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Code	**M-BC-MEC**		
Course	**Molecular Enzymology with Computer-Assisted Evaluation of Biochemical Experiments**	1st sem.	6 CP
Faculty/Subject/Department	08/Biology/Institute for Biochemistry		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), core area Biochemistry / 1. Semester		
Prerequisites	-		
Learning outcomes	Students will: • be familiar with the planning, conduct, evaluation and interpretation of typical biochemical experiments (thermodynamics and kinetics of macromolecule/ligand interactions, steady-state and pre-steady-state enzyme kinetics) • know PC-assisted procedures for the simulation and evaluation of experiments • be able to develop in-depth understanding of the relationship between measurement accuracy and reliability of the results • be capable of developing solutions for specific problems		
Module content	Experiments (choice of) • enzymatic conversion of substrates e.g. by colorimetric procedures using a microtiter plate reader • enzymatic cleavage of fluorescence-labelled substrates using a fluorometric plate reader with *on line* detection Evaluation and interpretation • Principles of quantitative evaluation of measurement results • Evaluation of binding experiments (independent identical binding sites, independent non-identical binding sites, cooperative binding) • Evaluation of dissociation kinetics, association kinetics, competition kinetics • Evaluation of steady-state and pre-steady-state kinetics		
Form(s) of instruction	Lectures (20%), tutorials (60%), seminars (20%)		
Student workload	Attendance: Lectures 13 hours, tutorials 43 hours, seminars 8 hours Preparation/revision: Lectures 22 hours, tutorials 80 hours, seminars 14 hours		
Total Workload	180 hours = 6 ECTS		
Method of assessment	Laboratory report (50%), seminar presentation (50%)		
Form of module component retake exam	None		
Form of Retake Exam	Laboratory report (50%), seminar presentation (50%)		
Language of instruction	German and English		
Frequency	Annually, 4 weeks, Winter semester		
Intake Capacity	18		

Code	**M-BC-MBK**	2nd sem.	3 CP
Course	**Molecular Biology of Carcinogenesis**		
Faculty/Subject/Department	08/Biology/Institute for Biochemistry		
Module coordinator	Cf. German version		
Classification	MSc (Biol.)		
Prerequisites	-		
Intake capacity	unlimited		
Learning outcomes	Students will: • be familiar with the molecular causes of cancer development and proliferation • know how knowledge of the molecular aspects of carcinogenesis can be applied to the diagnosis and treatment of tumours		
Module content	• Molecular basis of genetic alterations – DNA damage and mutations • DNA repair: enzyme systems and enzyme deficiencies • Epigenetic changes in tumours • Regulatory pathways in proliferation: oncogenes, tumour suppressor genes, control of the cell cycle • Apoptosis • Angiogenesis and development of metastases • Biochemical and molecular biological strategies for tumour diagnosis • Biochemical and molecular biological strategies for the treatment of cancer		
Form(s) of instruction	Lectures (49%), seminars (51%)		
Student workload	Attendance: Lectures 15 hours, seminars 14 hours, Preparation and revision: Lectures 29 hours, seminars 32 hours		
Total workload	90 hours = 3 ECTS credits		
Method of assessment	Seminar presentation (100%)		
Form of module component retake exam	None		
Form of retake exam	Seminar presentation (100%)		
Credit points	3 ECTS		
Language of instruction	German and English		
Frequency	Annually, 2 weeks, summer semester		

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Code	**M-BC-RNA**		
Course	**Biochemistry of Ribonucleic Acids**	2nd sem.	6 CP
Faculty/Subject/Department	08/Biology/Institute for Biochemistry		
Module coordinator	Cf. German version		
Lecturers	Bindereif and colleagues		
Guidance	Cf. German version		
Classification	MSc (Biol.)		
Prerequisites	BSc (Biol.) or equivalent		
Intake capacity	12		
Learning outcomes	Students should: • acquire an overview of the structural and functional diversity of RNA • understand the biochemistry of RNA processing reactions, in particular in eukaryotes • become familiar with essential experimental methods for RNA biochemistry in theory and through practical exercises ad well as with the approaches to RNA bioinformatics		
Module content	• Fundamentals of RNA composition, structure and occurrence • RNA world hypothesis • Biochemistry of RNA processing, especially in eukaryotes (RNA capping, tRNA processing, mRNA splicing, 3'-polyadenylation, RNA editing, RNA modification) • Structure, function and dynamics of spliceosomes • Regulation of mRNA splicing • Splicing defects and human diseases • Catalytic RNA, ribozymes and riboswitches • RNA aptamers and SELEX • Intracellular transport of RNA and RNA-protein complexes • RNA stability and degradation • Non-coding RNAs: micro-RNAs and RNA interference • RNomics: RNA and the Human Genome Project • Experimental basics for the analysis of RNA structure and processing • RNA synthesis (also with the use of radioisotopes) • Preparation of cell extracts for RNA processing • *In vitro* mRNA splicing • Detection methods for RNA processing (direct RNA analysis; reverse transcription/PCR; quantitative RT-PCR) • Detection and analysis of alternative mRNA splicing processes • RNA analysis using denaturing polyacrylamide gel electrophoresis • Detection of RNA using silver staining and Northern hybridisation • Separation and characterisation of RNA-protein complexes by means of centrifugation • Methods for affinity purification of RNA-protein complexes • Genome-wide analysis of RNA function and processing (microarrays, *high-throughput sequencing*) • Database analysis (sequences, alternative splicing variants)		
Form(s) of instruction	Lectures (50%), laboratory (50%)		
Student workload	Attendance: Lectures (30 hours), Laboratory (30 hours),	Preparation/revision: Lectures (60 hours), Laboratory (60 hours)	
Method of assessment	Exam 90 min (50%), oral examination 15-30 min (25%), report (25%)		
Form of module component retake exam			
Form of retake exam	Exam (50%), oral examination (25%), report (25%)		
Credit points	6 ECTS		
Language of instruction	German/English		
Frequency	Annually, 4 weeks, summer semester		

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Code	**M-BC-SNP**		
Course	**Structure and Function of Nucleic Acids and Proteins**	2nd sem.	3 CP
Faculty/Subject/Department	08/Biology/Institute for Biochemistry		
Module coordinator	Cf. German version		
Classification	MSc (Biol.)		
Prerequisites	-		
Intake capacity	no restrictions		
Learning outcomes	Students will: • be familiar with the detailed structure of nucleic acids and proteins and their building blocks • have learned to understand the structural diversity and conformational flexibility of proteins and nucleic acids • develop in-depth understanding of the structure-function relationships in proteins • know the processes involved in the synthesis, post-translational modification and folding of proteins • understand what determines protein stability • be familiar with the methods of structural analysis		
Module content	• Structure and conformation of nucleic acids • Analytical methods for the sequence analysis of nucleic acids • Biological function of alternative DNA conformations • Conformational transitions of nucleic acids • Structure and dynamics of supercoiled DNA • Low-molecular-weight ligands of nucleic acids • SELEX, ribozymes, aptamers • PNA and other nucleic acid analogues • Thermodynamics and kinetic of the ds/ss transition • Structure and conformation of proteins • Analytical methods for the sequence analysis of proteins • Post-translational modifications • Structural elements of proteins • Analytical methods for the analysis of protein secondary structure • Structural patterns, supersecondary structures • Structure of domains • Prediction of structures • Biosynthesis and folding of proteins, folding helpers • Protein stability • Protein complexes • Protein-DNA interactions, nucleoprotein complexes • Methods of structural analysis		
Form(s) of instruction	Lectures 73%, seminars 27%		
Student workload	Attendance: Lectures 22 hours, seminars 11 hours Preparation/revision: Lectures: 44 hours, seminars 13 hours		
Total workload	90 hours = 3 ECTS credits		
Method of assessment	Exam 60 min (50%), seminar presentation (50%)		
Form of module component retake exam	None		
Form of retake exam	Exam 60 min (50%), seminar presentation (50%)		
Credit points	3 ECTS		
Language of instruction	German and English		
Frequency	Annually, 2 weeks, ummer semester		

Code	**M-BD-LPB**		
Course	**Learning Process in Life Sciences –Development and Research Projects**	2nd sem	6 CP
Faculty/Subject/Department	08/Biology/Institute for Biology Education		
Module coordinator	Cf. German version		
Classification	MSc (Biol.)		
Prerequisites	-		
Intake capacity	16		
Learning outcomes	Students will be familiar with basic theories, methods and results of research into teaching and learning. Students will be able to plan learning and teaching processes in a project-based and target-specific manner and to implement and evaluate them. Thereby, students will be able describe the different types of requirements and give appropriate consideration to them in the creation of learning environments. Students will be able to develop analytical tools for evaluating the effectiveness of their teaching and learning process and use these both for self-assessment and for reflecting on the work processes of learners. Thereby they will take into consideration the provisions that are of significance to the psychology of learning and development and will relate these to the framework of the learning situation. Students will be able to have an active perception of the learning process and will also be able to reflect on and evaluate the guidance of the learning process within the project. Suitable materials and methods will be selected in a process-oriented manner, used and documented in an appropriate manner parallel to the learning process. Students will be able to plan a learning process independently in a team test, evaluate and reflect on learning sequences.		
Module content	• Knowledge of theories of research on teaching and learning. • Development and testing of a learning sequence in a selected example (for example at the Hermann-Hoffmann-Academy, in the Student Laboratory of the Institute for Biology, in the Green School of the Botanical Garden or at a suitable, preferably external, learning centre). • Selection, on the basis on subject-related education, pedagogy and psychology of learning and use of materials and methods to support the learning and teaching processes in the learning sequence. • Development and testing of approaches to evaluation and research in relation to the developed learning sequences in the project.		
Form(s) of instruction	Seminar 33% Project 67%		
Student workload	Specified hours (total 60 hours): Seminar 20 hours, Practical training 40 hours	Preparation/revision (120 hours): Seminar 40 hours, Practical training 80 hours	
Total workload	180 hours = 6 ECTS credits		
Method of assessment	Presentation 30%, Portfolio or report 70%		
Form of module component retake exam	None		
Form of retake exam	Presentation 30% Portfolio or report 70%		
Credit points	6 ECTS		
Language of instruction	German		
Frequency	Annually, 4 weeks, summer semester		

Code	**M-BD-TBV**		
Course	**Life Science Topics and Their Communication**	2nd sem	3 CP
Faculty/Subject/Department	08/Biology/Institute for Biology Education		
Module coordinator	Cf. German version		
Classification	MSc (Biol.)		
Prerequisites	-		
Intake capacity	16		
Learning outcomes	Students will be able to identify, develop, elaborate and reflect on selected areas of the life sciences for different subgroups of the population. They will select relevant issues in the specialist subject field and actively participate in the social and political discourse. Students will be able to choose different ways of communicating bioscience content and use them in a target-group-specific manner. Out of selected topics in the life sciences, students will choose to communicate principles targeting a given audience and reflecting subject-specific education and will adapt suitable materials and media from the drafting process. They will recognise the requirements and competency profiles of the target group and will be able to describe important provisions for their theory-based elaboration. Students will have the knowledge and skills to test the efficacy of their concept on different target populations and to evaluate it by means of suitable methods. Students will document the concept that has been developed, explain the materials and media used, and present the results of the evaluation. In this way, they will develop a critical attitude to their own concept and develop the first concrete prospects for its further extension.		
Module content	- Overview of topic areas in the life sciences - Presentation and analysis of an example (work in small groups with presentation) - Provisions relating to subject-area education, pedagogy and developmental psychology for the communication of topics in the life sciences. - Communication practices for life science topics including references to theory - Presentation and discussion of students' own concepts relating to one example - Documentation of the concept (incl. materials and media), e.g. portfolio - Final presentation with oral presentation and documentation		
Form(s) of instruction	Seminar 33% Lectures 17% Practical work 50%		
Student workload	Specified hours (30 hours): Seminars 10 hours, Practical placement 15 hours,	Preparation/revision (60 hours): Seminars 20 hours, Practical placement 30 hours,	
Total workload	90 hours = 3 ECTS credits		
Method of assessment	Presentation of the topic area 30% Portfolio or report 70%		
Credit points	3 ECTS		
Form of module component retake exam	None		
Form of retake exam			
Language of instruction	German		
Frequency	Annually, 2 weeks, summer semester		

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Code	**M-BO-BFS**		
Course	**Biodiversity: Function and Evolution of Spermatophytes**	1st sem.	6 CP
Faculty/Subject/Department	08/Biology/Institute for Botany/Work Group on Specialised Botany		
Module coordinator	Cf. German version		
Guidance	Cf. German version		
Classification	MSc (Biol.), specialisation in Botany, elective		
Prerequisites	-		
Intake capacity	12		
Learning outcomes	Students will: • acquire in-depth knowledge of the structure and function of the vegetative and reproductive organs of spermatophytes • learn to recognise and evaluation evolutionary innovations in the spermatophyte evolution • acquire an understanding of the relationships between morphology, anatomy, physiology, ecology and genetics • learn comparative methods for the reconstruction of family relationships and population structures • understand the basics of the origin of species		
Module content	Special systematics of spermatophytes Methods of phylogenetic reconstruction Practical observation, description and summary of the structure and evolution of the reproductive and vegetative organs of spermatophytes Molecular investigations of the phylogeny and/or kinship structure (population level) of spermatophytes		
Form(s) of instruction	Lectures (9%), seminars (31%), tutorials (60%)		
Total Workload	180 hours = 6 ECTS credits		
Student workload	Attendance: Lectures 8 hours, Seminars 16 hours, Tutorials 56 hours Preparation revision Lectures 8 hours, Seminars 40 hours, Tutorials 52 hours		
Method of assessment	Report (40%), seminar talk (60%)		
Form of module component retake exam	None		
Form of retake exam	Oral examination (100%)		
Credit points	6 ECTS		
Language of instruction	German		
Frequency	Annually, 4 weeks, winter semester		

Code	**M-BO-TEF**		
Course	**Methods in Electron Microscopy and Fluorescence Microscopy**	2nd sem	6 CP
Faculty/Subject/Department	08/Biology/Institute for Botany/ Work group Developmental Biology of Plants		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Botany		
Prerequisites	6 CP Cell Biology in B.Sc. (Biology)		
Intake capacity	16		
Learning outcomes	Students will: • learn the fundamentals and techniques of scanning and transmission electron microscopy and methods for the preparation of samples from plants • acquire an overview of selected special procedures in analytical electron microscopy (e.g. cytochemical detection procedures, immunocytochemistry, cryogenic techniques, EDXA, EFTEM) • learn various procedures for light microscopy (e.g. histochemistry, CLSM, polarisation microscopy) • learn the fundamentals and methods of fluorescence microscopy • learn to recognise the areas of application for the described techniques • approach the qualitative evaluation of the techniques described with a critical attitude, discussing sources of error and learning to identify artefacts • deal with the planning of a scientific experiment, choice of control studies and documentation of the results • gain insight into the current research activities of the teaching staff		
Module content	• Analysis of selected items using various light microscopic procedures • Preparation of plant cell materials for scanning and transmission electron microscopy • Tutorials in chemical fixation and embedding, critical-point drying, cathode coating, microtomy of semi- and ultra-thin sections and contrast procedures • Theoretical basics and tutorials on scanning and transmission electron microscopy, including selected special analytical procedures • Tutorials on microphotography and digital image processing • Theoretical basics and tutorials on fluorescence microscopy, analysis of promoter and protein interactions and transient gene expression in plants		
Form(s) of instruction	Lectures (27%), tutorials in small groups (59%), seminars (14%),		
Total workload	180 hours = 6 ECTS credits		
Student workload	Attendance: Lectures 18 hours, Tutorials 40 hours, Seminars 16 hours	Preparation/revision: Lectures 30 hours, Tutorials 66 hours, Seminar 10 hours	
Method of assessment	Seminar presentation 30%, report 70%		
Form of module component retake exam	None		
Form of retake exam	Oral examination (100%)		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, summer semester		

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Code	**M-BO-PEG**	2nd sem.	6 CP
Course	**Analysis of Genes Regulating Plant Development**		
Faculty/Subject/Departm	08/Biology/Institute for Botany/ Working group Developmental Biology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Botany or specialisation in Developmental Biology		
Prerequisites	6 CP Cell Biology in BSc (Biol.),		
Intake capacity	16		
Learning outcomes	Students will: • understand special aspects of the genetics of plant development • develop an integrative understanding of the molecular and developmental biological processes controlling special physiological and functional processes in plant cells and tissues • approach the qualitative evaluation of the techniques used with a critical attitude, discussing sources of error and learning to identify artefacts • deal with the planning of a scientific experiment, choice of control studies and documentation of the results. • gain insight into the current research activities of the teaching staff • practise performing independent literature searches		
Module content	• Fundamentals of the molecular regulation of flower development • Analysis of transgenic plants (e.g. insertion mutants, hpRNA, virus-induced gene silencing) • Genotyping and morphological analysis (macroscopic, microscopic) • Isolation of plant nucleic acids • Gene expression analysis (e.g. qRT-PCR, RT-PCR, Northern Blot, RNA in-situ hybridisation, GUS assay) • Protein interactions of plant transcription factors (e.g. yeast two-hybrid analyses, bifluorescence complementation)		
Form(s) of instruction	Lectures (18%), tutorials (53%), seminars (29%),		
Total Workload	180 hours = 6 ECTS credits		
Student workload	Attendance: Lectures 16 hours, Tutorials 40 hours, Seminars 16 hours	Preparation/revision: Lectures 16 hours, Tutorials 256hours, Elaboration of seminar topic 36 hours,	
Method of assessment	Laboratory report (70%), seminar presentation (30%)		
Form of module component retake exam	None		
Form of retake exam	Laboratory report (70%), seminar presentation (30%)		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, Summer semester		

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Code	**M-BP-LHT**	1st sem.	6 CP
Course	**Life History Theory**		
Faculty/Subject/Departmen	08/Biology/ Professorship for the philosophy of bio sciences		
Module coordinator	Cf. German version		
Classification	M.Sc. (Biol.), Optional subject Biophilosophy		
Prerequisites	6 CP Biophilosophy B.Sc. (Biol.)		
Intake capacity	6		
Learning outcomes	Students will: • acquire advanced knowledge of human life history theory • transfer this knowledge into a scientific study design • reflect and justify their design against the background of a normative philosophy of biological science • acquire the methodological tools to implement the study design operationally • acquire a basic knowledge of historical and evolutionary demography • learn how to use databases and software applications (SPSS) for management and statistical analysis of data • develop a critical awareness of anthropological theories that have been proposed and practise developing creative strategies to improve them • develop arguments for the naturalisation of philosophical anthropology		
Module content	• A theoretical and empirical overview of human life history evolution • Insights into the life history theory according to the results of the "Krummhörn project" (reconstitution of the population of Krummhörn, East Frisia in the 18th and 19th centuries) • Introduction to the method of historical family reconstitution on the basis of church records and other historical sources • SPSS-based data analysis (especially: logistical regression, Cox regression) • Behavioural-ecological, socio-historical and local cultural aspects of the historical Krummhörn • Anthropological and philosophical consideration of the results of the Krummhörn project		
Form(s) of instruction	Seminar (33%), tutorial (67%)		
Total Workload	180 hours = 6 ECTS credits		
Student workload	Attendance: Seminar 20 hours, Tutorial 60 hours	Preparation/revision: Seminars 40 hours, Tutorial 60 hours	
Method of assessment	Presentation (70%), report (30%)		
Form of module component retake exam	None		
Form of retake exam	Presentation (70%), report (30%)		
Credit points	6 ECTS		
Language of instruction	German		
Frequency	Winter semester		

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Code	**M-EB-EAM**	1st sem.	6 CP
Course	**Cell and Molecular Analysis of Model Organisms**		
Faculty/Subject/Department	08/Biology/Institute for General and Special Zoology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Developmental Biology		
Prerequisites	specialisation in Developmental Biology		
Intake capacity	16		
Learning outcomes	• Students will learn • methods of harvesting gametes and *in vitro* fertilisation • advantages and disadvantages of working with various model systems • culture conditions for embryos and isolated embryonic cells • monitoring of developmental processes using modern microscopic methods • monitoring of developmental processes using labelling techniques • analysis of stages of development by determination of gene products (RNA and protein)		
Module content	• Cultures of embryos and embryonic cells • Introduction to the general developmental biology of various model organisms • Introduction to microscopic analysis of developmental processes • Description of cell types and histology • Cell differentiation during development • Antibody staining • *In situ* hybridisation		
Form(s) of instruction	Lectures (31%), laboratory (69%)		
Total Workload	180 hours = 6 ECTS credits		
Student workload	Attendance: Lectures: 20 hours, Laboratory: 55 hours	Preparation/revision: Lectures: 35 hours, Laboratory: 70 hours	
Method of assessment	Report (100%)		
Credit points	6 ECTS		
Form of module component retake exam	None		
Form of retake exam	Report (100%)		
Language of instruction	German		
Frequency	Annually, 4 weeks, Winter semester		

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Code	**M-EB-MEM**	2nd sem.	6 CP
Course	**Molecular Embryology**		
Faculty/Subject/Department	08/Biology/Institute for General and Special Zoology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Developmental Biology,		
Prerequisites			
Intake capacity	16		
Learning outcomes	Students will: • learn to formulate questions for molecular studies from observations of developmental processes • use literature and gene bank searches to identify genes potentially involved in these developmental processes • be able to isolate and clone the paralogous genes from cDNA or genomic banks • be able to investigate the spatial and temporal expression of these genes • detect the totality of proteins from certain genes with the aid of immunocytochemistry • have an insight into work and guidelines concerning GMOs (S1)		
Module content	• Analysis of developmental and housekeeping genes in embryos and larvae of invertebrates and vertebrates • Insulation of DNA and RNA • Analysis of genetic libraries, differences between genetic libraries • Primer design and isolation of gene fragments and their cloning • *In-situ* hybridisation and expression analysis • Testing the significance of genes by means of gene knock-down with RNAi		
Form(s) of instruction	Lectures (47%), tutorials (53%)		
Total workload	180 hours = 6 ECTS credits		
Student workload	Attendance: Lectures: 24 hours Tutorials: 36 hours Exam: 1 hour	Preparation/revision: Lectures: 60 hours Tutorials: 60 hours	
Method of assessment	Report (33%), presentation (67%)		
Form of module component retake exam	None		
Form of retake exam	Report (33%), presentation (67%)		
Credit points	6 ECTS		
Language of instruction	German		
Frequency	Annually, 4 weeks, Summer semester		

Code	**M-EB-MRE** 2^{nd} sem.	6 CP
Course	**Molecular Feedback Loops in Developmental Systems**	
Faculty/Subject/Department	08/Biology/Institute for General and Special Zoology	
Module coordinator	Cf. German version	
Classification	MSc (Biol.), specialisation in Developmental Biology /2^{nd} semester	
Prerequisites	specialisation in Developmental Biology	
Intake capacity	16	
Learning outcomes	Students will: • learn t universal mechanisms during the process of development • recognise the evolutionary conservation of embryonic control circuits • understand the cascade of these events, which results in gene activation • be familiar with important patterns of protein-DNA interactions • learn scientifically correct description and interpretation • discuss new interrelationships scientifically	
Module content	• **Genetic control of development by means of differential gene activity** • Molecular analysis of regulatory circuits with Drosophila during embryonic development • Cell communication and cellular functional analysis • Comparative Analysis of GOF, LOF and phenocopy-phenotypes • Over- and misexpression studies • Modify-Screens to revealing of genetic interaction	
Form(s) of instruction	Lectures (27%), tutorials (73%)	
Total Workload	180 hours = 6 ECTS credits	
Student workload F=1.8	Attendance: Lectures: 20 hours Tutorials: 60 hours	Preparation/revision: Lectures: 40 hours Tutorials: 60 hours
Method of assessment	Assigned exercises (50%), seminar presentation (50%)	
Form of module component retake exam	None	
Form of retake exam	Assigned exercises (50%), seminar presentation (50%)	
Credit points	6 ECTS	
Language of instruction	German	
Frequency	Annually, 4 weeks, Sumer semester	

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Code	**M-GE-CHF**	1st Sem.	6 CP
Course	**Chromatin Function**		
Faculty/Subject/Departmen	08/Biology/Institute for Genetics		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Genetics, 1st semester, elective		
Prerequisites	-		
Intake capacity	16		
Learning outcomes	Students will: • have in-depth knowledge of gene regulation and molecular genetics • have in-depth knowledge of the structure of chromosomes and chromatin • have in-depth knowledge of epigenetics and DNA methylation • have in-depth knowledge of chromatin function • have in-depth knowledge of chromatin modification • have the ability to correlate chromatin modification with gene activity • have the skills to alter chromatin modification		
Module content	• Introduction to molecular genetics • Mechanisms of gene regulation and epigenetics • Investigation of epigenetic regulation • Isolation of chromatin • Identification of various chromatin modifications • Analysis of DNA methylation • Analysis of gene expression		
Form(s) of instruction	Lectures (45%), tutorials (55%)		
Total Workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Lectures 21 hours, Tutorials 39 hours	Preparation/revision: Lectures 60 hours, Tutorials 60 hours	
Method of assessment	Exam (50%), report (50%)		
Form of module component retake exam	None		
Form of retake exam	Oral exam (100%)		
Credit points	6 ECTS		
Language of instruction	German, English by arrangement		
Frequency	Annually, 4 weeks, winter semester		

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Code	**M-GE-HGR**	1st Sem.	6 CP
Course	**Hormone Controlled Gene Regulation**		
Faculty/Subject/Department	08/Biology/Institute for Genetics		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Genetics, 1st semester		
Prerequisites	-		
Intake capacity	16		
Learning outcomes	Students will: • have in-depth knowledge of eukaryotic gene function • have in-depth knowledge of methods in molecular genetics • have the ability to measure and modulate gene activity • have the ability to analyse and alter promoter function • understand the mechanisms of hormonally controlled gene regulation • be aware of hereditary diseases caused by defects in hormonally controlled genes		
Module content	• Performance of DNA cloning • Various techniques for targeted mutagenesis • Sterile work with cell cultures • Various techniques for DNA transfection • Use and analysing of non-coding RNA • Measurement of DNA-protein interactions • Various methods for detecting protein expression • Measurement of hormonally controlled gene activity (microarray)		
Form(s) of instruction	Lectures (34%), practical course, tutorials (66%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Lectures 21 hours, Tutorials 39 hours,	Preparation/revision: Lectures 40 hours, Tutorials 80 hours	
Method of assessment	Report (50%), exam 60 minutes (50%)		
Form of module component retake exam	None		
Form of retake exam	exam (100%) or oral examination (100%), form will be published at the begin of module		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, winter semester		

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Code	**M-GE-MPA**	1^{st}-2^{nd} sem.	6 CP
Course	**Methods in Proteome Analysis**		
Faculty/Subject/Departmen	08/Biology/Institute for Genetics		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Genetics, 1st semester (alternative to M-GE-STD)		
Prerequisites			
Intake capacity	10		
Learning outcomes	Students will: • have in-depth knowledge of the complexity of the proteome • have in-depth knowledge of proteome analysis • have in-depth knowledge of the fractionation of cellular components • have the ability to select and use specific methods for isolation and fractionation		
Module content	• Isolation and purification of cell nuclei • Preparation of protein extracts • Gel electrophoresis • Chromatography • Immunoblotting • Immunoprecipitation • Computer-assisted proteome analysis		
Form(s) of instruction	Lectures (34%), tutorials (66%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Lectures 21 hours, Tutorials 39 hours,	Preparation/revision: Lectures 40 hours, Tutorials 80 hours	
Method of assessment	Report (50%), exam (60 min) (50%)		
Form of module component retake exam	None		
Form of retake exam	exam (100%) or oral examination (100%), form will be published at the begin of module		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, winter semester/summer semester		

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Code	**M-GE-STD**	1st.-2nd sem.	6 CP
Course	**Signal Transduction in Gene Regulation**		
Faculty/Subject/Department	08/Biology/Institute for Genetics		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Genetics, 1st semester (alternative to M-GE-MPA)		
Prerequisites	-		
Intake capacity	16		
Learning outcomes	Students will: • have an in-depth knowledge of the function of regulatory factors • have in-depth knowledge of various signal transduction cascades • have an in-depth knowledge of activation by means of phosphorylation • have the ability to detect the phosphorylated regulatory factors		
Module content	• Expression of fusion proteins • Detection of nuclear translocation of regulatory factors • Detection of phosphorylation of regulatory factors • Use of fluorescence microscopy • Modulation of the activity of regulatory factors • Functional antagonisms of regulatory factors		
Form(s) of instruction	Lectures (34%), practical course, tutorials (66%)		
Total workload	180 hours = 6 ECTS-Credits		
Student workload	Attendance: Lectures 21 hours, Tutorials 39 hours,	Preparation/revision: Lectures 40 hours, Tutorials 80 hours	
Method of assessment	Report (50%), exam (50%)		
Form of module component retake exam	None		
Form of retake exam	Exam (100%) or oral examination (100%), form will be published at the begin of module		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, winter semester/summer semester		

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Code	**M-IM-EIM (A)**	1st sem.	12 CP
Course	**Experimental Immunology – Immune Systems of Animals**		
Faculty/Subject/Department	08/Biology/Chair of Immunology & General Zoology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Immunology, 1st semester		
Prerequisites	6 CP Immunology in BSc (Biol.)		
Intake capacity	16		
Learning outcomes	In the theoretical part, Students will: • acquire a detailed insight into the various humoral and cellular immune responses of various groups of animals (from Porifera to Aves) • thereby learning to recognise the diversity of recognition processes, receptors (pattern recognition proteins), signalling pathways and effector molecules • obtain a comparative overview of the various cells and organs of the immune systems of different taxa as well as of their differentiation to immunocompetence • obtain an overview of special mechanisms used by pathogens to bypass immune defences (parasitoids, fungi) • learn to recognise and understand how various molecules (receptors, adhesion proteins, antibodies, complement factors, antimicrobial peptides) as well as cells and organs of relevance to the immune response have evolved In the practical part, Students will: • learn the use of specially selected methods in insects, annelids and other "model animals", which result in the detection of immune reactions in these animals • practise recording, logging, documenting, evaluating and interpreting original results and producing a scientific report • compare the results obtained against the working hypothesis and discuss them, as well as presenting the results in their biological context to the group (poster)		
Module content	In the theoretical part: • Humoral immune responses of invertebrates (antimicrobial peptides, structure, mode of action) • Induction and regulation of the synthesis of antimicrobial peptides (receptors & signal cascades, transcription factors (NFkB-related factors)) • Protease cascade-dependent humoral defence processes (coagulation, melanisation reactions) • Cytotoxic reactions (pore-forming proteins) • Cellular immune reactions (phagocytosis, nodule formation and encapsulations) • Reactions dependent on arachidonic acid metabolites • Antiviral immune responses in invertebrates • Haematopoietic organs, differentiation of immunocompetent cells • Parasitoid-virus models • Wound reactions In the practical part: • Detection of the induction of antimicrobial peptides and their spectrum of activity as a function of different pathogens • Differential detection of an antimicrobial peptide (lysozyme) using SDS-PAGE, acidic native PAGE, Western blotting, • Evidence of the importance of proteases in an immune response (various modified PAGE techniques) • Characterisation and identification of immunocompetent cells (histology, immunohistochemistry, functional evidence) • Preparation of haematopoietic or phagocytically active organs of various taxa • Detection of lectins in immune systems of insects and annelids (agglutination assays with competition studies) • Detection and determination of the activation of a melanisation reaction (photometry/phenol oxidase activity)		
Form(s) of instruction	Lecture (17%), tutorial (11%), exercises (58%), seminar (14%)		
Total workload	360 hours = 12 ECTS-credits		
Student workload F=1.58	Lectures (30 hours), tutorials (10 hours), tutorials (90 hours), seminar (8 hours), Preparation/revision: lecture (30 hours), tutorials (30 hours), tutorials (120 hours), seminar (42 hours)		

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Method of assessment	Exams (40%) (overall 90 min), seminars presentation (15%), report (45%)
Form of module component retake exam	None
Form of retake exam	Exam (100%) or oral examination (100%), form will be published at the begin of module
Credit points	12 ECTS
Language of instruction	German, English
Frequency	Annually, 8 weeks, winter semester

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Code	**M-IM-EIM (B)**	1st sem.	12 CP
Course	**Experimental Immunology – Cellular and Molecular Communication**		
Faculty/Subject/Department	08/Biology/Chair of Immunology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Immunology, 1st semester, obligatory		
Prerequisites	6 CP Immunology in BSc (Biol.)		
Intake capacity	16		
Learning outcomes	In the theoretical part, students will: • obtain a detailed insight into the various molecular mechanisms by which immunocompetent cells communicate with each other and with cells with which they come into contact within tissues • learn to recognise and understand the different mechanisms by which the immune system distinguishes between what is dangerous and what is safe and how these recognition processes lead to various signalling pathways and differentiated biological responses • understand how immune mediators coordinate and regulate immune reactions by means of specific receptor complexes and intracellular signal cascades In the practical part, students will: • learn specially selected methods in order to measure prototype mechanisms of signal transduction by immune cells • practise recording, logging, documenting, evaluating and interpreting original results and producing a scientific report • compare the results obtained against the working hypothesis and discuss them, as well as presenting the results in their biological context to the group (poster)		
Module content	In the theoretical part: • Fundamentals of cell-cell interactions (chemokines, adhesion molecules, migration) • Basic principles of signal transduction (kinases, G proteins, etc.) • Molecular structure and function of central receptor modules (antigen receptors, cytokine receptors, pattern recognition receptors) • Membrane-associated signal transduction modules (Tyr PTK, Ser/Thr PTKs, PI3-K, PKCs) • Amplification of signals in the cytoplasm (MAP-Ks, PKBs, G protein, PKA) • Activation of transcription factors (NFkB, NFAT, IRF and others.) • Regulation of the transcription and translation of genes relevant to inflammation In the practical part: • Activation of T cells via the TCR with pan-T-cell activators, recording proliferation and effects of clinically relevant immunosuppressants in vitro • Measurement of the increase in intracellular calcium ions by means of fluorescent dyes (FACS) • Characterisation of interleukin-1 receptor complexes, role of the TIR domain • Measurement of the activation of the central transcription factor NF-kB • Triggering and detection of apoptotic processes (caspase activation, PARP cleavage)		
Form(s) of instruction	Lectures (17%), tutorials (11%), exercises(58%), seminar (14%)		
Total workload	360 hours = 12 ECTS-credits		
Student workload	Lectures (30 hours), tutorials (10 hours), tutorials (92 hours), seminar (8 hours) Preparation/revision: lecture (30 hours), tutorials (30 hours), tutorials (120 hours), seminar (40 hours)		
Method of assessment	Oral examination (40%) seminar presentation (20%), report (40%)		
Form of module component retake exam	None		
Form of retake exam	Exam (100%) or oral examination (100%), form will be published at the begin of module		
Credit points	12 ECTS		
Language of instruction	German		
Frequency	Annually, 2+6 weeks, winter semester		

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Code	**M-IM-MAI**	2nd sem.	6 CP
Course	**Modern Biomedical Aspects in Immunology**		
Faculty/Subject/Department	08/Biology/Chair of Immunology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Immunology, 2nd semester		
Prerequisites	Specialisation in Immunology for MSc or 6 CP Immunology in BSc (Biol.)		
Intake capacity	32		
Learning outcomes	Students: • with guidance (selection of topics, the original literature, introduction to the topic through the lectures), address selected areas of biomedicine in order to gain insight into the relationships between experimental medicine, cell biology and molecular biology. The topics will be selected with an emphasis on immunological aspects • gain understanding of the molecular and cellular basis of life and the role the immune system plays in pathological changes • learn to recognise the areas of application of biomedicine/molecular medicine in research and therapy • deal critically with the ethical and social aspects of applied biomedicine • learn how to individually prepare an oral and a written presentation on a biomedical topic and learn to present and discuss it in front of the group in English language		
Module content	• Cell culture models in research and pharmaceutics (e.g. testing of immunosuppressants) • Animal models in research (e.g. rheumatism research) • Production of artificial tissues/organs (MHC compatibility) • Organ transplantation, immunosuppression, tolerance induction • Production of transgenic animals in order to obtain organs for xenotransplantation • Harvesting and use of stem cells • Harvesting and use of haematopoietic stem cells • Principles of the production of transgenic/knock-out/knock-in animals for research purposes (production purposes) • Recombinant proteins, preparation and use as therapeutic agents (e.g. interferons, colony-stimulating factors) • Approaches for gene therapy • Generation, production and characterisation of monoclonal antibodies • Use of antibodies in diagnosis and therapy • Modern methods of vaccine production		
Form(s) of instruction	Lectures (30%), seminars (70%) in English		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Lectures (18 hours), seminars 28 hours Preparation/revision: Lectures (36 hours), seminar (98 hours)		
Method of assessment	Seminar presentation 50%, handout/poster presentation 50%		
Form of module component retake exam	None		
Form f retake exam	Seminar presentation 50%, handout/poster presentation 50%		
Credit points	6 ECTS		
Language of instruction	English		
Frequency	Annually, 4 weeks, summer semester		

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Code	**M-MI-MBP**	1st sem.	9 CP
Course	**Molecular Biology of Prokaryotes**		
Faculty/Subject/Department	08/Biology/Institute for Microbiology and Molecular Biology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), 1st semester, specialization in microbiology		
Prerequisites	12 CP Microbiology in BSc (Biol.)		
Intake capacity	16		
Learning outcomes	Students will: • have in-depth knowledge of the structure, organisation and plasticity of the bacterial genome • have an overview of current methods for the molecular biology of prokaryotes • have in-depth knowledge of prokaryote differentiation and the underlying molecular mechanisms • have in-depth knowledge of microbial gene expression and its analysis • understand the principles of the exchange of materials as well as of intra- and intermolecular signal transmission and be able to apply these to various case studies • have in-depth knowledge of various adaptation mechanisms, by which bacteria achieve cellular homoeostasis in altered environmental conditions • be familiar, on the basis of case studies, with the principles of the feedback mechanisms between external stimuli, metabolism and gene regulation • understand complex cell physiological adaptations (cell differentiation and communication) as the implementation of highly developed regulatory mechanisms • have insight into methods of mutagenesis and the use of mutants to investigate scientific questions • be experienced in basic techniques for the genetic manipulation of prokaryotic cells • be experienced in dealing with bacteria and sterile techniques • have knowledge of the way of life of Archaea and have experience in handling them • understand original literature in the English language		
Module content	• Bacterial genes, cistrons, genome (bioinformatics) • Bacterial and phage genetics • Recombinant DNA techniques (biological safety) • Processes of gene expression • From gene to gene product: levels of regulation • Interaction between metabolism and gene regulation • Regulatory mechanisms for adaptation to environmental changes and nutrient control • Control of growth, growth-dependent regulation • Cell-cell communication and cell differentiation in bacteria • Studies on molecular mechanisms of adaptation/differentiation in prokaryotes • Isolation and characterisation of bacterial DNA and RNA • Mutagenesis techniques • Complementation of bacterial mutants • Recording physiological parameters in prokaryotes • The use of various methods for the analysis of gene expression in prokaryotes		
Form(s) of instruction	Lectures (23%), exercises (54%), seminars (23%)		
Total workload	270 hours = 9 ECTS-credits		
Student workload	Attendance: Lectures 17 hours, Exercises 80 hours, Seminars 20 hours,	Preparation/revision: Lectures 44 hours Exercises 65 hours, Seminar 44 hours	
Method of assessment	Exam 60 min (40%), report/laboratory report (40%), seminar presentation (20%)		
Form of module component retake exam	None		
Form of retake exam	Exam (100%)		
Credit points	9 ECTS		
Language of instruction	German, English		
Frequency	Annually, 6 weeks, winter semester		

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Code	**M-MI-MIK**	2nd sem.	6 CP
Course	**Molecular Microbiology of Infectious Diseases**		
Faculty/Subject/Departme	08/Biology/Institute for Microbiology and Molecular Biology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), 2nd semester, specialisation in microbiology		
Prerequisites	-		
Intake capacity	16		
Learning outcomes	Students will acquire: • an understanding of the historical development of medical microbiology • an overview of the different classes of antibiotics, their modes of action and bacterial resistance mechanisms • basic knowledge of treatment options and an understanding of the strategies of vaccine development • an understanding of the basic differences in the infection of animal and plant cells by pathogens and their spread into various types of cells • in-depth knowledge of the molecular basis of bacterial and viral infections and the fundamental differences between them • a basic knowledge of the body's defence mechanisms against pathogens • An understanding of how pathogens undermine the defence mechanisms • deeper insight into the evolution of RNA viruses and retroviruses and the problems of how to combat them • in-depth knowledge of the molecular mechanisms of damage caused to eukaryotic cells by selected bacterial toxins • a deeper understanding of host-pathogen interactions • a basic knowledge of medical diagnostic techniques • the ability to make oral presentations and to teach about pathogen-host interactions		
Module content	• History of medical microbiology • Fundamentals of epidemiology • Fundamentals of medical diagnostics and vaccine development • Fundamental principles of immune defences • Structure and function of antibiotics and resistance mechanisms • Basic mechanisms of infection and the proliferation of pathogenic bacteria • Mechanisms of action of bacterial toxins • Mechanisms of bacterial pathogenicity • Basic mechanisms of infection and the proliferation of viruses • Groups of animal viruses, infection, proliferation, clinical pictures • Genetic variability of RNA viruses • Strategies for the proliferation of RNA viruses in eukaryotic cells • Examples of eukaryotic pathogens • Prions • Overview of plant pathogens, principles of infection, proliferation, clinical pictures		
Form(s) of instruction	Lectures (46%), seminars (37%), exercise (17%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Lectures 27 hours, Seminars 24 hours, Exercises 15 hours, Exam 1 hour	Preparation/revision: Lectures 55 hours, Elaboration of a seminar topic 44 hours, Exercises 15 hours	
Method of assessment	Exam (60 min) (60%), seminar presentation (40%)		
Form of module component retake exam	None		
Form of retake exam	Exam (100%)		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, summer semester		

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Code	**M-MI-STB**	1st sem.	3 CP
Course	**Signal Transduction in Bacteria**		
Faculty/Subject/Department	08/Biology/Institute for Microbiology and Molecular Biology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), 1st semester, elective, specialisation microbiology		
Prerequisites	-		
Intake capacity	16		
Learning outcomes	Students will: • acquire deeper insights into the methods with which the molecular processes of bacterial signal transduction can be investigated, with a particular focus on the - functional analysis of mutants - signal transduction chains - signal processing • acquire the ability to apply the methods and experimental approaches that have been learned in order to evaluate their own results critically and draw conclusions from them		
Module content	• Investigation of the reaction of a selected bacterial signal system to external stimuli, by means of: - quantification of the expression of genes, which are under the control of the signal system being investigated - physiological and biochemical studies on the adaptability of organisms to altered environmental conditions		
Form(s) of instruction	Lectures (23%), tutorials (77%)		
Total workload	90 hours = 3 ECTS-credits		
Student workload	Attendance: Lectures 6 hours, Tutorials 49 hours	Preparation/revision: Lectures 15 hours, Tutorials 20 hours	
Method of assessment	Report (100%)		
Form of module component retake exam	None		
Form of retake exam	Report (100%)		
Credit points	3 ECTS		
Language of instruction	German		
Frequency	Annually, 2 weeks, winter semester		

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Code	**M-MI-VIR**	2nd sem.	3 CP
Course	**Molecular Biology of Viral Infections**		
Faculty/Subject/Departmen	11/Virology/Institute for Medical Virology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), optional, 2nd semester		
Prerequisites	Specialisation: Virology, Cell Biology, Molecular Genetics		
Intake capacity	10		
Learning outcomes	Students will: • learn methods for cell culture • improve their knowledge for dealing with reports, documentation and evaluation • learn how to handle infectious material • learn how to work under L2/S2 conditions • learn methods for cell transfection • learn the fundamentals of genome replication/transcription in ss (-) RNA viruses • learn the fundamentals of "reverse genetics" and *de novo* production of influenza viruses • learn how to work with various microscopes (light transmission, UV, confocal) • learn detection techniques for virus replication • learn how to purify and detect avian hepadnaviruses (from bird sera)		
Module content	• Propagation and maintenance of cell line cultures • Calculation of MOI and infecting cell cultures • Sterile work in virology and cell cultures • Genome replication of ss (-) RNA viruses • Reverse genetics systems for ss (-) RNA viruses • Transfection of cell cultures • In-vivo reconstitution of influenza virus replication complexes (RNP) • Detection, documentation and evaluation of influenza virus RNP activity in comparison to a reconstituted RNP complex • Virus titration (Standard plaque assay and haemagglutination assay) • Density gradient centrifugation for purification of viruses from sera • Quantitative determination of viral antigens (Laurell electrophoresis)		
Form(s) of instruction	Tutorials with integrated seminars (100%)		
Total workload	90 hours = 3 ECTS-credits		
Student workload	Attendance: Tutorials: 50 hours,	Preparation/revision: Tutorials: 40 hours	
Method of assessment	Laboratory report (100%)		
Form of module component retake exam	None		
Form of retake exam	Laboratory report (100%)		
Credit points	3 ECTS		
Language of instruction	German		
Frequency	Annually, 2 weeks, summer semester		

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Code	**M-MS-SEM**	1^{st} – 4^{th} sem.	3 CP
Course	**Master Seminar**		
Faculty/Subject/Department	08/Biology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), compulsory		
Prerequisites	-		
Intake capacity	Cohort		
Learning outcomes	Students will: • gain knowledge of the breadth of the field of biology at the level of current research • be able to discuss foreign research topics critically and intelligently • be able to conduct scientific discussions • acquire experience in dealing amicably with professional colleagues • establish contacts with potential research partners • be able to plan and conduct courses autonomously together with fellow students • gain experience in acquiring financial support from various sources • interact on a regular basis to share experiences as a scientific team		
Module content	Various research topics presented by guests		
Form(s) of instruction	Seminars (100%)		
Total workload	90 hours = 3 ECTS-credits		
Student workload	Attendance: Seminars 30 hours Preparation/revision:		
Advance performance for assessment	Participation at 10 sessions at least		
Method of assessment	Report (no grades)		
Form of module component retake exam	None		
Form of retake exam	Report		
Credit points	3 ECTS		
Language of instruction	English		
Frequency	Annually, 4 semester (during term), winter semester/ summer semester		

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Code	**M-MS-THE**	3rd -4th sem.	30 CP
Course	**Master Dissertation**		
Faculty/Subject/Department	08/Biology/		
Module coordinator	Cf. German version		
Classification	MSc (Biol.)/ 3rd-4th sem./ compulsory		
Prerequisites	Modules from the first year of the master's studies, SpezO M.Sc. (Biol.) §19		
Intake capacity	unlimited		
Learning outcomes	Students should: • possess the skills, based on an actual task, to use scientific methods from a field of biological activity • present their results as a scientific work and defend it		
Module content	• Drafting a work plan • Introduction to the literature • Development of methods for measurement and evaluation, implementation and evaluation • Detailed discussion of the results • Production of the thesis • Whole-day instruction on scientific work in a scientific team		
Form(s) of instruction	Dissertation (100%)		
Total workload	900 hours = 30 ECTS-credits		
Method of assessment	Dissertation		
Form of module component retake exam	None		
Form of retake exam	According to 34 (2) AllB		
Credit points	30 ECTS		
Language of instruction	German/English (Thesis abstract: German and English)		
Frequency	Annually, 20 weeks, winter semester/ summer semester, preferably in the 4th semester		

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Code	**M-MS-PPP**	3^{rd}-4^{th} sem.	6 CP
Course	**Project Laboratory**		
Faculty/Subject/Department	08/Biology/		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), compulsory/ 3^{rd}-4^{th} sem.		
Prerequisites	-		
Intake capacity	-		
Learning outcomes	Students will be able to: • conduct complex experiments independently, with guidance, in the context of a research project • summarise, classify and discuss results in the form of a written scientific publication		
Module content	• Introduction to the literature • Drafting a plan of work • Development of methods for measurement and evaluation • implementation and evaluation of the experiments • Written and oral presentation of the project work • Whole-day instruction on scientific work in a scientific team		
Form(s) of instruction	Practical Training (100%)		
Student workload	Attendance, including preparation and revision: 4 weeks, full-time		
Total workload	180 hours = 6 ECTS-credits		
Method of assessment	Report (100%)		
Form of module component retake exam	None		
Form of retake exam	Report (100%)		
Credit points	6 ECTS		
Language of instruction	German and English		
Frequency	Annually, 4 weeks, winter semester/ summer semester, preferably in the 3rd and 4th semesters		

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Code	**M-NS-BPN**	1^{st}-2^{nd} sem.	6 CP
Course	**Placement with the Public Authorities: Nature Conservation**		
Faculty/Subject/Department	08/Biology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Nature Conservation, 1st/2nd semester, obligatory		
Prerequisites	BSc (Biol.), specialisation: Nature Conservation or B.Sc. (Biol.) Module V-NS-1 resp.		
Intake capacity	18		
Learning outcomes	Students will: • be familiar with the requirements for the protection of endangered animal and plant species • possess the professional background for the establishment and maintenance of nature reserves • be able to implement nature conservation legislation, particularly the Federal Nature Conservation Act (recognition of organisations, exemptions from legal regulations in individual cases) in the regional context • deal with supervising downstream agencies • be able to contribute to decision-making in appeal procedures concerning nature conservation legislation • learn about the management and distribution of government funds for nature conservation • provide technical advice on questions of environmental impact assessment		
Module content	• Placement with a government agency (e.g. authority for nature conservation) dealing with nature conservation, landscape protection and environmental protection • Federal Nature Conservation Act and associated regulations • Procedures in applied environmental protection and nature conservation • Advanced problems of administrative enforcement • Supervisory and advisory activities		
Form(s) of instruction	Tutorials (100%)		
Total workload	180 hours= 6 ECTS-credits		
Student workload	Attendance: Tutorials 140 hours	Preparation/revision: Tutorials 40 hours	
Method of assessment	Report (50%), portfolio (50%)		
Form of module retake exam	None		
Form of retake exam	Report (50%), portfolio (50%)		
Credit points	6 ECTS		
Language of instruction	German		
Frequency	Annually, 4 weeks, summer semester/winter semester		

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Code	**M-NS-EXN**	1st sem.	6 CP
Course	**Experimental Nature Conservation**		
Faculty/Subject/Department	08/Biology/Institute for General and Special Zoology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Nature Conservation, 1st semester		
Prerequisites	-		
Intake capacity	18		
Learning outcomes	Students will: • master the nature conservation-related fundamentals of population ecology and synecology • be able to conduct and evaluate experiments focusing on nature conservation • be able to assess changes in land use change and analyse them using geostatistical methods • recognise the role of experimental work in nature conservation and in the protection of biodiversity • learn methods of applied population genetics • acquire the skills for planning of nature reserves • be able to plan goal-oriented experimental work in nature conservation.		
Module content	• Nature conservation-related fundamentals of population ecology and synecology • Design and evaluation of experiments focusing on nature conservation • Assessment and analysis of changes in use • Statistics and modelling in nature conservation • Applied population genetics • Planning of nature reserves		
Form(s) of instruction	Lectures (22%), exercises (56%), seminars (12%), tutorials (10%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Lectures 20 hours, Exercises 45 hours, Seminars 15 hours, Tutorials 10 hours	Preparation/revision: Lectures 20 hours, Exercises 22 hours, Seminars 7,5 hours, Tutorials 7,5 hours	
Method of assessment	Oral examination 30 minutes (40%), exercises (60%)		
Form of module component retake exam	None		
Form of retake exam	Oral examination 30 minutes (40%), exercises (60%)		
Credit points	6 ECTS		
Language of instruction	German		
Frequency	Annually, 4 weeks, winter semester		

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Code	**M-NS-NLS**	2nd sem.	6 Cp
Course	**Nature Conservation in Landscapes**		
Faculty/Subject/Department	08/Biology/Institute for General and Special Zoology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), 2nd semester, specialisation Nature Conservation		
Prerequisites	M.Sc. module M-NS-EXN or equivalent		
Intake capacity	18		
Learning outcomes	Students will: • recognise the functions of landscapes • recognise the biotic inventory of the usage systems and be able to evaluate it qualitatively and quantitatively • identify the areas of conflict between conservation and use and be able to derive measures to eliminate them • understand the relationships between location factors and species inventory • be able to publish, present and communicate data on nature conservation		
Module content	• Effects of traditional and modern usage processes on biodiversity • Function and structures of Middle-European ecosystems • Biotope types of selected landscapes • Synecological relationships in complex habitat patterns • Location factors and species inventory • Problem-oriented work in small groups • Scientific evaluation of nature conservation data • Techniques for publications, presentations and public relations work		
Form(s) of instruction	Lectures (11%), tutorials (72%), seminars (17%),		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Lectures 10 hours, Tutorials (with excursions) 80 hours, Seminars 10 hours	Preparation/revision: Lectures 10 hours, Tutorials 50 hours, Seminars 20 hours	
Method of assessment	Oral examination (30 min) (50%), reports (50%)		
Form of module component retake exam	None		
Form of retake exam	Oral examination (30 min) (50%), reports (50%)		
Credit points	6 ECTS		
Language of instruction	German		
Frequency	Annually, 4 weeks, summer semester		
Note	May entail excursion costs up to maximum to 500 euros		

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Code	**M-PÖ-APS**	1st sem.	3 CP
Course	**Global Change and Strategies of Acclimation**		
Faculty/Subject/Department	08/Biology/Institute for Plant Ecology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Ecology/1st semester		
Prerequisites	Specialisation in Ecology		
Intake capacity	16		
Learning outcomes	Students will: • have an in-depth knowledge of the system "Plants and Environment" • know the essential methods in modern ecology • be able to assess the significance of global change for plant development and for the functional capacity of terrestrial habitats • have skills in dealing independently with current research literature • have the ability to plan ecological experiments rationally, interpret the results, classify them scientifically, discuss them and present them in a satisfactory manner		
Module content	• Current state of research on the impact of increases in CO_2 concentrations, temperatures and tropospheric ozone concentrations on terrestrial ecosystems • Strategies to reduce the impact of global change through ecosystem management (including increasing incorporation of carbon into the soil, reducing greenhouse gas emissions)		
Form(s) of instruction	Lectures (29%), seminars (7%), tutorials (64%)		
Total workload	90 hours = 3 ECTS-credits		
Student workload F=1.8	Attendance (32 hours): Lectures: 10 hours Seminars: 2 hours Tutorials: 20 hours	Preparation/revision (58 hours): Lectures: 16 hours Seminars: 4 hours Tutorials: 38 hours	
Method of assessment	Seminar presentation (30%), report (70%)		
Form of module component retake exam	None		
Form of retake exam	Seminar presentation (30%), report (70%)		
Credit points	3 ECTS		
Language of instruction	German/English		
Frequency	Annually, 2 weeks, winter semester		

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Code	**M-PÖ-STÖ**	1st sem.	3 CP
Course	**Stress Ecology**		
Faculty/Subject/Department	08/Biology/Institute for Plant Ecology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Plant Ecology, 1st semester		
Prerequisites	Specialisation in Plant Ecology		
Intake capacity	16		
Learning outcomes	Students • have an in-depth knowledge of the system "Plants and Environment" • are able to assess the significance of biotic and abiotic stress factors for the development of plants and for their habitats • gain insights into the consequences of stress on plants, populations, communities and eco systems • understand the interlude between extrinsic (abiotic and biotic) and intrinsic (genetic) components during plants adapting to stress • learn how plants react on abiotic and biotic stress factors: avoidance and tolerance • learn how global changes (climate change, increase of atmospheric CO2 concentration and nitrification) interact with different stress sources • are able to design simple experiments in order to evaluate the impact of abiotic and biotic stress factors on single plant species, populations, communities and ecosystems • learn the interpretation of literature about plant-environment-interaction and stress • have the ability to discuss and present the results of modern research about the impact of stress on single plant species, populations, communities and ecosystems		
Module content	• Communication of the current status of research in the field of stress ecology • The environment as a stressor: biotic and abiotic stressors - Water, salinity, flooding, lack of oxygen, oxidative stress, heat, frost, air pollution - Competition, herbivory, parasitism and invasions of allochthonous species - Infection, herbivory, competition • Plant-strategies: Adaptation and Avoidance (competitors, ruderals and stress resistant species		
Form(s) of instruction	Lectures (47%), seminars (20%), tutorials (33%)		
Total workload	90 hours = 3 ECTS-credits		
Student workload	Attendance: Lectures (14 hours): Seminars 6 hours, Preparation/revision Lectures 28 hours, Seminars 12 hours,		
Method of assessment	Seminar presentation (50%), report (50%)		
Form of module component retake exam	None		
Form of retake exam	Seminar presentation (50%), report (50%)		
Credit points	3 ECTS		
Language of instruction	English		
Frequency	Annually, 2 weeks, winter semester		

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Code	**M-PÖ-GCE**	2nd sem.	3 CP
Course	**Global Change Ecology: Stable Isotopes and Other Advanced Techniques**		
Faculty/Subject/Department	08/Biology/Institute for Plant Ecology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Plant Ecology, 2nd semester, M.Sc. Global Change / 2nd semester		
Prerequisites	Specialisation in Ecology		
Intake capacity	16		
Learning outcomes	Students will: • have a good knowledge of the problems of global change • be aware of current methods for investigating the effects on the ecosystem of global change • have skills in dealing independently with current research literature • have the ability to plan ecological experiments rationally, interpret the results, classify them scientifically, discuss them and present them in a satisfactory manner		
Module content	• Current status of research on "Global Change" (including palaeoclimatology, indicator proxies, current trends, Intergovernmental Panel on Climate Change) • Quantification of global material cycles using stable isotopes on an example of a permanent pasture • Automated methods for the quantification of gaseous flows and their influence via abiotic factors in permanent pasture • Positive feedback from "Global Change" on processes in the biosphere (including phenology) • Programming of models • Presentation and validation of model results		
Form(s) of instruction	Lectures (27%), seminars (59%), tutorials (64%)		
Total workload	90 hours = 3 ECTS-credits		
Student workload	Attendance (32 hours): Lectures: 8 hours Seminars: 4 hours Tutorials: 20 hours	Preparation/revision (58 hours): Lectures: 16 hours Seminars: 4 hours Tutorials: 38 hours	
Method of assessment	Seminar presentation (30%), report (70%)		
Form of module component retake exam	None		
Form of retake exam	Seminar presentation (30%), report (70%)		
Credit points	3 ECTS		
Language of instruction	English, German		
Frequency	Annually, 2 weeks, summer semester		

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Code	**M-PÖ-ÖUM**	2nd sem.	3 CP
Course	**Geoecology and Modelling**		
Faculty/Subject/Department	08/Biology/Institute for Plant Ecology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Plant Ecology / 2nd semester, MSc Global Change / 2nd semester		
Prerequisites	Specialisation in Ecology		
Intake capacity	16		
Learning outcomes	Students will: • understand how to structure and analyse scientific problems • have a good overview of current topics in functional biodiversity research • be able to work independently with current literature and the relevant botanical databases • master the basics of constructing of mathematical models for the treatment of environmental and geo-ecological problems • mastered the essential techniques for the programming of mathematical models • understand how to deal critically with models and their results and how to validate them		
Module content	• The system and its components • Structures of ecological systems and their mathematical treatment • Acquisition and analysis of data from ecological experiments • Meta-analysis of selected traits data sets • Programming of models • Presentation and validation of model results		
Form(s) of instruction	Lectures (27%), seminars (9%), tutorials (64%)		
Total workload	90 hours = 3 ECTS-credits		
Student workload F=2.0	Attendance (32 hours): Lectures: 8 hours Seminars: 4 hours	Preparation/revision (58 hours): Lectures: 16 hours Seminars: 4 hours	
Method of assessment	Exercises (50%), report (50%)		
Form of module component retake exam	None		
Form of retake exam	Exercises (50%), report (50%)		
Credit points	3 ECTS		
Language of instruction	German/English		
Frequency	Annually, 2 weeks, summer semester		

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Code	**M-PÖ-PSA**	2nd sem.	6 CP
Course	**Plant-Soil-Atmosphere Interactions**		
Faculty/Subject/Department	08/Biology/Institute for Plant Ecology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Plant Ecology / 2nd semester, MSc Global Change / 2nd semester		
Prerequisites	Specialisation in Ecology		
Intake capacity	16		
Learning outcomes	Students will: • have a good knowledge of ecophysiology, systems ecology and microbial ecology • know the essential methods in autecology and synecology • master processes and material flows at the stand and ecosystem levels • have skills in dealing independently with current research literature • have the ability to plan ecological experiments, interpret the results, classify them scientifically, discuss them and present them in a satisfactory manner		
Module content	• Photosynthesis of plants and plant stands as a function of location factors and climate change (e.g. with increasing [CO_2]) • C and N flows in a terrestrial ecosystem (e.g. permanent pasture) • Energy flows in a permanent pasture • Vegetation-soil interactions • Statistical methods in autecology and synecology		
Form(s) of instruction	Lectures (32%), seminars (5%), tutorials (63%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload F=1.8	Attendance (64 hours): Lectures: 20 hours Seminars: 4 hours	Preparation/revision (116 hours): Lectures: 37 hours Seminars: 5 hours	
Method of assessment	Report (100%)		
Form of module component retake exam	None		
Form of retake exam	Report (100%)		
Credit points	6 ECTS		
Language of instruction	German/English		
Frequency	Annually, 4 weeks, summer semester		

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Code	**M-ZO-EVO**	2nd sem.	6 CP
Course	**Following the Footsteps of Darwin: Evolutionary Biology of Organisms**		
Faculty/Subject/Department	08/Biology/Institute for General and Special Zoology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Zoology		
Prerequisites	-		
Intake capacity	18		
Learning outcomes	Students will: • acquire an overview of important evolutionary mechanisms in the animal and plant kingdoms • understand evolution as a complex and differentiated process • understand the temporal and spatial components of evolutionary changes • be able to establish hypotheses in evolutionary biology • have a high cognitive competence (thinking in context, logical and abstract thinking, conceptual thinking) • have a great respect for life and develop the ability to make ethical judgments • develop a critical awareness of problems concerning the comparison of animals and humans		
Module content	• "Extended Synthetic Theory" of biological evolution • Palaeobiology and geological time scale • Evolutionary mechanisms of plants and animals • Macro- and microevolution • Evolution of sexual reporduction • Biogeography • Neobiota • Experimental research into evolution • Creationism and criticism of evolution		
Form(s) of instruction	Lectures (40%), seminars (35%), excursions (25%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Lectures 26 hours, Seminars 22 hours, Excursions 16 hours Exam 2 hours	Preparation/revision: Lectures 42 hours, Seminars 62 hours, Excursions 12 hours	
Method of assessment	Exam (70%), seminar presentation (30%)		
Form of module component retake exam	None		
Form of retake exam	Exam (70%), seminar presentation (30%)		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, summer semester		
Note			

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Code	**M-OP-GMZ**
Course	**Large Scale Equipment and Biochemical Methods in Cell Biology**
Faculty/Subject/Departmen	08/Biology/Central Biotechnology Unit
Module coordinator	Cf. German version
Lecturers	Cf. German version
Guidance	Cf. German version
Classification	M.Sc.studies, optional subject
Prerequisites	Molecular Biology in basic studies, Biochemistry in advanced studies
Intake capacity	8
Learning outcomes	Students will: • acquire an overview of the possibilities for using large equipment and current biochemical methods to solve questions in cell biology • acquire practical experience in the handling of large equipment • learn to use current experimental methods for protein biochemistry *in vivo* and *in vitro* and to detect changes in excitable tissues • understand how to use imaging techniques and interpret the results with a critical assessment of the methodology
Module content	• Fundamentals of biological digestion and homogenisation procedures • Sedimentation velocity and isopycnic centrifugation as methods of subcellular fractionation, measurement of marker enzymes, de Duve plot • Theory of protein structure and resulting properties, which can be used to separate proteins. • Electrophoretic separation methods (PAGE, isoelectric focusing) and detection method for proteins (silver staining, Coomassie staining, Western blot, immunodetection) • Theory and practice of transmission and scanning electron microscopy with an introduction to procedures for elemental analysis using X-ray fluorescence spectroscopy and electron energy-loss spectroscopy • Atomic absorption spectrometry of body fluids for the measurement of changes in ion concentrations as a function of physiological arousal • Setting up experiments in behavioural biology and measurement of the influence of classical and operant learning trials on the expression and distribution of cell adhesion molecules; possibility of inhibiting memory formation and dependence of memory consolidation on glycoprotein molecules • Immunological procedures for detection of proteins *in situ* with light microscopic and electron microscopic resolution • Image analysis procedures for the assembly of sub-images, in order to detect immunogold particles and membranes so as to improve contrast and for background correction • Using biochemical and cell biological scientific literature
Form(s) of instruction	Lectures (15%), laboratory (70%), seminars (15%)
Student workload	Attendance: Laboratory (45 hours), Lectures (10 hours), seminars (10 hours) Preparation/revision: Laboratory (55 hours), lectures (20 hours), seminars (40 hours)
Method of assessment	Reports (50%), presentations (50%)
Credit points	6 ECTS
Language of instruction	German
Frequency	Winter semester

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Code	**M-OP-HUB**	1st sem.	6 CP
Course	**Human Biology**		
Faculty/Subject/Departmen	08/Biology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.) optional module / 1st semester		
Prerequisites	-		
Intake capacity	20		
Learning outcomes	Students will: • become familiar with the latest knowledge about human evolution • learn about modern methods in palaeoanthropology • address current problems of population biology (human ecology, demographics) • get knowledge of selected organ systems of the human body and common diseases • become familiar with important human -parasites, ways of infection and diseases caused • get an overview about methods of forensic anthropology and their significance in forensic medicine • consolidate their skills in histology and light microscopy • gain practice in searching for, presenting and interpreting new scientific data		
Module content	• Latest knowledge and modern methods in palaeoanthropology • Selected macroscopic and microscopic aspects of human anatomy and pathology • Introduction to methods of forensic anthropology • Aspects of human behaviour • Human parasitology		
Form(s) of instruction	Lectures (34%), seminars (22%), practical courses (44%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: 61 hours Lectures: 21 hours Seminars: 10 hours Practical courses: 30 hours	Preparation/revision: 119 hours Lectures: 40 hours Seminars: 29 hours Practical courses: 50 hours	
Method of assessment	Written exam (60%), seminar presentation (40%)		
Form of module component retake exam	None		
Form of retake exam	Written exam (60%), seminar presentation (40%)		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, winter semester		

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Code	**M-OP-MOM**	1st sem.	6 CP
Course	**Molecular Medicine**		
Faculty/Subject/Department	08 and 11/Biology and Human Medicine		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), optional subject / 1st semester		
Prerequisites	-		
Intake capacity	-		
Learning outcomes	Students will: • be familiar with the molecular mechanisms of cell function and cell-cell interactions in multicellular tissues and organs and with their pathological changes • develop a deeper understanding of the mechanisms of cellular communication in physiological and pathological conditions, on the basis of selected case studies • recognise causal mechanisms of disease development, tumour progression, inflammatory processes and cardiovascular diseases • be familiar with the processes of pathogenesis of selected diseases and with the concepts of experimental therapy • be familiar with methods in biostatistics, epidemiology and bioinformatics and be able to use these to develop quantitative relationships in the pathogenesis and therapy of certain diseases		
Module content	Molecular mechanisms of morphogenesis and organogenesis during embryonic development, including examples of transgenic and knock-out models • Embryonic and adult stem cells; mechanisms in reproductive biology • Mechanisms of cell proliferation and cell differentiation, and their induction (using medicinal products); processes of tumour progression and metastasis, possibilities and consequences of gene transfer • Molecular genetics of human disease, methods of gene and genome analysis • Bioanalytical and bioinformatic methods for analysis of the genome and proteome as an aid to clarifying structural and functional analysis of cells • Pharmacokinetic and pharmacodynamic treatment of active substances and the therapeutic significance of important substance classes • Pathogenetic mechanisms of microbial pathogens; molecular-mechanistic relationships with infectious and cardiovascular diseases • Immune system, inflammatory processes, complement, oxidative burst • Vascular biology and medicine; the body's defence system and cardiovascular diseases • Functions of neuronal systems; electrophysiological mechanisms and signal transmission • Radiological procedures, handling isotopes and radiation protection • Modern methods of molecular genetics: recombinant expression procedures, knock-outs and transgenes; gene transfer • Physiological effects of nutrition on the body, risk factors and preventive medicine • Animal disease models; laboratory animal science and hygiene measures		
Form(s) of instruction	Lectures (40%), seminars (20%), tutorials (40%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Lectures 28 hours, Seminars 14 hours, Tutorials 28 hours,	Preparation/revision: Lectures 45 hours, Seminars 20 hours, Tutorials 45 hours	
Method of assessment	Exam (50%), oral examination (25%), reports (25%)		
Form of module component retake exam	None		
Form of retake exam	Exam (100%) or oral examination (100%): form will be announced		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, summer semester		

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Code	**M-OP-NBC**	1st sem.	3 CP
Course	**Biochemistry of Neurons**		
Faculty/Subject/Department	08/Biology/Central Biotechnology Unit		
Module coordinator	Cf. German version		
Classification	MSc (Biol.) optional module / 1st semester		
Prerequisites	Specialisation in Biochemistry		
Intake capacity	15		
Learning outcomes	Students will: • acquire knowledge of neuroanatomy and the structure of nerve cells and glial cells • learn about neurotransmitter systems have and about the mechanisms of neurotransmitter release, their effects on receptors and their inactivation • be able to understand important transduction mechanisms and explain brain diseases as a function of the effects of neurotransmitters • learn to recognise proteins specific to the nervous system and be able to classify the role of cell adhesion molecules in neural plasticity and regeneration		
Module content	• On the basis of cell biological characteristics of nervous tissue, introduction to: the motor neuron as a prototype; important types of glial cells; synapses • Neurotransmitters exemplified by the effects of acetylcholine on muscle contraction: detection of acetylcholine and norepinephrine, the role of calcium in neuronal transmission, end plate potentials, mEPPs, quantum analysis, intracellular calcium sources, detection and isolation of the synaptic vesicles, the torpedo fish as a model system, choline acetyltransferase, acetylcholinesterase • Receptor molecules acting as signal transducers: the nicotinic acetylcholine receptor, reversal potential, EPSP and IPSP, animal, vegetative, autonomic, sympathetic nervous systems, muscarinic receptors • The biogenic amines DOPA, dopamine, norepinephrine and 5-HT: Adrenergic pathways in the CNS and PNS, regulation of catecholamine synthesis, degradation and recovery of catecholamines, adrenergic receptors and drug targets • Signal transduction by G proteins: small G-proteins in membrane recognition, G protein-coupled receptors, the effects of G-proteins: direct effects on ion channels, effects on cAMP and PKA and on inositol triphosphate, diacylglycerol, calcium and protein kinase C, G proteins in sensory cells • Transmitter diseases: Parkinson's disease, schizophrenia, depression, neuroleptics and atypical antipsychotic drugs, DA receptors, paranoia induced by amphetamine, cocaine and PCP, contribution of serotonin • Structural proteins of the nervous system and axonal transport: structure of the nerve cell membrane, tubulin, actin, NFP, vimentin, structure of glial cells, S100 • Importance of the extracellular matrix (ECM) and the cell adhesion molecules (CAMs) in the CNS for: the neural tube and neural crest, axon growth and performance, synaptic stabilisation and plasticity, myelination and regeneration; homophilic and heterophilic interactions of CAMs, interaction with ECM molecules, post-translational modifications, polysialic acids; CAM families: Ig superfamilies, cadherins and integrins. substrate adhesion molecules • Peptide transmitters: substance P, enkephalins, endorphins, morphine, heroin, withdrawal, hypothalamic releasing and release-inhibiting factors, neurosecretion and anterior pituitary hormones, pituitary-adrenocortical axis • Neuronal plasticity and regeneration: short-term and long-term memory, amnesia due to inhibition of transcription or translation, correlative and immunological approaches to investigation, memory formation as local CAM-mediated differentiation, redistribution of ependymin molecules in CNS plasticity. • Amino acid transmitters: glycine, GABA glutamate, LTP, Aplysia as a model of the learning process		
Form(s) of instruction	Lectures (48%), seminars (52%)		
Total workload	90 hours = 3 ECTS-credits		
Student workload	Attendance: Lectures (22 hours), seminars (14 hours) Preparation/revision: Lectures (21 hours), seminars (33 hours)		
Method of assessment	Exam (60%), seminar presentation (40%)		

Form of module component retake exam	None
Form of retake exam	Exam (60%), seminar presentation (40%)
Credit points	3 ECTS
Language of instruction	German, English
Frequency	Annually, 2 weeks, winter semester

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Code	**M-OP-RBW**	1st sem.	6 CP
Course	**Application and Measurement of Radionuclides in Life Sciences**		
Faculty/Subject/Department	08/Biology/Central Biotechnology Unit		
Module coordinator	Cf. German version		
Classification	M.Sc. (Biol.), optional module / 1st semester		
Prerequisites	Specialisation in Biochemistry		
Intake capacity	8		
Learning outcomes	Students will: • acquire a thorough understanding of the causes and different types of radioactive decay and understand the forms of interaction between radioactive radiation and matter as explained by physics • master the handling of radioactive materials in the laboratory • know all the standard methods for measuring radioactive samples • be familiar with current procedures for radiolabelling and with the use and detection of radioactive markers in vivo and in vitro • have a basic knowledge of dosimetry and the Radiation Protection Act as well as experience in practice concerning radiation protection in laboratory and in the environment		
Module content	• Theory of atomic structure (Thomson, Rutherford, Bohr, Sommerfeld, de Broglie, Pauli) and basic ideas of quantum and wave mechanics (Planck, Schrödinger) • Core structure and classification of elementary particles, nuclide chart • Forms of radioactive decay (α-, β-, γ-radiation, electron capture, internal conversion, X-rays, Auger electrons, spontaneous fission) • Mass-energy equivalence, nuclear binding forces, mass defect • Excitation and ionisation, detection range, self-absorption and backscattering, photo effect, Compton effect and pair production effect; neutron capture • law of decay, half-life, specific activity, count statistics • Single trace detection, ionisation chamber, proportional counting tube and Geiger-Müller counter, gamma-spectrometry and whole-body counters • Liquid scintillation counting with basic instruction in various ways to correct for quenching and fluorescence; double-labelling measurements with correction for spillover • Occurrence and production of radionuclides; natural decay series and primordial nuclides; cosmic and terrestrial radiation, nuclear fallout • Biological effects of radiation, equivalent dose, stochastic and non-stochastic radiation damage with dose-effect relationships • Autoradiography, phosphorimager and micro-imager with digital image analysis • Procedures for radiolabelling and product purification • Radioimmunoassay (RIA and IRMA variants) with Scatchard plot analysis • DNA phosphorylation and PCR • In situ hybridisation • Photosynthesis in a [^{14}C]-CO_2atmosphere • [^{14}C]-deoxyglucose method for the measurement of energy consumption in brain tissue • Radiochemical enzyme test: two -phase assay for choline acetyltransferase • Practical radiation protection and decontamination techniques		
Form(s) of instruction	Lectures (33%), laboratory (67%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Lectures (20 hours), laboratory (45 hours) Preparation/revision: Laboratory (75 hours), lectures (40 hours)		
Method of assessment	Exam (50%), oral examination (20%), reports (30%)		
Form of module component retake exam	None		
Form of retake exam	Exam (100%) or oral examination (100%): will be announced		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, winter semester		

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Code	**M-OP-ETH**	2nd sem.	6 CP
Course	**Ethology of Wild and Zoo Animals**		
Faculty/Subject/Department	08/Biology/Institute for General and Special Zoology		
Module coordinator	Cf. German version		
Classification	MSc Module , optional module, 2nd semester		
Prerequisites			
Intake capacity	16 students		
Learning outcomes	Students will: • acquire in-depth knowledge of the history and principles of behavioural research • have an overview of the ways of life of wild animal species • acquire knowledge about the detection of wild animals • learn the methodology for observation of animals in the wild and in zoos • gain experience in processing the relevant scientific literature • learn methods for teaching and work in public relations		
Module content	• Introduction to the methodology of recording behaviour • Introduction to issues, problems and their solutions in behavioural biology • Evaluation of husbandry systems (zoo, wild life park) • Presentation of concepts and results by means of seminar presentations		
Form(s) of instruction	Lectures (17%), seminars (10%), tutorials (73%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload F=1.6	Attendance (70 hours): Lectures: 10 hours Seminars: 8 hours Tutorials: 52 hours	Preparation/revision (110 hours): Lectures: 20 hours Seminars: 10 hours Tutorials: 80 hours	
Method of assessment	Seminar presentation (100%)		
Form of module component retake exam	None		
Form of retake exam	Seminar presentation (100%)		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, summer semester		
Date	September		

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Code	**M-OP-OTX**	2nd sem.	3 CP
Course	**Introduction to Ecotoxicology**		
Faculty/Subject/Department	08/Biology/Institute for Animal Physiology and Institute for Plant Ecology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), 2nd semester, optional module		
Prerequisites	Specialisation in Ecology		
Intake capacity	16		
Learning outcomes	Students will: • acquire the principles for the recording, characterisation and assessment of pollutants • have in-depth knowledge of the effects of pollutants in the living environment • know the basis for the characterisation and assessment of the risks of a pollutant for the environment • learn the techniques of ecotoxicology • learn to interpret experimental results critically • have a detailed knowledge of the statutory provisions (including ChemG, WHG, PflSchG) and methods (according to OECD, ISO, DIN, U.S.EPA) • have in-depth knowledge of ecotoxicology for production of the MSc thesis		
Module content	• Insight into the ecotoxicology of pollutants • Role of ecotoxicology in environmental protection • Relationship between standardised testing procedures, legal requirements and environmental objectives • Overview of registered ecotoxicological tests • Possibilities for use of ecotoxicological test organisms • Performance of a biotest • Characterisation of pollutants • Risk assessment of pollutants ("Risk") • Safety aspects of handing pollutants ("Safety") • Evaluation of test procedures using logit analysis, dose-effect models, EC10, EC50, NOEC and LOEC • Models for the evaluation of pollutants • Calculation of the emission potential of suitable examples • Excursion to a site relevant to the topic		
Form(s) of instruction	Lectures (22%), seminars (11%), tutorials (61%), excursions (6%)		
Total workload	90 hours = 3 ECTS-credits		
Method of assessment	Report (50%), presentation (50%)		
Form of module component retake exam	None		
Form of retake exam	Oral examination (100%)		
Student workload	Attendance: Lectures 10 hours, Seminars 5 hours, Tutorials 25 hours, Excursions 5 hours	Preparation/revision: Lectures 10 hours, Seminars 5 hours, Tutorials 30 hours	
Credit points	3 ECTS		
Language of instruction	German, English		
Frequency	Annually, 2 weeks, summer semester		

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Code	**M-PP-EBP**	1st sem.	6 CP
Course	**Developmental Biology of Plants**		
Faculty/Subject/Department	08/Biology/Plant Physiology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Plant Physiology / 1st semester		
Prerequisites	-		
Intake capacity	16		
Learning outcomes	Students will: • have an overview of the current status plant developmental biology • have knowledge of the roles of external factors, genetic factors and phytohormone systems in plant development • have an insight into methods and their use in the investigation of developmental processes in plants • gain experience in the oral and written presentation of results		
Module content	• Fundamentals of plant development • Developmental biology of plant cells • Differences and similarities of plant and animal developmental systems • Evolution of development (Evo-Devo) • Morphogenetic fields, Turing's loops • Gametogenesis, fertilization and embryogenesis • Seed development and germination • Plants grown up: meristems and meristemoids, acclimation • Phytohormone systems • The biological clock and circadian rhythm • Flower induction and development • Creation of a poster for the presentation of laboratory results		
Form(s) of instruction	Lectures (31%), seminars (11%), tutorials (58%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Lectures 20 hours, Tutorials 40 hours, Seminars 10 hours	Preparation/revision: Lectures 36 hour, Tutorials 64 hours, Seminar 10 hours	
Method of assessment	Exam (50%), presentation (50%)		
Form of module component retake exam	None		
Form of retake exam	Oral examination (100%)		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, winter semester		

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Code	**M-PP-MLP**	1st-2nd sem.	6 CP
Course	**Molecular Light Physiology**		
Faculty/Subject/Department	08/Biology/Plant Physiology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Plant Physiology / 1st and 2nd semester		
Prerequisites	-		
Intake capacity	16		
Learning outcomes	Students will: • have a broad knowledge of research in the field of plant photoreceptors and their mode of action • have confidence when using photobiological and molecular biological techniques • have theoretical and practical knowledge of 3D structural research on biological macromolecules • have confidence in using electronic resources as well as the English-language scientific literature • have obtained initial experience in independent project work • acquire experience in the written presentation of scientific results in English		
Module content	• Light and photoreceptors: transition dipole moment; ionisation, S- and T-states; extinction and quantum yield; effect spectroscopy; molecular structure- function relationships • Physiological, biochemical, spectroscopic, molecular-genetic and structural biological analysis of photoreceptors • Crystallisation of wild type and mutated Cph1-phytochromes, p.r.n. X-ray diffraction analysis at the rotating anode • Independent use of electronic resources (databases, molecular-genetic and structural biological software) • Final report in English		
Form(s) of instruction	Lectures (28%), seminars (4%), tutorials (68%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Lectures 20 hours, Seminars 8 hours, Tutorials 60 hours	Preparation/revision: Lectures 30 hours, Seminars 0 Tutorials 62 hours	
Method of assessment	Exam (50%), report (50%)		
Form of module component retake exam	None		
Form of retake exam	Oral examination (100%)		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, winter semester/ summer semester		

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Code	**M-PP-MPP**	1st sem.	6 CP
Course	**Molecular Plant Physiology**		
Faculty/Subject/Department	08/Biology/Plant Physiology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Plan Physiology / 1st semester		
Prerequisites	-		
Intake capacity	16		
Learning outcomes	Students will: • have in-depth knowledge of current gene and genome research • have in-depth knowledge of various plant model systems • receive an insight into the 3D-structural research of biological macromolecules • have good practical and theoretical knowledge of common and special techniques in plant molecular biology • be able to work effectively with web-based data sources • be able to deal with English-language primary literature • have the ability to plan molecular biological experiments appropriately, implement them, interpret the results and discuss the conclusions • be able to present and discuss scientific results in English as a small symposium • gain core competences for their master dissertation		
Module content	• Plant genes and genomes • Recombinant gene technology, sequencing, genetic markers and mapping in the context of genome research • Transgenes, reporters, techniques for transformation and cultures • Mutagenesis and the identification of mutated genes • Inactivation/alteration of genes by homologous recombination • Localising of proteins intra-plant • Preparation and detection of plant DNA, RNA and proteins • Analysis of protein-protein interactions • Methylation, silencing and RNAi • Benefits, opportunities and risks of genetic engineering in crop plants • Molecular structural research • Dealing with electronic resources for molecular biology • Dealing with primary literature in molecular plant physiology		
Form(s) of instruction	Lectures (26%), seminars (37%), tutorials in small groups (37%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Lectures 18 hours, Seminars 16 hours, Tutorials 50 hours	Preparation/revision: Lectures 28 hours Seminars 50 hours Tutorials 18 hours	
Method of assessment	Exam (50%), seminar presentation (50%)		
Form of module component retake exam	None		
Form of retake exam	Oral examination (100%)		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, winter semester		

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Code	**M-TÖ-PHY**	1st sem.	3 CP
Course	**From Genes to the Tree of Life: Introduction to Phylogenetics**		
Faculty/Subject/Department	08/Biology/Institute for General and Special Zoology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Ecology, 1st semester		
Prerequisites	-		
Intake capacity	16		
Learning outcomes	Students will: • obtain an overview of important methods in phylogenetics and be able to evaluate their individual performance in a critical manner, • be familiar with the collection, management and analysis of DNA data, • have skills in the experimental analysis of evolutionary processes and in their evaluation/interpretation • obtain an overview of current trends in molecular systematics, • have a basic knowledge concerning the testing of phylogenetic hypotheses, • know how to use biological and biomedical databases, • be familiar with the fundamentals of scientific publication		
Module content	• Introduction to phylogenetics • Sequence databases • Sequence alignment • Phylogeography • Reconstruction of phylogenetic trees • Models of sequence evolution • Molecular clocks • Scientific publishing		
Form(s) of instruction	Lectures (40%), tutorials (55%), seminars (5%)		
Total workload	90 hours = 3 ECTS-credits		
Student workload	Attendance: Lectures 14 hours Tutorials 20 hours Seminars 2 hours	Preparation/revision: Lectures 21 hours Tutorials 28 hours Seminars 5 hours	
Method of assessment	Tests (45 min in total) (25%), reports (75%)		
Form of module component retake exam	None		
Form of retake exam	Oral examination (100%)		
Credit points	3 ECTS		
Language of instruction	German, English		
Frequency	Annually, 2 weeks, winter semester		

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Code	**M-TÖ-BDI**	1st sem.	3 CP
Course	**Informatics in Biodiversity**		
Faculty/Subject/Department	08/Biology/Institute for General and Special Zoology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Animal Ecology, elective, 1st semester		
Prerequisites	-		
Intake capacity	18		
Learning outcomes	Students will: • obtain an overview of important methods in biodiversity informatics and be able to evaluate their individual performance in a critical manner • be familiar with the digital collection, management and analysis of biodiversity data • be able to design complex case studies • be familiar with the main aspects of biodiversity modelling • be capable of critically evaluating biodiversity changes • understand the impact of humans on biodiversity • possess a high level of cognitive competence		
Module content	• Recording, management and evaluation of biodiversity data • Biological databases and collections • Georeferencing/GPS • Visualisation of spatial statistical data • Distribution dynamics in global change scenarios • Human impact and invasion biology		
Form(s) of instruction	Lectures (40%), tutorials (40%), seminars (20%)		
Total workload	90 hours = 3 ECTS-credits		
Student workload	Attendance: Lectures 14 hours, Tutorials 14 hours, Seminars 7 hours	Preparation/revision: Lectures 13 hours, Tutorials 28 hours, Seminars 14 hours	
Method of assessment	Practical exercises (50%), seminar presentation (50%)		
Form of module component retake exam	None		
Form of retake exam	Oral examination (100%)		
Credit points	3 ECTS		
Language of instruction	English, English		
Frequency	Annually, 2 weeks, winter semester		

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Code	**M-TÖ-FÖK**	2nd sem.	6 CP
Course	**Outdoor Ecology**		
Faculty/Subject/Department	08/Biology/Institute for General and Special Zoology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Ecology, 2nd semester		
Prerequisites	M.Sc. Modul M-TÖ-LAÖ oder Äquivalent		
Intake capacity	18		
Learning outcomes	Students will: • master the recording and quantification of abundance, distribution, diversity, habitat preference and community structure of animals in the field • be able to characterise selected habitats with respect to animal ecology • be capable of handling selected groups of animals (e.g. spiders, ground beetles, Heteroptera, grasshoppers, wild bees) in various terrestrial habitats • master the essential procedures for the measurement of environmental factors in the terrain • recognise milestones in current field research • be able to evaluate and use techniques in field ecology in a problem-oriented manner • know how to deal with knowledge-based evaluation systems • gain the necessary skills to produce an appropriate master's thesis		
Module content	• Recording and quantification in animal ecological field research • animal-ecological characterisation of habitats for advanced • in-depth work with selected animal groups • Measurement of environmental factors in the terrain • Knowledge-based evaluation systems • Problem-oriented work in small groups • Scientific evaluation of field ecological data • Techniques for publications and presentations		
Form(s) of instruction	Seminars (39%), tutorials (61%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Tutorials (10 days field station) 80 hours, Seminars 20 hours	Preparation/revision: Tutorials 30 hours, Seminars 50 hours	
Method of assessment	Report (mini-publication) (50%), seminar presentation (20%), report to tutorials (20%)		
Form of module component retake exam	None		
Form of retake exam	Report (mini-publication) (50%), seminar presentation (20%), report to tutorials (20%)		
Credit points	6 ECTS		
Language of instruction	German		
Frequency	Annually, 4 weeks, summer semester		

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Code	**M-TÖ-LAÖ**	2nd sem.	6 CP
Course	**Landscape Ecology**		
Faculty/Subject/Department	08/Biology/Institute for General and Special Zoology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Ecology, elective / 2nd semester		
Prerequisites	-		
Intake capacity	18		
Learning outcomes	Students will: • learn the influence of spatial structure on the population dynamics, genetics and community structures of animals. • recognise the problems of spatially explicit ecology • be able to use a wide spectrum of landscape ecological methods independently • master the independent use of procedures for measuring animal ecological parameters and environmental factors at the level of the landscape • recognise the influence of anthropogenic change on patterns and processes • learn the most important aspects of landscape ecological analysis (GIS, etc.) • learn to use geostatistical software independently		
Module content	• Advanced techniques in landscape ecology (investigation of spatial patterns/structures of landscapes and their dynamics, relationships between patterns and processes in landscapes, molecular ecology) • Effects of disturbances at levels of scale • Advanced field work in landscape ecology and evaluation techniques • Problem-oriented work in small groups • Scientific evaluation of ecological data • Techniques for publications and presentations		
Form(s) of instruction	Lectures (11%), tutorials in small groups (50%), tutorials (11%), seminars (28%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Lectures 10 hours Tutorials in small groups 60 hours Seminars 10 hours Tutorials 20 hours	Preparation/revision: Lectures 10 hours Tutorials 30 hours Seminars 40 hours	
Method of assessment	Report (mini-publication) (20%), seminar presentation (30%), report (50%)		
Form of module component retake exam	None		
Form of retake exam	Report (70%), seminar presentation (30%)		
Credit points	6 ECTS		
Language of instruction	German		
Frequency	Annually, 4 weeks, summer semester		

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Code	**M-TÖ-SÖK**	2nd sem.	6 CP
Course	**Mammal Ecology**		
Faculty/Subject/Department	08/Biology/Institute for General and Special Zoology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Animal Ecology / 2nd semester		
Prerequisites	-		
Intake capacity	16		
Learning outcomes	Students will: • acquire in-depth knowledge about the seasonal influence of landscape features on habitat use, population structure and food acquisition of mammals • identify problems of spatially explicit ecology in a mammalian example • be able to use basic methods in mammalian ecology independently • know the legal foundations of the experimental work with wild animals • have the skills required for the comparative measurement of behavioural-ecological and ecophysiological parameters and of abiotic and biotic factors • recognise the influence of anthropogenic land use on the occurrence and distribution of mammals • learn the most important aspects of the ecological analysis of bats in different areas of research • learn to use geostatistical software independently		
Module content	• Advanced techniques of mammalian ecology o Studies on the spatial and temporal use of various habitats o Studies of the influence of fluctuating food supplies on behaviour and population dynamics o Studies in reproductive biology • Identification of the sensitivity profiles of various mammalian groups • Advanced recording methods for field ecological studies of bats, legal foundations and techniques for their evaluation • Problem-oriented work in small groups • Scientific evaluation of mammalian ecology data • Techniques for publications and presentations		
Form(s) of instruction	Lectures (17%), seminars (10%), tutorials (73%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload F=1.6	Attendance (70 hours): Lectures: 10 hours Seminars: 8 hours Tutorials: 52 hours	Preparation/revision (110 hours): Lectures: 20 hours Seminars: 10 hours Tutorials: 80 hours	
Method of assessment	Seminar presentation (30%), report (70%)		
Form of module component retake exam	None		
Form of retake exam	Seminar presentation (30%), report (70%)		
Credit points	6 ECTS		
Language of instruction	German		
Frequency	Annually, 4 weeks, summer semester		

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Code	**M-TP-ION**	2nd sem.	6 CP
Course	**Ion Channels and Molecular**		
Faculty/Subject/Department	08/ Biology/Institute for Animal Physiology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Animal Physiology / 2nd semester		
Prerequisites	-		
Intake capacity	20		
Learning outcomes	Students will: • learn the basics of cell physiology at the molecular level (including, structure and function of the cytoskeleton, mass transfer and cellular communication, structure and function of receptors, signal transduction mechanisms) • be familiar with the principles of ion channel function • know the characteristics and functions of various ion channels • be familiar with electrophysiological methods and techniques used to study ion channels • gain insight into the in vitro transcription and heterologous expression of cloned ion channels • know how the function of ion channels can be modulated through the use of pharmaceuticals • be able to plan and implement experiments independently, so as to investigate ion channel functions		
Module content	• cRNA synthesis and *in vitro* transcription of cloned ion channels • Microinjection of cRNA into *Xenopus* oocytes • Measurement of transepithelial ion transport using the Ussing chamber • Microelectrode recordings of native oocytes and of heterologously transfected oocytes. • Performance of patch-clamp measurements • Regulation of ion channels by signal transduction mechanisms • Regulation of ion channels by physical forces		
Form(s) of instruction	Lectures (33%), seminars (38%), practical work in small groups (29%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: 63 hours • Lectures 15 hours • Seminars 8 hours • Tutorials 40 hours	Preparation/revision • Lectures 45 hours • Seminars 60 hours • Tutorials 12 hours	
Method of assessment	Exam (40%), production and presentation of a poster (60%)		
Form of module component retake exam	None		
Form of retake exam	Exam (40%), production and presentation of a poster (60%)		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, summer semester		

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Code	**M-TP-KAP**	2nd sem.	6 CP
Course	**Ion Channels in the Cardiopulmonary System**		
Faculty/Subject/Department	08/ Biology/Institute for Animal Physiology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Animal Physiology, elective / 2nd semester		
Prerequisites	-		
Intake capacity	20		
Learning outcomes	Students will: • be familiar with the physiology of the lungs, heart and pulmonary vasculature • be aware of the functions and tasks of lung epithelial cells, pulmonary endothelial cells and cardiomyocytes • learn to recognise the regulatory mechanisms, which regulate the functions of the cardiopulmonary system • learn to recognise the functions of the various ion channels, which are essential for the functions of the respective cell types • acquire knowledge of the pathophysiological mechanisms of cardiopulmonary diseases, which are due to ion channel defects (e.g. cystic fibrosis, pulmonary oedema, cardiac arrhythmias) • gain insight into the electrophysiological methods and techniques for investigating ion channels • have knowledge of ion channel activity through the use of pharmaceuticals (agonists and antagonists) to modulate this activity • be able to plan and implement experiments independently, so as to investigate ion channel functions		
Module content	• Transepithelial Ussing chamber experiments on lung epithelial cells • Action potential recordings from cardiomyocytes using intracellular microelectrodes • Performance of patch-clamp measurements on human epithelial Na^+ channels in the lungs and on human lung epithelial cells • Regulation by neurotransmitters (acetylcholine, adrenaline) of ion channels in heart muscle • Regulation of pulmonary ion channels by physical forces		
Form(s) of instruction	Lectures (33%), seminars (38%), practical work in small groups (29%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: 63 hours • Lectures 15 hours • Seminars 8 hours • Practical work 40 hours	Preparation/revision • Lectures 45 hours • Seminars 60 hours • Practical work 12 hours	
Method of assessment	Exam (25%), written reports (25%), seminar presentation (50%)		
Form of module component retake exam	None		
Form of retake exam	Exam (100%) or oral examination (100%), will be announced at the begin		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, summer semester		

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Code	**M-TP-NET**	1st sem.	6 CP
Course	**Neuroethology**		
Faculty/Subject/Department	08/ Biology/Institute for Animal Physiology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Animal Physiology / 1st semester		
Prerequisites	-		
Intake capacity	16		
Learning outcomes	Students will: • have in-depth knowledge of ethology and neurobiology • be able to present neuronal structures • have knowledge of modern methods for neurobiological measurements • be able to perform extracellular and intracellular recordings • be able to perform acoustic analyses • learn how to quantify behavioural analyses • be able to work in a team • be able to produce a poster		
Module content	• Function of selected neuronal networks and sensory structures in insect behaviour • Recording electrical potentials • Modern histological and neuroanatomical tracing methods • Acoustic recordings, computer-assisted acoustic analysis • Analysis of biological acoustic signals and the propagation of sound in the field • Quantification of behavioural reactions • Production of a poster • Primary cultures of nervous system cells		
Form(s) of instruction	Lectures (22%), practical work in small groups (78%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Lectures (20 hours), Laboratory (70 hours)	Lectures (20 hours) Laboratory (70 hours)	
Method of assessment	Presentation in English (100%)		
Form of module component retake exam	None		
Form of retake exam	Presentation (100%)		
Credit points	6 ECTS		
Language of instruction	German		
Frequency	Annually, 4 weeks, winter semester		

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Code	**M-WP-ASS 1**	3rd-4th sem.	6 CP
Course	**Work as Assistant in Biology I**		
Faculty/Subject/Department	08/Biology/		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), elective subject / 3rd – 4th semester		
Prerequisites	-		
Intake capacity	In consultation with the lecturers		
Learning outcomes	Students will: • be able to carry out investigations in biological fields • be able to interpret results of investigations • be able to transmit theoretical and practical knowledge • be able to provide accurate and targeted instruction • be able to categorise and answer subject-specific questions • acquire social skills		
Module content	• Subject-specific recapitulation • Knowledge transfer within the team • Training in subject-specific methods and demonstrations		
Form(s) of instruction	Practical work (33%), tutorials (67%)		
Total workload	180 hours = 6 ECTS-credits		
Method of assessment	Presentation (no mark)		
Form of module component retake exam	None		
Form of retake exam	Presentation		
Student workload	Attendance: Practical work 60 hours Tutorials 10 hours	Preparation/revision: Tutorials 110	
Credit points	6 ECTS		
Language of instruction	German		
Frequency	Annually, 4 weeks, winter semester / summer semester		

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Code	**M-WP-ASS 2**	3rd-4th sem.	6 CP
Course	**Work as Assistant in Biology II**		
Faculty/Subject/Department	08/Biology/		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), elective subject / 3rd-4th semester		
Prerequisites	-		
Intake capacity	In consultation with the lecturers		
Learning outcomes	Students will: • be able to carry out investigations in biological fields • be able to interpret results of investigations • be able to transmit theoretical and practical knowledge • be able to provide accurate and targeted instruction • be able to categorise and answer subject-specific questions • acquire social skills		
Module content	• Subject-specific recapitulation • Knowledge transfer within the team • Training in subject-specific methods and demonstrations		
Form(s) of instruction	Practical work (33%), tutorials (67%)		
Total workload	180 hours = 6 ECTS-credits		
Method of assessment	Presentation (100%) (no grading, only pass)		
Form of module component retake exam	None		
Form of retake exam	Presentation		
Student workload	Attendance: Practical work 60 hours Tutorials 10 hours	Preparation/revision: 110 hours in total	
Credit points	6 ECTS		
Language of instruction	German		
Frequency	Annually, 4 weeks, winter semester/ summer semester		

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Code	**M-WP-BBP**	4th sem.	6 CP
Course	**Biological Work Placement**		
Faculty/Subject/Department	08/Biology/Institute for Biology in cooperation with companies, businesses, government agencies and (scientific) establishments with an orientation to the life sciences or biomedical		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), elective subject / 3rd-4th semester		
Prerequisites			
Intake capacity	-		
Learning outcomes	Students will: • have a sound knowledge of the job profiles and requirements of biological professions • be able to apply for a work experience placement (in writing and orally) • have a sound knowledge of the use of biological expertise in various operational procedures • obtain practical work experience in a typical field of activity • be able to collaborate in the practical operations of the company/government agency/establishment • experience specific conditions of professional fields • recognise the professional, organisational and social structures of the various levels of the company/government agency/establishment • learn teamwork • build contacts for potential fields of activity • be able to evaluate, document and confidently present their experiences • be able to answer questions about the operational processes and discuss them satisfactorily • reflect on their work experience and draw conclusions with respect to the further planning of studies • be able to communicate with other students about activities in biologically oriented fields of work		
Module content	• Researching professional fields/professional fields in research and teaching, industry and management as well as media • Requirements of the job market for academics • Tips for job applications • Efficient planning of work routine • Collaboration in the workflow and special technologies of the company, government agency, establishment • Quality assurance and marketing of biological, biomedical or pharmacological products • Data protection and patent law • Training for the interview • Assessment of the interview • Presentation to a third party (report, seminar presentation)		
Form(s) of instruction	Placement (83%), seminars (17%)		
Total workload	180 hours = 6 ECTS-credits		
Method of assessment	Presentation, report (no grading, module is passed when presentation and report are		
Form of module component retake exam	None		
Form of retake exam	Presentation, report		
Student workload	Attendance: Work experience 120 hours Seminars 5 hours	Preparation/revision: 55 hours in total	
Credit points	6 ECTS		
Language of instruction	German/English		
Frequency	Annually, 4 weeks, winter semester/ summer semester		

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Code	**M-WP-EXK**	3rd-4th sem.	6 CP
Course	**Excursion for Master Students**		
Faculty/Subject/Department	08/Biology/		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), elective subject / 3rd-4th semester		
Prerequisites	BSc (Biol.)		
Intake capacity	In consultation with the lecturers		
Learning outcomes	Students will: • be able to plan and implement a biological excursion • have in-depth knowledge of the biodiversity of biological ecosystems • master the essential subject-specific methods for collection and experimentation in the field • be able to present their knowledge credibly • acquire social skills		
Module content	• Basic principles of organising excursions • Training in subject-specific methods during the excursion • Training in modern documentation and media techniques • Demonstration of training to a third party		
Form(s) of instruction	Excursion (72%), seminars (28%)		
Total workload	180 hours = 6 ECTS-credits		
Method of assessment	Presentation or journal (100%) , will be announced		
Form of module component retake exam	None		
Form of retake exam	Presentation or journal (100%) , will be announced		
Student workload	Attendance: Excursion 100 hours Seminars 10 hours	Preparation/revision: Excursion 30 hours Seminars 40 hours	
Credit points	6 ECTS		
Language of instruction	German/English		
Frequency	Annually, 4 weeks, winter semester/ summer semester		
Literature	Will be announced in due course		

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Code	**M-WP-LAB 1**	3^{rd}-4^{th} sem.	6 CP
Course	**Laboratory Courses for Master Students I**		
Faculty/Subject/Department	08/Biology/		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), elective subject / 3^{rd}-4^{th} semester		
Prerequisites	-		
Intake capacity	In consultation with the lecturers		
Learning outcomes	Students will: • acquire specific, research-oriented laboratory skills • learn to develop contacts for cooperation		
Module content	• Cooperation between various work groups • Training in modern laboratory techniques • Demonstration of training to a third party		
Form(s) of instruction	Laboratory work (47%), seminars (53%)		
Total workload	180 hours = 6 ECTS-credits		
Method of assessment	Presentation or journal (100%), will be announced		
Form of module component retake exam	None		
Form of retake exam	Presentation or journal (100%), will be announced		
Student workload	Attendance: Laboratory work 85 hours Seminars 5 hours	Preparation/revision: Seminars 90 hours	
Credit points	6 ECTS		
Language of instruction	German/English		
Frequency	Annually, 4 weeks, winter semester/ summer semester		

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Code	**M-WP-LAB 2**	3^{rd}-4^{th} sem.	6 CP
Course	**Laboratory Courses for Master Students II**		
Faculty/Subject/Department	08/Biology/		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), elective subject / 3^{rd}-4^{th} semester		
Prerequisites	-		
Intake capacity	In consultation with the lecturers		
Learning outcomes	Students will: • acquire specific, research-oriented laboratory skills • learn to develop contacts for cooperation		
Module content	• Cooperation between various work groups • Training in modern laboratory techniques • Demonstration of training to a third party		
Form(s) of instruction	Laboratory work (47%), seminars (53%)		
Total workload	180 hours = 6 ECTS-credits		
Method of assessment	Presentation or journal (100%), will be announced		
Form of module component retake exam	None		
Form of retake exam	Presentation or journal (100%), will be announced		
Student workload	Attendance: Laboratory work 85 hours Seminars 5 hours	Preparation/revision: Seminars 90 hours	
Credit points	6 ECTS		
Language of instruction	German/English		
Frequency	Annually, 4 weeks, winter semester/ summer semester		

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Code	**M-WP-TEA**	3rd-4th sem.	3 CP
Course	**Team Work**		
Faculty/Subject/Department	08/Biology/		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), elective subject / 3rd-4th semester		
Prerequisites	-		
Intake capacity	In consultation with the teachers		
Learning outcomes	Students will: • be able to handle questions in the team • be able present a question properly and credibly in the team • be able to integrate results from different disciplines in the team • acquire social skills		
Module content	• Handling of integrative question in the team • Combination of results from individual disciplines • Division of labour within the team • Training in modern media techniques • Demonstration of training to a third party		
Form(s) of instruction	Practical work in small groups (50%), seminars (50%)		
Method of assessment	Presentation (100%)		
Form of module component retake exam	None		
Form of retake exam	Presentation (100%)		
Student workload	Attendance: Practical work in small groups 45 hours, Seminars 5 hours	Preparation/revision: Seminars 40 hours	
Total workload	90 hours = 3 ECTS-credits		
Language of instruction	German/English		
Frequency	Annually, 2 weeks, winter semester/ summer semester		

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Code	**M-ZB-SEM**
Course	**Work Group Seminar on the Role of Cell Adhesion Molecules in Neuronal Plasticity**
Faculty/Subject/Department	08/Biology/Central Biotechnology Unit
Module coordinator	Cf. German version
Lecturers	Cf. German version
Guidance	Cf. German version
Classification	M.Sc. (Biol.), Optional subject
Prerequisites	B.Sc. (Biol.)
Intake capacity	12
Learning outcomes	Students will be able: • to find scientific publications by themselves • to work through an English-language scientific article • to filter out the key messages from scientific publications and critically compare them with other publications • to present and discuss short scientific lectures in front of an expert audience They will be aware of the research projects at the Central Biotechnology Unit and the current methods for investigation of neuronal plasticity in learning and regeneration processes in the central nervous system.
Module content	• Selected publications dealing with current issues of neuronal plasticity will be regularly reviewed by MSc students, work experience project participants, undergraduates, PhD students and scientific staff • The focus will be on the role of cell adhesion molecules in central nervous system plasticity subsequent to the learning process, and this will be compared to the involvement of this class of molecules in ontogenetic development. Work on neuronal regeneration and acclimatisation processes will also be discussed • During the seminar, staff will also report on the progress of their own work and will discuss the experimental problems they have encountered • Issues relating to statistical testing of the results and the presentation of scientific statements will be discussed
Form(s) of instruction	Seminars (100%), during the semester
Student workload	Attendance: Participation in 15 seminars (30 hours) Preparation/revision: 45 hours Seminar presentation 15 hours
Method of assessment	Seminar (100%)
Credit points	3 ECTS
Frequency	Summer semester and winter semester
Literature	Is assigned at the time

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Code	**M-MB-EMB**	1st sem.	6CP
Course	**Introduction to Marine Biology**		
Faculty/Subject/Department	08/Biology/ Institute for General Zoology and Special Zoology		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation: Marine Biology / 1st semester		
Prerequisites	-		
Intake capacity	18		
Learning outcomes	Students will: • obtain an overview of current methods in interdisciplinary marine research • have a great respect for life and nature develop the ability to make ethical judgments • understand the influence of abiotic and biotic factors on marine biodiversity • critically examine the role of humans in the use of marine resources • recognise the importance of marine conservation in addressing global problems		
Module content	• History of marine biological research • Geology and geography of the oceans • Sea water, waves and tides • Marine ecosystems • Biological productivity of the seas • Marine organisms • Marine resources • Marine conservation and global change		
Form(s) of instruction	Lectures (38%), seminars (47%), field work/excursions (15%)		
Student workload	Attendance: Lectures 26 hours, Seminars 22 hours, Field work/excursions 16 hours	Preparation/revision: Lectures 42 hours, Seminars 62 hours, Field work/excursions 12 hours	
Method of assessment	Exam 60 min. (70%), presentation (30%)		
Form of module component retake exam	None		
Form of retake exam	Oral examination (100%)		
Total workload	180 hours = 6 ECTS-credits		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, winter semester		
Literature	see: current list in StudIP		

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Code	**M-ZO-FTZ**	1st sem.	6 CP
Course	**Fine Structure of Animal Cells**		
Faculty/Subject/Department	08/Biology/ Institute for General Zoology and Systematics		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation Zoology/ 1st semester		
Prerequisites	-		
Intake capacity	16		
Learning outcomes	Students will learn: • fixation methods and artefacts due to fixation • ultramicrotomy methods • use of scanning and transmission electron microscopes • morphometric methods • to recognise essential ultrastructural characteristics of animal cell • be able to analyse and interpret images from electron microscopes		
Module content	• Production of own glass gauge • Coating carrier foils • Preparation and staining of semi-thin sections • Microphotography • Preparation and contrast-staining of ultra-thin sections • Work with transmission and scanning electron microscopes • Analysis of electron micrographs		
Form(s) of instruction	Lectures (22%), tutorials (36%), seminars (42%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Lectures 15 hours, Tutorials 40 hours, Seminars 10 hours	Preparation/revision: Lectures 25 hours, Tutorials 25 hours Seminars 65 hours	
Method of assessment	Report (60%), seminar presentation (40%)		
Form of module component retake exam	None		
Form of retake exam	Report (60%), seminar presentation (40%)		
Credit points	6 ECTS		
Language of instruction	German		
Frequency	Annually, 4 weeks, winter semester		

Please note that only the German version of the modules is official and legally binding. The English version is for informative purposes only.

Code	**M-ZO-FOR**	2nd sem.	6 CP
Course	**Identification Exercise Zoology**		
Faculty/Subject/Department	08/Biology/ Institute for General Zoology and Systematics		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Zoology, 2nd semester		
Prerequisites	-		
Intake capacity	18		
Learning outcomes	Students will: • learn to recognise more precisely important animal groups in their habitats • master established methods of quantitative taxonomy and phylogeny • learn the relationship between location and animal inventory • be able to use alternative approaches to kinship analysis • analyse the relationship between functional morphology and biological performance • consider the relationship between biodiversity and knowledge of species • be able to use the techniques and evaluation methods of taxonomic and systematic research • be able to use various methods for the acquisition of biological information in a targeted manner • possess a high level of cognitive and social competence (logical, abstract and conceptual thought, working in groups) • be able to read and interpret the English-language literature of the field • gain the necessary skills to produce an appropriate master's thesis		
Module content	• Selected techniques in taxonomy, systematics and phylogeny • Analysis of evolution and differentiation for advanced • problem-oriented work in small groups • Scientific evaluation of zoological data • Techniques for publications and presentations		
Form(s) of instruction	Seminars (15%), tutorials (70%), demonstrations (15%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Practical work (with excursions) 70 hours, Seminars 15 hours, Tutorials 15 hours	Preparation/revision: Practical work 50 hours, Seminars 30 hours,	
Method of assessment	Report (mini-publication) (50%), seminar presentation (20%), reports (30%)		
Form of module component retake exam	None		
Form of retake exam	Report (mini-publication) (50%), seminar presentation (20%), reports (30%)		
Credit points	6 ECTS		
Language of instruction	German/English		
Frequency	Annually, 4 weeks, summer semester		
Note	May entail excursion costs up to a maximum of 750 euros		

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Code	**M-MB-MAF**	1st sem.	6 CP
Course	**Marine Aquaculture and Fishery**		
Faculty/Subject/Department	08/Biology/ Institute for General Zoology and Systematics		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Marine Biology / 1st semester		
Prerequisites	M.Sc. Modul M-MB-EMB oder Äquivalent		
Intake capacity	18		
Learning outcomes	Students will: • have a critical understanding of the effects of fishing and aquaculture on marine ecology • develop a capacity for ethical judgments with respect to dealing with living organisms and with respect to their culture and propagation • be able to understand the complex effects and interactions of abiotic and biotic factors in marine aquaculture • be able independently to create the concept of a culture system and to analyse the ensuing problems • be aware of the global importance of marine habitats in the ecological and social context		
Module content	• Nutrition of mariner organisms • Forage crops (phytoplankton and zooplankton) • Current fishery methods • Ecological and social problems of fishing • Caging and care of breeding animals • Rearing of larvae of finfish and shellfish • Construction and operation of aquacultures • Water chemistry • Ecological and social problems of aquaculture		
Form(s) of instruction	Lectures (29%), seminars (33%), laboratory (31%), excursions (7%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Lectures 22 hours, seminars 20 hours, laboratory 15 hours, excursions 8 hours, Preparation/revision: Lectures 30 hours, seminars 40 hours, laboratory 40 hours, excursions 5 hours		
Method of assessment	Exam (50%), report (25%), seminar presentation (25%)		
Form of module component retake exam	None		
Form of retake exam	Oral examination (100%)		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, winter semester		

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Code	**M-MB-MBG**	1st sem.	6 CP
Course	**Marine Biogeography**		
Faculty/Subject/Department	08/Biology/ Institute for General Zoology and Systematics		
Module coordinator	Cf. German version		
Classification	MSc (Biol.), specialisation in Marine Biology / 1st semester		
Prerequisites	BSc (Biol.)		
Intake capacity	18		
Learning outcomes	Students will: • deal in detail with basic questions of marine biogeography • learn to think in various dimensions of space and time • develop the ability to consider biogeographical processes in ecological and geological periods • understand the emergence of patterns in the global distribution of marine biodiversity and the role of historical events, climate and topography • critically examine the influence of human activities on marine ecosystems • learn principles and strategies for the sustainable use and conservation of marine biodiversity		
Module content	• Biogeographical principles • Historical geology and physical geography of the seas • Biogeography of selected marine ecosystems and organisms • Geographical variation of marine biodiversity • Processes of speciation and extinction in oceans • Dispersal and vicariance • Biogeography of islands • Biological invasions and biotic homogenisation • Marine conservation		
Form(s) of instruction	Lectures (38%), seminars (47%), excursions (16%)		
Total workload	180 hours = 6 ECTS-credits		
Student workload	Attendance: Lectures 26 hours, seminars 22 hours, field work/excursions 16 hours Preparation/revision: Lectures 42 hours, seminars 62 hours, field work/excursions 12 hours		
Method of assessment	Exam (70%), seminar presentation (30%)		
Form of module component retake exam	None		
Form of retake exam	Oral examination (100%)		
Credit points	6 ECTS		
Language of instruction	German, English		
Frequency	Annually, 4 weeks, winter semester		