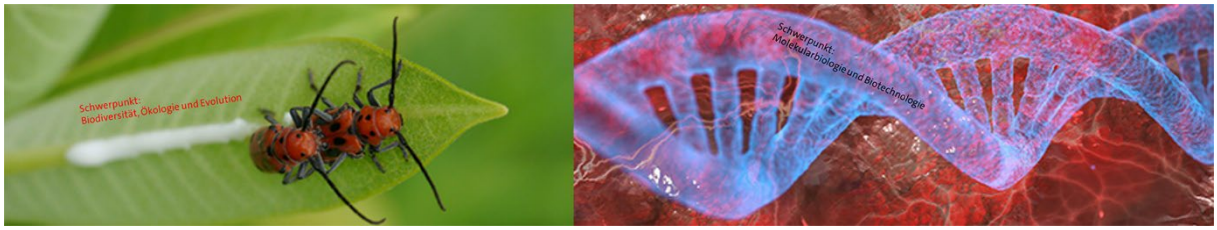
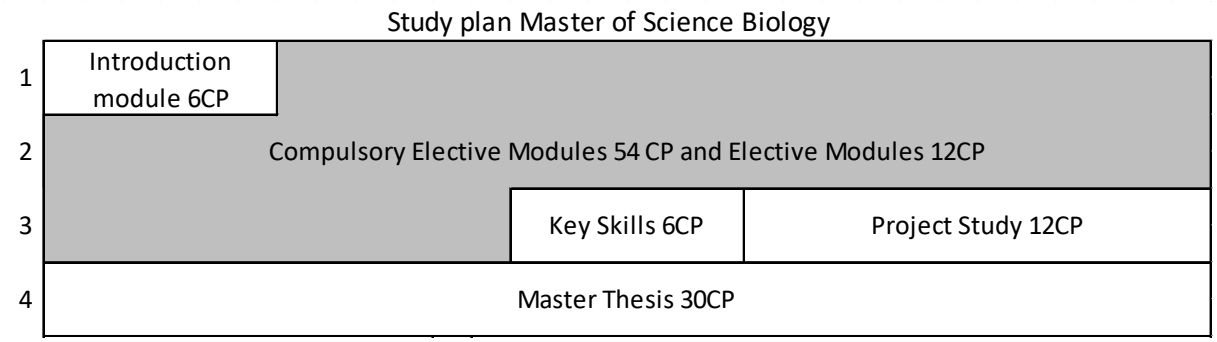
Modulehandbook - Master of Science Biology

(January 23rd, 2025)





Learning outcome:

Graduates have acquired an individual selection of advanced general, theoretical and practical skills and competencies from the various disciplines of biology, which, on the one hand, enable them to develop the full breadth of the profession and, on the other hand, pursue a scientific career and continue with doctoral studies. Students have the opportunity to specialise in the program through the selection of modules in the fields of "Biodiversity, Ecology and Evolution" or "Molecular Biology and Biotechnology". They have internalised the "rules of good scientific work" and are sensitised to the effects of science on politics and society.

Content

L=Lecture
E=Exercise
Ex=Excursion
P=Practical course

P (HRS) = Present time
S (HRS) = elf-study
EP (HRS) = Exam preparation

Compulsory Modules

Title:	**Introduction Module**				
Module number:	MBIO-Einf				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	None				
Module coordinator:	Prof. Dr. Thorsten Burmester, thorsten.burmester (at) uni-hamburg.de				
Instructors:	Prof. Dr. Thorsten Burmester Dr. Mirko Himmel				
Language	German				
Intended learning objectives:	The students know • the master's program Biology and its main subjects • the current research priorities of biology • Core concepts of ethical theories such as deontology and teleology • Basic principles of risk ethics • the necessary foundations for the ethical evaluation of biological research • Examples of ethical assessment processes from biological/biomedical research practice You are capable • Create your interest profile • Identify sector-specific (bio-) ethical questions in their field of expertise as such on the basis of normative ethics, and then analyse them from a scientific-technical and ethical perspective • Participate in public debates on bioethical issues and engage with their expertise in an informed discourse • To guide responsible action in the life sciences on the basis of ethical principles				
Contents	• In the tutorial "Orientation Unit" an introduction to the structure and content of the study course is given. The students create an individual study plan. • The Colloquia will present selected topical research topics in biology. • The lecture "Fundamentals of Bioethics" introduces fundamental ethical theories and explains practical applications in bioethical evaluation processes. Area-specific ethical issues arise in central areas of the life sciences and biomedicine, such as the application of novel technologies for genome editing, dealing with and working on human stem cells, nanomedicine or the use of green and red genetic engineering. In addition, there are ethically-relevant aspects of global food security, the preservation of ecosystems and the preservation of global biodiversity. The role of the individual scientist and actors in the scientific community as a whole is explained in the context of ethically sound good scientific practice and responsible action in the life sciences. In particular, this includes dealing responsibly with safety-relevant research (dual-use research of concern, DURC), which will be examined in more detail on the basis of relevant practical and solution examples.				
Course types and forms of instruction:	• E: Orientation Unit • L: Fundamentals of Bioethics • C: Colloquia				1 SEM./HRS 2 SEM./HRS 2 SEM./HRS
		credits	P (hrs)	S(hrs)	EP (hrs)

Workload (module components and total):	• E: Orientation Unit • L: Fundamentals of Bioethics • C: Colloquia		14 28 28	 56 28	26
	Total Workload	6	70	84	26
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Exam (pass/fail) on the topics of the lecture, Confirmation of 12 Colloquium visits or 6 Colloquium visits and an international scientific conference				
Duration	four semesters				
Module frequency:	annual				
Literature:	Will be announced				

Title:	**Key Skills in Academic Research and Writing**				
Module number:	MBIO-WA				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Jutta Schneider, Phone 42838 3878, jutta.schneider (at) uni-hamburg.de				
Instructors:	Instructors of the program				
Language	German or English				
Intended learning objectives:	Students have the ability to write and critically review and review scientific applications and articles, conduct literature research, and have experience in using databases; professional Presentations through knowledge of different presentation techniques.				
Contents	Introduction to scientific work: Development of a research question; Drawing up a research proposal including the presentation of the state of knowledge; scientific presentation in the form of a lecture.				
Course types and forms of instruction:	• E: Academic Research and Writing				2 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• E: Academic Research and Writing		28	112	40
	Total Workload	6	28	112	40
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Exercise (pass/fail)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced				

Title:	**Project Study**				
Module number:	MBIO-Pro				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	Advanced knowledge of biology, certain compulsory elective modules may be required.				
Module coordinator:	Instructors of the program				
Instructors:	Instructors of the program				
Language	German or English				
Intended learning objectives:	Students have acquired relevant theoretical knowledge as well as methodological and communication skills for a selected research topic.				
Contents	In a project study, general practical and theoretical skills for working on a specific research topic are learned. The question and the methodology can be transferred to the master thesis.				
Course types and forms of instruction:	• Project Study				12 SEM./HRS
Workload (module components and total):	• Project Study	credits	P (hrs)	S(hrs)	EP (hrs)
	Total Workload	12			
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* report (pass/fail)				
Duration	one semester				
Module frequency:	each semester				
Literature:	Will be announced				

Title:	**Master Thesis**				
Module number:	MBIO-AB				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	Advanced knowledge of biology, proven by at least 60 credits				
Module coordinator:	Instructors of the program				
Instructors:	Instructors of the program				
Language	German or English				
Intended learning objectives:	Students have the ability to work independently in a selected field of M.Sc. Biology. They have practical experience in the classification and evaluation of their own research against the background of current research on the selected topic and have problem-solving skills.				
Contents	The master's thesis comprises a detailed work on a current topic from the research fields of biology. This includes the structuring of the project, experimental design, literature research, documentation, as well as the evaluation and critical discussion of scientific results. The written thesis follows the rules of good scientific practice, the results will be presented in the form of a lecture.				
Course types and forms of instruction:					
Workload (module components and total):	• Master thesis	credits	P (hrs)	S(hrs)	EP (hrs)
	Total Workload	30			
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Writing the written master's thesis according to the formal scientific requirements in the amount of 27 CP, as well as an oral examination (3 CP).				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced				

Compulsory Elective modules

Title:	**General Microbiology**
Module number:	MBIO-AB-6
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology and M.Sc. Molecular Life Sciences
Prerequisites for participation:	Extensive basic knowledge in microbiology
Module coordinator:	PD Dr. Andreas Pommerening-Röser, Phone 42816 453, andreas.pommerening (at) uni-hamburg.de
Instructors:	PD Dr. Andreas Pommerening-Röser Dr. Gabriele Timmermann
Language	German or English, usually German
Intended learning objectives:	The students have acquired theoretical foundations and practical skills in the areas of microbial ecology, evolution and phylogeny as well as microbial diversity on a structural, physiological and taxonomic level. They understand the working methods of modern microbial ecology and systematics, taking into account molecular methods and culture-dependent techniques.
Contents	Presentation of the extraordinarily large diversity of microbial life forms against the background of ecological and phylogenetic aspects. Adaptation strategies in the context of interaction with the living and inanimate environment as well as the importance of microorganisms for the global cycles of carbon, nitrogen and sulfur.
Course types and forms of instruction:	• L: Introduction to Microbiology — 2 SEM./HRS • S: Biodiversity and Distribution of Procaryotes — 2 SEM./HRS • P: Ecology and Physiology of Mircoorganisms — 6 SEM./HRS

Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: Introduction to Microbiology		28	62	20
	• S: Biodiversity and Distribution of Procaryotes		28	62	-
	• P: Ecology and Physiology of Mircoorganisms		84	56	20
	Total Workload	12	140	180	40

Coursework and examinations:	*Formal requirements for examinations:* successful completion of the internship (pass/fail), presentation (pass/fail) *examinations:* Written examination (graded, 100%)
Duration	one semester
Module frequency:	annual
Literature:	Fuchs (Schlegel) Allg. MikroBiology, Thieme Verlag Brock: Allgemeine MikroBiology, 11. Auflage, Pearson Verlag Script of the practical course More will be announced at the beginning of the module

Title:	**Biodiversity and Evolution - Research at the Botanical Collections of the University of Hamburg**
Module number:	MBIO-AB-14
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	None
Module coordinator:	Thea Lautenschläger, Phone 42816 516, thea.lautenschlaeger (at) uni-hamburg.de
Instructors:	Dominik Begerow Thea Lautenschläger Stefan Rust Matthias Schultz Petra Schwarz Nikolaus von Schwartzenberg
Language	German or English, usually German
Intended learning objectives:	Students have gained insights into working methods in scientific collections and have acquired in-depth knowledge in the following subject areas: different species concepts in biology, species descriptions and international codes, biodiversity and stability of ecosystems, recording biodiversity in databases, use of various databases for biodiversity research, identification of organisms from the groups of fungi, lichens, microalgae and vascular plants. Techniques of species identification, collection-specific preparation and creation of collection specimens (incl. live cultures), deduction of evolutionary processes based on collection material.
Contents	Students gain an exclusive insight into the botanical collections at UHH: Botanical Garden, Herbarium, Loki Schmidt House and Microalgae Collection. They learn about the functions and relevance of scientific collections and how to distinguish them from non-scientific collections. Using a self-collected plant object, they will accompany the process of collection, preparation, storage and database entry. Important collection techniques include scientifically correct labeling and systematic filing of the object. Students learn about the opportunities but also the risks and limitations of digitizing collections. They discuss the various possibilities of public relations work such as websites, social media and citizen science.
Course types and forms of instruction:	• S: Biodiversity research using organismic collections in plant sciences — 1 SEM./HRS • P: Biodiversity research using organismic collections in plant sciences — 3 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• S: Biodiversity research using organismic collections in plant sciences		14	35	
• P: Biodiversity research using organismic collections in plant sciences		42	35	40
Total Workload	*6*	*56*	*70*	*40*

Coursework and examinations:	*Formal requirements for examinations:*

	Active participation at the practical course and seminar *examinations:* Talk (graded, 100%)
Duration	one semester
Module frequency:	annual
Literature:	-

Title:	**The Organism in its Marine Environment**
Module number:	MBIO-W-11
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Dieter Hanelt, Phone 42816 372, dieter.hanelt (at) uni-hamburg.de
Instructors:	Prof. Dr. Dieter Hanelt
Language	German or English, usually German
Intended learning objectives:	Students are able to recognize important groups of aquatic organisms in their habitats and enable them to be systematically classified. They have an understanding of the adaptation to the aquatic environment with their communities and the knowledge about the evolutionary relation between environment on the one hand and morphology and ecophysiological particularities of aquatic organisms on the other hand. They are aware of the importance of aquatic organisms to humans, including in relation to global anthropogenic change.
Contents	Multi-day excursion which is maintained by the working group Aquatic Ecophysiology / Phycology. Field and / or laboratory work with completed own sub-examinations within the project
Course types and forms of instruction:	• L: Biology of Algae — 2 SEM./HRS • S: The Organism in its Aquatic Environment — 1 SEM./HRS • P: The Organism in its Aquatic Environment — 6 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• L: Biology of Algae		28	62	25
• S: The Organism in its Aquatic Environment		11	34	
• P: The Organism in its Aquatic Environment		70	86	45
Total Workload	9	109	181	70

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar *examinations:* Protocol (graded, 66%) and Presentation (graded, 34%)
Duration	one semester
Module frequency:	annual
Literature:	van den Hoek: Algen, Lüning: Meeresbotanik, Tardent: MeeresBiology Straßburger: Lehrbuch der Botanik Kirk: Light and photosynthesis in aquatic ecosystems Designated scientific articles as a basis for the respective seminar topic, internet and literature research

Title:	**Digital Methods in Morphology**
Module number:	MBIO-W-31
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	Basic computer skills, Windows operating system
Module coordinator:	Prof. Dr. Alexander Haas, Phone 238317 614, alexander.haas (at) uni-hamburg.de
Instructors:	Dr. Frank Friedrich Prof. Dr. Alexander Haas Dr. Jörg Hammel (DESY)
Language	German or English, usually German
Intended learning objectives:	Students have an overview of the types and formats of digital data sets. They understand the steps to turn real objects into digital, editable objects. They learn, remember and understand the basics in the theoretical part. They acquire basic skills in various software packages to apply the basics to digital datasets, to assess them, to quantify if necessary. They are visualized in publication quality.
Contents	E: Learning basic skills in essential software packages (ImageJ, Amira, Modo) for digital organismic structure analysis, morphometrics, visualization and animation. P: Exemplary processing of a real object from the object over the preparation for digitization (histology and sectional digitization) up to the reconstruction and measurement on the computer.
Course types and forms of instruction:	• E: Software Lab for Morphologists — 3 SEM./HRS • P: Morphological Lab Projects — 6 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• E: Software Lab for Morphologists		42	42	30
• P: Morphological Lab Projects		84	48	30
Total Workload	9	126	90	60

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course *examinations:* Oral examination (graded, 100%)
Duration	one semester
Module frequency:	annual
Literature:	Current literature will be provided.

Title:	**Introduction to Habitat Mapping**
Module number:	MBIO-SP-19
Semester:	Summer
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	Basic knowledge of the plants of Northern Germany
Module coordinator:	Prof. Dr. Kai Jensen, Phone 42816 576, kai.jensen (at) uni-hamburg.de
Instructors:	Prof. Dr. Kai Jensen
Language	German or English, usually German
Intended learning objectives:	The students have an overview of the theoretical background as well as the methods of biotope mapping. They have in-depth basic knowledge and practical skills in these areas.
Contents	The module provides an overview of the method of biotope mapping frequently used in nature conservation in Germany. Theoretical background (ecology of selected ecosystems, legal foundations) will be developed within the framework of a seminar. The implementation of a biotope mapping is learned and applied in an internship exemplary for a study area in the Hamburg area. As part of an internship, biotope descriptions are developed by the participating students, which can be used as a basis for nature conservation measures.
Course types and forms of instruction:	• L: Basics in Habitat Mapping — 2 SEM./HRS • P: Habitat Mapping in the Area of Hamburg — 6 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• L: Basics in Habitat Mapping		28	35	27
• P: Habitat Mapping in the Area of Hamburg		84	96	-
Total Workload	9	112	131	27

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar *examinations:* Presentation (graded, 35%) and Protocol (graded, 65%)
Duration	one semester
Module frequency:	annual
Literature:	Current literature will be provided.

Title:	**Evolution and Behaviour**
Module number:	MBIO-AB-2
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	Fundamentals in the theory of evolution and behavioural biology are provided.
Module coordinator:	Prof. Dr. Jutta Schneider, Phone 42838 3878, Jutta.schneider (at) uni-hamburg.de
Instructors:	Prof. Dr. Esther Diekhof Prof. Dr. Jutta Schneider PD Dr. Guido Westhoff
Language	German or English, usually German
Intended learning objectives:	Students have an understanding of evolutionary processes and levels and their influence on patterns of behaviour and an in-depth understanding of the concepts of sexual selection and evolution of social systems. They can apply this knowledge differentiated and form hypotheses and falsify it.
Contents	Evolution (fitness, natural & sexual selection, co-evolution, trade-offs); Social systems; Cooperation and conflict; Communication (signals, networks, fraud); Personality traits and emotions; Cognition and intelligence. The evolution of behaviour is considered throughout the animal kingdom, including humans
Course types and forms of instruction:	• L: Evolution and Behaviour — 2 SEM./HRS • S: The Evolution of Sociality — 1 SEM./HRS • S: Hormones and Behaviour — 1 SEM./HRS • P: Evolution of Adaptive Behaviour — 6 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• L: Evolution and Behaviour		28	62	
• S: The Evolution of Sociality		14	21	10
• S: Hormones and Behaviour		14	21	10
• P: Evolution of Adaptive Behaviour		84	56	40
Total Workload	12	140	160	60

Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Completion of the practical course (graded, 60%), presentations in seminars (graded, 20%)
Duration	one semester
Module frequency:	annual
Literature:	Will be announced

Title:	**Evolution, Ecology and Systematics of Fungi**
Module number:	MBIO-SP-22
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Dominik Begerow, Phone: 42816-260, dominik.begerow (at) uni-hamburg.de
Instructors:	Prof. Dr. Dominik Begerow Dr. Martin Kemler
Language	German or English, usually German
Intended learning objectives:	Students are able to recognize the major groups of fungi and place them in the phylogenetic tree of life; have experience in cultivating fungi and can characterize their ecological niche; can classify fungi based on their characteristics and identify them molecularly; can describe new species of fungi; organize themselves in small groups; are confident in the necessary methods and have the ability to critically question and discuss the results; write scientific protocols.
Contents	Introduction to the evolution, ecology, and systematics of fungi with special focus on yeast fungi and their ecology. In addition to theoretical discussion of species concepts in mycology, these concepts will be reviewed using the student's own examples and new species using a wide variety of methods. Current topics in mycology; basic mycological techniques; microscopy; growth tests; molecular identification of yeasts; phylogeny and taxonomy of fungi.
Course types and forms of instruction:	• L: Evolution and Ecology of Fungi — 2 SEM./HRS • S: Biology of Yeasts — 2 SEM./HRS • P: Methods of Systematics of Fungi — 3 SEM./HRS

Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: Evolution and Ecology of Fungi		28	40	
	• S: Biology of Yeasts		28	40	25
	• P: Methods of Systematics of Fungi		42	42	25
	Total Workload	9	98	112	50

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar *examinations:* Protocol (graded, 50%), presentation in the seminar (graded, 50%)
Duration	one semester
Module frequency:	annual
Literature:	Will be announced

Title:	**Evolutionary Ecology**
Module number:	MBIO-SP-6
Semester:	summer
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology and M.Sc. Molecular Life Sciences
Prerequisites for participation:	Basic knowledge of genetics in theory and methods
Module coordinator:	Prof. Dr. Susanne Dobler, Phone 42838 4288, susanne.dobler (at) uni-hamburg.de
Instructors:	Prof. Dr. Susanne. Dobler
Language	German or English, usually German
Intended learning objectives:	Students know the current genetic methods in ecology and evolutionary biology and can evaluate their applicability to different questions. They are able to choose the right methods and design an appropriate experimental design. They are capable of independently carrying out and evaluating molecular studies of evolutionary ecology.
Contents	In-depth presentation of population genetic methods and their applications, data collection and evaluation in the context of evolutionary and ecological questions
Course types and forms of instruction:	• L: Methods in Evolutionary Ecology 1 SEM./HRS • S: Current Problems in Evolutionary Ecology 1 SEM./HRS • P: Case Studies in Molecular Evolutionary Ecology 6 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Methods in Evolutionary Ecology		14	28	
• S: Current Problems in Evolutionary Ecology		14	28	20
• P: Case Studies in Molecular Evolutionary Ecology		84	124	48
Total Workload	12	112	180	68

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar *examinations:* Protocol (graded, 50%) and presentation (graded, 50%)
Duration	one semester
Module frequency:	annual
Literature:	Hartl & Clark: Principles of Population Genetics, Sinauer Associates Frankham, Ballou, Briscoe: Introduction to Conservation Genetics, Cambridge Uni Press einschlägige Arbeiten aus renommierten Journalen, e.g. Molecular Ecology, Evolution, Journal of Evolutionary Biology, Heredity

Title:	**Evolutionary Systematics**				
Module number:	MBIO-AB-1				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology • Elective module M.Sc. Bioinformatics				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Bernhard Hausdorf, Phone 238317-617, bernhard.hausdorf (at) uni-hamburg.de				
Instructors:	Prof. Matthias Glaubrecht Prof. Dr. Bernhard Hausdorf				
Language	German or English, usually German				
Intended learning objectives:	Students have the ability to create alignments and pedigrees using various algorithms and programs and to assess the quality of traits and pedigrees. They can critically evaluate systematic work, published pedigrees and their meaningfulness. They are able to understand and present current research results based on the original literature.				
Contents	Presentation of the methods of classical and molecular systematics in theory and practice. Exercises for data acquisition, initial evaluation and analysis.				
Course types and forms of instruction:	• L: Evolutionary Systematics • S: Examples of Studies in Molecular Systematics • E: Exercises in Molecular Systematics				2 SEM./HRS 1 SEM./HRS 5 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Evolutionary Systematics		28	53	9
	• S: Examples of Studies in Molecular Systematics		21	24	
	• E: Exercises in Molecular Systematics		70	124	31
	Total Workload	12	119	201	40
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the seminar and exercises *examinations:* Completion of the exercise (graded, 40%) and written examination (graded, 60%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Knoop, V. & Müller, K. (2009) Gene und Stammbäume. 2. Auflage. Spektrum Verlag Heidelberg.				

Title:	**Applied Nature Conservation - Case Study Madagascar**
Module number:	MBIO-W-24
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Kathrin Dausmann, Phone 42838 3864, kathrin.dausmann (at) uni-hamburg.de
Instructors:	Prof. Dr. Kathrin Dausmann Dr. Julian Glos
Language	German or English, usually German
Intended learning objectives:	Students have a broader understanding of tropical systems and the ability to critically assess the criteria relevant to applied species conservation. They have an insight into the development of species conservation concepts, especially against the background of the manifold challenges in tropical countries (eg environmental problems, population growth). Students have acquired skills in data processing, analysis and presentation.
Contents	Basic introduction to the ecosystems of Madagascar, their ecology and biodiversity, as well as current research topics. Environmental issues of Madagascar. Principles of the assessment criteria for Red List species or other conservation relevant estimation modes (lecture, seminar). Application of these criteria for the development of a species conservation concept (exercise).
Course types and forms of instruction:	• L: Madagascar Ecology — 1 SEM./HRS • S: Ecosystems and Animal Biodiversity of Madagascar — 1 SEM./HRS • E: Development of Concepts in Species Conservation — 9 SEM./HRS

Workload (module components and total):

	credits	P (hrs)	S(hrs)	EP (hrs)
• L: Madagascar Ecology		14	21	22
• S: Ecosystems and Animal Biodiversity of Madagascar		14	21	21
• E: Development of Concepts in Species Conservation		126	100	21
Total Workload	9	154	142	64

Coursework and examinations:	*Formal requirements for examinations:* Active regular participation at the seminar and exercises *examinations:* Completion of the exercise (graded, 60%) and oral examination (graded, 40%), Presentation (pass/fail)
Duration	one semester
Module frequency:	annual
Literature:	Current and classic papers

Title:	**Geographical Information Systems in Ecology**				
Module number:	MBIO-SP-3				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology				
Prerequisites for participation:	none				
Module coordinator:	Dr. Veit Hennig, Phone 42838 4235, Veit.Hennig(at)uni-hamburg(dot)de				
Instructors:	Dr. Veit Hennig				
Language	German or English, usually German				
Intended learning objectives:	The students have an advanced knowledge of spatial analysis of ecological issues using geographic information systems. They can perform more complex evaluations based on both vector data and raster data. They can work with different coordinate reference systems and download and import various freely available data bases.				
Contents	• Introduction to common software products for GIS systems; • Structure and structure of spatial data (vector and raster data). • Map reference systems and transformations • Relational databases and geodatabases • Advanced GPS use and space measurement • Analysis of vector and raster data on ecological issues				
Course types and forms of instruction:	• L: Geographical Information Systems in Ecology • E: Geographical Information Systems in Ecology				2 SEM./HRS 4 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: Geographical Information Systems in Ecology		28	56	
	• E: Geographical Information Systems in Ecology		56	112	108
	Total Workload	12	84	168	108
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the exercise *examinations:* Oral examination (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Kratz, R. & F. Suhling (1997): GIS im Naturschutz. Forschung - Planung - Praxis. (1. Aufl.). 236 S. Westarp Wissenschaften, Magdeburg.; Liebig, W. & R.-D. Mummenthey (2005): ArcGIS-Analysen. ArcGIS-ArcView 9. (Band 2). 1. Auflage. 241 Seiten. Points Verlag Norden, Halmstad. Lang, S. und T. Blaschke (2007) Landschaftsanalyse mit GIS; BECK				

Title:	**Hymenoptera: Identification and ecology**
Module number:	MBIO-SP-26
Semester:	*Wintersemester*
Applicability, type of module, and curricular area	• Compulsory elective module in M.Sc. Biology
Prerequisites for participation:	Basic knowledge in zoological systematics, insect morphology and identification (order level)
Module coordinator:	Prof. Dr. Jochen Fründ, Tel. 42816-660, jochen.fruend(at)uni-hamburg.de
Instructors:	Prof. Dr. Jochen Fründ
language	German
Intended learning objectives:	Students can classify the various groups (families, etc.) of Hymenoptera in terms of their systematics, biology, and ecological role. They are familiar with important (morphological) characteristics, can name them on the specimen and use them for identification. They can identify insects up to the species level using various sources and tools and recognize when this is not possible. They are skilled in using identification keys. They possess skills in the preparation and labeling of entomological specimens.
Contents	Overview of the taxonomy and systematics of Hymenoptera (sawflies, wasps, bees, and ants); Life history and ecological interactions of Hymenoptera; Advanced practice in the identification of Hymenoptera. These topics are covered theoretically and practically using collection material, and identification with stereo-microscope and a range of identification literature is practiced for all major groups of Hymenoptera (sawflies, "Parasitica", families of Aculeata).
Course types and forms of instruction:	• V Systematics and Ecology of Hymenoptera — 1 SEM./HRS • S Biology of selected Hymenoptera taxa — 0.5 SEM./HRS • P Identification exercises for Hymenoptera — 4 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• V Systematics and Ecology of Hymenoptera		*14*	*24*	*10*
• S Biology of selected Hymenoptera taxa		*7*	*14*	*10*
• P Identification exercises for Hymenoptera		*56*	*35*	*10*
Total Workload	*6*	*77*	*73*	*30*

Coursework and examinations:	Formal requirements for examinations: Active participation in the seminar and practical sessions. examinations: Presentation (graded, 50%) and written exam (graded, 50%)
Duration	one semester
Module frequency:	annual
Literature:	Will be provided in the course

Title:	**Marine deep-sea benthic biodiversity**
Module number:	MBIO-AB-14
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology • Compulsory elective module M.Sc. Marine Ecosystem and Fisheries Sciences
Prerequisites for participation:	none
Module coordinator:	Dr. Anne-Nina Lörz, Tel: 42838 9891, anne-nina.loerz (at) uni-hamburg.de
Instructors:	Dr. Saskia Brix Dr. Anne-Nina Lörz
Language	German or English, usually German
Intended learning objectives:	The students have theoretical knowledge about different marine benthic habitats such as seamounts, cold water corals, sponge gardens, abyssal plains, hot vents, cold seeps and trenches. The students gained an overview of anthropogenic stressors to marine benthic habitats such as acidification, warming, pollution via plastic, noise and mining. They know the main invertebrate groups of marine benthos. The participant develop a systematic understanding of crustaceans and understand crustaceans to be key players of different habitats. Students learn basic systematic and phylogenetic concepts of Crustacea and the application of characters and characters states in taxonomic keys. Students know how to search / use literature and online databases for species identifications like WoRMS (World of Marine Species) and species occurrence in OBIS (Ocean Biodiversity Information System). The students have aquired basic skills in documenting species new to science, they learn to illustrate via drawing tube at the stereoscope and microscope. They know how to ink their drawings according to the present state of art.
Contents	Biodiversity and threats of benthic marine habitats. Marine Invertebrate taxonomy with focus on evolutionary systematics of Crustacea.
Course types and forms of instruction:	• L: Marine benthic habitats, systematics and biodiversity of crustacea — 1 SEM./HRS • S: Current topics in marine biodiversity research — 2 SEM./HRS • P: Determination of marine Invertebrates in deep-sea benthic samples. Taxonomic methods identifying and describing marine benthic Crustacea — 5 SEM./HRS • Exkursion eg *Multimar Wattforum (https://multimar-wattforum.de/)* — 1 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• L: Marine benthic habitats, systematics and biodiversity of crustacea		14	28	
• S: Current topics in marine biodiversity research		28	56	
• P: Determination of marine Invertebrates in deep-sea benthic samples. Taxonomic methods identifying and describing marine benthic Crustacea		70	40	20

	• Exkursion eg *Multimar Wattforum (https://multimar-wattforum.de/)*		14	0	
	Total Workload	12	126	124	20
Coursework and examinations:	*Formal requirements for examinations:* Regular and active participation at practical parts, to be handed in are six inked drawings of minimum one invertebrate taxon and one species of crustaceans: habitus and five different appendices (mouthparts, antennae or legs) *examinations:* Oral examination (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	To be handed out at beginning of class / Access to shared cloud storage provided				

Title:	**Functional Morphology of Invertebrate Animals**
Module number:	MBIO-AB-10
Semester:	Summer
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	Basic knowledge of the morphology and diversity of animals.
Module coordinator:	Prof. Dr. Andreas Schmidt-Rhaesa, Phone 238317-638, andreas.schmidt-rhaesa (at) uni-hamburg.de
Instructors:	Dr. Frank Friedrich Prof. Dr. Andreas Schmidt-Rhaesa Dr. Ilka Sötje
Language	German or English, usually German
Intended learning objectives:	Students understand microscopic and electron microscopic methods and apply them to selected groups of animals. They are able to analyse and evaluate the fine structural results. They have insights into the comparative morphology of invertebrate animals and can perform the results of microscopic and electron microscopic examinations in written and spoken form.
Contents	Structure, function and evolution of animal organs, understanding of the animal organism as a functional structure of organelles, cells, tissues and organs, light and electron microscopic structure of important animal tissues. Theoretical and practical acquaintance with microscopic methods (preparation methods, functioning of microscopes), especially histology, transmission and scanning electron microscopy. Optionally, insights into fluorescence microscopy and X-ray elemental analysis are offered.
Course types and forms of instruction:	• L: Evolution of Organ Systems — 1 SEM./HRS • S: Comparative Anatomy of Invertebrate Animals — 1 SEM./HRS • P: Histology and Functional Morphology of Invertebrate Animals — 8 SEM./HRS

Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: Evolution of Organ Systems		14	20	
	• S: Comparative Anatomy of Invertebrate Animals		14	40	20
	• P: Histology and Functional Morphology of Invertebrate Animals		112	80	50
	Total Workload	12	150	140	70

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the courses *examinations:* Presentation in the seminar (graded, 30%), protocol (graded, 40%), presentation at the practical course (graded, 30%).
Duration	one semester
Module frequency:	annual
Literature:	Schmidt-Rhaesa, A. (2007): The Evolution of Organ Systems, Oxford University Press

Title:	**Molecular Master Thieves: How Mycobacteria Manipulate Host Cells**
Module number:	MBIO-SP-27
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology • Compulsory elective module M.Sc. Molecular Life Sciences
Prerequisites for participation:	Basic molecular and cell biology skills are required.
Module coordinator:	Prof. Dr. Caroline Barisch, Tel.: 8998 87620, caroline.barisch (at) cssb-hamburg.de
Instructors:	Dr. Aby Anand Prof. Dr. Caroline Barisch
language	German or English
Intended learning objectives:	The students possess basic insights into the infection biology of *Mycobacterium tuberculosis* (tuberculosis).
Contents	The infection mechanism of *Mycobacterium tuberculosis* is examined at the molecular and cellular biology levels. A particular focus is on understanding how mycobacteria manipulate the lipids of the host cell to optimize their survival and proliferation strategies. Primarily, microscopic and biochemical techniques are employed. The experimental work is carried out using a non-virulent model system and safety requirements of biosafety level 1. Through hands-on laboratory experiments, students learn important methods and techniques essential for modern biomedical research.
Course types and forms of instruction:	• L: Infection Biology of Mycobacteria 1,5 SEM./HRS • S: Lipid Manipulation by Mycobacteria 1,5 SEM./HRS • P Modification of the Subcellular Lipid Code by Mycobacteria 1,5 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Infection Biology of Mycobacteria		*21*	30	20
• S: Lipid Manipulation by Mycobacteria		*21*	30	20
• P Modification of the Subcellular Lipid Code by Mycobacteria		*21*	17	
Total Workload	*63*	*77*	*40*	*63*

Coursework and examinations:	Formal requirements for examinations: Active participation in the seminar. Examinations: Presentation (graded, 34%) and oral examination (graded, 66%)
Duration	One Semster
Module frequency:	annual
Literature:	Will be announced at the beginning of the module

Title:	**Molecular, Genomic and Synthetic Microbiology**
Module number:	MBIO-SP-10
Semester:	Summer
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology and M.Sc. Molecular Life Sciences
Prerequisites for participation:	Participation in safety instruction and successful participation in a basic microbiology event
Module coordinator:	Prof. Dr. Wolfgang Streit; Phone 42816 463, wolfgang.streit (at) uni-hamburg.de
Instructors:	Prof. Dr. Wolfgang Streit Dr. Christel Vollstedt Dr. Gabriele Timmermann
Language	German or English, usually German
Intended learning objectives:	The students have an overview of the current topics of microbiology with a focus on microbial genomics and microbial cell-cell communication. Secretion, biofilm formation, transport, biotechnology, pathogenicity as well as catabolic and anabolic metabolic activities form further focal points. In addition, methods of recombinant DNA technologies, e.g. CrispR-Cas_Gene as well as modern biochemical techniques are learned.
Contents	The module includes molecular biology, physiology, and genetics of prokaryotic and eukaryotic microorganisms, with special emphasis on the interactions of higher eukaryotic microorganisms and their environment under aerobic and anaerobic conditions. The module also aims to provide an insight into microbial biotechnology and the modern methods of microbiology (genomics, transcriptomics, etc.) in theory and practice.
Course types and forms of instruction:	• L: Molecular, Genomic and Synthetic Microbiology — 2 SEM./HRS • S: Molecular, Genomic and Synthetic Microbiology — 2 SEM./HRS • P: Molecular Microbiology and Biotechnology — 6 SEM./HRS

Workload (module components and total):	*credits*	*P (hrs)*	*S(hrs)*	*EP (hrs)*
• L: Molecular, Genomic and Synthetic Microbiology		28	62	20
• S: Molecular, Genomic and Synthetic Microbiology		28	42	
• P: Molecular Microbiology and Biotechnology		84	56	40
Total Workload	12	140	160	60

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar *examinations:* Protocol (pass/fail), presentation (pass/fail) and oral examination (graded, 100%)
Duration	one semester
Module frequency:	annual
Literature:	Lehrbuch: Fuchs (Schlegel) Allg. MikroBiology, 8. Auflage, Thieme Verlag Brock: Allgemeine MikroBiology, 11. Auflage, Pearson Verlag

Title:	**Molecular Parasitology**
Module number:	MBIO-SP-4
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	Basic knowledge of cell biology in theory and methods
Module coordinator:	Prof. Dr. Iris Bruchhaus, Phone 42818 472, bruchhaus (at) bnitm.de
Instructors:	Prof. Dr. Iris Bruchhaus PD. Dr. Joachim Clos PD Dr. Hannelore Lotter
Language	German or English, usually German
Intended learning objectives:	Students have general and specialized knowledge of parasitology, with particular emphasis in areas of molecular parasitology, protozoology, helminthology and vaccine development. In addition, they will learn various molecular, protein-chemical and biochemical working techniques used in parasitology. This should be done using putative pathogenicity factors of Entamoeba histolytica whose significance for pathogenicity is to be evaluated with the help of the determined results. In summary, students should gain basic theoretical and methodological knowledge in molecular parasitology.
Contents	The course contents of the module include general and specific knowledge of parasitology with emphasis on the importance of human pathogenic parasites. Topics covered include: Presentation of the most important parasites, protection against the host's defense mechanisms, vectors, parasite metabolism, gene regulation of parasites, vaccine development, therapy, recombinant protein expression, fluorescence microscopy and enzymatic analyses.
Course types and forms of instruction:	• L: Molecular Parasitology — 2 SEM./HRS • P: Molecular Parasitology — 6 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• L: Molecular Parasitology		28	58	34
• P: Molecular Parasitology		72	138	30
Total Workload	12	100	196	64

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course *examinations:* Written examination (graded, 50%) and Protocol (graded, 50%)
Duration	one semester
Module frequency:	annual
Literature:	Meyer: Tropenmedizin Infektionskrankheiten; Mehlhorn/Piekarski: Grundriss der Parasitenkunde, Hiepe/Lucius/GottsteinLucius: Allgemeine Parasitologie

Title:	**Molecular Parasitology (3 CP)**				
Module number:	MBIO-SP-4a				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Iris Bruchhaus, Phone 42818 472, bruchhaus (at) bnitm.de				
Instructors:	Prof. Dr. Iris Bruchhaus PD. Dr. Joachim Clos PD Dr. Hannelore Lotter				
Language	German or English, usually German				
Intended learning objectives:	The students have acquired basic theoretical knowledge in molecular parasitology.				
Contents	General and special knowledge of parasitology with emphasis on the importance of human pathogenic parasites. Topics covered include: Presentation of the most important parasites, protection against the host's defense mechanisms, vectors, parasite metabolism features.				
Course types and forms of instruction:	• L: Molecular Parasitology				2 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: Molecular Parasitology		28	48	14
	Total Workload	3	28	48	14
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Written examination (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Meyer: Tropenmedizin Infektionskrankheiten; Mehlhorn/Piekarski: Grundriss der Parasitenkunde, Hiepe/Lucius/GottsteinLucius: Allgemeine Parasitologie				

Title:	**Molecular Plant Physiology – Signal Transduction and Bioimaging**
Module number:	MBIO-AB-4
Semester:	Summer
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology and M.Sc. Molecular Life Sciences
Prerequisites for participation:	Basic knowledge in biochemistry / molecular biology in theory and practice.
Module coordinator:	Prof. Dr. Stefan Hoth, Phone 42816 582, stefan.hoth (at) uni-hamburg.de
Instructors:	Dr. Olaf Döring Prof. Dr. Stefan Hoth PD Dr. Hartwig Lüthen Dr. Magdalena Weingartner
Language	German or English, usually German
Intended learning objectives:	Students have knowledge of molecular biology and molecular physiology of plants, with particular emphasis on phytohormones, membrane, energy and stress physiology, including functional characterization of the genes and proteins involved. They have advanced methodological knowledge of biochemistry, molecular biology and genetics as well as bioimaging for the study of protein functions, gene regulation and molecular physiological processes. They can understand and coordinate experimental procedures, analyse research results and evaluate them in context.
Contents	The curriculum includes biochemistry, molecular biology, and molecular physiology of plant development and stress response; General molecular biological, biochemical, molecular-physiological and imaging techniques; The cell and its compartments as a system: membranes, transport, gene regulation, proteins and lipids; Transmission of signals in the cell; Life under stress: Examining the response of cells to abiotic and / or biotic stressors; Recombinant protein expression: function and importance of proteins; Reportergenstudien; Bioimaging / fluorescence microscopy.
Course types and forms of instruction:	• L + S: Molecular Plant Physiology - Signal Transduction and Bioimaging — 2 SEM./HRS • L: Introduction to Molecular Plant Science — 1 SEM./HRS • P: Molecular Plant Physiology - Signal Transduction and Bioimaging — 5 SEM./HRS

Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L + S: Molecular Plant Physiology - Signal Transduction and Bioimaging		28	33	
	• L: Introduction to Molecular Plant Science		14	15	
	• P: Molecular Plant Physiology - Signal Transduction and Bioimaging		70	70	40
	Total Workload	9	112	118	40

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar, Presentation (pass/fail) *examinations:* Completion of the practical course (graded, 50%), oral examination (graded, 50%)
Duration	one semester

Module frequency:	annual
Literature:	Bibliography of textbook chapters and introductory reviews (some literature in electronic format) Internship script, current textbooks of biochemistry and bioanalytics, current English literature, internet research.

Title:	**Molecular and Cellular Immunology**
Module number:	MBIO-AB-11
Semester:	Summersemester (L) / Wintersemester (P, S)
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	Basic knowledge in biochemistry / molecular biology in theory and practice
Module coordinator:	PD Dr. Minka Breloer, Phone 42818 830; Breloer (at) bnitm.de
Instructors:	PD Dr. Minka Breloer Prof. Dr. Bernhard Fleischer Prof. Dr. Friedrich Haag Dr. Wiebke Hartmann PD Dr. Thomas Jacobs Prof. Dr. Hans-Willi Mittrücker Prof. Dr. Friedrich Nolte Prof. Dr. Eva Tolosa
Language	German and English
Intended learning objectives:	Students will have an understanding of the molecular basis of immune system and its functions and will be qualified for experimental scientific work in this field. During the practical course they will be trained in relevant immunological laboratory techniques. In the seminar, the students will read, present, and discuss current publications in the field of molecular and cellular immunology. The elective module enables students to perform scientific research projects in the field of molecular and cellular immunology.
Contents	Cells of the immune system, interaction molecules, receptors for antigen, antigenpresentation, mechanisms of tolerance and immunological memory, autoimmunity, defence against infections, tumour immunology. Basic research methodology: isolation, culture and analysis of lymphocytes and antigenpresenting cells; Preparation, purification and fluorochrome conjugation of antibodies; Immunofluorescence microscopy, flow cytometry, immunoblotting, ELISA., ELISPOT
Course types and forms of instruction:	• L: Introduction into Cellular and Molecular Immunology — 2 SEM./HRS • S: Recent Findings in Immunology (Journal Club) — 2 SEM./HRS • P: Introduction into Immunological Methods — 4 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Introduction into Cellular and Molecular Immunology		28	62	
• S: Recent Findings in Immunology (Journal Club)		28	62	
• P: Introduction into Immunological Methods		56	124	
Total Workload	12	112	248	

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course *examinations:* Oral examination on the content of the lecture (graded, 50%), presentation on the content of the seminar and the practical course (graded, 50%)
Duration	two semesters

Module frequency:	annual
Literature:	Janeway`s Immunobiology Abbas Cellular and Molecular Immunology

Title:	**Molecular and Cellular Immunology**				
Module number:	MBIO-AB-11a				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology				
Prerequisites for participation:	none				
Module coordinator:	PD Dr. Minka Breloer, Phone 42818 830; Breloer (at) bnitm.de				
Instructors:	PD Dr. Minka Breloer Prof. Dr. Bernhard Fleischer Prof. Dr. Friedrich Haag Dr. Wiebke Hartmann PD Dr. Thomas Jacobs PD Dr. Marc Jacobson Prof. Dr. Hans-Willi Mittrücker Prof. Dr. Friedrich Nolte Dr. Anke Osterloh				
Language	German or English				
Intended learning objectives:	Students will have an understanding of the molecular basis of immune system functions. The module forms the basis for experimental scientific work in the field of molecular and cellular immunology.				
Contents	Cells of the immune system, interaction molecules, receptors for antigen, antigen presentation, mechanisms of tolerance and immunological memory, autoimmunity, defence against infections, tumour immunology.				
Course types and forms of instruction:	• L: Introduction into Cellular and Molecular Immunology				2 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Introduction into Cellular and Molecular Immunology		28	52	*10*
	Total Workload	3	28	52	10
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Oral examination (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Janeway`s Immunobiology Harlow/Lane: Using Antibodies – a Laboratory Manual Luttman/Bratke: Der Experimentator. Immunologie				

Title:	**Methods of Ecosystem Analysis**				
Module number:	MBIO-SP-20				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology				
Prerequisites for participation:	none				
Module coordinator:	Dr. Christopf. Reisdorff, Phone: 42816 573, christoph.reisdorff (at) uni-hamburg.de				
Instructors:	Dr. Christoph Reisdorff				
Language	German or English, usually German				
Intended learning objectives:	Students possess knowledge in the field of ecosystem analyses and stress physiology. They get familiar with methods of quantifying ecosystem processes with respect to fluxes of energy, carbon and water.				
Contents	Basics of eco-physiological principles and methods: stand structures, biometrics, allometrics, primary production, growth rate, assimilation, dissimilation, water balance, regulation of transpiration, indication of stress, soil water dynamics, stable isotopes of C and N, allocation, micro and macro climate, basics of modelling water and carbon fluxes.				
Course types and forms of instruction:	• S Principles of ecosystem analyses • P Methods of ecosystem analyses • S Data processing and presentation				2 SWS 5 SWS 1 SWS
Workload (module components and total):		*LP*	P (Std)	S(Std)	PV (Std)
	• S Principles of ecosystem analyses		*21*	*69*	*0*
	• P Methods of ecosystem analyses		*80*	*15*	*40*
	• S Data processing and presentation		*20*	*10*	*15*
	Total Workload	*9*	*121*	*94*	*55*
Coursework and examinations:	*Formal requirements for examinations:* Active participation, seminar presentation (pass / fail) *examinations:* Oral examination (graded, 100%), final presentation (pass / fail).				
Duration	one semester				
Module frequency:	**irregularly**				
Literature:	articles from: Plant Cell and Environment, Tree Physiology, Oecologia, Journal of Applied Ecology, Ecosystems. books: Schulze et al.: Pflanzenökologie; Lambers et al.: Ecological Physiology; Larcher: Ökophysiologie der Pflanzen; Sala et al.: Methods in Ecosystem Science; Von Willert et al.: Experimentelle Pflanzenökologie				

Title:	**Network analysis in ecology and beyond**
Module number:	MBIO-SP-25
Semester:	Winter semester
Applicability, type of module, and curricular area	• Compulsory elective module in M.Sc. Biology
Prerequisites for participation:	*Basic knowledge in statistics and a programming language (e.g., R)*
Module coordinator:	Prof. Dr. Jochen Fründ, Tel. 42816-660, jochen.fruend(at)uni-hamburg.de
Instructors:	Prof. Dr. Jochen Fründ (and guests)
language	English
Intended learning objectives:	Students acquire solid knowledge of basic programming in R and can write small simulations. They gain an overview of concepts and methods of (ecological) network analysis; they can confidently use key terms and interpret and compare network graphs for various objectives. They are able to critically engage with results of network analysis. They have insights into the theory and current research on ecological networks. They can create and present a concise scientific poster.
Contents	This module covers essential concepts and methods of ecological network analysis (stability, structural indices, dynamics, null models, etc.). A key focus is on conducting own analyses of various example datasets (ecological data as well as other network data from within and outside of biology) and engaging in joint discussions regarding the differences and similarities between various network types. In addition to showing potentials, we will also discuss limitations and problems of network analysis. Finally, all individual projects will be synthesized in a comparative analysis and a poster session.
Course types and forms of instruction:	• V Network Analysis 1.5 SEM./HRS • Ü Network Analysis 3 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• V Network Analysis		*21*	*36*	
• Ü Network Analysis		*42*	*36*	*45*
Total Workload	*6*	*63*	*72*	*45*

Coursework and examinations:	Formal requirements for examinations: Active participation in the exercise examinations: Presentation of a poster (graded, 100%)
Duration	one semester
Module frequency:	annual
Literature:	Will be provided during the course.

Title:	**Neurophysiology**
Module number:	MBIO-AB-12
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology and M.Sc. Molecular Life Sciences
Prerequisites for participation:	Basic knowledge of molecular biology, experience in practical methods in the laboratory
Module coordinator:	Prof. Dr. Christian Lohr, Phone 42838 5924, Christian.Lohr (at) uni-hamburg.de
Instructors:	Prof. Dr. Christian Lohr
Language	German or English, usually German
Intended learning objectives:	The students possess the theoretical foundations for sensory perception and information processing in the central nervous system and have experience in the practical application of modern physiological techniques for the investigation of neuronal function. The focus is on the structure and function of the olfactory system of mammals.
Contents	The module comprises the investigation of neurons and glial cells in living tissue preparations by means of electrophysiology (patch-clamp), confocal microscopy and calcium imaging. Of particular interest is the synaptic transmission between neurons, calcium as a second messenger and the function of glial cells.
Course types and forms of instruction:	• S: Recent Studies in Neurophysiology 3 SEM./HRS • P: Neurophysiology 8 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• S: Recent Studies in Neurophysiology		42	84	30
• P: Neurophysiology		104	80	20
Total Workload	*12*	*91*	*164*	*50*

Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Oral examination (graded, 100%)
Duration	one semester
Module frequency:	annual
Literature:	Current literature in the field of neurophysiology will be provided

Title:	**Ecology of Terrestrial Habitats**
Module number:	MBIO-AB-8
Semester:	Summer
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Kai Jensen, Phone 42816 576, kai.jensen (at) uni-hamburg.de
Instructors:	Prof. Dr. Kai Jensen Dr. Veit Hennig
Language	German or English, usually German
Intended learning objectives:	The students are able to quantify the composition and structure of communities of specific habitats, their abiotic location factors and their functionality. They have experience in coordinated field work in the field of animal and plant ecology.
Contents	Introduction to the field survey of soil characteristics, plant populations and vegetation types as well as animal populations and animal communities; Getting to know and measuring ecological parameters in terrestrial habitats; Project-oriented work and coordination of site-ecological, botanical and faunistic investigations.
Course types and forms of instruction:	• S: Ecology of Habitats — 2 SEM./HRS • P: Ecology of Terrestrial Habitats — 8 SEM./HRS

Workload (module components and total):	*credits*	*P (hrs)*	*S(hrs)*	*EP (hrs)*
• S: Ecology of Habitats		28	32	30
• P: Ecology of Terrestrial Habitats		92	158	20
Total Workload	12	120	190	50

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar *examinations:* Presentation (graded, 35%) and completion of the practical course (graded, 65%)
Duration	one semester
Module frequency:	annual
Literature:	Dierschke, H. (1994): Pflanzensoziologie – Grundlagen und Methoden. – 683 S., Ulmer, Stuttgart. Keddy, P.A. (2007): Plants and Vegetation: Origins, Processes, Consequences. Cambridge. Kratochwil, A. & A. Schwabe (2001): Ökologie der Lebensgemeinschaften. 756 pp. Verlag Eugen Ulmer, Stuttgart. Martin, K. (2002): Ökologie der Biozönosen. 325 Seiten. Springer-Verlag, Berlin - Heidelberg. Leyer, I., Wesche, K. (2007): Multivariate Statistik in der Ökologie. – 221 S., Springer-Verlag, Berlin [u. a.]. Quinn, G. P., Keough, M. J. (2002): Experimental Design and Data Analysis for Biologists. – 537 S., Cambridge Univ. Pr., Cambridge [u. a.]. Tremp, H. (2005): Aufnahme und Analyse vegetationsökologischer Daten. - UTB 8299: 141 S., Ulmer, Stuttgart.

Title:	**Ecology and Medical Relevance of Vectors and Associated Pathogens**
Module number:	MBIO-AB-15
Semester:	summer
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	Field biology experience, basic knowledge of morphology and molecular biology in theory and practice. Interest in ecology, med. relevance and distribution of vector-relevant arthropods and associated pathogens, basic knowledge in invertebrate identification and human biology.
Module coordinator:	Prof. Dr. Dr. Jonas Schmidt-Chanasit, Phone: 42818 546, schmidt-chanasit (at) bnitm.de
Instructors:	Prof. Dr. Dr. Jonas Schmidt-Chanasit Dr. Daniel Cadar Dr. Anna Heitmann Dr. Stephanie Jansen Dr. Hanna Jöst Dr. Renke Lühken Dr. Jessica Rauch
Language	German and English
Intended learning objectives:	Students have basic knowledge of the systematics, ecology and medical relevance of vector-relevant arthropods and associated pathogens. They have the ability to classify the most important representatives morphologically. They are able to catch vectors independently, to determine them morphologically and molecularly and to examine samples for pathogens. They are capable of independent evaluation and classification of the results.
Contents	Overview of the ecology, biogeography and med. relevance of the most important vector-relevant arthropods and associated pathogens; collection, preservation and identification methods; anatomical identification characteristics; use of identification keys; overview and implementation of molecular biological and serological identification and screening methods for vectors and associated pathogens; independent analysis of results.
Course types and forms of instruction:	• L: Introduction to the Ecology of Vectors and Associated Pathogens — 3 SEM./HRS • S: Seminar on the Ecology of Vectors and Associated Pathogens — 2 SEM./HRS • P: Practical Course on the Ecology of Vectors and Associated Pathogens — 3 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• L: Introduction to the Ecology of Vectors and Associated Pathogens		42		
• S: Seminar on the Ecology of Vectors and Associated Pathogens		28	50	25
• P: Practical Course on the Ecology of Vectors and Associated Pathogens		42	93	80

	Total Workload	12	112	143	105
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course, approved protocol *examinations:* Presentation in the seminar (graded; 50%); internship report in the form of a scientific publication (graded, 50%).				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning				

Title:	**Ecophysiology in Aquatic Habitats**
Module number:	MBIO-AB-9
Semester:	summer
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Dieter Hanelt, Phone 42816 372, dieter.hanelt (at) uni-hamburg.de
Instructors:	Prof. Dr. Dieter Hanelt
Language	German or English, usually German
Intended learning objectives:	The students have the understanding of the process of aquatic ecosystems, especially against the background of a worldwide, anthropogenically induced change in which they are to be regarded as unique ecosystems to be protected. Furthermore, they recognize the biotechnological possibilities that this habitat opens up to humans in the future.
Contents	Recognition of the functional diversity of aquatic plants and their special ecophysiological adaptation to the aquatic environment. Learn specific measurement methodologies, apparatus and experiments to measure and simulate specific environmental conditions. Recognize how algae and lower plants can be used to provide food and energy for humans.
Course types and forms of instruction:	• L: Ecophysiology and Biotechnology on Aquatic Habitats — 2 SEM./HRS • P: Ecophysiology — 6 SEM./HRS

Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: Ecophysiology and Biotechnology on Aquatic Habitats		28	57	5
	• P: Ecophysiology		70	200	
	Total Workload	12	98	257	5

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course *examinations:* Presentation (graded, 20%) and completion of the practical course (graded, 80%)
Duration	one semester
Module frequency:	annual
Literature:	Lüning: Meeresbotanik; von Willert: Experimentelle Pflanzenökologie

Title:	**Functional Ecology and Energetics**
Module number:	MBIO-SP-17
Semester:	summer
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Kathrin Dausmann, Phone 42838 3864, kathrin.dausmann (at) uni-hamburg.de
Instructors:	Prof. Dr. Kathrin Dausmann Dr. Julian Glos
Language	German or English, usually German
Intended learning objectives:	Students have basic knowledge of ecophysiology, their concepts and state-of-the-art methods. They have acquired a wide range of methods (ecological and physiological), which can also be applied in the field, and have the gained the ability to integrate biological underpinnings in the general context and, above all, in the effective context relevant to the animals. They have embraced the concept of transfer of learning by linking different subject areas and have improved their scientific skills (data acquisition, evaluation, presentation).
Contents	Introduction to ecophysiology: costs of living in different habitats; Principles of energy management; Integration of physiological parameters in the ecological context; Application of ecophysiological working methods, if possible in the field
Course types and forms of instruction:	• L: Life at the Edge — 2 SEM./HRS • S: Adaptation to Seasonal Variations — 2 SEM./HRS • P: Energetics and Thermoregulation — 7 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• L: Life at the Edge		28	30	31
• S: Adaptation to Seasonal Variations		28	31	20
• P: Energetics and Thermoregulation		98	64	30
Total Workload	12	154	125	81

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar *examinations:* Completion of the practical course (pass/fail), presentation (pass/fail), written examination (graded, 100%)
Duration	one semester
Module frequency:	annual
Literature:	Campbell & Reece, Heldmaier & Neuweiler, Schmidt-Nielsen Current and classic papers

Title:	**Plants and Plant Parasites of the Alps**
Module number:	MBIO-SP-24
Semester:	summer
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	Basic knowledge in the identification of higher plants is required
Module coordinator:	Prof. Dr. Dominik Begerow, Tel.: 2816-260, dominik.begerow@uni-hamburg.de
Instructors:	Prof. Dr. Dominik Begerow Dr. Martin Kemler
Language	German or English, usually German
Intended learning objectives:	Students are able to identify the plants and plant parasites of the Alps and classify them in the phylogenetic tree of life; have experience in identification of plants and plant parasites and are able to characterize their ecological requirements; are able to describe the differences of alpine vegetation forms; are able to describe the ecological requirements of fire and rust fungi; organize themselves in small groups; are confident in the necessary methods and have the ability to critically question and discuss the results; write scientific protocols; present scientific topics.
Contents	Introduction to the geology, flora and funga of the Alps. Identification of plants and fungi, creation of a herbarium and fungal cultures. Current topics in systematics, vegetation science and population ecology.
Course types and forms of instruction:	• S: Plants and Plant Parasites — 1 SEM./HRS • P: Field Trip to the Alps — 7 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• S: Plants and Plant Parasites		*14*	66	15
• P: Field Trip to the Alps		*98*	62	15
Total Workload	*9*	*112*	*128*	*30*

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar *examinations:* Presentation (graded, 50%), Protocol (graded, 50%)
Duration	one semester
Module frequency:	annual
Literature:	Will be announced at the beginning

Title:	**Plant-Animal Interactions**
Module number:	MBIO-SP-7
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology and M.Sc. Molecular Life Science
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Susanne Dobler, Phone 42838 4288, susanne.dobler(at)uni-hamburg.de
Instructors:	Prof. Dr. Susanne Dobler
Language	German or English, usually German
Intended learning objectives:	Students have an understanding of the principles, driving forces, and mechanisms of coevolution and arms race between animals and plants. They have learned basic approaches and techniques to elucidate causal chains in these interactions.
Contents	Interactions between plants and animals, such as host choice of specialized phytophagous, constitutive and induced defence of plants, defence against predators against several trophic levels, attracting and manipulating pollinators and physiological adaptations of specialized phytophagous species. The underlying chemical and physiological processes are presented in a variety of examples from the molecular level to the long-term evolutionary outcome. In the practical part, behavioural tests, chemical-analytical techniques, enzymological and molecular-biological methods are used to illustrate specific aspects of coevolution between insects and their host plants.
Course types and forms of instruction:	• L: Plant - Animal Interactions 1,5 SEM./HRS • S: Coevolution and Arms Race between Plants and Animals 1,5 SEM./HRS • P: Strategies of Plants Defence and Phytophagous Insects Counter Defence 9 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Plant - Animal Interactions		21	20	
• S: Coevolution and Arms Race between Plants and Animals		21	38	20
• P: Strategies of Plants Defense and Phytophagous Insects Counter Defense		126	64	50
Total Workload	12	168	122	70

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar *examinations:* Completion of the practical course (graded, 80%) and presentation (graded, 20%)
Duration	one semester
Module frequency:	annual
Literature:	Bernays & Chapman, 1994, Host-Plant Selection by Phytophagous Insects Evolution, Journal of Evolutionary Biology, Heredity e.g. Ecology, Oecologia, Journal of Chemical Ecology, Chemoecology, Planta, Plant Physiology

Title:	**Reprogramming animal cells and Introduction to using Caenorhabditis elegans (C. elegans) as a model organism for research**
Module number:	MBIO-SP-21
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology and M.Sc. Molecular Life Science
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Baris Tursun, Phone: 42838 3857, baris.tursun (at) uni-hamburg.de
Instructors:	Prof. Dr. Baris Tursun
Language	German and English
Intended learning objectives:	Students acquired an overview of the research field Reprogramming = conversion of cell identities (e.g. to stem cells or neurons). They extended knowledge about transcription factors and epigenetics, which can antagonize Reprogramming. The students learned that the nematode (roundworm) *C. elegans* is a powerful model organism to study Reprogramming and cellular safeguarding mechanisms. During the practical course, students learned to work with *C. elegans* including techniques such as: use of stereoscope, maintenance of worm lines, cross breeding, and RNA interference (RNAi) to knockdown gene activities. The course has been accomplished by presenting and discussing a published study (= paper; research field Reprogramming / *C. elegans*) given by each student individually.
Contents	This module teaches Reprogramming (conversion of cell identities), which could be used in the future to generate stem cells or healthy neurons for regenerative medicine. The students learn how Reprogramming of cells can be accomplished and that epigenetics plays a role during conversion of cell identities. Epigenetic mechanisms can counteract aberrant changes of cell states, and thereby, can counteract Reprogramming. The students will hear about open questions in the Reprogramming research field and how to address them by using the model *C. elegans*. They also get an impression, to which extend reprogrammed cells may be used in the future for regenerative therapies. The practical course teaches basic techniques of handling *C. elegans* and will refer to content of the lectures in order to connect theory and practice. The presentation and discussion of a published study (peer-reviewed paper within the research field Reprogramming / *C. elegans*) by each student should be in English. Presenting and discussing a paper aims at training critical thinking.
Course types and forms of instruction:	• L: Introduction to Reprogramming and *C. elegans* — 2 SEM./HRS • P: Practical course to learn basic techniques of handling *C. elegans* — 3 SEM./HRS

Workload (module components and total):

	credits	*P (hrs)*	*S(hrs)*	*EP (hrs)*
• L: Introduction to Reprogramming and *C. elegans*		28	60	30
• P: Practical course to learn basic techniques of handling *C. elegans*		42	40	70
Total Workload	9	70	100	100

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar, Talk and Protocol *examinations:* Written examination (graded, 100%)

Duration	one semester
Module frequency:	annual
Literature:	Alberts et al., Molekularbiologie der Zelle, Wiley-VCH Verlag, Weinheim. In der jeweils aktuellen Auflage (derzeit 6.). Jochen Graw.: Genetik. Springer-Spektrum Verlag, Heidelberg. In der jeweils aktuellen Auflage (derzeit 7.). Allis, et al.: Epigenetics. Second ed., CSH Press, New York. . In der jeweils aktuellen Auflage (derzeit 2.)

Title:	**Behavioural Ecology**				
Module number:	MBIO-SP-18				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology				
Prerequisites for participation:	Basic knowledge of the theory of evolution and behavioural biology are assumed. Knowledge of statistics is desired.				
Module coordinator:	Prof. Dr. Jutta Schneider, Phone: 42838 3878, jutta.schneider (at) uni-hamburg.de				
Instructors:	Prof. Dr. Jutta Schneider				
Language	German and English				
Intended learning objectives:	Students have an expanded understanding of evolutionary processes and mechanisms that work on behavioural strategies, have in-depth understanding of the link between ecology and behaviour, and are able to apply theoretical concepts to experiments under natural conditions.				
Contents	Mechanisms and evolution of behaviour; Practical implementation through field experiments.				
Course types and forms of instruction:	• S: Evolution and Mechanisms of Behaviour • P: International Behavioral Ecology Field Course				2 SEM./HRS 6 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• S: Evolution and Mechanisms of Behaviour		28	38	40
	• P: International Behavioral Ecology Field Course		84	60	20
	Total Workload	9	112	98	60
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course *examinations:* Completion of the practical course (graded, 100%) and presentation (pass/fail)				
Duration	one semester				
Module frequency:	annual				
Literature:	Kappeler Peter: Animal Behavior; Evolution and Mechanisms				

Title:	**From Population Ecology to Community Ecology**
Module number:	MBIO-SP-15
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	Advantageous (not compulsory): courses in population genetics and / or population biology
Module coordinator:	Dr. Julian Glos, Phone: 42838 3679, julian.gloas (at) uni-hamburg.de
Instructors:	Dr. Julian Glos
Language	German or English, usually German
Intended learning objectives:	The students will use patterns of population characteristics to derive processes (dispersal, extinction) that led to these patterns. The data will be used to interpret single species population dynamics and community assembly.
Contents	The students inventory the distribution and abundance of ground beetles in the field. Selected groups identify parameters of genetic diversity (intraspecific diversity) and characteristics of communities (level of species and functional diversity).
Course types and forms of instruction:	• L: Population Genetics and Community Ecology 1 SEM./HRS • S: Population Genetics and Community Ecology 1 SEM./HRS • P: Population Genetics and Community Ecology 6 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• L+S: Population Genetics and Community Ecology		28	55	57
• P: Population Genetics and Community Ecology		84	106	30
Total Workload	12	112	161	87

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the lab course and seminar *examinations:* Completion of the lab course (graded, 50%) and written examination (graded, 50%)
Duration	one semester
Module frequency:	annual
Literature:	Will be announced

Title:	**Host-Parasite Coevolution**
Module number:	MBIO-SP-23
Semester:	Summer
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology and M.Sc. Molecular Life Sciences
Prerequisites for participation:	Basic knowledge of evolutionary and molecular biology, experience in practical methods in the laboratory, knowledge of statistics are desirable
Module coordinator:	Prof. Dr. Tobias Lenz, Phone: 42838 5369, tobias.lenz (at) uni-hamburg.de
Instructors:	Prof. Dr. Tobias Lenz Dr. Joanna Malukiewicz
Language	German and English
Intended learning objectives:	Students will have an in-depth understanding of evolutionary ecological and genetic processes and mechanisms resulting from biotic, especially host-parasite interactions, will be familiar with current molecular biology methods, will have an insight into the functions of the adaptive immune system of vertebrates, and will be able to carry out a project from data collection to statistical analysis.
Contents	The module includes sampling stickleback populations in the field, microscopic examination of the parasite fauna of sticklebacks in the laboratory, sequencing and genotyping of immune genes and neutral genetic markers of sticklebacks, and statistical and population genetic analysis of the data collected.
Course types and forms of instruction:	• S: Current Topics on the Interaction of Hosts and Parasites — 2 SEM./HRS • P: Host-Parasite Coevolution in Stickleback — 9 SEM./HRS

Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• S: Current Topics on the Interaction of Hosts and Parasites		28	70	10
	• P: Host-Parasite Coevolution in Stickleback		126	76	50
	Total Workload	12	154	146	60

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the courses *examinations:* Completion of the practical course (graded, 80%) and presentation (graded, 20%)
Duration	one semester
Module frequency:	annual
Literature:	Will be announced

Elective Modules

Title:	**Applied Bioinformatics: Sequences**				
Module number:	MBI-ASE				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Molecular Life Sciences, M.Sc. Chemistry • Elective module M.Sc. Biology				
Prerequisites for participation:	Recommended: Basic knowledge of molecular life sciences. Mandatory: none				
Module coordinator:	Prof. Dr. Andrew Torda, Phone: 42838 7331, andrew.torda (at) uni-hamburg.de				
Instructors:	Members of the Center for Bioinformatics				
Language	German and English				
Intended learning objectives:	The students have basic knowledge in the fields of sequence and genome analysis. They know the common data formats in sequence analysis and can confidently handle biological databases and web applications. Students have basic knowledge of phylogenetic analysis based on multiple sequence comparisons. They have experience in handling data from new sequencing technologies.				
Contents	In this module, the main methods and software applications for protein and nucleotide sequences are introduced from an application-oriented point of view; in particular, the following topics are covered: - Fundamentals of biological sequence analysis - Computer-assisted annotation of sequences - The relationship between sequence and structure of biomolecules - Reconstruction of phylogenetic trees				
Course types and forms of instruction:	• L: Applied Bioinformatics: Sequences • E: Applied Bioinformatics: Sequences				2 SEM./HRS 2 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: Applied Bioinformatics: Sequences		28	42	20
	• E: Applied Bioinformatics: Sequences		28	42	20
	Total Workload	6	56	84	40
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the courses *examinations:* Written examination (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**Applied Microbiology**
Module number:	MBIO-SP-16
Semester:	Winter
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology • Compulsory elective module M.Sc. Molecular Life Sciences
Prerequisites for participation:	Extensive basic microbiological knowledge
Module coordinator:	PD Dr. Eva Spieck, Phone: 42816 424, Eva.spieck (at) uni-hamburg.de
Instructors:	PD Dr. Eva Spieck
Language	German or English, usually German
Intended learning objectives:	Students have acquired theoretical basics and practical skills in the fields of microbial ecology and physiology as well as diversity in the nitrogen cycle on a structural, physiological and taxonomic level. You will be able to identify nitrifying bacteria at the genus level and characterize nitrifying communities using molecular and visual methods (FISH, electron microscopy, etc.). They use selective factors for directed cultivation and compare physiological performances using analytical methods (HPLC technique). Individual sites can be evaluated in terms of expected nitrifying community.
Contents	Understand ecological niche formation during the degradation of nitrogenous effluents in wastewater treatment plants and biofilters. Identification of nitrifiers by molecular biological and microscopic methods and characterization of new representatives.
Course types and forms of instruction:	• V: Niche Differentiation of Nitrifying Microorganisms — 1 SEM./HRS • P: Practical Course in Microbiology — 5 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• V: Niche Differentiation of Nitrifying Microorganisms		14	28	
• P: Practical Course in Microbiology		70	48	20
Total Workload	6	84	76	20

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course *examinations:* Protocol (graded, 50%) and Oral examination (graded, 50%)
Duration	one semester
Module frequency:	annual
Literature:	Will be announced Lehrbuch: Fuchs (Schlegel) Allg. Mikrobiologie, 8. Auflage, Thieme Verlag Brock: Allgemeine Mikrobiologie, 11. Auflage, Pearson Verlag The lab script with the experiment descriptions is distributed by the lecturers in the current form.

Title:	**The Organism in its Aquatic Environment**				
Module number:	MBIO-W-21				
Semester:	Summer				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	none				
Module coordinator:	PD Dr. Dörthe Müller-Navarra, Phone 42816 364, doerthe.mueller-navarra (at) uni-hamburg.de				
Instructors:	PD Dr. Dörthe Müller-Navarra				
Language	German or English, usually German				
Intended learning objectives:	Students are able to recognize important groups of aquatic organisms as well as their importance for the structuring of communities. They have an understanding of adaptations in morphology and ecophysiology, v.a. in behaviour, in different aquatic habitats, and recognize them in an evolutionary context. They are aware of the functioning and importance of aquatic habitats for humans, but also of changes by humans.				
Contents	Repeated sampling of aquatic organisms and abiotic environmental parameters. Determination of organisms in the context of communities and investigation of adaptation mechanisms. Different aquatic habitats will be successively studied in fieldwork as field and coursework or laboratory work.				
Course types and forms of instruction:	• S: The Organism in its Aquatic Environment • P: The Organism in its Aquatic Environment				1 SEM./HRS 6 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• S: The Organism in its Aquatic Environment		14	31	33
	• P: The Organism in its Aquatic Environment		63	39	
	Total Workload	6	77	70	33
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the courses *examinations:* Completion of the practical course (graded, 100%) and presentation (pass/fail)				
Duration	one semester				
Module frequency:	annual				
Literature:	Lampert und Sommer: Limnoökologie, Tardent: MeeresBiology;				

Title:	**Introduction to the NGS World**
Module number:	MBIO-W-27
Semester:	Winter
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology • Compulsory elective module M.Sc. Molecular Life Sciences
Prerequisites for participation:	Extensive knowledge of genetics and the willingness to do computer-based work and evaluation are required
Module coordinator:	Prof. Dr. Tobias Lenz, Phone: 42838 5369, tobias.lenz (at) uni-hamburg.de
Instructors:	Artemis Efstratiou Prof. Dr. Tobias Lenz
Language	German and English
Intended learning objectives:	Students have an overview of the latest DNA sequencing methods (Next Generation Sequencing, NGS), and the new opportunities these methods open up for biological research. They will have in-depth knowledge and practical skills (analysis of NGS data, transcriptome assembly, gene expression analysis, genetic variation analyses, working on the Galaxy server).
Contents	NGS sequencing methods, quality control, manipulation of NGS data, de novo assembly of genes and transcripts, overview of comparison methods of genes and transcripts, gene expression analysis (RNAseq), typing and annotation of genetic variation.
Course types and forms of instruction:	• L: Introduction to the NGS World — 1 SEM./HRS • E: Hands-on Training in NGS Data Analysis — 5 SEM./HRS • S: Case Study — 1 SEM./HRS

Workload (module components and total):	*credits*	*P (hrs)*	*S(hrs)*	*EP (hrs)*
• L: Introduction to the NGS World		14	24	24
• E: Hands-on Training in NGS Data Analysis		70	62	16
• S: Case Study		14	76	
Total Workload	12	98	162	40

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and exercise *examinations:* Completion of the exercise (graded, 70%), presentation (graded, 30%)
Duration	one semester
Module frequency:	annual
Literature:	Will be announced

Title:	**Global Change in Biodiversity and International Concepts for Sustainability and Nature Conservation**
Module number:	MBIO-W-48
Semester:	Summer
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology
Prerequisites for participation:	none
Module coordinator:	Dr. Ute Schmiedel, Phone: 42816 548, Ute.Schmiedel (at) uni-hamburg.de
Instructors:	Manfred Finckh Ute Schmiedel
Language	German or English, usually German
Intended learning objectives:	Students develop an overview of the various problems of biodiversity change and the tools and approaches developed internationally to manage, mitigate, or adapt.
Contents	• Global Environmental Change - Fundamentals, Introduction and Overview: Terms, Concepts, Drivers, Thematic Subdivisions: Climate change, Biogeochemical cycles, Socio-economics, Biodiversity. • Global biodiversity change before the Anthropocene / in the Anthropocene. • UN Conventions: UNCBD, UNFCCC, UNCCD, ... Migratory Species, ... • Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from Their Utilization • CITES - Washington Convention on International Trade in Endangered Species, TRAFFIC • Ecosystem Services - Millennium Ecosystem Assessment • Recording on species level: GBIF / Tree of live / Barcoding • International and national protected area concepts: recording on ecosystem/biome level: Biosphere Reserves • The role and networking of NGOs: From WWF-Panda to Edeka, • Special section: specific problem cases... "from coral bleaching to polar bears to rainforest clearing for palm oil and soy", Biodiversity in urban and rural areas. Human-wildlife conflicts. Rich countries - poor countries.
Course types and forms of instruction:	• L: Global Change in Biodiversity and International Concepts for Sustainability and Nature Conservation — 1 SEM./HRS • S: Global Change in Biodiversity and International Concepts for Sustainability and Nature Conservation — 1 SEM./HRS

Workload (module components and total):	*credits*	*P (hrs)*	*S(hrs)*	*EP (hrs)*
• L: Global Change in Biodiversity and International Concepts for Sustainability and Nature Conservation		14	26	
• S: Global Change in Biodiversity and International Concepts for Sustainability and Nature Conservation		14	26	10
Total Workload	3	28	52	10

Coursework and examinations:	*Formal requirements for examinations:* Active participation in the seminar

	examinations: Presentation (graded, 100%)
Duration	one semester
Module frequency:	annual
Literature:	Wittig, Rüdiger, Niekisch, Manfred: Biodiversität: Grundlagen, Gefährdung, Schutz Springer-Spectrum

Title:	**Infection Biology of Tropical Diseases**				
Module number:	MBIO-W-32				
Semester:	Winter				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	Basic molecular biology skills are required.				
Module coordinator:	Prof. Dr. Tim Gilberger, Phone 8998 87600, tim.gilberger (at) cssb-hamburg.de				
Instructors:	Prof. Dr. Tim Gilberger Dr. Maya Kono PD Dr. Jonas Schmidt-Chanasit Dr. Tobias Spielmann				
Language	German and English				
Intended learning objectives:	Students have basic insights into the infection biology of two major tropical pathogens (malaria and dengue).				
Contents	The focus will be on the molecular, genetic, physiological and biochemical level of pathogen biology and its interaction with the subject.				
Course types and forms of instruction:	• L: Infection Biology of Tropical Diseases • S: Infection Biology				2 SEM./HRS 2 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: Infection Biology of Tropical Diseases		28	42	
	• S: Infection Biology		28	42	40
	Total Workload	6	56	84	40
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the seminar *examinations:* Presentation (graded, 34%) and oral examination (graded, 66%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Interactions of biota and global biogeochemical cycles from the geological past to the future**				
Module number:	MBIO-W-49				
Semester:	Winter				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	advanced knowledge of evolutionary biology, animal and plant biodiversity, ecology and biostatistics is recommended				
Module coordinator:	Prof. Dr. Philipp Porada, Phone: 42816 577, philipp.porada (at) uni-hamburg.de				
Instructors:	Prof. Dr. Philipp Porada				
Language	German or English, usually German				
Intended learning objectives:	The students have basic knowledge of the interactions between biota and the main relevant biogeochemical cycles of the Earth system (carbon, water, nitrogen, phosphorus, etc.). They are able to apply this knowledge to assess the importance of organisms for global climate on different time scales. The students can independently understand, summarize and analyze scientific publications on the topic, and discuss the results of their analyses in a presentation.				
Contents	The role of organisms for global biogeochemical cycles and the associated development of the global climate from the Earth's past to the future is analyzed using literature research. The students read several studies on a topic of their choice from the research field and prepare a presentation on this basis which thematizes one aspect of the interactions between biota and global biogeochemical cycles.				
Course types and forms of instruction:	• S Interactions of biota and global biogeochemical cycles				2 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• S Interactions of biota and global biogeochemical cycles		28	40	22
	Total Workload	*3*	*28*	*40*	*22*
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the seminar *examinations:* Presentation (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Modeling Vegetation in the Earth System**
Module number:	MBIO-W-38
Semester:	Summer
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology
Prerequisites for participation:	Successful completion of the modules "Plant Physiology" and "Ecology" is strongly recommended
Module coordinator:	Prof. Dr. Philipp Porada, Phone: 42816 577, philipp.porada (at) uni-hamburg(dot)de
Instructors:	Prof. Dr. Philipp Porada
Language	German or English, usually German
Intended learning objectives:	Students have basic knowledge of the effect of climate factors on vegetation functions (photosynthesis, water uptake, growth), and of the feedback effect of vegetation on climate. They can apply this knowledge to the quantitative determination of vegetation functions based on given climate data. Furthermore, they can independently develop their own model approaches for given vegetation processes. The students have basic knowledge of global computer models of the land surface.
Contents	Basics of interactions of vegetation with its environment; mathematical description of biogeochemical and ecological processes related to vegetation: photosynthesis, respiration, growth; energy balance and water balance of the land surface and soil; biotic interactions; programming in Matlab and Fortran; functioning of global vegetation models and parallel programming; methods to abstract local processes to the global scale.
Course types and forms of instruction:	• L: The Role of Vegetation in the Earth System — 1 SEM./HRS • E: Process-based Vegetation Modelling — 1 SEM./HRS

Workload (module components and total):		*credits*	*P (hrs)*	*S(hrs)*	*EP (hrs)*
	• L: The Role of Vegetation in the Earth System		14	20	11
	• E: Process-based Vegetation Modelling		14	20	11
	Total Workload	*3*	*28*	*40*	*22*

Coursework and examinations:	*Formal requirements for examinations:* Independent solution of exercises *examinations:* Term paper (independent development and application of a vegetation process model to a chosen problem, graded, 100%).
Duration	one semester
Module frequency:	annual
Literature:	Will be announced at the beginning of the module

Title:	**Modern methods for high-throughput analyses in molecular biology**				
Module number:	MBIO-W-44				
Semester:	Summer				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	Solid knowledge of molecular biology and genetics; Knowledge of standard molecular biological methods such as PCR, Sanger sequencing, electrophoresis techniques for DNA and protein analysis				
Module coordinator:	PD Dr. Birgit Kersten, Phone 04102-696105, birgit.kersten (at) thuenen.de				
Instructors:	Prof. Dr. Julia Kehr PD Dr. Birgit Kersten				
Language	German or English, usually German				
Intended learning objectives:	The students have an overview about modern methods for high-throughput analyses in molecular biology and related applications in functional genome research, among others. They have a deep methodical knowledge and are able to select suitable methods for different research questions.				
Contents	Introduction, Next- and third generation sequencing and applications for DNA/RNA analyses; Array-based DNA/RNA-analyses methods; Analyses of epigenetic modifications (e.g., ChIP-Seq); Analyses of small functional RNAs; Protein analyses (e.g., MS, 2DE); Analyses of protein-protein-interactions (e.g. Y2H) and posttranslational protein modifications such as phosphorylations (e.g., protein microarrays); Metabolic profiling (GC-MS, LC-MS); Integration of different omics-approaches				
Course types and forms of instruction:	• L: Modern methods for high-throughput analyses in molecular biology				2 SEM./HRS
Workload (module components and total):		*credits*	*P (hrs)*	*S(hrs)*	*EP (hrs)*
	• L: Modern methods for high-throughput analyses in molecular biology		28	56	16
	Total Workload	3	28	56	16
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Written Examination (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Molecular Entomology and Arboviruses**				
Module number:	MBIO-W-42				
Semester:	Winter				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	Basic knowledge of molecular biology is assumed				
Module coordinator:	Prof. Dr. Esther Schnettler, Phone 42818 840, schnettler (at) bnitm.de				
Instructors:	Dr. Anna Heitmann Dr. Mayke Leggewie Prof. Dr. Esther Schnettler				
Language	German and English				
Intended learning objectives:	Students gain an overview of arthropod vectors and selected vector-borne tropical diseases. In addition, students understand the molecular biology of selected arboviruses and the mosquito as one of the most important vectors of such viruses.				
Contents	General and specific knowledge of molecular entomology and diseases transmitted by arthropods, focusing on human pathogenic viruses and mosquitoes as a vector. Topics covered include: Presentation of the most important arthropod vectors, molecular biology of the arboviruses, biology of the mosquito as a vector, defence mechanisms of the vector				
Course types and forms of instruction:	• L: Introduction to Molecular Entomology and Diseases Transferred by Arthropods • P: Molecular Entomology and arbovirology				2 SEM./HRS 3 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Introduction to Molecular Entomology and Diseases Transferred by Arthropods		28	56	30
	• P: Molecular Entomology and arbovirology		42	84	*30*
	Total Workload	9	70	140	60
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course *examinations:* Three partial examinations: Presentation (graded; 25%) with written elaboration (graded; 25%); oral examination (graded; 50%).				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Molecular Mechanisms of Infection**
Module number:	MBIO-W-52
Semester:	Winter
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology and M.Sc. Molecular Life Sciences
Prerequisites for participation:	Knowledge of basic molecular and cell biology and microbiology is required.
Module coordinator:	Dr. Mirko Himmel, Phone: 42816 448, mirko.himmel (at) uni-hamburg.de
Instructors:	Dr. Mirko Himmel Dr. Maria Riedner
Language	German or English, usually German
Intended learning objectives:	Students possess basic insights into molecular infection mechanisms of pathogenic microorganisms. They also have advanced methodological knowledge of infection biology, biochemistry, molecular biology and mass spectrometry. They have in-depth fundamental knowledge and practical skills of molecular infection mechanisms of mainly bacterial pathogens. In the practical course, bacterial pathogens (e.g. *Burkholderia thailandensis; Burkholderia plantarii*) are studied in detail in cellular infection experiments. Bacterial proteins relevant to the mechanism of infection are studied by protein biochemistry.
Contents	Understanding of basic processes
Course types and forms of instruction:	• L: Molecular Infection Mechanisms of Pathogenic Microorganisms — 2 SEM./HRS • P: Molecular Mechanisms of Infection — 9 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Molecular Infection Mechanisms of Pathogenic Microorganisms		28	33	35
• P: Molecular Mechanisms of Infection		126	*100*	38
Total Workload	12	154	133	73

Coursework and examinations:	*Formal requirements for examinations:* Passing the safety test (handling biological agents; genetic engineering work; safety in biological laboratories; not graded) and regular active participation in the internship are prerequisites for the partial exam on the internship. *examinations:* Written examination on the contents of the lecture (graded, 50%) and one of the practical course (graded, 50%).
Duration	one semester
Module frequency:	annual
Literature:	- Suerbaum: Medizinische Mikrobiologie und Infektiologie, 9. Auflage, 2020, Springer [eBook über Staatsbibliothek verfügbar] - Brock: Allgemeine Mikrobiologie, 15. Auflage, 2020, Pearson Verlag [eBook über Staatsbibliothek verfügbar] - Current technical literature will be named by the lecturer. The lecturer will distribute the current version of the internship script.

Title:	**Molecular Neurobiology**				
Module number:	MBIO-W-15				
Semester:	Winter				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	none				
Module coordinator:	Dr. Anne Willing, Phone 7410 55668, anne.willing (at) zmnh.uni-hamburg.de				
Instructors:	Instructors:s of the ZMNH				
Language	English				
Intended learning objectives:	Students have a basic understanding of molecular and cellular mechanisms that govern the functioning of the nervous system. They have knowledge of the macroscopic and cellular anatomy of the brain, signal transmission, signal transmission, neuronal plasticity and degeneration, as well as experimental skills to answer neurobiological questions.				
Contents	It provides an overview of classical and current issues in molecular and cellular neurobiology: Introduction to cell biology and development of the nervous system and signal transmission between nerve cells. Methods for answering neurobiological questions (histological, cell biological, molecular biology, biochemical and electrophysiological techniques).				
Course types and forms of instruction:	• S: Molecular Neurobiology • P: Molecular Neurobiology				2 SEM./HRS 4 SEM./HRS
Workload (module components and total):		*credits*	*P (hrs)*	*S(hrs)*	*EP (hrs)*
	• S: Molecular Neurobiology		28	86	30
	• P: Molecular Neurobiology		56	110	50
	Total Workload	12	84	196	80
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course *examinations:* Presentation (graded, 20%) and oral examination (graded, 80%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Neuroscience-Exploring the Brain – M. Bear, B.W. Connors, M. Paradiso Neuroscience – D. Purves Neurowissenschaften: Eine Einführung – E.R. Kandel, J. Schwartz, T. Jessel				

Title:	**Neurobiological Immunology**
Module number:	MBIO-W-37
Semester:	Winter
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology
Prerequisites for participation:	Knowledge of the basics of cell biology is required.
Module coordinator:	Dr. Clemens Wülfing, Phone 42838 8179, Clemens (at) ini-research.org
Instructors:	Dr. Hauke Günther Dr. Clemens Wülfing
Language	German or English, usually German
Intended learning objectives:	The students explain the basic functions of the nervous system and the immune system and their communication with each other. They have become acquainted with the research field of psychoneuroimmunology and have special knowledge to illustrate the anatomy and physiology of the lymph node as well as its immunological functions. In the practical course they have learned techniques from the field of immunohistochemistry and protein biochemistry intensively. As a result, students are qualified to independently plan, implement, evaluate and present experimental approaches. In the seminar, the students independently processed, critically scrutinized and presented current publications in the fields of immunology and neuroscience.
Contents	Immunology, Neurobiology, Neuroanatomy, Histology, Cell Biology, Psychoneuroimmunology, Lymph Node Anatomy, Conduit Systems, Stromal Cells of Lymphatic Organs, Dendritic Cells and Macrophages, Neurophysiology of the Autonomic Nervous System. Fixation methods, immunohistochemical procedures such as Immunofluorescence staining / microscopy and handling of analysis software, protein biochemistry (polymerase chain reaction, protein purification and Western Blot)
Course types and forms of instruction:	• L: Basics in Neuroscience and Immunology — 1 SEM./HRS • S: Current Topics in Anatomy and Physiology of Lymph Nodes — 1 SEM./HRS • P: Working methods — 4 SEM./HRS

Workload (module components and total):	*credits*	*P (hrs)*	*S(hrs)*	*EP (hrs)*
• L: Basics in Neuroscience and Immunology		14	24	7
• S: Current Topics in Anatomy and Physiology of Lymph Nodes		14	24	7
• P: Working methods		84	56	40
Total Workload	9	112	104	54

Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Oral examination (graded, 33%), completion of the practical course (graded, 33%), presentation (graded, 34%)
Duration	one semester
Module frequency:	annual
Literature:	Netter's Atlas of Neuroscience – D. L. Felten, A. N. Shetty Junqueira's Basic Histology Text & Atlas – A. L. Mescher

	Janeway's Immunobiology – Kenneth Murphy Neurowissenschaften – Eine Einführung – E.R. Kandel, J. Schwartz, T. Jessel Cell Communication in Nervous and Immune System - E. Gundelfinger Nerve-Driven Immunity - Neurotransmitters and Neuropeptides in the Immune System – M. Levite

Title:	**Ecology of Arthropods**				
Module number:	MBIO-W-68				
Semester:	Summer				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology • - For all M.Ed. teaching degree biology Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Dr. Oliver Hallas, Phone: 42838 3928, oliver.hallas (at) uni-hamburg.de				
Instructors:	Dr. Oliver Hallas Dr. Hilke Schröder				
Language	German				
Intended learning objectives:	Students will be able to work independently on a field biology topic with the associated practical and theoretical work. I.e. collection, processing and evaluation of field biological data as well as presentation of the results in the form of a short presentation and a scientific protocol. The students gain in-depth knowledge of trapping methods, preparation, identification and biology of selected arthropod groups as well as in dealing with special literature.				
Contents	The practical course includes project work in small groups, for example: Population surveys in different habitats as well as characterization and comparison of habitats based on different arthropod groups (e.g. spiders, grasshoppers, wild bees and wasps); analysis of succession on carcasses; investigation of coexistence or competition in red forest ant states as well as analysis of the macroinvertebrate fauna of a stream including food selection experiments.				
Course types and forms of instruction:	• P+S: Ecology of Arthropods				6 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• P+S: Ecology of Arthropods		130	100	40
	Total Workload	*9*	*130*	*100*	*40*
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course *examinations:* Protocol (graded, 75%), presentation (graded, 25%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Dettner: Lehrbuch der Entomologie. Townsend & Harper & Begon: Ökologie.				

Title:	**Ecology and Biodiversity of Africa**
Module number:	MBIO-SP-5
Semester:	Summer
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology
Prerequisites for participation:	none
Module coordinator:	Dr. Ute Schmiedel, Phone: 42816 548, Ute.Schmiedel (at) uni-hamburg.de
Instructors:	Dr. Manfred Finckh Felicitas Gunter Dr. Ute Schmiedel
Language	German or English, usually German
Intended learning objectives:	Students have knowledge of ecological relationships, groups of organisms, patterns of biodiversity and current environmental problems of the African biome. They have acquired practical skills for recording and measuring characteristics of the ecosystems (identification of plant species, vegetation surveys, pedological profile descriptions, use of ecological measuring instruments). Digital documentation and use of database systems and GIS are familiar to them.
Contents	Abiotic and biotic themes of the different biomes of Africa in general (climate, soils, environmental history, evolution, adaptations, biodiversity / groups of organisms, environmental problems). Detailed discussion of the specific excursion area.
Course types and forms of instruction:	• L: Ecology and Biodiversity of Africa 1 SEM./HRS • S: Ecology and Biodiversity of Africa 1 SEM./HRS • P: Ecology and Biodiversity of Africa 6 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• L: Ecology and Biodiversity of Africa		14	31	
• S: Ecology and Biodiversity of Africa		14	11	20
• P: Ecology and Biodiversity of Africa		84	76	20
Total Workload	9	112	118	40

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar *examinations:* Completion of the practical course (graded, 25%) and presentation (graded, 75%)
Duration	one semester
Module frequency:	annual
Literature:	Walter, H., Breckle, S.-W. (2004) [Hrsg.]: Ökologie der Erde – Band 2: Spezielle Ökologie der Tropischen und Subtropischen Zonen. – 3. Aufl., XXII + 764 S., Spektrum Akademischer Verlag, München. Walter, H., Breckle, S.-W. (1991): Ökologie der Erde – Band 4: Spezielle Ökologie der Gemäßigten und Arktischen Zonen außerhalb Euro-Nordasiens. – XVI + 586 S., Fischer, Stuttgart. Special literature will be announced in the seminar Depending on the excursion destination (mostly provided)

Title:	**Past and ongoing carbon dynamics in ecosystems of the coastal zone**				
Symbol:	MBIO-W-56				
Semester:	Wintersemester				
Module type:	• compulsory elective module				
Formal requirements for participation:	Obligatory: none Recommended: basic knowledge on (i) the role of ecosystems in the carbon cycle and (ii) coastal ecology				
Executive professor:	Prof. Dr. Kai Jensen, Tel.: 42816 576, kai.jensen (at) uni-hamburg.de				
Lecturer:	Kai Jensen Lars Kutzbach Sebastian Lindhorst Peter Mueller Gerhard Schmiedl				
Language:	English				
Educational concept:	Students have pronounced knowledge on the role of ecosystems in the coastal zone for past and ongoing carbon cycling. They are able to evaluate the possible role of coastal ecosystems as “natural climate solutions”.				
Content:	Carbon cycling in ecosystems: stocks and fluxes; Coastal salt marshes in the Wadden Sea; Embanked marshes in the Wadden sea region; Past and current sea-level rise in the Wadden Sea region; Management scenarios for optimizing carbon sequestration in the coastal zone. Methods to evaluate carbon stocks and carbon fluxes. Methods to evaluate sources and ages of organic matter;				
Courses:	• S Past and ongoing carbon dynamics in ecosystems of the coastal zone				2 SEM/hrs
Workload:		*CP*	*P (in h)*	*S (in h)*	*PV (in h)*
	• S Biostatistics and mathematical principles		*28*	*31*	*31*
	Total workload	*3*	*28*	*31*	*31*
Grading framework (possibly including examinations):	*Formal requirements for examinations:* *none* *Examinations:* Presentation (graded, 100%)				
Duration:	One semester				
Frequency of occurence:	Annual				
Literature:	McLeod, E., Chmura, G.L., Bouillon, S., Salm, R., Bjork, M., Duarte, C.M. et al. (2011) A blueprint for blue carbon: toward an improved understanding of the role of vegetated coastal habitats in sequestering CO2. Frontiers in Ecology and the Environment, 9, 552–560. Mueller, P., Granse, D., Nolte, S., Do, H.T., Weingartner, M., Hoth, S. et al. (2017) Top-down control of carbon sequestration: grazing affects microbial structure and function in salt marsh soils. Ecological Applications, 27, 1435–1450. Mueller, P., Granse, D., Nolte, S., Weingartner, M., Hoth, S. & Jensen, K. (2020) Unrecognized controls on microbial functioning in Blue Carbon ecosystems:				

	the role of mineral enzyme stabilization and allochthonous substrate supply. Ecology and Evolution, 10, 998–1011. Ren, L.; Jensen, L.; Porada, P.; Mueller, P. (2022) Biota-mediated carbon cycling - A synthesis of biotic-interaction controls on blue carbon. Ecology Letters, 25, 521-540. Rogers, K., Kelleway, J.J., Saintilan, N., Megonigal, J.P., Adams, J.B., Holmquist, J.R. et al. (2019) Wetland carbon storage controlled by millennial-scale variation in relative sea-level rise. Nature, 567, 91–95. Schlesinger, W.H. & Bernhardt, E. (2013) Biogeochemistry: an analysis of global change, 3rd edition. Durham, NC: Elsevier. Additional literature might be given during the course.

Title:	**Plant Biotechnology**				
Module number:	MBIO-W-18				
Semester:	Summer				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	Solid knowledge of molecular biology and genetics, basic knowledge of plant physiology				
Module coordinator:	Dr. Tobias Brügmann, Phone: 04102 - 696-170, tobias.bruegmann (at) thuenen.de				
Instructors:	Dr. Tobias Brügmann				
Language	German or English, usually German				
Intended learning objectives:	Students have an overview of the development of plant biotechnology from the first cultivated plants to modern high-performance varieties. They know the classical breeding techniques and modern breeding technologies as well as their molecular analysis methods. Students understand the potentials and risks of modern biotechnology as well as regulatory aspects. They are able to discuss controversial, societal views on plant biotechnology.				
Contents	History and techniques of plant breeding (including selection, cross and mutation breeding), plant tissue culture, methods for genetic transformation, genome editing (including CRISPR/Cas, TALEN, ZFNs), molecular analysis of transformed and genome-edited plant lines, modern applications of molecular breeding, legal regulations and ethics of biotechnology, science communication and societal opinion formation.				
Course types and forms of instruction:	• S: Plant Biotechnology				2 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• S: Plant Biotechnology		28	56	16
	Total Workload	3	28	56	16
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the seminar *examinations:* Written examination (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Kempken (2020) Gentechnik bei Pflanzen. Chancen und Risiken. Springer Verlag. Cathomen & Puchta (2018) CRISPR/Cas9 – Einschneidende Revolution in der Gentechnik. Springer Verlag. Weitze et al. (2021) Kann Wissenschaft witzig? Wissenschaftskommunikation zwischen Kritik und Kabarett. Springer Verlag.				

Title:	**Psycho-Neuro-Endocrino-Immunology**
Module number:	MBIO-W-17
Semester:	Summer
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology • (as well as also elective in the Department of Psychology, Exercise and Health Sciences).
Prerequisites for participation:	Previous participation in lecture and seminar of module W-37 Neurobiological Immunology (winter semester) is recommended.
Module coordinator:	Dr. Clemens Wülfing, Phone: 42838 8179, clemens.wuelfing (at) uni-hamburg.de
Instructors:	Prof. Dr. Esther Diekhof Dr. Clemens Wülfing
Language	German
Intended learning objectives:	Students have basic knowledge in the field of psychoneuroimmunology, and have understood the basis of bi-directional communication between the nervous and immune systems as a prerequisite. The students have an overview of the mutual influence of mental health/disease and the immune system as well as the possible influence of psychotherapy on immunological processes. They will be able to name the most important influencing factors and explain the associated relationships. Students should be able to combine the diverse interactions between the nervous and immune systems and apply them to possible new research approaches. They should therefore be able to understand and independently summarize and interpret the literature and present it to an audience by working through current publications in the field.
Contents	Brief overview of the nervous and immune systems, psychoneuroimmunology and psychoendocrine immunology / Functionality of the brain and endocrine processes / Gut-Brain Axis / Influence of lifestyles in exercise and diet on immune functions / Behavioral patterns as well as social environment and their importance for immunological processes / Mental health and psychiatric diseases and their influence on inflammatory processes / Psychoneuroimmunology and pathological stress / Aging and the immune system / Sleep and importance for immunological processes and memory / Influence of the immune system on development of chronic pain, Psychoneuroimmunology of psychotherapy / Conditioning of the immune system / Immunological influence on the pathophysiology of oncological processes, viral diseases (HIV) and autoimmune diseases.
Course types and forms of instruction:	• L: Psycho-Neuro-Endocrino-Immunology — 1 SEM./HRS • S: Current Developments in Psychoneuroimmunology — 1 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• L: Psycho-Neuro-Endocrino-Immunology		*14*	*20*	*10*
• S: Current Developments in Psychoneuroimmunology		*14*	*20*	*12*
Total Workload	*3*	*28*	*40*	*22*

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the seminar *examinations:* Oral examination (graded, 50%) and presentation (graded, 50%)
Duration	one semester

Module frequency:	annual
Literature:	- Psychoneuroimmunology – an interdisciplinary introduction – M. Schedlowski, U. Tewes - Psychoneuroimmunology – Q. Yan - The Oxford Handbook of Psychoneuroimmunology – S. Segerstrom - Psychoneuroimmunologie und Psychotherapie – C. Schubert - Cell Communication in Nervous and Immune System - E. Gundelfinger - Nerve-Driven Immunity - Neurotransmitters and Neuropeptides in the Immune System – M. Levite

Title:	**Sensory Ecology**				
Module number:	MBIO-W-45				
Semester:	Summer				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	Fundamentals in the theory of evolution and behavioural biology				
Module coordinator:	Dr. Cynthia Tedore, Phone: 42838 3673, cynthia.tedore (at) uni-hamburg.de				
Instructors:	Dr. Cynthia Tedore				
Language	English				
Intended learning objectives:	Students should understand the basic physics underlying sensory stimuli and the physiology of sensory reception and neural encoding in the major animal modalities (vision, audition, chemoreception, mechanoreception, magnetoreception, electrosense). They should be able to predict how habitat preference, sensory systems, and signals and camouflage may evolve in response to one another. They should be knowledgeable about common experimental techniques in sensory ecology, and be able to discuss and critique experimental designs in published works.				
Contents	Students will attain the above learning objectives through assigned readings, short lectures, collaborative problem sets, discussions of published literature, and practical exercises in which the students use themselves as test subjects to explore sensory and perceptual phenomena.				
Course types and forms of instruction:	• L: Sensory Ecology • E: Problem Solving in Sensory Ecology				1 SEM./HRS 3 SEM./HRS
Workload (module components and total):		*credits*	*P (hrs)*	*S(hrs)*	*EP (hrs)*
	• L: Sensory Ecology		14	80	40
	• E: Problem Solving in Sensory Ecology		42	74	20
	Total Workload	9	56	154	60
Coursework and examinations:	*Formal requirements for examinations:* Active participation in discussions and exercises *examinations:* Written examinations (40%): Multiple choice quizzes and short answer questions on assigned readings Exercise completion (60%): Peer evaluations of preparation and participation in group exercises (15%); presentations and class discussions (30%); final essay (15%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Stevens, M. (2013) Sensory Ecology, Behaviour, & Evolution. Oxford University Press. Other primary literature TBA.				

Title:	**Methods in Vegetation Science**
Module number:	MBIO-W-54
Semester:	Summer semester (lecture and practical course) and winter semester (exercise and seminar)
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology
Prerequisites for participation:	Knowledge of the local flora is an advantage
Module coordinator:	Dr. Ute Schmiedel, Tel.: 42816 548, Ute.Schmiedel (at) uni-hamburg.de Manfred Finckh, Tel: 42816 549, Manfred.Finckh (at) uni-hamburg.de
Instructors:	Manfred Finckh Ute Schmiedel
Language	German (English on request)
Intended learning objectives:	Students have theoretical foundations and practical skills in the field of vegetation science. The students have an overview of the most important vegetation science concepts. They can carry out vegetation surveys independently, prepare the data for analysis and carry out basic vegetation analysis steps independently and have acquired an increased routine in the use of vegetation science and statistical evaluation programs.
Contents	Introduce different vegetation survey and analysis methods using various analysis tools for classification and ordination (in Juice, PAST, and R). Conducting vegetation surveys in the field, addressing plant species. Discussion of current examples of scientific and applied use of vegetation science methods.
Course types and forms of instruction:	• L: Introduction to Methods in Vegetation Science — 1 SEM./HRS • P: Practical course in Vegetation Science — 4 SEM./HRS • S: Examples of the Use of Vegetation Science Methods — 1 SEM./HRS • E: Evaluation of Vegetation Data — 4 SEM./HRS

Workload (module components and total):	*credits*	*P (hrs)*	*S(hrs)*	*EP (hrs)*
• L: Introduction to Methods in Vegetation Science		14	50	20
• P: Practical course in Vegetation Science		56	60	
• S: Examples of the Use of Vegetation Science Methods		14	10	
• E: Evaluation of Vegetation Data		56	60	20
Total Workload	12	140	180	40

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the seminar, practical course, exercises *examinations:* Presentation (graded, 50%), Term paper (graded, 50%)
Duration	two semester
Module frequency:	annual
Literature:	Leyer I, Wesche K. Multivariate Statistik in der Ökologie: Eine Einführung: Springer; 2007.

Title:	**Cytology**				
Module number:	MBIO-W-36				
Semester:	Summer				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	Basic molecular biology skills are required.				
Module coordinator:	Prof. Dr. Tim Gilberger, Phone 42838 240, gilberger(at) bni-hamburg (dot) de				
Instructors:	Prof. Dr. Tim Gilberger Dr. Stephan Lorenzen Dr. Kathrin Schuldt Dr. Tobias Spielmann				
Language	German or English, usually German				
Intended learning objectives:	Students are familiar with the advanced fundamentals of cell biology with a focus on the structural units of the eukaryotic cell and their function in cellular processes.				
Contents	Cellular structures and processes of the eukaryotic cell. Presentation and discussion of recent publications in the field of cell biology.				
Course types and forms of instruction:	• L: Cytology • S: Cytology				2 SEM./HRS 2 SEM./HRS
Workload (module components and total):		*credits*	*P (hrs)*	*S(hrs)*	*EP (hrs)*
	• L: Cytology		*28*	*42*	
	• S: Cytology		*28*	*42*	*40*
	Total Workload	6	56	84	40
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the seminar *examinations:* Presentation (graded, 50%), Oral examination (graded, 50%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				