Elective Subject - Research)
Developmental Biology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Biophysics (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each term	1 term	German/English	4	2

Mandatory			
T-CHEMBIO-108664	Molecular Cell Biology	8 CR	Gradl, le Noble

Competence Certificate
The control of success takes place in the form of a written examination over 120 minutes, to the lecture and to the contents of the practical course.

Through individual status talks with the students and inspection of the results of the experiments, the contents of the internship are checked. The results are summarized in a protocol.

Prerequisites
none

Competence Goal
Cell culture as model system to understand complex processes including cell adhesion, cell migration, protein trafficking and gene regulation.

Content

- Introduction of proteins with dual-localization
- Properties of tumor cells (cell cycle, migration...)
- Signal transduction pathways
- Vasculogenesis induced by tumor cells
- Stem cells
- Organoids
- Passage of tissue culture cells
- Transfection methods
- Recombinant expression of proteins in eucaryotic cells
- Live imaging
- Reporter gene analyses
- Adhesion- and migration assays
- Immuno fluorescence analyses

Literature

- Alberts et al., Molekularbiologie der Zelle, Wiley, VCH
- Pollar & Earnshaw, Saunders
- Internetmaterialien unter http://www.zi2.uni-karlsruhe.de/hauptstudium_ss.html

und http://www.zi2.uni-karlsruhe.de/forschung.html

M 8.65 Module: Research Module: Molecular Plant-Microbe Interactions (M2208) [M-CHEMBIO-100201]

Responsible: Prof. Dr. Natalia Requena Sanchez
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Research)
Genetics (Compulsory Elective Subject - Research)
Microbiology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Biotechnology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	English	4	2

Mandatory			
T-CHEMBIO-108654	Molecular Plant-Microbe Interactions	8 CR	Requena Sanchez

Competence Certificate
The control of success of this module is one markedperformance of different types of examination
Maximum 100 points can be reached. These points consits the following components:

- On examination is a written part,with duration of 120 minutes, about the contents of the lecture and the practical part. With this performance 90 points can be reached.
- Beside this written test, a protocol of the practical part must be written. This protocol must be in accordance with scientific requirements.
  For this protocol 10 points can be reached.

Prerequisites
none

Competence Goal
The following teaching goals are supposed to be reached:

•You will get acquired with the basic knowledge of plant-microbial interactions, the mechanisms of plant colonization, avoidance of plant defenses, and feeding on plants. Similarly, you will learn how plant organize their defense responses towards microbes and which molecular and biochemical mechanisms are involved.

•You will get extensive knowledge in three type of model interactions and the molecular mechanisms governing them.

•You will learn how to transform plant roots and to express reporter constructs to analyze microbial interactions in this organ.

•You will be able to plan and carry out complex molecular biological experiments involving microbes and plants.

Content
•Introduction, Concepts and Definitions

•Recognition and Plant-Microbe Specificity

•Mechanisms of Plant Disease Resistance

•Bacterial and Fungal Pathogenicity/Symbiosis

•Agrobacterium-Plant Interaction

•Magnaporthe grisea and Xanthomonas spp. as model pathogenic microorganisms

•Arbuscular Mycorrhizal Fungi: model symbiotic fungi

•Hot topics

Learning type
Lecture, seminar, practical course

Literature
Molecular Biology and Biochemistry of Plants (Buchanan)

And review articles of the group http://www.iab.kit.edu/heisenberg/Publications.php

M 8.66 Module: Research Module: Pathophysiology, Molecular Basis of Diseases (M6205) [M-CHEMBIO-103501]

Responsible: Prof. Dr. Ferdinand le Noble
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Research)
Zoology (Compulsory Elective Subject - Research)
Developmental Biology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each term	1 term	German	4	3

Mandatory			
T-CHEMBIO-106980	Pathophysiology, Molecular Basis of Diseases	8 CR	Gradl, le Noble

Competence Certificate
The control of success takes place in the form of a written examination of 120 minutes, on the lecture and on the contents of the practical course.

Through individual status discussions with the students, the contents of the internship and the results of the experiments are reviewed. The results are summarized in a protocol.

Prerequisites
none

Competence Goal
Cardiovascular diseases such as heart attacks are, together with cancer, the most common cause of death in the western hemisphere. In many of these diseases, signaling cascades of embryonic growth factors are activated.

A fundamental understanding of molecular mechanisms of organogenesis and cardiovascular development will help in the development of new therapeutic approaches to treat these devastating diseases.

This module provides an insight into how developments in basic research can inform the development of new therapeutic strategies to treat patients

Content

- Introduction to Pathophysiology models for hypertension, diabetes, heart infarct-stroke-PAVD, cancer
- Introduction in the basic principles of cardiovascular development
- Physiology of the cardiovascular system (heart, vessels, kidney)
- Therapeutic strategies in ischemic cardiovascular disease
- Therapeutic strategies in cancer related disease
- Signaling cascades (including Vegf, Notch, Wnt, Bmp)
- Germ layer determination (including EMT)
- (Cardio) vascular stem cells
- Neuro-Vascular Interactions (differentiation/growth)
- Rare diseases
- Analysis of Cardiovascular development in model system (zebrafish, chicken embryo, mouse)
- Gene editing in zebrafish
- Introduction CrisprCas usage in zebrafish
- Standard molecular biology & biochemistry: PCR, cloning, Western blot
- Analysis of fluorescent reporter constructs
- In situ hybridization
- Live Imaging
- General histological methods

Annotation
Period:

WS: 3rd block period
SS: Block after the semester

This course can serve as a basic introduction to understanding how medical research is conducted. Starting from understanding the principles of molecular cell biology to implementation approaches in the clinic. Modern medical approaches, including personalized medicine, are based on the discoveries of basic scientists.

Declaration according to § 30a LHG

Information on animals and their use.

Animals are used**in**this module. Zebrafish from the laboratory's own husbandry are mated to obtain embryos. Studies are carried out on these embryos up to an age of 5 dpf. Fin-clips of adult animals can also be produced All husbandry and interventions are approved by the responsible regional council.

Reasons why the use of animals cannot be dispensed with in this module

The development of the vertebrate vascular system is based on complex interactions between the cell types involved. Often only some of the cell types or proteins involved have been identified. Consequently, these questions cannot be fully investigated in *in vitro culture systems*because not all molecular parameters are known that would have to be reconstructed in these systems. Furthermore, the complex spatial environment into which the developing vessel grows cannot be fully simulated in culture.

Information on the courses and performance assessments to which students can alternatively switch

This is an elective course; students can alternatively take other FOR/PRO modules that do not involve working with animals.

Learning type
Lecture, Practical Course, Seminar

Literature

- Scott F. Gilbert, Developmental Biology, 7th ed., Sinauer, 2006
- Guyton & Hall: Textbook of Medical Physiology. 12th edition, 2011 (Saunders, Elsevier).
- Internetmaterialien unter http://www.zi2.uni-karlsruhe.de/hauptstudium_ss.html

M 8.67 Module: Research Module: Phenomics and Chemomics (M3209) [M-CHEMBIO-103298]

Responsible: Dr. Thomas Dickmeis
Prof. Dr. Lennart Hilbert

Organisation: KIT Department of Chemistry and Biosciences

Part of: Genetics (Compulsory Elective Subject - Research)
Zoology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Biochemistry (Compulsory Elective Subject - Research)
Biotechnology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	English	4	2

Mandatory			
T-CHEMBIO-108673	Phenomics and Chemomics	8 CR	Strähle

Competence Certificate
The examination consists of two different exam components

- In the first course part, handling of zebrafish for experimental purposes will be taught. This one week-long course part will be closed with a written test.
- Subsequently, knowledge on high-throughput methods in phenotyping and chemical screening will be acquired by introductory lectures as well as practical experimental work. Topics include: analysis of the transcriptome, the metabolome, the chemome, small molecule screens, genetic screens, high-throughput microscopy and robotics,and behvioural analysis (photomotor response, swimming behaviour etc.). This 3 weeks-long part of the course will be closed with a second written test. The final mark will be composed from the marks obtained in the two course exams (25 and 75%, respectively).

Prerequisites
none

Content
In this course you will learn how to conduct chemical in vivo screens in the zebrafish model system. Equally, you will be introduced to selected methods for follow-up analysis of such screens, including OMICS-type methods.

Already one week before the actual start of the course, you will receive a set of tasks to prepare you for the course. In the first part of the course, you will then receive a small chemical library and test the effects of these compounds on various aspects of zebrafish biology, such as embryonic development, escape response behavior, and the hormone system.

In the second part of the course, you will further characterize the effects caused by some of the library compounds and thereby become acquainted with methods typically used in the zebrafish model system. As it will sometimes be necessary to understand changes in gene expression on a global level to understand how a compound affects the phenotype of an organism, we will also introduce you to the theory behind Next Generation Sequencing (NGS) techniques. In the last part of the course, you will learn how to use R, a program environment for statistical data analysis, and apply it to selected problems relevant to the techniques and concepts examined in the first parts of the course, such as analyzing behavior assay results or evaluating statistical differences between large sets of gene expression data.

To fill experimental breaks, we will both give lectures and listen to your presentations of selected literature that provides deeper insights into some special aspects of chemical screening and the zebrafish model. Also, at selected times during the course, we will take a step back from the experimental and theoretical focus of the course and look at science in its broader context within our society. You will present and discuss papers from the “Science and Society” section of the journal EMBO reports, dealing for example with questions such as advantages and disadvantages of pre-print publishing, research with human embryos, the role prizes and awards play in science etc.

The course ends with a written exam on Friday of the last week.

Learning type
Vorlesung, Practical Course, Seminar

M 8.68 Module: Research Module: Photoreceptors in Plants and Microorganisms (M1205) [M-CHEMBIO-100195]

Responsible: Prof. Dr. Tilman Lamparter
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Research)
Microbiology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	German	4	2

Mandatory			
T-CHEMBIO-108618	Photoreceptors in Plants and Microorganisms	8 CR	Lamparter

Competence Certificate
Written examination with a duration of 120 minutes

Prerequisites
none

Competence Goal
The following teaching goals are supposed to be reached:

•Dealing with photometers and fluorometers

•What is a chromophore ?

•Learning protein techniques such as recombinant expression, chromatography, SDS -PAGE , Western Blot

•Preparing media and buffers

•Understanding of the operation of photoreceptors

•Overview of different photoreceptors

•Optogenetics

Content
We will perform biochemical studies on photolyases and phytochrome from Agrobacterium tumefaciens and plants. Experiments will deal e.g. with light-induced conformational changes of the protein. These photoreceptors are recombinantly expressed and purified by affinity chromatography. Site-directed mutagenesis might be performed to determine the function of individual amino acids. The biological action of phytochrome in plants and Agrobacterium are also investigated.

M 8.69 Module: Research Module: Plant Cell Biology (M1201) [M-CHEMBIO-100191]

Responsible: Prof. Dr. Peter Nick
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Research)
Developmental Biology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each term	1 term	English	4	2

Mandatory			
T-CHEMBIO-108615	Plant Cell Biology	8 CR	Nick

Competence Certificate
The performance review takes place in the form of an examination performance of a different kind
A total of 120 points can be acquired. These are composed of

- a written test of 120 minutes on contents of the lecture. 60 points of the total score can be achieved with this test.
- Group exercises (individual input via Ilias). With this 18 points can be acquired.
- In-depth exercises accompanying the lectures. This allows 30 points to be earned.
- a protocol of the practical course, which must meet scientific standards. For this protocol 8 points can be earned.
- a project proposal, which must be developed according to scientific criteria. 4 points can be earned for this proposal.
- the presentation of the project in a lecture. For good presentations a grade bonus of maximum 0.3 grade levels can be earned.

Successful participation in the internship is a necessary prerequisite for completion of the module. This is documented by a countersigned acceptance protocol. Criteria for passing are regular attendance, compliance with safety regulations, documentation of experiments and data, and organization of samples according to scientific standards. In case the acceptance protocol is not accepted, the internship is considered as failed. Here, depending on the individual case, conditions are agreed upon that must be fulfilled before the examination performance can be accepted as passed.

Prerequisites
none

Competence Goal
You will be expected to achieve the following learning objectives.

-In-depth introduction to the methods and concepts of modern plant cell biology.

-Competence in the interpretation of common laboratory methods, especially fluorescence microscopy.

-Found understanding of these methods.

-Introduction to independent scientific thinking, critical use of primary and secondary literature.

-Understanding of the peculiarities of the plant cytoskeleton.

-Cellular aspects of plant development.

Content
The lecture will be given in English.

-Molecular microscopy (fundamentals of fluorescence and confocal microscopy, FRET, FRAP, quantitative image analysis, superresolution-microscopy).

-Molecular probes (GFP, immunofluorescence, artifacts and controls, novel fluorescent proteins with applications).

-Cellular manipulation (microinjection, patch-clamp, biolistics, cell sorting, enhancer trap, laser-tweezer, chemical engineering, optical engineering)

-Plant cytoskeleton (structure, functions, cell cycle, tubulin modifications, actin).

-Self-organization (cellular basis of development, totipotency, self-organization in different organisms in comparison, auxin, polarity)

Annotation
Module rotation:

WS: 1st block
and after WS together with the bachelor preparation module approx. end of February to end of March

Module duration: 4 weeks full day

Workload
Attendance time:

- Lecture: 15 h; 1 SWS; 1 LP
- Practical course: 90 h; 6 SWS; 7 LP

Preparation and wrap-up time:

- Lecture: 15 h
- Practical course: 120 h

Recommendation
The course can be well combined with a subsequent project module in Plant Cell Biology.

Learning type
Lecture, seminar, practical course

Literature
http://www.botanik.kit.edu/botzell/578.php

Base for
Project Module Plant Cell Biology, Master thesis

M 8.70 Module: Research Module: Plant Developmental Biology (MFOR1221) [M-CHEMBIO-106909]

Responsible: Dr. Jathish Ponnu
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Research)
Developmental Biology (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-CHEMBIO-113846	Plant Developmental Biology	8 CR	Ponnu

Competence Certificate
The course includes classroom lectures and a research module featuring hands-on laboratory experience. The research module will be conducted individually or in groups, depending on the number of participating students. The total marks for the whole course are 100, with 80 marks allocated to a 120-minute written examination based on the lectures. The remaining 20 marks can be earned from the research module (10 marks for the performance in the practical module and presentation of the results and 10 marks for the written report).

Competence Goal

- Introduction to the Methods and Concepts of Plant Developmental Biology
- Hands-on Experience and Competence in Common Laboratory Methods including confocal microscopy
- Understanding the Basis of Plant Development
- Factors Influencing Plant Development
- Introduction to Leaf Development
- Heterophylly as a Developmental and Adaptive Mechanism

Content

- Cells to organs: Concepts in organ formation
- Seed germination and development
- Plant stem cells and development
- Regulation of plant shoot architecture
- Origin of leaves and auxin as a driver of leaf development
- Molecular mechanisms of leaf development
- Evolution of leaf shapes
- Heterophylly, an extreme form of phenotypic plasticity

Module grade calculation
The total marks for the whole course are 100, with 80 marks allocated to a 120-minute written examination based on the lectures. The remaining 20 marks can be earned from the research module (10 marks for the performance in the practical module and presentation of the results and 10 marks for the written report).

Annotation
1st block

Workload
Internship: 90 h
Preparation and follow-up time: 120 h

Recommendation
A basic understanding of plant sciences would be advantageous.

Learning type
Lecture and exercise

Literature
Plant Physiology and Development: Lincoln Taiz

M 8.71 Module: Research Module: Plant Evolution: Methods and Concepts (M1202) [M-CHEMBIO-100192]

Responsible: Prof. Dr. Peter Nick
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Research)
Genetics (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Biotechnology (Compulsory Elective Subject - Research)
Taxonomy and Geoecology (Taxonomy and Geoecology)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each term	1 term	English	4	3

Mandatory			
T-CHEMBIO-108616	Plant Evolution	8 CR	Nick

Competence Certificate
The performance is rated as examination of mixed type. In total 120 points can be raised. These are composed of

- a written examen over 120 min on contents of the lecture maximally yielding 60 points.
- group exercises (individual entry via Ilias) maximally yielding 18 points.
- exercises on special topics accompanying the lecture maximaly yielding 30 points.
- a protocol on the practical project meeting scientific standards maximally yielding 8 points.
- a project proposal following scientific criteria maximally yielding 4 points.
- a presentation of the project which can improve the final mark by maximally a step of 0.3

Successful participation in the practical project is a necessary condition for completion of the module. This is documented by a countersigned handover protocol. Success criteria are, in addition of regular presence, compliance with security rules, documentation of experiments and data, as well as handling of samples following good scientific practice. In case that the handover protocol is not accepted, due to violation of these criteria, the practical part is considered as not passed. This can be compensated by agreement of appropriate conditions that have to be met, before the practical part is accepted as successfully passed.

Prerequisites
none

Competence Goal

- In-depth introduction to the methods and concepts of modern plant evolutionary biology.
- Competence in the interpretation of common laboratory methods.
- Thorough understanding of these methods.
- Introduction to independent scientific thinking, critical approach to primary and secondary literature.
- Understanding of the causes of plant biodiversity.
- Insight into the use of plant biodiversity.

Content
The lecture will be held in English.

- Mechanisms of plant evolution (variation, selection, speciation, species concept, coevolution)
- Cardinal points of plant evolution (multicellularity, shore leave, telomere theory, sexuality, alternation of generations, angiosperm evolution)
- Molecular phylogeny (basics, MP, NJ, ML, UPGMA, creation of trees, limitations, genetic barcoding, microsatellites, molecular authentication)
- Plant-human coevolution (biogeography, domestication, Wawilow centers, biodiversity and society, patenting, seeds as a political issue)
- Plant-pathogen coevolution (plant immunity, necrotrophy, biotrophy, effectors, application, resistance breeding and management)

Annotation
Module cycle:

WS: Block period after the winter semester

SS: 1st block period

Module duration: 4 weeks, full day

Learning type
Lecture, seminar, practical course

Literature
https://www.jkip.kit.edu/botzell/90.php

M 8.72 Module: Research Module: Plant Gene Technology - Precise Genome Engineering (M2201) [M-CHEMBIO-100198]

Responsible: Prof. Dr. Holger Puchta
Dr. Michelle Meghan Rönspies

Organisation: KIT Department of Chemistry and Biosciences

Part of: Botany (Compulsory Elective Subject - Research)
Genetics (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Biotechnology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each term	1 term	German/English	4	2

Mandatory			
T-CHEMBIO-108629	Plant Gene Technology - Precise Genome Engineering	8 CR	Puchta, Schindele, Schindele

Competence Certificate
Written examination with a duration of 120minutes

Prerequisites
none

Competence Goal
The following teaching goals are supposed to be reached:
• You are able to work with transgenic plants in a molecular biology basic research setting
• You acquire methods to generate directed changes in the genome of plants and to analyze them
• You can employ experiments to link mutations in certain genes with changes in a plant organism
• You are able to understand and interpret results of such experiments
• You can present theoretical and practical details of such experiments in a written and oral manner

Content
This module will offer an in-depth look into current research in plant molecular genetics. Aspects of DNA recombination and biotechnological applications will be discussed. Using examples from current research questions, newly developed methods to quantitatively analyse recombination mechanisms and to make targeted changes to these mechanisms will be addressed.
Through experiments related to current research of the institute, students will learn techniques and developments in modern gene technology. Guided by several supervisors, the students will carry out and analyze a number of experiments on their own. This also includes theoretical revision of the experiments and the preparation of a detailed report.

Learning type
Lecture, Practical work

Literature

- Gentechnik bei Pflanzen (F. u. R. Kempken), Springer, 2012
- Lewin's Genes XI (Krebs, Goldstein und Kilpatrick), Jones and Barlett, 2013
- Molecular Biology of the Gene (Watson et al.), Cummings, 2013
- Molekulare Genetik (Nordheim und Knippers), Thieme Verlag, 2015
- Genome und Gene (T.A. Brown), Spektrum Akademischer Verlag, 2007
- Der Experimentator: Molekularbiologie / Genomics (Mülhardt), Spektrum Akademischer Verlag, 2013
- online scripts

M 8.73 Module: Research Module: Protein Crystallization (M1207) [M-CHEMBIO-100197]

Responsible: Prof. Dr. Tilman Lamparter
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Research)
Microbiology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Biochemistry (Compulsory Elective Subject - Research)
Biotechnology (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	German	4	2

Mandatory			
T-CHEMBIO-108624	Protein Crystallization	8 CR	Lamparter

Competence Certificate
Written Examination with a duration of 120 minutes

Prerequisites
none

Competence Goal
The following teaching goals are supposed to be reached:

- You should purify proteins so that they can be used for crystallization
- You should get to know the different conditions for protein crystallization
- You should get familiar with screening strategies and optimization procedures
- You should learn how to access coordinates in the database and how to visualize 3D structures of proteins
- You should understand how to get from the crystal to diffraction to the electron density and the 3D model
- They should deepen understanding of individual proteins used in the course,

Learning type
Lecture, seminar, practical work

Literature
PROTEIN CRYSTALLIZATION Second Edition, edited by Terese Bergfors

Sylvie Doublie, Macromolecular Crystallography 1 and2

M 8.74 Module: Research Module: Protein Isolation and Kinetics (M7202) [M-CHEMBIO-100270]

Responsible: Prof. Dr. Anne Ulrich
Organisation: KIT Department of Chemistry and Biosciences
Part of: Biochemistry (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CHEMBIO-100517	Biochemistry II - Protein Purification (Lecture)	1 CR	
T-CHEMBIO-100518	Biochemistry - Protein Purification, Kinetics (Practical Research Course)	7 CR	

Competence Certificate
This module contains two parts:

- A written examination of 120 minutes is written on the contents of the lecture
- The practical course is an ungraded course achievement, a report must be prepared

Competence Goal
After completing the module, students have basic specialist knowledge in the field of chemical biology. They acquire basic knowledge of the manipulation of biological processes using chemical methods. They gain an insight into the organic synthesis of biologically active molecules such as nucleic acids, lipids, peptides and glycostructures as well as the combinatorial synthesis of small molecules and solid-phase chemistry. They acquire knowledge in the field of bioconjugation, bioorthogonal reactions and various labeling strategies for biomolecules. Furthermore, students gain insights into modern techniques in chemical biology such as various high-pressure techniques, FRET, RNAi and knockdown techniques, chemical genetics, phage display, yeast systems, pulldowns, microarrays, etc. They know how biomembranes are composed and how signals and substances are transported through them. You will be able to transfer the knowledge acquired in physical chemistry, such as thermodynamics, kinetics and spectroscopy, to biological systems

Content
"Introduction to chemical biology; fundamentals of solid phase synthesis" Peptide synthesis, DNA and RNA synthesis, oligosaccharide synthesis, chemical genetics; biologically relevant properties of small molecules; drugs, natural products; lipinski and drug delivery, lipids and membranes, DOS and BIOS, chemical bioorthogonal reactions, microarraysI: principles, production, analysis and application (DNA and protein microarrays), microarrays II: Production, analysis and application (peptide, carbohydrate and small-molecule microarrays),Site-specific labeling in macromolecules; semisynthesis, SNAP tag, FlAsH, sortase tag, halo tag, "fluorescence techniques, fluorescence polarization; TRFP; FRET, "theory of binding models, systematics of binding studies, "pulldown assays, chemical genetics, yeast-based screens, reporter genes, Yeast-2-hybrid, allele-specific chemical sensitivity, DNA-tags, chemical complementation, Y2H in proteomics, protein networks, RNAi and antisense techniques, PNA, morpholinos, cell penetration techniques for synthetic substances, antibodies, natural combinatorics, AK as tools in chemical biology & medicine; combinatorics and biomolecular biology; combinatorics and biomolecular biology; combinatorics and biomolecular biology; combinatorics and biomolecular biology; combinatorics and biomolecular biology. Medicine; combinatorics and biomolecules: AK mapping; directed evolution, phage display, miniproteins, ribozymes, aptamers, SELEX, DNA structures, basics of crosslinkers, crosslinking strategies, chemical inducers of dimerization, allele-specific inhibitors / bump-hole strategy,deleted, proteomics, activity-based protein profiling, SILAC,mutagenesis strategies, expansion of the genetic code, photoprotective groups, cagedcompounds, photoswitchable molecules

Workload

- Lecture 15 hours (1 SWS, 1 LP)
- Practical course: 105 hours attendance time (7 SWS, 7 LP)
- Preparation and follow-up time 120 hours

M 8.75 Module: Research Module: Quantitative Phenotyping in Breeding (MFOR1204) [M-CHEMBIO-106694]

Responsible: Dr. Katja Herzog
Prof. Dr. Peter Nick

Organisation: KIT Department of Chemistry and Biosciences

Part of: Botany (Compulsory Elective Subject - Research)
Genetics (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	German/English	4	1

Mandatory			
T-CHEMBIO-113461	Quantitative Phenotyping in Breeding	8 CR	Herzog, Nick

Competence Goal
They should achieve the following learning objectives

- You will be familiar with various fields of application of quantitative phenotyping in different crops and model plants and their importance for basic research, breeding and precision agriculture
- You will have learned the basics and fields of application of the various sensor techniques for laboratory, greenhouse and field applications and know how to apply them yourself to practical vine breeding and breeding research issues
- They have become familiar with methods from practical breeding research and can apply these to their own search for solutions

Content

- Importance, development and potential of sensor-based high-throughput phenotyping and automated data analysis in plant breeding/breeding research, basic research, applied research including data science and data interpretation.
- Imaging and non-imaging sensors
- Satellite-, air- & ground-based platforms depending on the research questions
- Sensor techniques (3D, hyperspectral, RGB, near-infrared (NIR), laser, etc.)
- Sensor data resolution vs. recording speed
- Basics of sensor and trait data evaluation (data science), incl. data processing and modeling for the development of prediction models, genetic mapping & selection, phytopathology and evaluation of gene-phenotype-environment interactions
- Importance of databases, international standards, metadata, setting up experiments for applications in the field of artificial intelligence
- Application of the basics you have learned: you will independently collect analytical, microscopic and quantitative reference data to check the accuracy and efficiency of the various sensors used.
- The practical part comprises three focus topics: Here you will learn about three different fields of application (including data collection, evaluation (statistics with R) and data visualization) in breeding, which you can also transfer to other crops and issues:
- Week 1: Identification of new disease resistance: AI-based leaf disk assay
- Week 2: Non-destructive sensors for the prediction of analytical ingredients
- Week 3: High-throughput phenotyping - trait prediction

Changes are possible.

M 8.76 Module: Research Module: Resilience - Plants Conquer Land (M1203) [M-CHEMBIO-106787]

Responsible: Dr. Gabriele Jürges
Prof. Dr. Peter Nick

Organisation: KIT Department of Chemistry and Biosciences

Part of: Botany (Compulsory Elective Subject - Research)
Microbiology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	German/English	4	2

Mandatory			
T-CHEMBIO-113638	Resilience - Plants Conquer Land	8 CR	Jürges, Nick

Competence Certificate
Testing of a different kind

Prerequisites
Basic knowledge of botany and evolution.

Competence Goal
Students are able to recognize the most important forms of algae, early land plants and fungi (traditionally "cryptogams") and know the key features of their life cycle, structure and ecological function. They know what challenges had to be overcome when going on land and what evolutionary solutions were developed for this. They have a basic understanding of plant stress physiology and understand why knowledge of "cryptogams" is important for overcoming the challenges of climate change.

Content
Plants without flowers, their algal ancestors and their fungal companions were considered a peripheral area of plant science for decades. As they do not bear flowers and their sexuality therefore remained hidden, cryptic, they were traditionally referred to as "cryptogams". They were seen as exotic, peripheral life forms, as archaic precursors of the "real" plants. This viewpoint has since been proven ignorant - it is becoming increasingly clear that these "cryptogams" developed numerous innovations that enabled them to cope with the harsh conditions of terrestrial life long before land animals came on the scene. These innovations helped to overcome numerous stress factors such as lack of water, heat, UV stress, strong light stress or lack of nutrients. Exactly the same stress factors are now becoming relevant as a result of man-made climate change. If we understand how plants managed to colonize the land, we can use these innovations for a more sustainable and resilient agriculture. Recent years have led to new insights into the early evolution of land plants, particularly through advances in phylogenomics. To interpret these data, a thorough understanding of the diversity of non-flowering plants, the specificities of their life cycle and their physiological adaptations is needed. This is only possible if one also considers their ancestors, the various groups of algae. A deeper understanding also requires looking at the plants' companions, the fungi, without which the land journey would never have been possible. The course consists of two parts

- In the theoretical part, the different groups of "cryptogams" are presented in terms of organization, diversity, life cycle and ecological relationships. Furthermore, the evolution of early land plants and the innovations in morphology, development and physiology that made this evolution possible are presented.
- In the practical part, students practise distinguishing and identifying different life forms of algae, mosses, lichens, ferns and fungi in order to be able to deal with this diversity. This is supplemented by excursions in the surrounding area, work in the herbarium of the Natural History Museum, but also by laboratory studies using classical and modern methods of taxonomy.

Topics:

Part 1 (Gabriele Jürges): Diversity

Algae. Mosses. Fungi. Lichens. Ferns

Part 2 (Peter Nick): Shore leave

Challenges and solutions. How it really happened - from freshwater algae to gymnosperms. Evolution of stress resilience - how it was, how it will be. The explorers - algae. The helpers - fungi. The pioneers - bryophytes. The breakthrough - ferns

Module grade calculation
Written exam (80%), minutes (10%) and final presentation (10%)

Workload
Attendance time: Lectures 15 h, practical part 90 h. Preparation and follow-up 15 h

Recommendation
If you have not studied the Bachelor's degree at KIT, you should take another look at the Evolution section in the Fundamentals of Biology (1st semester Bachelor's degree).

Learning type
Impulse lectures in the morning, followed by a practical part to practice knowledge of forms, excursions, developmental biology experiments.

Literature
Strasburger, Chapter 5
Büdel et al.: Biology of Algae, Lichens and Bryophytes, Springer Verlag

M 8.77 Module: Research Module: Seed Technology (M1204) [M-CHEMBIO-100194]

Responsible: Prof. Dr. Peter Nick
Organisation: KIT Department of Chemistry and Biosciences
Part of: Botany (Compulsory Elective Subject - Research)
Genetics (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	German	4	2

Mandatory			
T-CHEMBIO-108710	Seed Technology	8 CR	Nick

Prerequisites
none

Literature
http://www.botanik.kit.edu/botzell/581.php

M 8.78 Module: Research Module: Signal Transduction and Gene Regulation I (M3204) [M-CHEMBIO-100222]

Responsible: Prof. Dr. Jörg Kämper
Prof. Dr. Véronique Orian-Rousseau

Organisation: KIT Department of Chemistry and Biosciences

Part of: Genetics (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	German	4	2

Mandatory			
T-CHEMBIO-108659	Signaltransduction and Gene Regulation I	8 CR	Kämper

Competence Certificate
The control of success takes place in the form of an examination performance of a different kind
A total of 100 points can be acquired.

- One part of the examination takes the form of a written test lasting 90 minutes, on the lecture and the contents of the internship. About this part of the examination 80 points of the total score can be achieved.
- In addition to this written test, a report on the internship must be prepared, which must meet scientific standards. For this protocol 10 points can be obtained.
- Furthermore, 10 points can be earned through a presentation prepared by the student on methods, techniques and/or contents of the internship.

Prerequisites
none

Competence Goal
Not recommended for beginning Master's students.The following learning objectives are aimed at:

-General understanding of the different regulatory concepts in signal transduction and gene regulation of prokaryotic and eukaryotic cells.

-Understand the applicability and use of various me-thods for analyzing regulatory processes.

-Authoring of scientific protocols and presentations.

Content
Lecture:

-Concepts and mechanisms of regulatory processes in prokaryotes and eukaryotes.

-control mechanisms of transcription

-Regulation of gene activity by external signals

-Signal perception: function of receptors; 2-component systems

-Signal transduction: GProteins, PKA, MAPK cascades

-Mechanisms of gene regulation: transcription factors, chromatin structure, DNA modification, complex regulatory mechanisms

-Analytical methods DNA/protein interaction (EMSA, footprint analyses)

Practical course:

Experimental part 1

Investigation of DNA-protein interactions: Overexpression and purification of a DNA-binding protein Analysis of DNA binding (Electrophoretic Mobility Shift Assay, EMSA) Determination of binding preferences (DNA bending assays).

Experimental part 2

Cellular responses to growth factors and dysregulated signaling pathways of receptor tyrosine kinases: Immunofluorescence Separation of protein mixtures and specific protein detection (SDS-PAGE, Western blot) Qualitative protein determination by Coomassie and ink staining Detection method for cell proliferation (BrdU assay).

Experimental part 3

Signal transduction and gene regulation by steroid hormone receptors in human cell lines: Determination of promoter activity by reporter gene analysis Determination of mRNA quantity by real-time PCR analysis; quantification of expression by Western blot analysis.

Annotation
Module cycle: WS: 2nd block period

Module duration: 4 weeks, full day

The module can be taken independently of Signal Transduction and Gene Regulation II

Workload
Attendance time:

- Lecture: 15 h; 1 SWS; 1 LP
- Practical course: 90 h; 6 SWS; 7 LP

Preparation and wrap-up time:

- Lecture: 15 h
- Practical course: 120 h

Recommendation
Not recommended for Master's students at the beginning of the program.

M 8.79 Module: Research Module: Signal Transduction and Gene Regulation II (M3205) [M-CHEMBIO-100223]

Responsible: Dr. Olivier Kassel
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	English	4	2

Mandatory			
T-CHEMBIO-108660	Signaltransduction und Gene Regulation II	8 CR	Schepers

Competence Certificate
The control of success of this module is one marked performance of different types of examination
Maximum 100 points can be reached. These points consits the following components:

- On examination is a written part, with duration of 120 minutes, about the contents of the lecture and the practical part. With this performance 90 points can be reached.
- Beside this written test, a protocol of the practical part must be written. This protocol must be in accordance with scientific requirements.
  For this protocol 10 points can be reached.

Prerequisites
none

Competence Goal
The students have an in-depth knowledge of the biology of the systems studied.

- They can also comprehend and reproduce complex relationships in the field.
- They can conduct experiments independently under guidance, can evaluate results and draw conclusions for a further procedure.
- They can evaluate the results of scientific work and discuss them by including results from the literature.
- They can present and discuss their results orally.

Content
Olivier Kassel:

Lecture:

- Skeletal muscle plasticity
- Transcriptional and translational control
- methods

Practical course:

- Cell culture, transfection
- In vitro myoblast differentiation
- SDS-PAGE/Western blot
- Myofiber growth in zebrafish embryo
- Confocal microscopy
- Optogenetics in vitro and in vivo (zebrafish)

Daniela Vallone:

Lecture:

- The endogenous circadian time-keeping mechanism
- The molecular mechanisms involved in the circadian clock entrainment and the rhythmic regulation of physiology and behavior in a vertebrate model system "the Fish"

Practical course:

- Cell culture, transfection
- Luciferase reporter assays in vivo and in vitro
- Gene expression analysis (quantitative RT-PCR, Western blotting...)

Annotation
Module cycle: SS: 2nd block period

Module duration: 4 weeks, full day

The module can be taken independently of Signal Transduction and Gene Regulation I

Workload

- Attendance time: (Lecture, Practical coursework): 98 hours
- independent study (homework, preparation for exams, recording): 142 hours

sum: 240 hours

Learning type
Lecture, seminar, practical course

Literature
Current publications and textbooks on the respective chosen practical course after consultation with the supervisors.

M 8.80 Module: Research Module: Techniques in Microscopy (M5206) [M-CHEMBIO-100248]

Responsible: Prof. Dr. Martin Bastmeyer
Organisation: KIT Department of Chemistry and Biosciences
Part of: Zoology (Compulsory Elective Subject - Research)
Developmental Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Biophysics (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	German	4	4

Mandatory			
T-CHEMBIO-108676	Techniques in Microscopy	8 CR	Bastmeyer, Weth

Competence Certificate
Control of success within this module is a graded exam consisting of the folllowing parts. A maximum 100 points can be reached.

- Part one is a written exam of 120 minutes duration. It covers the contents of the lecture and of the practical course. 80 points can be acquired here.
- In addition, a protocol of the practical part must be written. This protocol has to be in accordance with scientific requirements.
  For this protocol up to 10 points can be aquired .
- Furthermore, up to 10 points can be aquired from oral knowledge checks during the during the practical couse.

Prerequisites
none

Competence Goal
They should achieve the following learning objectives

-master the geometric and wave-optical principles of image formation in the light microscope

-Understand the physical principles of fluorescent proteins and fluorescent dyes

-Understand laser scanning microscopy

-You are proficient in digital image processing

-You will master the handling of various microscopy techniques

-Understand how the technical development of microscopy techniques has influenced biological research

Content
Lecture:

The lecture introduces general principles of light microscopy and modern methods of fluorescence microscopy.

Contents:

-formation in the light microscope, optical resolution, phase contrast, interference contrast

-Sample preparation

-Theory of fluorescence microscopy

-Fluorescent dyes and fluorescent proteins

-Theory of laser scanning microscopy (LSM)

-Microscopy methods for the production of optical sections

-High-resolution microscopy (super-resolution)

-Digital cameras, photomultipliers, digital image processing

Practical course:

Students carry out small scientific projects as part of a team. They learn methods for preparing biological samples and apply various fluorescence microscopy techniques. They read original scientific literature, write a final report in the form of a short scientific publication and present their project in an oral presentation.

Focus areas:

-Immunohistochemical staining of cell cultures

-transfection with fluorescent proteins

-Wide-field fluorescence microscopy

-Laser scanning microscopy (LSM)

High-resolution microscopy (SIM, dSTORM)

-live cell imaging

-Digital image processing, 3D reconstruction, quantitative evaluation methods

Annotation
Module cycle: SS: 3rd block period

Module duration: 4 weeks, full-time

Learning type
Lecture, seminar, practical course

Literature
Alan R. Hibbs: Confocal Microscopy for Biologists, Springer Press

Rafael Yuste (Ed.): Imaging, a laboratory manual, CSH Press

James Pawley: Handbook of biological confocal microscopy, Plenum Press

M 8.81 Module: Research Module: Tissue Engineering and 3D Cell Culture (M3207) [M-CHEMBIO-101596]

Responsible: Prof. Dr. Ute Schepers
Organisation: KIT Department of Chemistry and Biosciences
Part of: Genetics (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Biochemistry (Compulsory Elective Subject - Research)
Biotechnology (Compulsory Elective Subject - Research)
Life Science Engineering (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	German	4	2

Mandatory			
T-CHEMBIO-108667	Tissue Engineering and 3D Cell Culture	8 CR	Schepers

Competence Certificate
The examination is a written examination with a duration of 120 minutes
Examnined are the contents of the lecture and the practical course.

Prerequisites
None

Competence Goal
The students get an overview of the general chemical and biological basics of tissue engineering. This includes: Chemical synthesis of hydrogels for cell culture, chemical analysis of synthesized gels, basics of 2D and 3D cell culture of human cells, formation of spheroids, embedding of cells in hydrogels and microscopic analysis of the formed structures.

Content

- Techniques in 2D cell culture
- Techniques in 3D cell culture
- Formation of spheroids
- Viability assay
- Fluorescence staining
- Toxicity screening of nanoparticles on spheroids
- Microscopy/Fluorescence Microscopy
- Chemical synthesis of hydrogels for application in 3D cell culture
- Chemical characterization of hydrogels
- Physical characterization of photoinitiators for application in 3D cell culture

M 8.82 Module: Research Module: Transcriptomic Analysis (MFOR5220) [M-CHEMBIO-106907]

Responsible: Prof. Dr. Simone Mayer
Organisation: KIT Department of Chemistry and Biosciences
Part of: Zoology (Compulsory Elective Subject - Research)
Developmental Biology (Compulsory Elective Subject - Research)
Molecular Biology (Compulsory Elective Subject - Research)
Cell Biology (Compulsory Elective Subject - Research)
Biotechnology (Compulsory Elective Subject - Research)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-CHEMBIO-113843	Transcriptomic analysis	8 CR	Mayer

Competence Certificate
Written examination, 60 min

Competence Goal
The aim of this module is to become familiar with state-of-the-art methods, experimental design, data analysis and the conceptualization of scientific projects. Moreover, we will practice understanding scientific publications and discussing them critically in different modes of communication.

Content
This module will give an overview of the growing field of systems biology and omics approaches to address biological questions. Specifically, we will focus on transcriptomic analysis in greater depth and students will learn to apply bioinformatics approaches to analyze transcriptomic data. Students will also read current research papers and critically discuss them in a presentation and written review article.

Module grade calculation
Written Exam, 120 min (50%), presentation (25%), practical work and discussion (15%), Paper Critique (10%)

Annotation
Repeated every winter semester, 3rd block
4 weeks full time

Workload
200 h

Recommendation
Book: Transcriptomics in Health and Disease, edited by G. Passos https://link.springer.com/book/10.1007/978-3-030-87821-4

Learning type
Lecture, seminar, practical course

M 8.83 Module: Supplementary Studies on Science, Technology and Society [M-FORUM-106753]

Responsible: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
Part of: Additional Examinations

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
16	Grade to a tenth	Each term	3 terms	German	4	1

Election notes
Students have to self-record the achievements obtained in the Supplementary Studies on Science, Technology and Society in their study plan. FORUM (formerly ZAK) records the achievements as "non-assigned" under "ÜQ/SQ-Leistungen". Further instructions on self-recording of achievements can be found in the FAQ at https://campus.studium.kit.edu/ and on the FORUM homepage at https://www.forum.kit.edu/english/. The title of the examination and the amount of credits override the modules placeholders.

If you want to use FORUM achievements for both your Interdisciplinary Qualifications and for the Supplementary Studies, please record them in the Interdisciplinary Qualifications first. You can then get in contact with the FORUM study services (stg@forum.kit.edu) to also record them in your Supplementary Studies.

In the Advanced Unit you can choose examinations from three subject areas: "About Knowledge and Science", "Science in Society" and "Science in Social Debates". It is advised to complete courses from each of the three subject areas in the Advanced Unit.

To self-record achievements in the Advanced Unit, you have to select a free placeholder partial examination first. The placeholders' title do *not* affect which achievements the placeholder can be used for!

Mandatory			
T-FORUM-113578	Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration	2 CR	Mielke, Myglas
T-FORUM-113579	Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration	2 CR	Mielke, Myglas
Advanced Unit Supplementary Studies on Science, Technology and Society (Election: at least 12 credits)			
T-FORUM-113580	Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration	3 CR	Mielke, Myglas
T-FORUM-113581	Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration	3 CR	Mielke, Myglas
T-FORUM-113582	Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration	3 CR	Mielke, Myglas
Mandatory			
T-FORUM-113587	Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society	0 CR	Mielke, Myglas

Competence Certificate
The monitoring is explained in the respective partial achievement.

They are composed of:
- Protocols
- Reflection reports
- Presentations
- Preparation of a project work
- An individual term paper
- An oral examination
- A written exam

Upon successful completion of the supplementary studies, graduates receive a graded report and a certificate issued by the FORUM.

Prerequisites
The course is offered during the course of study and does not have to be completed within a defined period. Enrollment is required for all assessments of the modules in the supplementary studies.
Participation in the supplementary studies is regulated by § 3 of the statutes. KIT students register for the supplementary studies by selecting this module in the student portal and booking a performance themselves. Registration for courses, assessments, and exams is regulated by § 8 of the statutes and is usually possible shortly before the start of the semester.
The course catalog, module description (module manual), statutes (study regulations), and guidelines for creating the various written performance requirements can be downloaded from the FORUM homepage at https://www.forum.kit.edu/begleitstudium-wtg.php.

Registration and exam modalities

PLEASE NOTE:
Registration on the FORUM, i.e. additionally via the module selection in the student portal, enables students to receive up-to-date information about courses or study modalities. In addition, registering on the FORUM ensures that you have proof of the credits you have earned. As it is currently (as of winter semester 24-25) not yet possible to continue additional credits acquired in the Bachelor's programme electronically in the Master's programme, we strongly advise you to digitally secure the credits you have earned by archiving the Bachelor's transcript of records yourself and by registering on FORUM.
In the event that a transcript of records of the Bachelor's certificate is no longer available - we can only assign the achievements of registered students and thus take them into account when issuing the certificate.

Competence Goal
Graduates of the Supplementary Studies on Science, Technology, and Society gain a solid foundation in understanding the interplay between science, the public, business, and politics. They develop practical skills essential for careers in media, political consulting, or research management. The program prepares them to foster innovation, influence social processes, and engage in dialogue with political and societal entities. Participants are introduced to interdisciplinary perspectives, encompassing social sciences and humanities, to enhance their understanding of science, technology, and society. The teaching objectives of this supplementary degree program include equipping participants with both subject-specific knowledge and insights from epistemological, economic, social, cultural, and psychological perspectives on scientific knowledge and its application in various sectors. Students are trained to critically assess and balance the implications of their actions at the intersection of science and society. This training prepares them for roles as students, researchers, future decision-makers, and active members of society.

Through the program, participants learn to contextualize in-depth content within broader frameworks, independently analyze and evaluate selected course materials, and communicate their findings effectively in both written and oral formats. Graduates are adept at analyzing social issues and problem areas, reflecting on them critically from a socially responsible and sustainable standpoint.

Content
The Supplementary Studies on Science, Technology and Society can be started in the 1st semester of the enrolled degree programme and is not limited in time. The wide range of courses offered by FORUM makes it possible to complete the program usually within three semesters. The supplementary studies comprises 16 or more credit points (LP). It consists of **two modules: the Basic Module (4 LP) and the Advanced Module (12 LP)**.

The **basic Module** comprises the compulsory courses 'Lecture Series Supplementary Studies on Science, Technology and Society' and a basic seminar with a total of 4 LP.

The **Advanced Module** comprises courses totalling 12 LP in the humanities and social sciences subject areas 'On Knowledge and Science', 'Science in Society' and 'Science in Public Debates'. The allocation of courses to the accompanying study programme can be found on the homepage https://www.forum.kit.edu/wtg-aktuellland in the printed FORUM course catalogue.

The 3 thematic subject areas:

Subject area 1: About Knowledge and Science

This is about the internal perspective of science: students explore the creation of knowledge, distinguishing between scientific and non-scientific statements (e.g., beliefs, pseudo-scientific claims, ideological statements), and examining the prerequisites, goals, and methods of knowledge generation. They investigate how researchers address their own biases, analyze the structure of scientific explanatory and forecasting models in various disciplines, and learn about the mechanisms of scientific quality assurance.

After completing courses in the "Knowledge and Science" area, students can critically reflect on the ideals and realities of contemporary science. They will be able to address questions such as: How robust is scientific knowledge? What are the capabilities and limitations of predictive models? How effective is quality assurance in science, and how can it be improved? What types of questions can science answer, and what questions remain beyond its scope?

Subject area 2: Science in Society

This focuses on the interactions between science and different areas of society, such as how scientific knowledge influences social decision-making and how social demands impact scientific research. Students learn about the specific functional logics of various societal sectors and, based on this understanding, estimate where conflicts of goals and actions might arise in transfer processes—for example, between science and business, science and politics, or science and journalism. Typical questions in this subject area include: How and under what conditions does an innovation emerge from a scientific discovery? How does scientific policy advice work? How do business and politics influence science, and when is this problematic? According to which criteria do journalists incorporate scientific findings into media reporting? Where does hostility towards science originate, and how can social trust in science be strengthened?

After completing courses in the "Sciene in Society" area, students can understand and assess the goals and constraints of actors in different societal sectors. This equips them to adopt various perspectives of communication and action partners in transfer processes and to act competently at various social interfaces with research in their professional lives.

Subject area 3: Science in Public Debates

The courses in this subject area provide insights into current debates on major social issues such as sustainability, digitalization, artificial intelligence, gender equality, social justice, and educational opportunities. Public debates on complex challenges are often polarized, leading to oversimplifications, defamation, or ideological thinking. This can hinder effective social solution-finding processes and alienate people from the political process and from science. Debates about sustainable development are particularly affected, as they involve a wide range of scientific and technological knowledge in both problem diagnosis (e.g., loss of biodiversity, climate change, resource consumption) and solution development (e.g., nature conservation, CCS, circular economy).

By attending courses in "Science in Public Debates," students are trained in an application-oriented way to engage in factual debates—exchanging arguments, addressing their own prejudices, and handling contradictory information. They learn that factual debates can often be conducted more deeply and with more nuance than is often seen in public discourse. This training enables them to handle specific factual issues in their professional lives independently of their own biases and to be open to differentiated, fact-rich arguments.

Supplementary credits:
Additional LP (supplementary work) totalling a maximum of 12 LP can also be acquired from the complementary study programme (see statutes for the WTG complementary study programme § 7). § 4 and § 5 of the statutes remain unaffected by this. These supplementary credits are not included in the overall grade of the accompanying study programme. At the request of the participant, the supplementary work will be included in the certificate of the accompanying study programme and marked as such. Supplementary coursework is listed with the grades provided for in § 9.

Module grade calculation
The overall grade of the supplementary course is calculated as a credit-weighted average of the grades that were achieved in the advanced module.

Annotation
Climate change, biodiversity crisis, antibiotic resistance, artificial intelligence, carbon capture and storage, and gene editing are just a few areas where science and technology can diagnose and address numerous social and global challenges. The extent to which scientific findings are considered in politics and society depends on various factors, such as public understanding and trust, perceived opportunities and risks, and ethical, social, or legal considerations.
To enable students to use their expertise as future decision-makers in solving social and global challenges, we aim to equip them with the skills to navigate the interfaces between science, business, and politics competently and reflectively. In the Supplementary Studies, they acquire foundational knowledge about the interactions between science, technology, and society.

They learn:
- How reliable scientific knowledge is produced,
- how social expectations and demands influence scientific research, and
- how scientific knowledge is adopted, discussed, and utilized by society.

The program integrates essential insights from psychology, philosophy, economics, social sciences, and cultural studies into these topics. After completing the supplementary studies programme, students can place the content of their specialized studies within a broader social context. This prepares them, as future decision-makers, to navigate competently and reflectively at the intersections between science and various sectors of society, such as politics, business, or journalism, and to contribute effectively to innovation processes, public debates, or political decision-making.

Workload
The workload is made up of the number of hours of the individual modules:

- Basic Module approx. 120 hours
- Advanced Module approx. 390 hours
> Total: approx. 510 hours

In the form of supplementary services, up to approximately 390 hours of work can be added.

Recommendation
It is recommended to complete the supplementary study program in three or more semesters, beginning with the lecture series on science, technology, and society in the summer semester. Alternatively, you can start with the basic seminar in the winter semester and then attend the lecture series in the summer semester.

Courses in the Advanced Module can be taken simultaneously. It is also advised to complete courses from each of the three subject areas in the advanced unit.

Learning type
- Lectures
- Seminars/Project Seminars
- Workshops

9 Courses

T 9.1 Course: Advanced Light Microscopy (Practical Project) [T-CHEMBIO-100483]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100257 - Project Module: Advanced Light Microscopy

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.2 Course: Advanced Module Large Excursion Giglio [T-CHEMBIO-111183]

Responsible: Dr. Joachim Bentrop
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-105576 - Advanced Module Integrative Thinking

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (practical)	6	pass/fail	Each summer term	1

Workload
180 hours

T 9.3 Course: Advanced Module Large Excursion Helgoland [T-CHEMBIO-111181]

Responsible: Prof. Dr. Tilman Lamparter
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-105576 - Advanced Module Integrative Thinking

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (practical)	6	pass/fail	Each summer term	1

Events					
ST 2025	7127	Großexkursion Helgoland (MSQ-02-5501)	7 SWS	Excursion (E / 🗣)	Weclawski, Jürges, Lamparter

Legend: Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Workload
160 hours

T 9.4 Course: Advanced Module Large Excursion Southern Alps [T-CHEMBIO-111182]

Responsible: Maren Riemann
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-105576 - Advanced Module Integrative Thinking

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (practical)	6	pass/fail	Each summer term	1

Events					
ST 2025	7032_1	Geländepraktikum Lebensraum Alpen (MSQ-02-1501)	3 SWS	Practical course / 🗣	Riemann

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Prerequisites

- another major excursion should already be completed
- Participation in the lecture Integrated Analysis of Ecosystems - Southern Alps and the associated Examination

Workload
180 hours

T 9.5 Course: Application of Bacterial Secretion Systems in Biotechnology, Healthcare and Plant Sciences (Project Module) [T-CHEMBIO-114127]

Responsible: Prof. Dr. Andreas Diepold
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-107086 - Project Module: Application of Bacterial Secretion Systems in Biotechnology, Healthcare and Plant Sciences

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	7	pass/fail	Each term	1 terms	1

Competence Certificate
The project module is not graded. A qualitative assessment of success takes place in the form of a final presentation.

The success of the internship is reviewed through individual status discussions with the students and inspection of the results of the experiments.

Workload
210 hours

T 9.6 Course: Bacterial Genomic & Computational Biology (Pactical Project) [T-CHEMBIO-109787]

Responsible: Dr. John Vollmers
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-104785 - Project Module: Bacterial Genomic & Computational Biology

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (practical)	7	pass/fail	Each term	1

Prerequisites
none

Workload
210 hours

T 9.7 Course: Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113579]

Responsible: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	2	pass/fail	Each summer term	1 terms	1

Competence Certificate
Study achievement in the form of a presentation or a term paper or project work in the selected course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
It is recommended that the basic seminar be completed during the same semester as the lecture series "Science in Society". If it is not possible to attend the lecture series and the basic seminar in the same semester, the basic seminar can also be attended in the semesters before the lecture series.
However, attending courses in the advanced unit before attending the basic seminar should be avoided.

Annotation

T 9.8 Course: Biochemical Seminar 1 - Presentation Skills [T-CHEMBIO-100499]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	1

T 9.9 Course: Biochemical Seminar 2 - Techniques of Information Management [T-CHEMBIO-100508]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	1

T 9.10 Course: Biochemistry - Genetics, Protein Chemical Methods (Practical Research Course) [T-CHEMBIO-100516]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100269 - Research Module: Genetics and Protein Chemistry

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.11 Course: Biochemistry - Peptide Structure and Function (Practical Project) [T-CHEMBIO-100519]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100271 - Project Module: Structure and Function of Peptides

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.12 Course: Biochemistry - Protein Purification, Kinetics (Practical Research Course) [T-CHEMBIO-100518]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100270 - Research Module: Protein Isolation and Kinetics

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.13 Course: Biochemistry II - Genetics (Lecture) [T-CHEMBIO-100515]

Responsible: Prof. Dr. Anne Ulrich
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100269 - Research Module: Genetics and Protein Chemistry

Type	Credits	Grading scale	Version
Written examination	1	Grade to a third	1

Prerequisites
none

T 9.14 Course: Biochemistry II - Protein Purification (Lecture) [T-CHEMBIO-100517]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100270 - Research Module: Protein Isolation and Kinetics

Type	Credits	Grading scale	Version
Written examination	1	Grade to a third	1

T 9.15 Course: Bioinformatics [T-CHEMBIO-112608]

Responsible: Prof. Dr. Lennart Hilbert
Prof. Dr. Anne-Kristin Kaster
Prof. Dr. Tilman Lamparter
Dr. Gunnar Sturm

Organisation: KIT Department of Chemistry and Biosciences

Part of: M-CHEMBIO-106206 - Research Module: Bioinformatics

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each summer term	1

Events					
WT 24/25	7400488	KOPIE Forschungsmodul Bioinformatik (MFOR 4211)	1 SWS	Lecture	Kaster, Hilbert, Vollmers, Sturm
WT 24/25	7400530	KOPIE Forschungsmodul Bioinformatik (MFOR 4211)	6 SWS	Practical course	Kaster, Hilbert, Lamparter, Vollmers
WT 24/25	7483	Forschungsmodul Bioinformatik (MFOR 4211)	1 SWS	Lecture	Kaster, Hilbert, Vollmers, Sturm
WT 24/25	7484	Forschungsmodul Bioinformatik (MFOR 4211)	6 SWS	Practical course	Kaster, Hilbert, Lamparter, Vollmers

Competence Certificate
The performance review is a written exam over 120 minutes

Prerequisites
none

Workload
240 hours

T 9.16 Course: Bioinformatics (Practical Project) [T-CHEMBIO-100418]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100211 - Project Module: Bioinformatics

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.17 Course: Biomolecular Microanalytics [T-CHEMBIO-108707]

Responsible: Prof. Dr. Christof Niemeyer
Dr. Tim Scharnweber

Organisation: KIT Department of Chemistry and Biosciences

Part of: M-CHEMBIO-100267 - Research Module: Biomolecular Microanalytics

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each summer term	1

Events					
ST 2025	5160	Biomolekulare Mikroanalytik (Forschungsmodul für Studierende der Biologie und der Chemischen Biologie)	6 SWS	Practical course / 🗣	Niemeyer

Legend: 💻 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Written exam lasting 120 minutes.

Prerequisites
none

Workload
240 hours

T 9.18 Course: Biomolecular Microanalytics (Practical Project) [T-CHEMBIO-100512]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100268 - Project Module: Biomolecular Microanalytics

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.19 Course: Biophotonics in Life Sciences (Practical Project) [T-CHEMBIO-113751]

Responsible: Prof. Dr. Moritz Kreysing
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-106861 - Project Module: Biophotonics in Life Sciences

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	7	pass/fail	Each term	1 terms	1

Workload
210 hours

T 9.20 Course: Botanical Seminar 1 - Presentation Skills [T-CHEMBIO-100489]

Responsible: Prof. Dr. Peter Nick
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	3

Events					
WT 24/25	7170	Originalliteratur kritisch lesen: Seminar Zell- und Entwicklungsbiologie der Pflanzen (Botanisches Seminar I) - (zu ModulBA-SQ 02/ ANG-06)	2 SWS	Seminar	Nick

Prerequisites
none

Annotation
Language:
Winter semester - German
Summer semester - English

T 9.21 Course: Botanical Seminar 1 - Techniques of Information Management [T-CHEMBIO-100503]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	1

Events					
ST 2025	07M-ÜQ-01	Master Seminar Konzepte bilden (Recherchetechniken und Präsentationstechniken)	2 SWS	Seminar	Biologie
ST 2025	7024	Botanisches Seminar - Vortragstechniken/ Recherchetechniken und Informationsmanagement (M1401)	2 SWS	Seminar / 🗣	Nick

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 9.22 Course: Botanical Seminar 3 - Techniques of Information Management [T-CHEMBIO-100504]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	2

Events					
WT 24/25	7172	Botanisches Seminar III - Photorezeptoren (MSQ-1402)	2 SWS	Seminar	Lamparter
ST 2025	07M-ÜQ-01	Master Seminar Konzepte bilden (Recherchetechniken und Präsentationstechniken)	2 SWS	Seminar	Biologie
ST 2025	7046	Seminar: Photorezeptoren bei Pflanzen und Mikroorganismen - Recherche-Techniken und Informationsmanagement (M1403)	2 SWS	Seminar / 🗣	Lamparter

Legend: 💻 Online, 💐 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 9.23 Course: Botanical Seminar 4 - Techniques of Information Management [T-CHEMBIO-100510]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	1

Events					
WT 24/25	7171	Botanisches Seminar IV - Molekularbiologie und Biochemie der Pflanzen (MSQ1-2403)	2 SWS	Seminar /	Puchta

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

T 9.24 Course: Cellular and Medicinal Microbiology [T-CHEMBIO-110761]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-105294 - Research Module: Cellular and Medicinal Microbiology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each summer term	1

Events					
ST 2025	7174	Forschungsmodul: Zelluläre und medizinische Mikrobiologie (MFOR-4205)	2 SWS	Lecture / 🗣	Schmidt-Heydt, Fischer

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The control of success is an examination of another type. The Maximum 100 points can be reached. These points consits the following components:

- On examination is an oral part,with this performance 90 points can be reached.
- Beside this written test, a protocol of the practical part must be written. This protocol must be in accordance with scientific requirements.
  For this protocol 10 points can be reached.

Prerequisites
none

Workload
240 hours

T 9.25 Course: Cellular and Medicinal Microbiology (Practical Project) [T-CHEMBIO-110792]

Responsible: Prof. Dr. Reinhard Fischer
PD Dr. Markus Schmidt-Heydt

Organisation: KIT Department of Chemistry and Biosciences

Part of: M-CHEMBIO-105304 - Project Module: Cellular and Medicinal Microbiology

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.26 Course: Chromatin Structures in Cell Division and Development [T-CHEMBIO-111754]

Responsible: Prof. Dr. Sylvia Erhardt
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-105842 - Research Module: Chromatin Structures in Cell Division and Development

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each summer term	1

Events					
WT 24/25	7249	Chromatin Structure Structures in Cell Division and Development	1 SWS	Lecture / 🗣	Erhardt

Legend: 💻 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Success is assessed in the form of a **different type of examination.**

Part of the assessment takes the form of a written test lasting approx. 90 minutes on the lecture and the content of the practical course. 80% of the points can be achieved through this part of the examination. In addition to this written test, a protocol of the practical course must be prepared, which must meet scientific standards. In addition, a method of chromatin research must be presented as a short lecture (topics are assigned). 20% of the points can be achieved through the protocol and short presentation.

Prerequisites
none

Workload
240 hours

T 9.27 Course: Chromatin Structures in Cell Division and Development (Practical Project) [T-CHEMBIO-112786]

Responsible: Prof. Dr. Sylvia Erhardt
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-106307 - Project Module: Chromatin Structures in Cell Division and Development

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (practical)	7	pass/fail	Each term	1

Competence Certificate

- The project module is an ungraded
- A protocol on the contents of the internship must be prepared
- The qualitative performance review takes place in the form of a presentation in English.
- During the internship, performance is monitored through individual status discussions with students and inspection of the results of their experiments.

T 9.28 Course: Current Topics in Cellular Neurobiology - Presentation Skills [T-CHEMBIO-100498]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	2

Events					
WT 24/25	7271	Seminar : Current topics in cellular neurobiology (MSQ1- 5402)	2 SWS	Seminar / 🗣	Weth, Bentrop, Hilbert, Bastmeyer, Rastegar, Mayer
ST 2025	07M-ÜQ-01	Master Seminar Konzepte bilden (Recherchetechniken und Präsentationstechniken)	2 SWS	Seminar	Biologie
ST 2025	7131	Seminar: Current topics in cellular neurobiology (M5404)	2 SWS	Seminar / 🗣	Weth, Bentrop, Bastmeyer, Hilbert, Rastegar

Legend: 📱 Online, 🌀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 9.29 Course: Current Topics in Molecular Genetics - Presentation Skills [T-CHEMBIO-100501]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	2

Events					
WT 24/25	7470	Genetisches Seminar: Aktuelle Schwerpunkte der molekularen Genetik (MSQ1-3402)	2 SWS	Seminar	Kämper, Requena Sanchez, Kaster

T 9.30 Course: Current Topics in the Life Science [T-CHEMBIO-100554]

Responsible: Prof. Dr. Véronique Orian-Rousseau
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100277 - Interdisciplinary Thinking

Type	Credits	Grading scale	Version
Completed coursework (oral)	3	pass/fail	1

Events					
ST 2025	07MÜQ-02	Master Biologie Vernetzungsseminar		Seminar	
ST 2025	7143	Current Topics in the Life Sciences: Research Seminar for PhD Students	2 SWS	Seminar / 🗣	Orian-Rousseau

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 9.31 Course: Current Topics Stem Cell Biology: Gene Regulation Programs Driving Stemness and Differentiation - Presentation Skills [T-CHEMBIO-114330]

Responsible: Prof. Dr. Sylvia Erhardt
Prof. Dr. Simone Mayer
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each summer term	1

Prerequisites
none

Recommendation
https://link.springer.com/book/10.1007/978-3-031-39027-2

Annotation
In this module, we will get an overview of different sub-topics of stem cell biology in a highly interactive format. Students will first present review papers to get an overview of a specific topic and will subsequently present primary research papers related to the overarching review.

T 9.32 Course: Developmental Neurobiology [T-CHEMBIO-108677]

Responsible: Prof. Dr. Martin Bastmeyer
Dr. Joachim Bentrop
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100249 - Research Module: Developmental Neurobiology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each winter term	1

Competence Certificate
Success is assessed in the form of a different type of examination.
A total of 100 points can be earned.

The first part of the examination is a 120-minute written test on the lecture and the content of the practical course. Up to 80 points can be achieved in this part of the examination.
In addition to this written test, a report on the practical course must be prepared, which must meet scientific standards. Up to 10 points are awarded for this report.
Furthermore, oral knowledge checks are carried out during the internship. This can also earn up to 10 points.

Prerequisites
none

Annotation
Information about the animals and their use:

This module involves working with animals. Zebrafish from the laboratory's own husbandry are mated to obtain embryos. Studies are carried out on these embryos up to an age of 5 dpf. Swabs can also be taken from the body surface of adult animals. Molecular biological and histological examinations are carried out on organs from laboratory-bred mice. Chicken eggs for embryo collection (E6 of 21) come from a commercial breeding farm. All husbandry and interventions are approved by the responsible regional council.

Reasons why the use of animals cannot be dispensed with in this module:

The development of the nervous system in vertebrates is based on complex interactions between the cell types involved. Often only some of the cell types or proteins involved have been identified. These questions cannot be fully investigated in in vitro culture systems because not all molecular parameters are known that would have to be reconstructed in these systems. Furthermore, the complex spatial environment in which nerve cells differentiate cannot be fully simulated in culture.

Information on the courses and assessments to which students can alternatively switch:

This is an elective course; students can alternatively take other FOR modules that do not involve working with animals.

Workload
240 hours

T 9.33 Course: Diversity, Systematics and Evolution of Insects [T-CHEMBIO-114315]

Responsible: Prof. Dr. Martin Husemann
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-107269 - Research Module: Diversity, Systematics and Evolution of Insects

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each summer term	1

Competence Certificate
This consists of cooperation, a written examination, a paper presentation, the project presentation and the project report.

Workload
240 hours

T 9.34 Course: Ecology of City Trees under Global Change [T-CHEMBIO-113844]

Responsible: Dr. Somidh Saha
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-106908 - Research Module: Ecology of City Trees under Global Change

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	8	Grade to a third	Each winter term	1 terms	1

Events					
WT 24/25	7151	Research Module: Ecology of City Trees under Global Change (MFOR1220)	1 SWS	Lecture / 🗣	Saha
WT 24/25	7152	Research Module: Ecology city trees und global Change (MFOR1220)	6 SWS	Practical course / 🗣	Saha

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate

- Each student needs to write a written exam of 90 minutes to get 50% of the total notes
- Students should form a group, select a topic for research, and write a short report.(maximum ten pages) on a selected practical research topic to get 50% of the notes. Based on enrollment number of groups and topics will be decided. In each group maximum 4 students are expected.

Prerequisites
Students should be open to data collection and excursion from outdoor trees (near streets, parks, cemeteries, etc.) during the module from mid-January to mid-February.

Workload
240 hours

T 9.35 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration [T-FORUM-113580]

Responsible: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Competence Certificate
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Annotation
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

In the Advanced Module, students can choose their own individual focus, e.g. sustainable development, data literacy, etc. The focus should be discussed with the module coordinator at the FORUM.

T 9.36 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration [T-FORUM-113582]

Responsible: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Competence Certificate
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Annotation
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

T 9.37 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration [T-FORUM-113581]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation: General Studies. Forum Science and Society (FORUM)

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Competence Certificate
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Annotation
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

T 9.38 Course: Epigenetics [T-CHEMBIO-111322]

Responsible: Prof. Dr. Sylvia Erhardt
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-105669 - Research Module: Epigenetics

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each summer term	1

Events					
ST 2025	7119	Forschungsmodul Epigenetik (MFOR-7201)	6 SWS	Practical course	Erhardt
ST 2025	7120	Forschungsmodul Epigenetik (MFOR-7201)	1 SWS	Lecture	Erhardt

Competence Certificate
Success is assessed in the form of a different type of examination
A total of 100 points can be earned.

Part of the performance assessment takes the form of a written test lasting 120 minutes on the lecture and the content of the practical course. This part of the examination can be used to achieve 80 points of the total number of points. In addition to this written test, a report on the internship must be prepared, which must meet scientific standards. This report can earn 10 points. Furthermore, the work of the internship must be presented within the working group as a poster or lecture. 10 points can also be earned for this part.

Prerequisites
none

Workload
240 hours

T 9.39 Course: Epigenetics (Practical Project) [T-CHEMBIO-111333]

Responsible: Prof. Dr. Sylvia Erhardt
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-105678 - Project Module: Epigenetics

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (practical)	7	pass/fail	Each term	1

Events					
WT 24/25	07MPRO-7301	Project Module Epigenetics	6 SWS	Practical course / 🗣	Erhardt

Legend: 📱 Online, 🎛 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate

- The project module is an ungraded course achievement.
- A protocol on the contents of the internship must be prepared.
- The qualitative performance review takes place in the form of a presentation.
- During the internship, the performance is checked by individual status discussions with the students and inspection of the results of their experiments.

T 9.40 Course: ExperiMentoring - The Mentoring-Program [T-CHEMBIO-111744]

Responsible: Dr. Katrin Sturm-Richter
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100277 - Interdisciplinary Thinking

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	3	pass/fail	Each winter term	5

Events					
WT 24/25	7100084	Studienstart an der Fakultät für Chemie und Biowissenschaften		Others (sons	Sturm-Richter
ST 2025	07BA-SQ-01_3	ExperiMentoring - The Mentoring-Program	1 SWS	Project (P /	Sturm-Richter

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Feedback forms and final report

Prerequisites
The orientation exam must be passed

Workload
90 hours

T 9.41 Course: Flower Ecology (Practical Project) [T-CHEMBIO-113285]

Responsible: Dr. Heiko Hentrich
Prof. Dr. Peter Nick
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-106596 - Project Module: Flower Ecology

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

Competence Certificate
The project module is not graded. A qualitative performance review takes place in the form of an accepted protocol and a final presentation (30 min).

Workload
210 hours

T 9.42 Course: Food Toxicology [T-CHEMBIO-104464]

Responsible: Prof. Dr. Andrea Hartwig
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-105674 - General and Food Toxicology for Biology Students

Type	Credits	Grading scale	Version
Oral examination	6	Grade to a third	1

Events					
ST 2025	6618	Lebensmitteltoxikologie	2 SWS	Lecture /	Hartwig, Köberle
ST 2025	6632	Übungen zur Risikobewertung toxikologisch relevanter Stoffe	1 SWS	Practice /	Hartwig, Köberle

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Workload
180 hours

T 9.43 Course: From Samples to Sequences [T-CHEMBIO-111319]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-105666 - Research Module: From Samples to Sequences

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each summer term	1

Events					
ST 2025	7150	From Samples to Sequences	6 SWS	Practical course / 🗣	Kaster, Sturm, Vollmers
ST 2025	7151	From Samples to Sequences	1 SWS	Lecture / 🗣	Kaster, Sturm, Vollmers

Legend: 🖥 Online, 💐 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Examination performance of a different kind consisting of:

- written test of 120 minutes, on the lecture and the contents of the internship. 80 points of the total score can be achieved.
- a report on the internship must be prepared, which must meet scientific standards. 10 points can be obtained.
- the work of the internship must be presented in a lecture. 10 points can be earned.

Prerequisites
none

Workload
240 hours

T 9.44 Course: Genetics of Lower Eukaryotes [T-CHEMBIO-108661]

Responsible: Prof. Dr. Jörg Kämper
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100224 - Research Module: Genetics of Lower Eukaryotes

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each summer term	1

Events					
ST 2025	7221	Forschungsmodul: Genetik niederer Eurkaryoten (Vorlesung MFOR-4201)	2 SWS	/ 🗣	Kämper
ST 2025	7222	Forschungsmodul: Genetik niederer Eurkaryoten (MFOR-4201)	6 SWS	Practical course / 🗣	Kämper

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

Workload
240 hours

T 9.45 Course: Innovative Microscopy (Practical Project) [T-CHEMBIO-113752]

Responsible: Prof. Dr. Moritz Kreysing
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-106862 - Project Module: Innovative Microscopy

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	7	pass/fail	Each term	1 terms	1

Workload
210 hours

T 9.46 Course: Integrated Analysis of Ecosystems - Giglio [T-CHEMBIO-100544]

Responsible: Dr. Joachim Bentrop
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100276 - Integrative Thinking
M-CHEMBIO-105576 - Advanced Module Integrative Thinking

Type	Credits	Grading scale	Version
Written examination	2	Grade to a third	6

Events					
WT 24/25	07MSQ2-1502	Meeresbiologie (MSQ-02-1502 Helgoland und MSQ-02-5501 Giglio	2 SWS	Lecture / 🗣	Lamparter, Weclawski, Jürges

Legend: 📱 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CHEMBIO-100542 - Integrated Analysis of Ecosystems - Helgoland must not have been started.

T 9.47 Course: Integrated Analysis of Ecosystems - Helgoland [T-CHEMBIO-100542]

Responsible: Prof. Dr. Tilman Lamparter
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100276 - Integrative Thinking
M-CHEMBIO-105576 - Advanced Module Integrative Thinking

Type	Credits	Grading scale	Version
Written examination	2	Grade to a third	7

Events					
WT 24/25	07MSQ2-1502	Meeresbiologie (MSQ-02-1502 Helgoland und MSQ-02-5501 Giglio	2 SWS	Lecture / 🗣	Lamparter, Weclawski, Jürges

Legend: 📱 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CHEMBIO-100544 - Integrated Analysis of Ecosystems - Giglio must not have been started.

T 9.48 Course: Integrated Analysis of Ecosystems - Living Environment Alpes [T-CHEMBIO-111696]

Responsible: Maren Riemann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100276 - Integrative Thinking

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	2	Grade to a third	Each winter term	2

Events					
WT 24/25	071501	Integrierte Analyse von Ökosystemen - Lebensraum Alpen	1 SWS	Lecture	Riemann
ST 2025	7032_1	Geländepraktikum Lebensraum Alpen (MSQ-02-1501)	3 SWS	Practical course / 🗣	Riemann

Legend: 📱 Online, 💐 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 9.49 Course: Integrated Analysis of Ecosystems - Southern Alps [T-CHEMBIO-111034]

Responsible: Maren Riemann
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-105576 - Advanced Module Integrative Thinking

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	2	Grade to a third	Each winter term	2

T 9.50 Course: Intensification of Bioprocesses - Written Exam [T-CIWVT-112998]

Responsible: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106416 - Intensification of Bioprocesses

Type	Credits	Grading scale	Version
Written examination	6	Grade to a third	1

Events					
ST 2025	2212050	Intensification of Bioprocesses	2 SWS	Lecture / 🗣	Holtmann
ST 2025	2212051	Intensification of Bioprocesses - Exercises	2 SWS	Practice / 🗣	Holtmann, und Mitarbeitende

Legend: 💻 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 9.51 Course: Intensivication of Bioprocesses - Lab [T-CIWVT-112999]

Responsible: Prof. Dr.-Ing. Dirk Holtmann
Dr. Anke Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106416 - Intensification of Bioprocesses

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	1

Events					
ST 2025	2212052	Intensification of Bioprocesses - Lab	2 SWS	Practical course / 🗣	Neumann, Holtmann, und Mitarbeitende

Legend: 💻 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 9.52 Course: Interdisciplinary Seminar Developmental Biology [T-CHEMBIO-100551]

Responsible: Dr. habil. Dietmar Gradl
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100277 - Interdisciplinary Thinking

Type	Credits	Grading scale	Version
Completed coursework (oral)	3	pass/fail	1

Events					
WT 24/25	7009	Interdisziplinäres Seminar Entwicklungsbiologie (Master Biologie Seminar zum Modul Interdiziplinär Denken)	2 SWS	Seminar /	Gradl, Nick, Erhardt, Bastmeyer, Ponnu

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

T 9.53 Course: Interdisciplinary Seminar Molecular Biology [T-CHEMBIO-100552]

Responsible: Prof. Dr. Jörg Kämper
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100277 - Interdisciplinary Thinking

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (oral)	3	pass/fail	Each summer term	2

Events					
ST 2025	077008	Interdisciplinary Seminar Molecular Biology (Master Biology Seminar for the module interdisciplinary thinking)	2 SWS	Seminar / 🗣	Kämper, Puchta, Orian-Rousseau, Kaster

Legend: 💻 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 9.54 Course: Introduction to R [T-BGU-107481]

Responsible: Prof. Dr. Sebastian Schmidtlein
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-105575 - Ecology

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (written)	3	pass/fail	Each summer term	1

Events					
ST 2025	6111049	Introduction to R	2 SWS	Practice / 🗣	Schmidtlein

Legend: Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Prerequisites
None

Recommendation
None

Annotation
None

Workload
90 hours

T 9.55 Course: Large Excursion Alpine Habitat [T-CHEMBIO-111699]

Responsible: Maren Riemann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100276 - Integrative Thinking

Type	Credits	Grading scale	Version
Completed coursework	7	pass/fail	2

Events					
WT 24/25	071501	Integrierte Analyse von Ökosystemen - Lebensraum Alpen	1 SWS	Lecture	Riemann

Competence Certificate
Active participation is expected during the excursions. Group protocols are written for the individual excursion days. The protocols should contain the special features of the landscape and the plant communities of the respective excursion and the most important, characteristic plants.
Furthermore, knowledge of species and professional identification of plants will be deepened, a vegetation survey will be carried out and the use of digital mapping methods and professional identification apps will be learned.

Prerequisites

- Participation in the lecture Integrated Analysis of Ecosystems - Alpine habitat and the associated Examination
- Average condition for hikes up to 10km and 600hm; sturdy hiking boots

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CHEMBIO-111696 - Integrated Analysis of Ecosystems - Living Environment Alpes must have been started.

T 9.56 Course: Large Excursion Giglio [T-CHEMBIO-100543]

Responsible: Dr. Joachim Bentrop
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100276 - Integrative Thinking

Type	Credits	Grading scale	Version
Completed coursework	7	pass/fail	4

Prerequisites
Participation in the lecture Integrated Analysis of Ecosystems - Giglio and the associated Examination

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CHEMBIO-100544 - Integrated Analysis of Ecosystems - Giglio must have been started.
2. The course T-CHEMBIO-100541 - Large Excursion Helgoland must not have been started.

T 9.57 Course: Large Excursion Helgoland [T-CHEMBIO-100541]

Responsible: Prof. Dr. Tilman Lamparter
Organisation: KIT Department of Chemistry and Biosciences
University
Part of: M-CHEMBIO-100276 - Integrative Thinking

Type	Credits	Grading scale	Version
Completed coursework	7	pass/fail	4

Events					
ST 2025	7127	Großexkursion Helgoland (MSQ-02-5501)	7 SWS	Excursion (E / 🗣)	Weclawski, Jürges, Lamparter

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Prerequisites
Participation in the lecture Integrated Analysis of Ecosystems - Helgoland and the associated Examination

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CHEMBIO-100542 - Integrated Analysis of Ecosystems - Helgoland must have been started.
2. The course T-CHEMBIO-100543 - Large Excursion Giglio must not have been started.

T 9.58 Course: Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113578]

Responsible: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	2	pass/fail	Each summer term	1 terms	1

Competence Certificate
Active participation, learning protocols, if applicable.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
It is recommended that you complete the lecture series "Science in Society" before attending events in the advanced module and in parallel with attending the basic seminar.
If it is not possible to attend the lecture series and the basic seminar in the same semester, the lecture series can also be attended after attending the basic seminar.
However, attending events in the advanced module before attending the lecture series should be avoided.

Annotation
The basic module consists of the lecture series "Science in Society" and the basic seminar. The lecture series is only offered during the summer semester.
The basic seminar can be attended in the summer or winter semester.

T 9.59 Course: Local excursion with exploration of the vegetation history of Baden [T-CHEMBIO-113851]

Responsible: Maren Riemann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100276 - Integrative Thinking

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	7	pass/fail	Each summer term	2

Events					
ST 2025	07113851	Local field internship in southwest Germany	3 SWS	Practical course / 🗣	Riemann

Legend: 🖳 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Active participation during the excursions is expected. The students independently create a scientifically sound botanical excursion. In doing so, old excursion reports by botanists from the last 150 years are taken up and the development of vegetation is researched.

Prerequisites
Participation in the lecture Integrated Analysis of Ecosystems - Alpine habitat and the associated Examination

T 9.60 Course: Master's Thesis [T-CHEMBIO-100150]

Organisation:

Part of: M-CHEMBIO-100178 - Master's Thesis

Type	Credits	Grading scale	Version
Final Thesis	30	Grade to a third	2

Competence Certificate
See Module

Prerequisites
90 LP have to be absolved

Final Thesis
This course represents a final thesis. The following periods have been supplied:

Submission deadline	6 months
Maximum extension period	3 months
Correction period	8 weeks

T 9.61 Course: Methods of Developmental Biology [T-CHEMBIO-108975]

Responsible: Dr. habil. Dietmar Gradl
Prof. Dr. Ferdinand le Noble

Organisation: KIT Department of Chemistry and Biosciences

Part of: M-CHEMBIO-100251 - Research Module: Methods of Developmental Biology

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each term	1

Events					
ST 2025	7116	Forschungsmodul: Methoden der Entwicklungsbiologie (MFOR-6202)	6 SWS	Practical course / 🗣	le Noble, Préau

Legend: 💻 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Workload
240 hours

T 9.62 Course: Methods of Developmental Biology (Practical Project) [T-CHEMBIO-100494]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100265 - Project Module: Methods of Developmental Biology

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.63 Course: Methods of Developmental Genetics [T-CHEMBIO-108671]

Responsible: Prof. Dr. Lennart Hilbert
Prof.Dr. Uwe Strähle

Organisation: KIT Department of Chemistry and Biosciences

Part of: M-CHEMBIO-103095 - Research Module: Methods of Developmental Genetics

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each winter term	1

Prerequisites
none

Workload
240 hours

T 9.64 Course: Methods of Developmental Genetics (Advanced Practical Course) [T-CHEMBIO-106140]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-103096 - Project Module: Methods of Developmental Genetics

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (practical)	7	pass/fail	Each winter term	1

Prerequisites
none

Workload
210 hours

T 9.65 Course: Microbiological Seminar - Presentation Skills [T-CHEMBIO-100495]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	2

T 9.66 Course: Microbiological Seminar 2 - Techniques of Information Management [T-CHEMBIO-100506]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	2

Events					
ST 2025	07M-ÜQ-01	Master Seminar Konzepte bilden (Recherchetechniken und Präsentationstechniken)	2 SWS	Seminar	Biologie
ST 2025	7164	Mikrobiologisches Seminar für Fortgeschrittene (M4402)	2 SWS	Seminar / 🗣	Fischer, Requena Sanchez, Kämper

Legend: 📱 Online, 🎭 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 9.67 Course: Microbiology of Eukaryotes [T-CHEMBIO-108663]

Responsible: Prof. Dr. Reinhard Fischer
Dr. Maria Cristina Stroe

Organisation: KIT Department of Chemistry and Biosciences

Part of: M-CHEMBIO-100225 - Research Module: Microbiology of Eukaryotes

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each winter term	1

Prerequisites
none

Workload
240 hours

T 9.68 Course: Microbiology of Eukaryotes (Practical Project) [T-CHEMBIO-100443]

Organisation: KIT Department of Chemistry and Biosciences
University

Part of: M-CHEMBIO-100233 - Project Module: Microbiology of Eukaryotes

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.69 Course: Molecular and Cell Biology in Plant/Pathogen Interactions (Practical Project) [T-CHEMBIO-113753]

Responsible: Prof. Dr. Jörg Kämper
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-106863 - Project Module: Molecular and Cell Biology in Plant/Pathogen Interactions

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	7	pass/fail	Each term	1 terms	1

T 9.70 Course: Molecular and Cell Biology of Mycorrhiza [T-CHEMBIO-108653]

Responsible: Prof. Dr. Natalia Requena Sanchez
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100200 - Research Module: Molecular and Cell Biology of Mycorrhiza

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each summer term	1

Events					
ST 2025	7169	Forschungsmodul: Molecular and Cell Biology of Mycorrhiza (MFOR-2207)	2 SWS	/ 🗣	Requena Sanchez
ST 2025	7170	Forschungsmodul: Molecular and Cell Biology of Mycorrhiza (MFOR-2207)	6 SWS	Practical course / 🗣	Requena Sanchez

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Prerequisites
none

Workload
240 hours

T 9.71 Course: Molecular and Cell Biology of Mycorrhiza (Practical Project) [T-CHEMBIO-100437]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100218 - Project Module: Molecular and Cell Biology of Mycorrhiza

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.72 Course: Molecular Biology of the Cell [T-CHEMBIO-107046]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-103530 - Research Module: Molecular Biology of the Cell

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each winter term	1

Events					
WT 24/25	7226	Forschungsmodul: Molekulare Biologie der Zelle (MFOR-5208)	1 SWS	Lecture	Bastmeyer
WT 24/25	7242	Forschungsmodul: Molekulare Biologie der Zelle (MFOR-5208)	6 SWS	Practical course	Bastmeyer

Competence Certificate
Success is assessed in the form of a different type of examination.
A total of 100 points can be earned.

- The first part of the examination is a 120-minute written test on the lecture and the content of the practical course. Up to 80 points can be achieved in this part of the examination.
- In addition to this written test, a report on the internship must be prepared, which must meet scientific standards. Up to 10 points are awarded for this report.
- Furthermore, oral knowledge checks are carried out during the internship. This can also earn up to 10 points.

Prerequisites
keine

Workload
240 hours

T 9.73 Course: Molecular Biology of the Cell (Practical Project) [T-CHEMBIO-108075]

Responsible: Prof. Dr. Martin Bastmeyer
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-103942 - Project Module: Molecular Biology of the Cell

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (practical)	7	pass/fail	Irregular	1

Prerequisites
none

Workload
210 hours

T 9.74 Course: Molecular Cell Biology [T-CHEMBIO-108664]

Responsible: Dr. habil. Dietmar Gradl
Prof. Dr. Ferdinand le Noble
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100226 - Research Module: Molecular Cell Biology

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each term	1

Events					
ST 2025	7104	Forschungsmodul: Molekulare Zellbiologie (MFOR-6201)	1 SWS	/	le Noble, Gradl
ST 2025	7115	Forschungsmodul: Molekulare Zellbiologie (MFOR- 6201)	6 SWS	Practical course /	le Noble, Gradl

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Prerequisites
none

Workload
240 hours

T 9.75 Course: Molecular Cell Biology (Practical Project) [T-CHEMBIO-100444]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100234 - Project Module: Molecular Cell Biology

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.76 Course: Molecular Developmental Neurobiology (Practical Project) [T-CHEMBIO-100484]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100258 - Project Module: Molecular Developmental Neurobiology

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

Prerequisites
none

Annotation
Information about the animals and their use:

Animals are used in this module. Zebrafish from the laboratory's own husbandry are mated to obtain embryos. Studies are carried out on these embryos up to an age of 5 dpf. Swabs can also be taken from the body surface of adult animals. Molecular biological and histological examinations are carried out on organs from laboratory-bred mice. Chicken eggs for embryo collection (E6 of 21) come from a commercial breeding farm. All husbandry and interventions are approved by the responsible regional council.

Reasons why the use of animals cannot be dispensed with in this module:

The development of the nervous system in vertebrates is based on complex interactions between the cell types involved. Often only some of the cell types or proteins involved have been identified. These questions cannot be fully investigated in in vitro culture systems because not all molecular parameters are known that would have to be reconstructed in these systems. Furthermore, the complex spatial environment in which nerve cells differentiate cannot be fully simulated in culture.

Information on the courses and performance assessments to which students can alternatively switch:

This is an elective course; students can alternatively take other PRO modules that do not involve working with animals.

T 9.77 Course: Molecular Genetics of Lower Eukaryotes (Practical Project) [T-CHEMBIO-100442]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100232 - Project Module: Genetics of Lower Eukaryotes

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.78 Course: Molecular Mechanism of Bacterial Secretion Systems (Project Module) [T-CHEMBIO-114126]

Responsible: Prof. Dr. Andreas Diepold
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-107084 - Project Module: Molecular Mechanism of Bacterial Secretion Systems

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	7	pass/fail	Each term	1 terms	1

Competence Certificate
The project module is not graded. A qualitative assessment of success takes place in the form of a final presentation.

The success of the internship is reviewed through individual status discussions with the students and inspection of the results of the experiments.

Workload
210 hours

T 9.79 Course: Molecular Methods in Higher Eukaryotes (Practical Project) [T-CHEMBIO-100441]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100231 - Project Module: Molecular Methods in Higher Eukaryotes

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

Events					
WT 24/25	7448	F3-Praktikum Transcriptional Control in Higher Eukaryotes (MPRO-3310)	7 SWS	Practical course	Kassel

T 9.80 Course: Molecular Plant-Microbe Interactions [T-CHEMBIO-108654]

Responsible: Prof. Dr. Natalia Requena Sanchez
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100201 - Research Module: Molecular Plant-Microbe Interactions

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each winter term	1

Prerequisites
none

Workload
240 hours

T 9.81 Course: Molecular Plant-Microbe Interactions (Practical Project) [T-CHEMBIO-100438]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100219 - Project Module: Molecular Plant-Microbe Interactions

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.82 Course: Numerical Ecology and Macroecology [T-BGU-112640]

Responsible: Prof. Dr. Sebastian Schmidtlein
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-105575 - Ecology

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	3	Grade to a third	Each winter term	1 terms	1

Events					
WT 24/25	6111205	Numerical Ecology and Macroecology	2 SWS	Practice / 🗣	Schmidtlein

Legend: 💻 Online, 🎛 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

Recommendation
None

Annotation
None

Workload
90 hours

T 9.83 Course: Pathophysiology, Molecular Basis of Diseases [T-CHEMBIO-106980]

Responsible: Dr. habil. Dietmar Gradl
Prof. Dr. Ferdinand le Noble

Organisation: KIT Department of Chemistry and Biosciences

Part of: M-CHEMBIO-103501 - Research Module: Pathophysiology, Molecular Basis of Diseases

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each term	1

Events					
WT 24/25	7244	Forschungsmodul: Pathophysiologie, Grundlagen von Erkrankungen (MFOR- 6205)	6 SWS	Practical course	le Noble
ST 2025	7118	Forschungsmodul: Pathophysiologie, Grundlagen von Erkrankungen (MFOR-6205)	6 SWS	Block /	le Noble, Gradl, Préau

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Success is assessed in the form of a 120-minute written examination on the lecture and the content of the practical course

Individual status discussions with the students are used to review the content of the practical course and the results of the experiments. The results are summarized in a protocol.

Prerequisites
none

Workload
240 hours

T 9.84 Course: Pathophysiology, Molecular Basis of Diseases (Practical Project) [T-CHEMBIO-111223]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-105600 - Project Module: Pathophysiology, Molecular Basis of Diseases

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

Prerequisites
none

T 9.85 Course: Phenomics and Chemomics [T-CHEMBIO-108673]

Responsible: Prof.Dr. Uwe Strähle
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-103298 - Research Module: Phenomics and Chemomics

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each summer term	1

Events					
ST 2025	7230	Phenomics and chemomics (MFOR-3209)	1 SWS	Lecture / 🗣	Hilbert, Dickmeis
ST 2025	7231	Phenomics and chemomics (MFOR-3209)	6 SWS	Practical course / 🗣	Hilbert, Dickmeis

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

Workload
240 hours

T 9.86 Course: Phenomics and Chemomics (Practical Project) [T-CHEMBIO-113722]

Responsible: Dr. Thomas Dickmeis
Prof. Dr. Lennart Hilbert
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-106841 - Project Module: Phenomics and Chemomics

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	7	pass/fail	Each summer term	3

T 9.87 Course: Photoreceptors (Practical Project) [T-CHEMBIO-100413]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100206 - Project Module: Photoreceptors in Plants and Microorganisms

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.88 Course: Photoreceptors in Plants and Microorganisms [T-CHEMBIO-108618]

Responsible: Prof. Dr. Tilman Lamparter
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100195 - Research Module: Photoreceptors in Plants and Microorganisms

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each term	1

Events					
WT 24/25	7329	Forschungsmodul: Photorezeptoren bei Pflanzen und Mikroorganismen (MFOR-1205)	6 SWS	Practical course	Lamparter
WT 24/25	7330	Forschungsmodul: Photorezeptoren bei Pflanzen und Mikroorganismen (MFOR-1205)	1 SWS	Lecture	Lamparter

Prerequisites
none

Workload
240 hours

T 9.89 Course: Plant Cell Biology [T-CHEMBIO-108615]

Responsible: Prof. Dr. Peter Nick
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100191 - Research Module: Plant Cell Biology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each term	2

Events					
WT 24/25	7146	Forschungsmodul: Plant Cell Biology - Methods and Concepts (zu Modul MFOR-1201) Kurse A+B	6 SWS	Practical course	Nick, Ponnu
WT 24/25	7147	Forschungsmodul: Plant Cell Biology - Methods and Concepts (MFOR-1201) Kurse A+B	2 SWS	Lecture	Nick, Ponnu

Prerequisites
keine

Workload
240 hours

T 9.90 Course: Plant Developmental Biology [T-CHEMBIO-113846]

Responsible: Dr. Jathish Ponnu
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-106909 - Research Module: Plant Developmental Biology

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	8	Grade to a third	Each winter term	1 terms	1

Events					
WT 24/25	7153	Research Module: Plant Developmental Biology (MFOR1221)	1 SWS	Lecture / 🗣	Ponnu
WT 24/25	7154	Research Module: Plant Developmental Biology (MFOR1221)	6 SWS	Practical course	Ponnu

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Workload
210 hours

T 9.91 Course: Plant Evolution [T-CHEMBIO-108616]

Responsible: Prof. Dr. Peter Nick
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100192 - Research Module: Plant Evolution: Methods and Concepts

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each term	1

Events					
WT 24/25	7135	Forschungsmodul: Plant Evolution - Methods and Concepts (MFOR-1202)	6 SWS	Practical course	Nick
WT 24/25	7139	Forschungsmodul: Plant Evolution - Methods and Concepts (MFOR-1202)	2 SWS	Lecture	Nick
ST 2025	7017	Forschungsmodul: Plant Evolution: Methods and Concepts (MFOR-1202)	1 SWS	Lecture / Practice (/	Nick

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Success is assessed in the form of a different type of examination
A total of 120 points can be earned. These are made up of

- a written test of 120 minutes on the contents of the lecture. 60 points of the total number of points can be achieved with this test.
- Group exercises (individual input via Ilias). This can earn 18 points.
- In-depth exercises accompanying the lectures. This can earn 30 points.
- A report on the practical course, which must meet scientific standards. 8 points can be earned for this report.
- a project proposal, which must be developed according to scientific criteria. 4 points can be earned for this proposal.
- the presentation of the project in a lecture. A maximum grade bonus of 0.3 grade levels can be earned for good presentations

Successful participation in the internship is a necessary prerequisite for completing the module. This is documented by a countersigned acceptance report. In addition to regular attendance and compliance with safety regulations, the criteria for passing the module are that the documentation of experiments and data and the organization of samples meet scientific standards. If the acceptance report is not accepted, the internship is deemed to have been failed. Depending on the individual case, conditions are agreed that must be fulfilled before the examination can be accepted as passed.

Prerequisites
none

Workload
240 hours

T 9.92 Course: Plant Gene Technology - Precise Genome Engineering [T-CHEMBIO-108629]

Responsible: Prof. Dr. Holger Puchta
Dr. Angelina Schindele
Dr. Patrick Schindele

Organisation: KIT Department of Chemistry and Biosciences

Part of: M-CHEMBIO-100198 - Research Module: Plant Gene Technology - Precise Genome Engineering

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each term	1

Events					
ST 2025	7025_2	Forschungsmodul: Plant Gene Technology - Precise Genome Engineering (MFOR-2201)	6 SWS	Block / 🗣	Puchta, Rönspies, Capdeville
ST 2025	7027	Forschungsmodul: Plant Gene Technology - Precise Genome Engineering (MFOR-2201)	1 SWS	/ 🗣	Puchta, Rönspies

Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

Workload
240 hours

T 9.93 Course: Plant Molecular Biology (Practical Project) [T-CHEMBIO-100420]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100214 - Project Module: Plant Molecular Biology

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.94 Course: Practical in Gene Technology (Practical Project) [T-CHEMBIO-100435]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100228 - Project Module: Plant Gene Technology - Precise Genome Engineering

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.95 Course: Practical Project Intensification of Bioprocesses [T-CIWVT-114319]

Responsible: Dr. Anke Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107275 - Project Module: Intensification of Bioprocesses

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	14	Grade to a third	Each summer term	1

Events					
ST 2025	2212053	Project Internship Intensification of Bioprocesses (for Biology Students)	8 SWS	Practical course / 🗣	Holtmann, Neumann, und Mitarbeitende

Legend: 💻 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 9.96 Course: Productive Biofilms (Practical Project) [T-CHEMBIO-111231]

Responsible: Dr. Gunnar Sturm
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-105603 - Project Module:Productive Biofilms

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (practical)	7	pass/fail	Each term	1

T 9.97 Course: Project in Technical Biology (Practical Projekt) [T-CIWVT-100560]

Responsible: Dr. Anke Neumann
Prof. Dr. Christoph Syldatk
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-100307 - Project Module: Project in Technical Biology

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

Events					
WT 24/25	2212175	Practical Project in Technical Biology		Block / 🗣	Neumann

Legend: 💻 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 9.98 Course: Protein Crystallization [T-CHEMBIO-108624]

Responsible: Prof. Dr. Tilman Lamparter
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100197 - Research Module: Protein Crystallization

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each winter term	1

Prerequisites
none

Workload
240 hours

T 9.99 Course: Quantitative Phenotyping in Breeding [T-CHEMBIO-113461]

Responsible: Dr. Katja Herzog
Prof. Dr. Peter Nick
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-106694 - Research Module: Quantitative Phenotyping in Breeding

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each summer term	1

Events					
ST 2025	077148	Quantitative Phänotypisierung in der Züchtung (zu Modul MFOR-1208)	2 SWS	Lecture / 🗣	Nick

Legend: 💻 Online, 🎛 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The performance review is a different type of examination.

The assessment consists of three parts:

- 60 points of the total number of points via a written test (120 minutes) on the lecture and the contents of the practical course.
- 20 points by means of scientific protocols. You choose two focus topics (practical course).
- 20 points with a 10-minute impulse lecture on an experiment of the practical course.

Prerequisites
The module takes place at a different location: Julius Kühn Institute, Institute for Grapevine Breeding Geilweilerhof in Siebeldingen (with probably 3 attendance days per week!)

Annotation
Summer semester: 2nd block

Module duration: 4 weeks all day

Workload:

Lecture: 15 h; 1 SWS; 1 CP

Practical course: 90 h; 6 SWS; 7 LP

Preparation and follow-up time:

Lecture: 15 h

Practical course: 120 h

Workload
240 hours

T 9.100 Course: Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society [T-FORUM-113587]

Responsible: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each term	1

Prerequisites
In order to register, it is mandatory that the basic module and the advanced module have been completed and that the grades for the partial performances in the advanced module are available.

Registration as a partial achievement means the issue of a certificate.

T 9.101 Course: Research Projects in Plant Cell Biology (Practical Project) [T-CHEMBIO-100410]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100202 - Project Module: Plant Cell Biology

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

Events					
WT 24/25	7164	Projektmodul Plant Cell Biology (MPRO-1301)	6 SWS	Practical course / 🗣	Nick, Ponnu

Legend: 💻 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 9.102 Course: Research Projects in Plant Evolution (Practical Project) [T-CHEMBIO-100411]

Organisation: University
Part of: M-CHEMBIO-100203 - Project Module: Plant Evolution: Methods and Concepts

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

Events					
WT 24/25	7166	Projektmodul Plant Evolution (MPRO-1302)	6 SWS	Practical course	Nick

T 9.103 Course: Resilience - Plants Conquer Land [T-CHEMBIO-113638]

Responsible: Dr. Gabriele Jürges
Prof. Dr. Peter Nick
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-106787 - Research Module: Resilience - Plants Conquer Land

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	8	Grade to a third	Each winter term	1 terms	1

Competence Certificate
Testing of a different kind

T 9.104 Course: Seed Technology [T-CHEMBIO-108710]

Responsible: Prof. Dr. Peter Nick
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100194 - Research Module: Seed Technology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each summer term	1

Prerequisites
none

Workload
240 hours

T 9.105 Course: Self Assignment - Interdisciplinary Seminar 1 (ungraded) [T-CHEMBIO-113901]

Responsible: Dr. Urszula Weclawski
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100277 - Interdisciplinary Thinking

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each winter term	1

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

Workload
30 hours

T 9.106 Course: Self Assignment - Interdisciplinary Seminar 2 (ungraded) [T-CHEMBIO-111731]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100277 - Interdisciplinary Thinking

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each winter term	2

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

Workload
60 hours

T 9.107 Course: Self Assignment - Interdisciplinary Seminar 3 (ungraded) [T-CHEMBIO-113902]

Responsible: Dr. Urszula Weclawski
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100277 - Interdisciplinary Thinking

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	3	pass/fail	Each winter term	1

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

Workload
90 hours

T 9.108 Course: Seminar Epigenetics and Genomics - Advanced Presentation Techniques [T-CHEMBIO-113223]

Responsible: Prof. Dr. Sylvia Erhardt
Prof. Dr. Jörg Kämper
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	2

Events					
WT 24/25	077272	Epigenetics and Genomics	2 SWS	Seminar / 🗣	Erhardt, Kämper

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Prerequisites
none

Workload
90 hours

T 9.109 Course: Seminar Epigenetics and Genomics - Techniques of Information Management [T-CHEMBIO-113222]

Responsible: Prof. Dr. Sylvia Erhardt
Prof. Dr. Jörg Kämper
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	1

Events					
WT 24/25	077272	Epigenetics and Genomics	2 SWS	Seminar / 🗣	Erhardt, Kämper

Legend: 🖳 Online, 🖳🗣 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

Workload
90 hours

T 9.110 Course: Seminar Food Chemistry - Presentation Skills [T-CHEMBIO-106144]

Responsible: Prof. Dr. Andrea Hartwig
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Prerequisites
none

Workload
90 hours

T 9.111 Course: Seminar Food Chemistry - Techniques of Information Management [T-CHEMBIO-106145]

Responsible: Prof. Dr. Andrea Hartwig
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Prerequisites
none

Workload
30 hours

T 9.112 Course: Seminar Molecular Genetics - Techniques of Information Management [T-CHEMBIO-100514]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	2

Events					
ST 2025	07M-ÜQ-01	Master Seminar Konzepte bilden (Recherchetechniken und Präsentationstechniken)	2 SWS	Seminar	Biologie
ST 2025	7255	Seminar Molekulargenetik (Modul 4403)	2 SWS	Seminar / 🗣	Kämper, Requena Sanchez

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 9.113 Course: Seminar Replication, Recombination & Reparation - Presentation Skills [T-CHEMBIO-100500]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	2

Events					
ST 2025	07M-ÜQ-01	Master Seminar Konzepte bilden (Recherchetechniken und Präsentationstechniken)	2 SWS	Seminar	Biologie
ST 2025	7025_1	Seminar: DNA-Replikation, -Rekombination, -Reparatur - Vortragstechniken (M2402)	2 SWS	Seminar / 🗣	Puchta

Legend: 💻 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 9.114 Course: Signal Transduction in Eukaryotic Systems (Practical Project) [T-CHEMBIO-100439]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100229 - Project Module: Signal Transduction in Eukaryotic Systems

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

T 9.115 Course: Signaling in Cancer - Techniques of Information Management [T-CHEMBIO-103071]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	2

Events					
WT 24/25	07SQ-01-R3403	Signaling in Cancer - Techniques of Information Management		Seminar	Orian-Rousseau

Prerequisites
none

Workload
90 hours

T 9.116 Course: Signaltransduction and Gene Regulation I [T-CHEMBIO-108659]

Responsible: Prof. Dr. Jörg Kämper
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100222 - Research Module: Signal Transduction and Gene Regulation I

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each winter term	1

Events					
WT 24/25	7402	Forschungsmodul: Signaltransduktion und Genregulation (MFOR-3204)	2 SWS	Lecture	Orian-Rousseau, Kämper

Competence Certificate
The control of success takes place in the form of an examination performance of a different kind
A total of 100 points can be acquired.

- One part of the examination takes the form of a written test lasting 90 minutes, on the lecture and the contents of the internship. About this part of the examination 80 points of the total score can be achieved.
- In addition to this written test, a report on the internship must be prepared, which must meet scientific standards. For this protocol 10 points can be obtained.
- Furthermore, 10 points can be earned through a presentation prepared by the student on methods, techniques and/or contents of the internship.

Prerequisites
none

Workload
240 hours

T 9.117 Course: Signaltransduction und Gene Regulation II [T-CHEMBIO-108660]

Responsible: Prof. Dr. Ute Schepers
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100223 - Research Module: Signal Transduction and Gene Regulation II

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each summer term	1

Events					
ST 2025	7223	Forschungsmodul: Signal transduction and gene regulation II (Vorlesung M3205)	2 SWS	/ 🗣	Kassel, Vallone
ST 2025	7224	Forschungsmodul: Signal transduction and gene regulation II (M3205)	6 SWS	Practical course / 🗣	Kassel, Vallone

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

Workload
240 hours

T 9.118 Course: Systemic cellular neurobiology (Practical Project) [T-CHEMBIO-113738]

Responsible: Prof. Dr. Simone Mayer
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-106854 - Project module: Systemic Cellular Neurobiology

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	7	pass/fail	Each term	1 terms	1

Events					
WT 24/25	7253	M-PRO systemische zelluläre Neurobiologie	6 SWS	Practical course /	Mayer

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Study Achievement: Report

Prerequisites
Knowledge in neurobiology and developmental biology

Annotation
Please get in touch at least 8 weeks before the desired start of the module

Workload
178 hours

T 9.119 Course: Systems Biology & Biophysics (Practical Project) [T-CHEMBIO-110791]

Responsible: Prof. Dr. Lennart Hilbert
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-105305 - Project Module: Systems Biology & Biophysics

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

Events					
WT 24/25	7257	PRO-Modul Systems Biology & Biophysics	6 SWS	Practical course /	Hilbert

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

T 9.120 Course: Techniques in Microscopy [T-CHEMBIO-108676]

Responsible: Prof. Dr. Martin Bastmeyer
Dr. Franco Weth

Organisation: KIT Department of Chemistry and Biosciences

Part of: M-CHEMBIO-100248 - Research Module: Techniques in Microscopy

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each summer term	1

Events					
ST 2025	7111	Forschungsmodul: Mikroskopische Techniken (MFOR-5206)	1 SWS	/	Bastmeyer, Hilbert
ST 2025	7122	Forschungsmodul: Mikroskopische Techniken (MFOR-5206)	6 SWS	Practical course /	Bastmeyer, Hilbert

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Prerequisites
none

Workload
240 hours

T 9.121 Course: Theory of Science and Ethics - Presentation Skills [T-CHEMBIO-100490]

Responsible: Prof. Dr. Peter Nick
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development
M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	2

Events					
WT 24/25	7111	Seminar Wissenschaftstheorie und Ethik in der Biologie (zu Modul BA-SQ02/ANG-06)	2 SWS	Seminar	Nick

Prerequisites
none

Annotation
Language:
Winter semester - German

T 9.122 Course: Tissue Engineering and 3D Cell Culture [T-CHEMBIO-108667]

Responsible: Prof. Dr. Ute Schepers
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-101596 - Research Module: Tissue Engineering and 3D Cell Culture

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each summer term	1

Events					
WT 24/25	7478	Forschungsmodul: Tissue Engineering und 3D Zellkultur (MFOR-3207)	1 SWS	Lecture /	Schepers

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Prerequisites
none

Workload
240 hours

T 9.123 Course: Tissue Engineering and 3D Cell Culture (Practical Project) [T-CHEMBIO-103059]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-101597 - Project Module: Tissue Engineering and 3D Cell Culture

Type	Credits	Grading scale	Version
Completed coursework (practical)	7	pass/fail	1

Prerequisites
none

Workload
210 hours

T 9.124 Course: Toxicology (Laboratory Practical Course) [T-CHEMBIO-111326]

Responsible: Dr. Beate Monika Köberle
Dr. Carsten Weiss
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-105673 - Research and Project Module: Toxicology and Food Toxicology

Type	Credits	Grading scale	Version
Completed coursework (practical)	10	pass/fail	2

Prerequisites
none

Workload
330 hours

T 9.125 Course: Toxicology and Food Toxicology [T-CHEMBIO-111325]

Responsible: Dr. Beate Monika Köberle
Dr. Carsten Weiss
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-105673 - Research and Project Module: Toxicology and Food Toxicology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	7	Grade to a third	Each summer term	4

Prerequisites
Registration for the lecture T-CHEMBIO-10446 Lebensmitteltoxikologie

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CHEMBIO-104464 - Food Toxicology must have been started.

Workload
240 hours

T 9.126 Course: Transcriptomic analysis [T-CHEMBIO-113843]

Responsible: Prof. Dr. Simone Mayer
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-106907 - Research Module: Transcriptomic Analysis

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	8	Grade to a third	Each winter term	1 terms	1

Events					
WT 24/25	7247	Forschungsmodul Transkriptomanalyse	1 SWS	Lecture	Mayer
WT 24/25	7248	Forschungsmodul Transkriptionsanalyse	6 SWS	Practical course	Mayer

Competence Certificate
Written examination 75 minutes. The grade is made up as follows: written exam 60%, presentations (1+2) 20%, practical work and discussion 20%

Workload
200 hours

T 9.127 Course: Vegetation Ecology [T-BGU-102982]

Responsible: Dr. rer. nat. Anne Lewerentz
Prof. Dr. Sebastian Schmidtlein

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences

Part of: M-BGU-105575 - Ecology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each winter term	2

Events					
WT 24/25	6111201	Vegetation Ecology	2 SWS	Seminar /	Lewerentz, Schmidtlein

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Prerequisites
None

Recommendation
None

Annotation
None

Workload
90 hours

T 9.128 Course: Vegetation Science [T-BGU-109123]

Responsible: Prof. Dr. Sebastian Schmidtlein
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-105575 - Ecology

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each summer term	1

Events					
ST 2025	6111051	Vegetation Science	2 SWS	Lecture / 🗣	Schmidtlein

Legend: 📱 Online, 🎛 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
computer-aided written exam with 60 minutes in ILIAS

Recommendation
none

Annotation
none

Workload
90 hours

T 9.129 Course: Vegetation Survey and Mapping [T-BGU-112637]

Responsible: Dr. Michael Ewald
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-105575 - Ecology

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	4	Grade to a third	Each summer term	1 terms	1

Events					
ST 2025	6111202	Vegetation Mapping and Vegetation Recording	2 SWS	Practice / 🗣	Ewald

Legend: Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Prerequisites
None

Recommendation
None

Annotation
None

Workload
120 hours

T 9.130 Course: Wildcard [T-CHEMBIO-105810]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-100275 - Concept Development

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	1