Georg-August-Universität
Göttingen

Modulverzeichnis

Bachelor's degree programme "Molecular Ecosystem Sciences" (supplement to the examination and study regulations for the Bachelor's degree programme published in Amtliche Mitteilungen I 17/2015 p. 235)

Module

Übersicht nach Modulgruppen

I. Bachelor's degree programme "Molecular Ecosystem Sciences"

To successfully complete the Bachelor's degree programme, a total of 180 C must be earned.

1. Compulsory Modules in the field of Molecular Ecosystem Sciences

The 19 following modules comprising 114 Credits must be successfully completed.

2. Professionalisation

A total of 54 C have to be earned according to the following regulations.

a. Key competencies

The 4 following modules comprising 24 C must be successfully completed.

b. Elective modules

A minumum of 5 modules mentioned below comprising at least 30 C must be successfully completed. Modules mentioned below may be substituted with alternative modules according to regulation 2 paragraph 4 of the examination regulations for this degree programme. Save sentence 2, one module may be substituted with any module regarding key competencies in the sense of Regulation 8 a of the General Examination Regulations comprising at least 6 C.

3. Bachelor's thesis

A total of 12 C are awarded for successfully completing the Bachelor's thesis.

Georg-August-Universität Göttingen **Module B.MES.101: Molecular plant and stress physiology**	6 C 4 WLH

Learning outcome, core skills: In this course the students will learn how a plant functions at the cell, tissue and whole-plant level. The contents of the lectures encompass basic cell biology and plant physiology (nutrient uptake, and transport process, photosynthesis, respiration, plant hormones, development and stress adaptation). In the practical courses students will be trained at modern microscopes, will lean the basics of tissue culture, and will obtain practical expertise with the use of ecophysiological methods such as measurements of photosynthesis, fluorescence, water potentials etc.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Molecular plant physiology (Lecture)	2 WLH
2. Cell biology, tissue culture and stress responses (Practical course)	2 WLH
Examination: Written exam (120 minutes)	6 C

Examination requirements: Cell compartments and organelles, their structure and function, membrane transport, molecular principles of photosynthesis and respiration, molecular functioning of plant hormones in plant development and stress adaptation, tree biotechnology. Skills: solid theoretical foundation in plant physiology and practical skills in tree regeneration and working under sterile conditions.	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in biology
Language: English	**Person responsible for module:** Prof. Dr. Andrea Polle
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 1
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.102: Chemical ecology**	6 C 4 WLH

Learning outcome, core skills: Students will learn to analyze the molecular basis of plant-insect interactions from the plant and from the insect point of view, based on plant volatiles associated to plant stress correlating with defence status and nutritional value of the plant. They learn how information gained by insect antennae is examined to understand the translation of this information into insect behaviour. Students will learn to assess how sensor-systems on the basis of insect olfaction can be utilized and how chemo-ecological findings can be extended into landscape by an integrative examination of biotic interactions from the molecular to the stand level. This will be the basis for understanding the role of semiochemical diversity in adaptation toward global change and for ecosystem functions and services.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Chemical ecology (Lecture)	1 WLH
2. Exercises in chemical ecology (Laboratory course, seminar)	3 WLH
Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Biosynthesis of semiochemicals, signaling pathways, perception of semiochemicals, transduction pathways, physiological action and behavioural activity of semiochemicals, syn- and demecological aspects.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Stefan Schütz
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 1
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.103: Ecological genetics**	6 C 4 WLH

Learning outcome, core skills: Understanding of the importance of intraspecific (genetic) variation for ecosystem processes and functions, in particular • knowledge of modern methods to assess genetic diversity in diverse groups of organisms • understanding of the role of the evolutionary factors to shape genetic diversity with emphasis on selection • understanding of evolutionary processes including adaptation under natural conditions and in managed ecosystems • understanding of the impact of global change on genetic resources	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Ecological genetics (Lecture)	2 WLH
2. Assessment of genetic variation (Laboratory course, workshops)	2 WLH
Examination: Oral examination (approx. 20 minutes)	

Examination requirements: Use of modern methods to assess genetic variation in diverse groups of organisms, evolutionary factors and how they shape genetic diversity, the role of adaptation under natural or managed conditions, impact of global change.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** N. N.
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 1
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.104: Biotic and abiotic interactions**	6 C 4 WLH

Learning outcome, core skills: Interactions between biotic and abiotic components of ecosystems are largely responsible for ecosystem properties and functions. Abiotic interactions will be studied in a submodule focused on the biochemistry of soils; biotic interactions are introduced with a focus on pathogens. Students will be trained to analyze these important ecological interactions at different scales. Significance of soil biochemistry for ecosystem processes will be analyzed based on basic soil properties and chemical principles. Transformations and interactions between solid, liquid, gaseous and living phases in soil will give background for understanding of soils as the main part of terrestrial ecosystems and application of biochemical knowledge from molecular to pedon and field scales. Biotic interactions will be studied at different levels taking into consideration their molecular basis such as genes and their products and with different organisms, plants and/or animals including wildlife.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Soil biochemistry (Lecture, seminar)	2 WLH
2. Biotic interactions in ecology (Lecture, seminar)	2 WLH
Examination: Written exam (90 minutes)	6 C

Examination requirements: Biochemical processes in soils, weathering and soil formation, biotic drivers, factors of soil formation, soil organisms and decomposition processes, soil organic matter and interactions with clay minerals, molecular basis of biotic interactions, genes and their products, interactions among different organisms.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Yakov Kuzyakov
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 1
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.106: Microbiology and molecular biology**	6 C 4 WLH

Learning outcome, core skills: Students will be introduced to molecular, biochemical and physiological aspects in microbiology and molecular biology which is important to Ecosystem Sciences. The acquired knowledge allows the students to address questions and problems in Ecology and Systems Biology on molecular levels and understand the background of modern molecular methods that can be applied to solve such topics.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Microbiology and biotechnology (Lecture)	2 WLH
2. Molecular biology (Lecture)	2 WLH
Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Basic knowledge on genetics, physiology, and ecology of microorganisms (bacteria and fungi), applications of microorganism in biotechnology generally and with specific focus on ecological tasks, structure and functions of DNA, RNA, proteins and exemplified metabolites, basic concepts and techniques in molecular biology, recombinant DNA technology, DNA transfer techniques, handling of GMOs.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Ursula Kües
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 2
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.107: Ecological modelling**	6 C 4 WLH

Learning outcome, core skills: Comprehensive knowledge of ecological models, theories and concepts. Development of interdisciplinary analytical thinking. Critical analysis and evaluation of the chances and limitations of different modelling approaches.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Ecological modelling (Lecture) *Contents*: Theoretical basics as well as classical and modern models of terrestrial ecology with special consideration of models in microbial ecology.	2 WLH
2. Ecological modelling (Tutorial) *Contents*: Application and analysis of classic and modern ecological models and concepts .	2 WLH
Examination: Written exam (90 minutes)	6 C

Examination requirements: Comprehensive knowledge of ecological models, theories and concepts. Interdisciplinary analytical thinking skills. Ability to critically analyze and evaluate the chances and limitations of different modelling approaches.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Kerstin Wiegand
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 2
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.108: Computer science and mathematics**	6 C 4 WLH

Learning outcome, core skills: Understanding of basic notions and methods of computer science and mathematics, including: representation of information, databases, the World Wide Web, foundations of programming, simulation, visualization; notations from logic and set theory, relations, graphs, functions, differentiation, extreme values, integration; vectors, linear transformations, matrices, eigenvalues; scale levels of variables, measures of location, dispersion and correlation, linear regression, probability, sampling, confidence intervals, fundamentals about statistical testing.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Computer science and mathematics (Lecture)	3 WLH
2. Computer science and mathematics (Exercise)	1 WLH
Examination: Written exam (90 minutes)	6 C

Examination requirements: Understanding of basic notions and methods of computer science and mathematics, including: databases, WWW, foundations of programming, simulation, visualization; graphs, functions, differentiation, extreme values, integration; vectors, linear algebra; descriptive statistics, linear regression, probability, sampling, simple tests.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Winfried Kurth
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 2
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.109: Plant ecology and diversity**	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
Students are familiar with global to regional scale patterns of plant diversity, the distribution of major climatic and vegetation zones (ecozones, biomes), as well as their predominant land uses and anthropogenic impacts. Students are familiar with basic aut- and synecological concepts in plant and vegetation ecology from the level of the individual plant to plant communities. They have learned to distinguish different major plant communities in Central Europe and are familiar with their specific abiotic site conditions, and their conservation significance. Students are able to apply ecological field methods and to perform basic analyses of diversity and community structure.	Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Plant ecology and diversity (Lecture)	2 WLH
2. Plant ecology and diversity (Field studies)	2 WLH
Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements:	
Distribution and determinants of ecozones and biomes, local to global scale patterns of plant diversity, alpha-beta-gamma diversity, aut-and synecological concepts, plant communities and their relations with abiotic site conditions, basic knowledge about field and analysis methods.	

Admission requirements:	**Recommended previous knowledge:**
none	none
Language: English	**Person responsible for module:** Prof. Dr. Holger Kreft
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 2
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.111: Terrestrial biogeochemistry**	6 C 4 WLH

Learning outcome, core skills: At the end of this course students should understand the major biogeochemical processes at the interface of biosphere, lithosphere hydrosphere and atmosphere. Students will be able to detect where measurements of biogeochemical processes are useful using a system based approach. They will have gained practical experience in relevant measurements of biogeochemical processes in terrestrial ecosystems.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Terrestrial biogeochemistry (Lecture)	2 WLH
2. Biogeochemical processes (Laboratory course)	2 WLH
Examination: Written examination (120 minutes) and term paper (10 pages max.)	6 C

Examination requirements: Cycles in biogeochemistry, element ratios, carbon cycle of terrestrial ecosystems, biogeochemical cycling on land, nitrogen cycle of terrestrial ecosystems, soil development, mass balances at different scales, redox reaction in natural environments, biogeochemistry of wetlands, measurements of biogeochemical processes.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Edzo Veldkamp
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.112: Environmentally friendly production of wood**	6 C 4 WLH

Learning outcome, core skills: Environmentally friendly use of timber, of wood for energy and wood products. Basics and practice of wood protection and degradation by fungi. Knowledge of technological relevant wood properties of important commercial timbers. Modification technology for long-living major forest products (lumber, veneer, plywood, wood-based composites) and their significance for forest utilization.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Wood biology (Lecture, exercises, laboratory visits, excursion) *Contents*: Classroom lectures with practical exercises, visits in labs and short presentations of the students, one excursion to a wood processing company.	2 WLH
2. Wood-based-composites (Lecture, exercises, laboratory visits, excursion) *Contents*: Classroom lectures with practical exercises, visits in labs and short presentations of the students, one excursion to a wood processing company.	2 WLH
Examination: Oral examination (approx. 20 minutes)	6 C

Examination requirements: Anatomy, wood physics, wood chemistry, wood properties, wood-based composites, wood-plastic composites, wood modification, wood protection.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Holger Militz
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.113: Methods in systems biology**	6 C 4 WLH

Learning outcome, core skills: "Omics" techniques are the backbone of modern systems biology. This course comprises lectures and practicals in genomics, proteomics, transcriptomics and statistical computing. The students will learn the theory of these applications, and the functioning of the required hard- and software. The students will obtain practical training in selected methods. This involves lab work as well as computer applications. The learning outcome will be that the students are to apply "omics" methods to questions in ecology and systems biology.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Genomics (Lecture, practicals)	1 WLH
2. Statistical computing and Transcriptomics (Lecture, practicals)	2 WLH
3. Proteomics (Lecture, practicals)	1 WLH
Examination: Term paper (20 pages max.)	6 C

Examination requirements: Detailed knowledge and understanding of methods to generate and analyse experiments involving approaches of modern systems biology. This includes a detailed understanding of basic statistical concepts to analyse “omics“ data sets as well as skills in laboratory analyses and application of software for proteomic and transcriptomic data analysis.. Skills: knowledge how to analyse plant tissues by application of molecular and statistical methods.	

Admission requirements: ***Admission requirements:*** Successful examination in a minimum of 2 of the following courses: B.MES.101: Molecular plant and stress physiology, B.MES.103: Ecological genetics, B.MES.106: Microbiology and molecular biology, B.MES.108: Computer science and mathematics.	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Andrea Polle
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.114: Biodiversity of pro- and eukaryotic soil microbial communities**	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
Biodiversity, phylogenetics, morphology and functions of soil microbial communities consisting of prokaryots (archea, bacteria) and eukaryots (algae and fungi); diversity of prokaryotic microbial metabolism and environmental functions. Knowledge of prokaryotic microorganisms and algae relevant for environmental functions, ability to identify these organisms and to analyse them with molecular methods; ability to identify major lineages of cyanobacteria and eukaryotic algae from cultures by microscopy.	Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Biodiversity of pro- and eukaryotic soil microbial communities (Lecture)	2 WLH
2. Biodiversity of pro- and eukaryotic soil microbial communities (Laboratory course)	2 WLH
Examination: Protocol (10 pages max.)	6 C

Examination requirements:	
Students prove their ability to perform specific microbiological molecular techniques independently and their ability to record, interpret and present their experimental results in written form.	

Admission requirements:	**Recommended previous knowledge:**
none	none
Language: English	**Person responsible for module:** Prof. Dr. Rolf Daniel
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.116: Conservation and ecosystem management**	6 C 4 WLH

Learning outcome, core skills: The course imparts knowledge about the sustainable management of forest ecosystems and about nature conservation. Based on some fundamentals of forest ecology such as the impact of competitive interactions between trees, options of stand management are presented. Mixed stands and their management are of special importance. The course will provide information on how to analyze forest stands and how to derive appropriate silvicultural treatments in order to achieve the goals set by a given forest owner. The nature conservation part will introduce priority goals of conservation biology, the major threats to natural ecosystems and how they can be managed.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Forest ecosystem management (Lecture)	2 WLH
2. Nature conservation (Lecture)	2 WLH
Examination: Written exam (120 minutes)	6 C

Examination requirements: Competition in plant communities, plant – environment interactions, mixed stands, principles of stand management, silvicultural systems, human land-use, climate change, biodiversity, ecosystem functioning.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Christian Ammer
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 5
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.117: Atmosphere-ecosystem interactions**	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
In this course students will gain insights in the main atmospheric characteristics and how they influence ecosystem processes and fluxes between ecosystem compounds (e.g. air, plants, soil). They will also learn how ecosystems feed back to the atmosphere at local and global scale. This will form the basis for understanding the impact of climate change on ecosystem functions and services. The lecture course will give an overview on atmospheric variables such as radiation, humidity, temperature, and wind and their interactions with terrestrial ecosystems. In the seminar/exercise class, the understanding will be deepened by quantitative exercises. The students will be trained in quantitative and qualitative scientific methods to describe climate-dependent physical, chemical and biological processes in terrestrial ecosystems enabling them to understand and evaluate the current discussion on climate change and its impact on terrestrial ecosystems.	Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Atmosphere-ecosystem interactions (Lecture)	2 WLH
2. Atmosphere-ecosystem interactions (Seminar, exercise)	2 WLH
Examination: Written exam (120 minutes)	6 C

Examination requirements:	
Qualitative and quantitative description of radiation, humidity, temperature, wind, their interactions with terrestrial ecosystems, carbon and water cycle, atmospheric chemistry, climate change, climate modelling.	

Admission requirements:	**Recommended previous knowledge:**
none	none
Language: English	**Person responsible for module:** Prof. Dr. Alexander Knohl
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 5
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.118: Resource assessment in ecosystems**	6 C 4 WLH

Learning outcome, core skills: The students will be trained • to analyse issues and problems of ecological monitoring, with a focus on terrestrial ecosystems, • to plan their own monitoring studies on statistically sound grounds balancing scientific-technical ojectives and economic feasibility, • to critically assess and understand monitoring studies carried out by other. These learning outcomes imply acquiring / enchancing knowledge and skills in the following fields: • design-based statistical sampling, including estimation design, • empirical statistical models, • characteristics of a seriers of sampling designs and plot designs, • the systematic planning process in monitoring studies.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Resource assessment in ecosystems (Lecture) *Contents*: The lectures comprise the theoretical foundations of monitoring and also the discussion based analysis of cases.	2 WLH
2. Resource assessment in ecosystems (Laboratory course) *Contents*: The field labs are practical exercises in field data collection techniques and measurement devices, the in-house labs are on data analysis and estimation.	2 WLH
Examination: Written exam (120 minutes)	6 C

Examination requirements: Basics of descriptive and inferential statistics (mean, variance, standard error, confidence interval, bias, precision, random selection), relevant basic sampling design options (simple random, stratified random, systematic, cluster sampling), relevant response designs options (fixed area plots, variable plots, distance techniques, point sampling, line sampling). Statistical estimation. Planning criteria for assessments.	

Admission requirements: B.MES-SK.115, B.MES.108	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Christoph Kleinn
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 5

Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.119: Isotopes in ecosystem sciences**	6 C 4 WLH

Learning outcome, core skills: The course provides a very broad background for isotope applications in ecosystem compartments including soils, plants, atmosphere, and microorganisms. Overview of various tracer methods and isotope applications will be presented. The specifics of stable and radioactive isotopes for investigations of ecosystem processes from submolecular to global scale will give deep background for future isotope applications in Bachelor, Master and PhD theses.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Stable isotopes (Lecture, seminar with exercises)	2 WLH
2. Radioactive isotopes and labeling techniques (Lecture, seminar)	2 WLH
Examination: Written exam (90 minutes)	6 C

Examination requirements: Knowledge of specified teaching content, achievement of defined goals and proof of target competence.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Yakov Kuzyakov
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 5
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.121: Global change**	6 C 4 WLH

Learning outcome, core skills: At the end of this course the students are expected to • have insight in the major components of the earth system and how they are connected, • understand how environmental processes and biogeochemical cycles are regulated by biosphere-hydrosphere-atmosphere feedbacks and how they are affected by global chance through natural and anthropogenic processes, • are able to understand and evaluate simple biogeochemical models.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Global change (Lecture)	2 WLH
2. Global change (Modelling exercises, seminar)	2 WLH
Examination: Presentation (approx. 30 minutes, 50%) and written report (10 pages max., 50%) **Examination prerequisites:** Successful completion of exercises and seminar	6 C

Examination requirements: Successful completion of assignments. After every lab students are given a mandatory homework assignment (though not graded).	

Admission requirements: none	**Recommended previous knowledge:** B.MES.111, B.MES.117
Language: English	**Person responsible for module:** Prof. Dr. Edzo Veldkamp
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 6
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.122: Molecular soil ecology**	6 C 4 WLH

Learning outcome, core skills: This lecture and laboratory course aims to integrate the basic knowledge on soil microbiology in ecological studies. The course is focused on the importance of active microorganisms and their diversity of species/genetic lineages as biogeochemical driver of soil processes linking microbial growth, enzymes kinetics and the stoichiometry with the modern molecular and isotopic approaches. Experiments will demonstrate how the hotspots of microbial activity (rhizosphere, detritusphere, biopores) can be revealed and visualized in situ in soil. • Goup 1: The microbial activity state is characterized by the values of eco-physiological indicators based on respiration, molecular biomarkers and viable cell compartments (ATP, PLFA, RNA). The Laboratory training links visualization of plant-microbial interactions by novel zymography approach (based on fluorogenic substrates) with enzyme kinetics and microbial growth parameters determined in the rhizosphere hotspots under impact of environmental stressors. • Group 2: Students will become familiar with molecular technologies used for analyzing the structure and function of decomposer systems, such as quantitative real time PCR, tagging of organisms by fluorescent markers compound specific stable isotope lipid analysis and molecular gut content analysis.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Molecular soil ecology (Lecture and Seminar)	2 WLH
2. Molecular soil ecology (Laboratory course and Seminar)	2 WLH
Examination: Oral presentation (approx. 15 minutes) with written outline (10 pages max.)	6 C

Examination requirements: Knowledge on: • Plant-microbial and microbial interactions in soil • Functional diversity and genetic diversity of soil microbial communities • Techniques to analyze soil-micro-foodwebs, such as zymography, application of fluorogenic substrates, enzymes kinetics, microbial growth, stable isotopes and lipid analysis • Response of soil microorganisms to environmental stressors	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Stefan Scheu
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**

cf. examination regulations	6
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.123: Project (research participation)**	6 C 4 WLH

Learning outcome, core skills: This course is a final step linking the data-set obtained and statistically treated by the students in practical trainings (B.MES. 105; 111; 113; B.MES-SK-115; 122) to the ongoing research projects. Introduction of structure, research strategy and outcome of the projects, from which the students have got the samples for practical training in previous semesters. Students compare their own results to the projects outcome. Course gives an advanced knowledge and application skills on the methods learnt within MES program (B.MES. 105; 111; 113; 115; 119; 122). Lecture course on Project design comprises all necessary steps to develop a scientific project: literature acquisition, research idea, scientific hypotheses, research strategy, design of the experiments (sites selection, sampling procedure, selection of methods), expected outcome and knowledge dissemination, time-table. Students develop and present their own projects for Bachelor study. This course is also aimed to help the students in preparation of their Bachelor study using as practical examples on-going projects of the department of “Soil Science of Temperate Ecosystems”.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Project design (Lectures and Seminar) *Contents*: Lecture course on Project design. Seminar on the own contribution to research.	2 WLH
2. Project (research participation) *Contents*: Laboratory courses work and/or active participation in ongoing research projects of lectures involved in the program.	2 WLH
Examination: Oral presentation (approx. 15 minutes) with written outline (10 pages max.)	6 C

Examination requirements: Scientific hypotheses, experimental design, laboratory techniques, analysis interpretation and scientific presentation of research results.	

Admission requirements: At least 120 credits earned	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** PD Dr. Evgenia Blagodatskaya
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 6
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.301: Special topics in plant methods and ecological applications I**	6 C 4 WLH

Learning outcome, core skills: This elective module consists of a seminar and advanced method courses. In the seminar the students will be informed about recent development and new discoveries in forest botany, plant – microbial interactions, biotechnology, plant molecular genetics and practical applications. In the advanced method courses student undertake internships and/or field excursions to learn new methods and applications in plant physiology and ecology. The students will take responsibility in the organization of their study program.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Forest botany (Seminar)	2 WLH
2. Ecological applications / Field excursion (Lecture, practical)	2 WLH
Examination: Oral presentation (aaprox. 15 minutes) and written report (10 pages max.)	6 C

Examination requirements: Discussion of scientific presentations, knowledge in recent problems in Forest Botany, application of advanced scientific methods to selected problems in plant science. Skills: knowledge in critical text analyses and presentation skills, knowledge in data base research, practical skills in handling modern equipment for plant analyses.	

Admission requirements: none	**Recommended previous knowledge:** In-depth knowledge in biology is required
Language: English	**Person responsible for module:** Prof. Dr. Andrea Polle
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 4
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module B.MES.302: Special topics in plant methods and ecological applications II**	6 C 4 WLH

Learning outcome, core skills: This elective module consists of a seminar and an advanced method course. The seminar will be conducted as a journal club. The students will get lists of papers which they have to read and present during the semester. The topics will be chosen from recent literature. The goal is to become involved in research and to learn to understand how to structure research and to publish. In the advanced method courses, lectures and specialized techniques will be taught and practiced. The students will organize the journal club.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Advanced plant biochemistry and genetics / Journal club (Seminar)	2 WLH
2. Advanced methods (Lecture, practical)	2 WLH
Examination: Oral presentation (approx. 15 minutes) and written report (10 pages max.)	6 C

Examination requirements: Reading and analyzing scientific publications, in-depth understanding of scientific working methods in plant ecology and molecular biology. Skills: knowledge in critical text analyses and presentation skills, knowledge in research methods.	

Admission requirements: none	**Recommended previous knowledge:** In-depth knowledge in biology is required
Language: English	**Person responsible for module:** Prof. Dr. Andrea Polle
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 4
Maximum number of students: 10	

Georg-August-Universität Göttingen **Module B.MES.303: Semiochemical diversity**	6 C 4 WLH

Learning outcome, core skills: Students will learn to investigate the dynamics of semiochemical diversity in different types of ecosystems. This involves field sampling of important plants and animals, volatile extraction from different tissues, laboratory analyses of various types of volatile markers, data analyses and interpretation. Students will learn practical steps to assess semiochemical diversity, and will be able to evaluate the use of chemo-ecological methods for applications in plant protection, nature conservation, and ecosystem management.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Semiochemical diversity (Lecture)	1 WLH
2. Methods to study semiochemical diversity and biodiversity (Workshop, laboratory course)	3 WLH
Examination: Term paper (20 pages max.)	6 C

Examination requirements: Classification of semiochemicals, measures of chemical and biological diversity, analytical and determination methods, key species, key volatiles, key processes, semiochemicals in practical application.	

Admission requirements: B.MES.102	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Stefan Schütz
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.304: Protection of renewable resources**	6 C 4 WLH

Learning outcome, core skills: The use of chemical methods is commonplace in protection measures at various levels of biological organization in forest protection, plant protection and stored product protection. Students will learn the results of chemo-ecological approaches in integrated pest management based on selected projects and recent literature. Students will be able to critically evaluate benefits and limitations of chemo-ecological approaches in a production and conservation context. Examples will be taken from different geographic and climatic regions.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Protection of renewable resources based on chemical and chemo-ecological methods (Lecture)	1 WLH
2. Assessment of protection measures for renewable resources (Seminar, workshop)	3 WLH
Examination: Oral presentation (approx. 15 minutes) with written outline (5 pages max.)	6 C

Examination requirements: Application of semiochemicals in different ecosystems, quality control, toxicology, integrated pest management, production of renewable resources, nature protection.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Stefan Schütz
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.305: Conservation of biodiversity**	6 C 4 WLH

Learning outcome, core skills: The use of molecular methods is commonplace in conservation at various levels of biological organization from genes to ecosystems. Students will examin the results of molecular approaches in biodiversity conservation based on selected projects and recent literature. Students will be able to critically evaluate benefits and limitations of molecular studies in a conservation context. Examples will be taken from different geographic and climatic regions.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Conservation of biodiversity based on molecular tools (Lecture)	1 WLH
2. Assessment of molecular diversity for conservation (Seminar, Workshop)	3 WLH
Examination: Oral presentation (approx. 15 minutes) with written outline (5 pages max.)	6 C

Examination requirements: Effective comprehension of scientific literature with regard to conservation of biodiversity, different methods used for conservation of biodiversity and their specific applications, critical evaluation of molecular studies in a conservation context.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** N. N.
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.306: Intraspecific diversity of plants**	6 C 4 WLH

Learning outcome, core skills: Students will learn to investigate the dynamics of intraspecific diversity in different types of ecosystems. This involves field sampling of important plants, DNA extraction from different tissues, laboratory analyses with various types of molecular markers, data analyses and interpretation. Students will learn practical steps to assess genetic diversity, and will be able to evaluate the use of DNA-based methods for applications in breeding, conservation, and ecosystem management.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Intraspecific diversity of plants (Lecture)	1 WLH
2. DNA based methods to study biodiversity (Workshops, laboratory exercise)	3 WLH
Examination: Term paper (20 pages max.)	6 C

Examination requirements: DNA markers and techniques, estimation of intraspecific diversity in different types of ecosystems, methods used for experimental sampling, DNA extraction from different tissues, laboratory techniques, data analyses and interpretation and application of results.	

Admission requirements: B.MES.103, B.MES.104	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** N. N.
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.307: Research practicum**	6 C 4 WLH

Learning outcome, core skills: Students have a possibility to participate in a research work at an institution of their choice (also abroad) to learn new scientific methods and get additional experiences about variety of research topics.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Research practicum (Laboratory courses/work)	3 WLH
2. Research practicum (Seminar)	1 WLH
Examination: Term paper (20 pages max.)	6 C

Examination requirements: Laboratory methods, analysis, interpretation and scientific presentation of research results. In case of abroad practicum: a confirmation letter from the supervisor with a grade (if possible, in the German grade system)	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Konstantin V. Krutovsky
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.308: Scientific project**	12 C 3 WLH

Learning outcome, core skills:	**Workload:**
Advanced knowledge of scientific methods and procedures, and practical skills acquired by active participation in a research project conducted under supervision of a lecturer of the programme at the University of Goettingen or a respective supervisor at a foreign institution. Ability to analyze, interpret and present relevant scientific data. Duration: 6 weeks.	Attendance time: 60 h Self-study time: 300 h

Courses:	
1. Scientific project (Laboratory courses/work)	2 WLH
2. Scientific project (Seminar)	1 WLH
Examination: Term paper (30 pages max.)	12 C

Examination requirements:	
Scientific hypotheses, experimental design, laboratory techniques, analysis, interpretation and scientific presentation of research results. In case of abroad practicum: a confirmation letter from the supervisor with a grade (if possible, in the German grade system).	

Admission requirements:	**Recommended previous knowledge:**
Conducted only together with the module B.MES.309 “Practical training in laboratory techniques”. Each student must get an approval from the MES programme’s coordinator 3 months before the start of work.	none
Language: English	**Person responsible for module:** Prof. Dr. Konstantin V. Krutovsky
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES.309: Practical training in laboratory techniques**	18 C 4 WLH

Learning outcome, core skills: Students learn about different research techniques, organization of work in a laboratory and an experiment planning by active participation in a research project conducted under supervision of a lecturer of the programme at the University of Goettingen or a respective supervisor at a foreign institution. Duration: 9 weeks.	**Workload:** Attendance time: 90 h Self-study time: 450 h

Courses:	
1. Practical training in laboratory techniques (Laboratory courses/work)	3 WLH
2. Practical training in laboratory techniques (Seminar)	1 WLH

Examination: Laboratory protocol (10 pages max.), passed/failed. In case of abroad practicum: a confirmation letter from the supervisor with a result., not graded	18 C

Examination requirements: Experimental design, laboratory techniques, analysis and interpretation of research results. In case of abroad practicum: a confirmation letter from the supervisor with a result.	

Admission requirements: Conducted only together with the module B.MES.308 “Scientific project”. Each student must get an approval from the MES programme’s coordinator 3 months before the start of work.	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Konstantin V. Krutovsky
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 4
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES-SK.105: Laboratory techniques**	6 C 4 WLH

Learning outcome, core skills: Students will train in small groups to work in a laboratory. They will be introduced into modern basic and sophisticated methods in the fields of chemistry, biochemistry, microbiology and molecular biology to rules assuring personal and environmental safety and good scientific practice. Students acquire knowledge in experimental planning, technical performance, data interpretation and documentation of practical scientific research.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Organic trace analysis (Seminar, laboratory course, exercises)	2 WLH
2. Inorganic analysis (Seminar, laboratory course, exercises)	1 WLH
3. Microbiology and molecular biology (Laboratory course)	1 WLH
Examination: Protocol (30 pages max.) **Examination prerequisites:** Regular attendance and participation	6 C

Examination requirements: Personal and environmental safety, handling and preparation of samples, calibration and use of standards, chromatographic methods, design, performance and documentation of chemical, microbial, and molecular experiments, assessment of results, team work to resolve experimental problems. Handling of radioactive substances, radiation safety, analytics of radioactive isotopes, contaminations with stable and radioactive isotopes .	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Stefan Schütz
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 1
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES-SK.110: The science-policy interface: society and research structures**	6 C 4 WLH

Learning outcome, core skills:	**Workload:**
Policy of Ecosystems: Knowledge about both: on the one hand the relation between ecosystem sciences and politics and on the other hand about the structure and processes of policy-making. Skills in political consulting and debating. The Research Community: Structure and Organization The scientific community depends on private and public research organizations and funding mechanisms. Students will understand the structure and organization of main institutions conducting or financing research and teaching (universities and large research institutions) in Germany and elsewhere.	Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Policy of ecosystems (Seminar)	2 WLH
2. The research community: structure and organization (Lecture, seminar)	2 WLH
Examination: 2 Oral presentations (approx. 10 minutes) with written outline (10 pages max.)	6 C

Examination requirements:	
Current theories of science-policy interface and scientific conditions for knowledge transfer, conditions for application of ecosystem knowledge in society, basics of public policy analysis, research infrastructures, comparison between different research structures. Skills: understanding of the relationship between ecosystem research and actual utilization in society, understanding of the role of different actors in science, planning a research career.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Maximilian Krott
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 5
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module B.MES-SK.115: Scientific methods and project design**	6 C 4 WLH

Learning outcome, core skills: Understanding, application and interpretation of basic terms of descriptive and confirmative statistics, such as important discrete and continuous distributions, least squares, confidence intervals, testing statistical hypotheses, error propagation and basic experimental designs. Understanding of advanced statistical methods such as two-way ANOVA and multiple regressions.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Courses:	
1. Research methods (Lecture)	3 WLH
2. Research methods (Exercises)	1 WLH
Examination: Written examination (90 minutes)	6 C

Examination requirements: Detailed knowledge of methods for statistical analysis (t-tests, ANOVA, regression, nonparametric methods), descriptive statistics and probability distributions.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Winfried Kurth
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:** 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module SK.FS.EN-FF-C1-1: Scientific Writing in English**	6 C 4 WLH

Learning outcome, core skills: Progression of pre-existing discursive skills and competences at a level above B2 according to the *Common European Framework of Reference for Languages*, which will enable the student to compose scientific texts in English, particularly in the area of molecular ecosystems sciences, e.g. • the skills needed to compose texts for scientific publications utilising specific language structures and conventions, • the acquisition of specific linguistic and stylistic structures in the English language as well as the development of a differentiated scientific vocabulary • the expansion of the operative intercultural knowledge about practices required to write a scientific paper with a focus on molecular ecosystems sciences in an academic context.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Scientific Writing in English (Course) Exam preparation: ungraded written work completed in class and outside of class.	4 WLH
Examination: Portfolio consisting of three tasks of max. 15 pages in total **Examination prerequisites:** regular active participation	6 C

Examination requirements: Proof of linguistic competence in an intercultural and scientific context. Demonstration of the ability to write scientific texts in the English language at a level above B2 according to the *Common European Framework of Reference for Languages*.	

Admission requirements: Module Mittelstufe II or placement test with a completed level B2 of the CEFR	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Heather Anne Kretschmer
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2
Maximum number of students: 16	

Additional notes and regulations: Applicable to: Bachelor’s Degree Programme “Molecular ecosystem sciences”