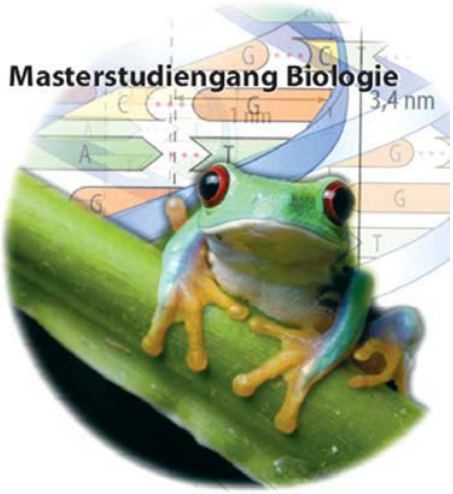
Modulehandbook - Master of Science Biology

(23.04.2018)



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, Phone 42838 3913, thorsten.burmester(at)uni-hamburg(dot)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
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• 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 semester
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(dot)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 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 Science
Prerequisites for participation:	Extensive basic knowledge in microbiology
Module coordinator:	PD Dr. Andreas Pommerening-Röser, Phone 42816 453, andreas.pommerening(at)uni-hamburg(dot)de
Instructors:	PD Dr. Andreas Pommerening-Röser Dr. Gabriele Timmermann
Language	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 of Aquatic Animals**				
Module number:	MBIO-AB-14				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology				
Prerequisites for participation:	Theoretical basic knowledge of the systematics of fish and an overview of aquatic invertebrates are recommended				
Module coordinator:	Prof. Dr. Ralf Thiel, Phone 42838 5637, ralf(dot)thiel(at).uni-hamburg(dot)de				
Instructors:	Prof. Dr. Ralf Thiel Dr. Martin Schwentner Dr. Saskia Brix				
Language	German (partly English literature)				
Intended learning objectives:	The students have theoretical knowledge of the systematics, biodiversity and conservation status of important aquatic animal taxa with a special focus on fish and invertebrates (special focus on Crustacea). They have applicable theoretical knowledge about the objectives and methodology of aquatic biodiversity research. They have practical methodological knowledge to perform species descriptions as well as species determinations of preserved and live fish and benthic invertebrates with a focus on peracarid crustaceans. They have the ability to use suitable identification keys as well as to carry out further analyses in the framework of taxonomic issues in online databases.				
Contents	Evolution, Systematics and Biodiversity of Fish and Crustaceans, Status and Background of the Biodiversity in Aquatic Habitats and their Endangerment by Humans, Day Excursion to a Public Aquarium in Northern Germany				
Course types and forms of instruction:	• L: Systematics and Biodiversity of Fishes • L: Systematics and Biodiversity of Crustacea • S: Current Topics in Aquatic Biodiversity Research • P: Taxonomical Exercises on Fishes and Benthic Invertebrates				1,5 SEM./HRS 1 SEM./HRS 1,5 SEM./HRS 6 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: Systematics and Biodiversity of Fishes		21	46,5	
	• L: Systematics and Biodiversity of Crustacea		14	31	
	• S: Current Topics in Aquatic Biodiversity Research		21	46,5	
	• P: Taxonomical Exercises on Fishes and Benthic Invertebrates		72	88	20
	Total Workload	12	128	212	20
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar, protocol, presentation *examinations:* Oral Examination (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be presented in the module: e.g. Rex, M.A. & Etter, R.J. (2010) Deep-Sea Biodiversity. Pattern and Scale. Harvard University Press: 354 pp.				

	- Hayward, P.J. & Ryland, J.S. Handbook of the Marine Fauna of North-West Europe. Oxford University Press. 800 pp. - Stresemann, E. Exkusionsfauna. Wirbellose. Bd.1. Volk und Wissen Verlag.637 pp. - Nelson, J.S., Grande, T.C. & Wilson, M.V.H. (2016): Fishes of the World. John Wiley & Sons, Inc.: 1-752. - Westheide, W. & Rieger, G. (2015): Spezielle Zoologie, Bd. 1; Einzeller und Wirbellose Tiere. Springer-Verlag, Berlin, Heidelberg: 1-894. - Westheide, W. & Rieger, G. (2015): Spezielle Zoologie, Bd. 2; Wirbel- oder Schädeltiere. Springer-Verlag, Berlin, Heidelberg: 1-713. - Bone, Q. & Marshall, N. B. (1985): Biology der Fische. Gustav Fischer Verlag: 1-236. - Mayr, E. (1975): Grundlagen der zoologischen Systematik. Theoretische und praktische Voraussetzungen für Arbeiten auf systematischem Gebiet. Paul Parey, Hamburg. S. 1-370. - Wägele, J. W. (2000): Grundlagen der Phylogenetischen Systematik. Verlag Dr. Friedrich Pfeil, München, 1-316. - Eschmeyer, W.N. (2016): Catalog of fishes. California Academy of Sciences. Online version. - Fricke, R. (1996): Deutsche Meeresfische. Bestimmungsbuch. Deutscher Jugendbund für Naturbeobachtung. Hamburg: 1-219. - Froese, R. & Pauly, D. (2016): FishBase. World Wide Web electronic publication. www.fishbase.org, actual version.

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(dot)de				
Instructors:	Prof. Dr. Dieter Hanelt				
Language	German and English				
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 • S: The Organism in its Aquatic Environment • P: The Organism in its Aquatic Environment				2 SEM./HRS 1 SEM./HRS 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	41	
	Total Workload	9	109	136	25
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 42838 3916 alexander.haas (at) uni-hamburg.de				
Instructors:	Dr. Frank Friedrich Prof. Dr. Alexander Haas Dr. Jörg Hammel (DESY)				
Language	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 • P: Morphological Lab Projects				3 SEM./HRS 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:					

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@uni-hamburg.de				
Instructors:	Prof. Dr. Kai Jensen				
Language	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 • P: Habitat Mapping in the Area of Hamburg				2 SEM./HRS 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:					

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(dot)de				
Instructors:	Prof. Dr. Esther Diekhof Prof. Dr. Jutta Schneider				
Language	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 • S: The Evolution of Sociality • S: Hormones and Behaviour • P: Evolution of Adaptive Behaviour				2 SEM./HRS 1 SEM./HRS 1 SEM./HRS 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:* Oral or written exam on the contents of the lecture (graded, 30%); completion of the practical course (graded, 50%), presentations in seminars (graded, 10%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced				

<table>
<tr><td>Title:</td><td colspan="5">Evolutionary Ecology</td></tr>
<tr><td>Module number:</td><td colspan="5">MBIO-SP-6</td></tr>
<tr><td>Semester:</td><td colspan="5">summer</td></tr>
<tr><td>Applicability, type of module, and curricular area</td><td colspan="5">• Compulsory elective module M.Sc. Biology and M.Sc. Molecular Life Science</td></tr>
<tr><td>Prerequisites for participation:</td><td colspan="5">Basic knowledge of genetics in theory and methods</td></tr>
<tr><td>Module coordinator:</td><td colspan="5">Prof. Dr. Susanne Dobler, Phone 42838 4288, susanne.dobler(at)uni-hamburg(dot)de;</td></tr>
<tr><td>Instructors:</td><td colspan="5">Prof. Dr. Susanne. Dobler</td></tr>
<tr><td>Language</td><td colspan="5">German and English</td></tr>
<tr><td>Intended learning objectives:</td><td colspan="5">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.</td></tr>
<tr><td>Contents</td><td colspan="5">In-depth presentation of population genetic methods and their applications, data collection and evaluation in the context of evolutionary and ecological questions</td></tr>
<tr><td>Course types and forms of instruction:</td><td colspan="4">• L: Methods in Evolutionary Ecology
• S: Current Problems in Evolutionary Ecology
• P: Case Studies in Molecular Evolutionary Ecology</td><td>1 SEM./HRS
1 SEM./HRS
6 SEM./HRS</td></tr>
<tr><td rowspan="2">Workload (module components and total):</td><td>• L: Methods in Evolutionary Ecology
• S: Current Problems in Evolutionary Ecology
• P: Case Studies in Molecular Evolutionary Ecology</td><td>credits</td><td>P (hrs)

14

14

84</td><td>S(hrs)

28

28

124</td><td>EP (hrs)

20

48</td></tr>
<tr><td>Total Workload</td><td>12</td><td>112</td><td>180</td><td>68</td></tr>
<tr><td>Coursework and examinations:</td><td colspan="5">Formal requirements for examinations:
Active participation at the practical course and seminar
examinations:
Protocol (graded, 50%) and presentation (graded, 50%)</td></tr>
<tr><td>Duration</td><td colspan="5">one semester</td></tr>
<tr><td>Module frequency:</td><td colspan="5">annual</td></tr>
<tr><td>Literature:</td><td colspan="5">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</td></tr>
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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 42838 2284, bernhard.hausdorf(at)uni-hamburg(dot)de				
Instructors:	Prof. Matthias Glaubrecht Prof. Dr. Bernhard Hausdorf Dr. Martin Husemann Dr. Marco Neiber				
Language	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	*9*	*91*	*134*	*45*
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(dot)dausmann(at)uni-hamburg(dot)de
Instructors:	Prof. Dr. Kathrin Dausmann Dr. Julian Glos
Language	German or English
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 — 6 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• L: Madagascar Ecology		14	21	12
• S: Ecosystems and Animal Biodiversity of Madagascar		14	21	10
• E: Development of Concepts in Species Conservation		84	84	10
Total Workload	9	112	126	32

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-3a
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology
Prerequisites for participation:	The module "Introduction Geographic Information Systems" may not have been used.
Module coordinator:	Dr. Veit Hennig, Phone 42838 4235, Veit.Hennig(at)uni-hamburg(dot)de
Instructors:	Dr. Veit Hennig Dr. Jens Oldeland
Language	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: Introduction to Geographical Information Systems in Ecology — 2 SEM./HRS • L: Geographical Information Systems in Ecology — 2 SEM./HRS • E: Geographical Information Systems in Ecology — 4 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• L: Introduction to Geographical Information Systems in Ecology		28	52	10
• L: Geographical Information Systems in Ecology		28	42	20
• E: Geographical Information Systems in Ecology		56	96	28
Total Workload	12	112	202	58

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:	**Food Biotechnology**				
Module number:	CHE 281				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology				
Prerequisites for participation:	Mandatory prerequisite: previous participation in a basic lecture and a basic internship on microbiology.				
Module coordinator:	Prof. Dr. Bernward Bisping Phone 42816 642, bernward.bisping(at)uni-hamburg(dot)de				
Instructors:	Prof. Dr. Bernward Bisping				
Language	German				
Intended learning objectives:	The students will have an overview of the current topics of microbiology with a focus on fermentations for food production, food preservation, fermentation technology, and the use of enzymes in food technology. In addition, practical knowledge of bioreactor technology will be acquired.				
Contents	Preservation of food, microbiological fermentation for the production of vegetable and animal products (bread, alcoholic fermentation products, coffee, tea, cocoa, tobacco, dairy, meat and sausage products), fermentation technology and enzymes in food technology.				
Course types and forms of instruction:	• L: Food biotechnology • P: Fermentation technology				1 SEM./HRS 3 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: Food biotechnology		14	34	10
	• P: Fermentation technology		42	65	15
	Total Workload	6	56	99	25
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course *examinations:* Internship (pass/fail). The final module examination usually consists of an oral examination (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Brock: MikroBiology, 13. Auflage, Pearson Verlag, 2013 Antranikian, Angewandte MikroBiology, Springer Verlag, 2006 Krämer, LebensmittelmikroBiology, 6. Auflage, Ulmer UTB, 2011 The script of practical course with the test descriptions will be distributed in the current form by the Instructors:s.				

Title:	**Functional Morphology of Invertebrate Animals**
Module number:	MBIO-AB-10/W-8
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 42838 3921, andreas(dot)schmidt-rhaesa(at)uni-hamburg(dot)de
Instructors:	Dr. Frank Friedrich Prof. Dr. Andreas Schmidt-Rhaesa Dr. Ilka Sötje
Language	German and English
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 Animal Adaptations**				
Module number:	MBIO-AB-7				
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 molecular biology, experience in practical methods in the laboratory.				
Module coordinator:	Prof. Dr. Thorsten Burmester, Phone 42838 3913, thorsten.burmester(at)uni-hamburg(dot)de				
Instructors:	Prof. Dr. Thorsten Burmester				
Language	German and English				
Intended learning objectives:	Students possess general and specialised knowledge of the physiology of animals, with particular emphasis in areas of molecular animal physiology, comparative physiology, ecophysiology and neurophysiology. They have learned various molecular and physiological working techniques theoretically and can apply them in practice. They are able to design experiments and critically evaluate the results.				
Contents	Molecular Foundations of Animal Physiology, with particular emphasis on comparative biochemistry and molecular biology; Adaptations to extreme environmental conditions and stress physiology; Cell Physiology; transcriptomics; Functioning of the nervous system.				
Course types and forms of instruction:	• S: Recent Studies in Animal Physiology • P: Molecular Animal Adaptations				2 SEM./HRS 9 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• S: Recent Studies in Animal Physiology		*26*	*54*	*10*
	• P: Molecular Animal Adaptations		*100*	*130*	*40*
	Total Workload	12	126	194	50
Coursework and examinations:	*Formal requirements for examinations:* Active participation *examinations:* Protocol (graded, 80%) and Presentation (graded, 20%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Current literature in the field of animal physiology will be provided				

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(dot)streit(at)uni-hamburg(dot)de				
Instructors:	Prof. Dr. Wolfgang Streit Dr. Christel Vollstedt Dr. Gabriele Timmermann				
Language	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 • S: Molecular, Genomic and Synthetic Microbiology • P: Molecular Microbiology and Biotechnology				2 SEM./HRS 2 SEM./HRS 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(dot)de				
Instructors:	Prof. Dr. Iris Bruchhaus				
Language	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 • P: Molecular Parasitology				2 SEM./HRS 6 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: Molecular Parasitology • P: Molecular Parasitology		28 72	58 138	34 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(dot)de				
Instructors:	Prof. Dr. Iris Bruchhaus				
Language	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:	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 in biochemistry / molecular biology in theory and practice.
Module coordinator:	Prof. Dr. Stefan Hoth, Phone 42816 582, stefan.hoth(at)uni-hamburg(dot)de
Instructors:	Dr. Olaf Döring Prof. Dr. Stefan Hoth PD Dr. Hartwig Lüthen Dr. Magdalena Weingartner
Language	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 — 4 SEM./HRS • L: Introduction to Molecular Plant Science — 1 SEM./HRS • P: Molecular Plant Physiology - Signal Transduction and Bioimaging — 1,5 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• L + S: Molecular Plant Physiology - Signal Transduction and Bioimaging		56 14	80 14	30
• L: Introduction to Molecular Plant Science		21	40	15
• P: Molecular Plant Physiology - Signal Transduction and Bioimaging				
Total Workload	9	91	134	45

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar, Presentation (pass/fail) *examinations:* Completion of the practical course (pass/fail), oral examination (graded, 100%)
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:	Summer
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(dot)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, tumor 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 semester
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(dot)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 Englisch				
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, defense against infections, tumor 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 or written 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:	**Molecular Virology and Cell Biology**				
Module number:	MBIO-SP-12				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology				
Prerequisites for participation:	Basic knowledge of virology and cell biology				
Module coordinator:	Prof. Dr. Thomas Dobner, Phone 48051 301, thomas.dobner(at)leibniz-hpi(dot)				
Instructors:	Prof. Dr. Thomas Dobner				
Language	German or English				
Intended learning objectives:	Students have general knowledge in virus-host interactions, with a focus on the pathogenesis of infections, immunodeficiency viruses and DNA tumor viruses. They have learned various aspects of virology and cell biology techniques and applied them to selected examples in practice.				
Contents	Molecular basis of the interaction of human pathogenic viruses with their host cells with particular emphasis on biochemical analyses on the functioning of viral control proteins in the regulation of the lytic and latent infection cycle and tumorigenesis.				
Course types and forms of instruction:	• S: Proceedings in Virology and Cell Biology • P: Molecular Virology and Cell Biology				1 SEM./HRS 7 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• S: Proceedings in Virology and Cell Biology		14	31	30
	• P: Molecular Virology and Cell Biology		98	127	60
	Total Workload	12	112	158	90
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the courses *examinations:* Presentation (graded, 50%) and Protocol (graded, 50%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Molekulare Virologie. Eine Einführung für Biologen und Mediziner (Taschenbuch) Modrow, Falke, Truyen. Spektrum Akademischer Verlag. Gustav Fischer. 2. Auflage				

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	Deutsch				
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 • P Methods of ecosystem analyses • S Data processing and presentation		*21* *80* *20*	*69* *15* *10*	*0* *40* *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:	**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(dot)de				
Instructors:	Prof. Dr. Christian Lohr				
Language	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 • P: Neurophysiology				3 SEM./HRS 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	*9*	*91*	*134*	*45*
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. Alexander Gröngröft Dr. Veit Hennig				
Language	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 • P: Ecology of Terrestrial Habitats				2 SEM./HRS 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:	**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(dot)de				
Instructors:	Prof. Dr. Dieter Hanelt				
Language	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 • P: Ecophysiology				2 SEM./HRS 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:	**Pharmaceutical microbiology**				
Module number:	CHE 280				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module M.Sc. Biology				
Prerequisites for participation:	Theoretical and methodical basic knowledge of microbiology Participation in the safety instruction at the beginning of the module				
Module coordinator:	Prof. Dr. Peter Heisig, Phone 42838 3899, Peter.Heisig(at)chemie.uni-hamburg(dot)de				
Instructors:	Prof. Dr. Peter Heisig				
Language	German				
Intended learning objectives:	The students have an overview of the current topics of medical and pharmaceutical microbiology with a focus on the causes and spread of infectious diseases as well as the mechanisms of action of antibiotics. Furthermore, knowledge about current problems of genesis and dissemination as well as selected molecular mechanisms of bacterial antibiotic resistance will be taught.				
Contents	Fundamentals of pathogenicity and microorganisms as producers and target structures of drugs are presented. The effects of anti-infective and resistance mechanisms, as well as microorganisms are treated as contaminants of drugs.				
Course types and forms of instruction:	• L: Pharmaceutical microbiology • P: Pharmaceutical microbiology				1,5 SEM./HRS 3 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: Pharmaceutical microbiology • P: Pharmaceutical microbiology		21 42	31 61	10 15
	Total Workload	6	63	92	25
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course *examinations:* Completion of the practical course (pass/fail), oral examination (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Brock: MikroBiology, 13. Auflage, Pearson Verlag, 2013 Slonczewski, Foster: MikroBiology, 2. Auflage, Springer-Verlag, 2011 Kayser, Böttger, Haller, Deplazes, Roers: Medizinische MikroBiology, 13. Auflage, Thieme Verlag, 2014				

Title:	**Ecophysiology 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(dot)dausmann(at)uni-hamburg(dot)de
Instructors:	Prof. Dr. Kathrin Dausmann Dr. Julian Glos
Language	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 — 1 SEM./HRS • S: Adaptation to Seasonal Variations — 1 SEM./HRS • P: Energetics and Thermoregulation — 6 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• L: Life at the Edge		14	10	21
• S: Adaptation to Seasonal Variations		14	21	10
• P: Energetics and Thermoregulation		84	64	32
Total Workload	9	112	105	53

Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar *examinations:* Completion of the practical course (graded, 67%), presentation (pass/fail), oral examination (graded, 33%)
Duration	one semester
Module frequency:	annual
Literature:	Campbell & Reece, Heldmaier & Neuweiler, Schmidt-Nielsen Current and classic papers

Title:	**Population Biology of Animals**
Module number:	MBIO-SP-9
Semester:	summer
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
Intended learning objectives:	The students are confident in the application of important evaluation and field methods and are able to design quantitative approaches.
Contents	Introduction to population ecology, determination of population demographic parameters, determination of animal population sizes using catch recovery methods, experimental design and design for capturing animal populations
Course types and forms of instruction:	• L: Concepts in Population Biology 1 SEM./HRS • S: Methods in population biology 1 SEM./HRS • P: Field Methods in Terrestrial Ecology 6 SEM./HRS

Workload (module components and total):	credits	P (hrs)	S(hrs)	EP (hrs)
• L: Concepts in Population Biology		14	16	15
• S: Methods in population biology		14	18	13
• P: Field Methods in Terrestrial Ecology		84	96	-
Total Workload	9	112	130	28

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:	Amler, K., A. Bahl, K. Henle, G. Kaule, P. Poschlod & J. Settele (1999): PopulationsBiology in der Naturschutzpraxis. 336 pp. Verlag Eugen Ulmer, Stuttgart.; Begon, M., M. Mortimer & D. J. Thompson (1996): Populationsökologie. 380. Spektrum Akademischer Verlag GmbH, Heidelberg Berlin Oxford.; Krebs, C. J. (1998): Ecological Methodology. 620 S. Addison Wesley Longman, Inc., Menlo Park, California. Krebs, C. J. (1985): Ecology - The experimental analysis of distribution and Abundance. (3. Aufl.). 800 S. Harper & Row, Publishers, New York. Krebs, C. J. (1998): Ecological Methodology. 620 S. Addison Wesley Longman, Inc., Menlo Park, California.; Mühlenberg (1989) Freilandökologie

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(dot)de;				
Instructors:	Prof. Dr. Susanne Dobler				
Language	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 defense of plants, defense 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 • S: Coevolution and Arms Race between Plants and Animals • P: Strategies of Plants Defense and Phytophagous Insects Counter Defense				1,5 SEM./HRS 1,5 SEM./HRS 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:	**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 (dot) 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 — 2 SEM./HRS • P: International Behavioral Ecology Field Course — 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 Genetics 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:	Prof. Dr. Jörg Ganzhorn, Phone 42838 4224, joerg.ganzhorn (at) uni-hamburg (dot) de				
Instructors:	Dr. Claudia Drees Prof. Dr. Jörg Ganzhorn Dr. Julian Glos				
Language	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 • S: Population Genetics and Community Ecology • P: Population Genetics and Community Ecology				4 SEM./HRS 1 SEM./HRS 1,5 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: Population Genetics and Community Ecology		56	80	
	• S: Population Genetics and Community Ecology		14	14	30
	• P: Population Genetics and Community Ecology		21	40	15
	Total Workload	9	91	134	45
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				

Elective Modules

Title:	**Advanced Statistics for Biologists**				
Module number:	MBIO-W-22				
Semester:	Summer				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	Prerequisite is the successful completion of the module "Fundamentals of Biostatistics" or “Ecology and Biostatistics “ (BSc Biology, University of Hamburg) or an equivalent module				
Module coordinator:	Dr. Jens Oldeland, Phone 42816 407, jens.oldeland (at) uni-hamburg (dot) de				
Instructors:	Dr. Jens Oldeland				
Language	German and English				
Intended learning objectives:	Students understand univariate and multivariate statistical methods and their applications in biology. They are able to choose the appropriate procedures for a given dataset, perform an exploratory data analysis and interpret the results expertly. Furthermore, the students are able to visualize and present the data as well as the results in the optimal form. All work is carried out with the free statistical software "R".				
Contents	1) Statistical measures and distributions 2) Univariate statistics 3) Linear regression 4) ANOVA statistics 5) GLM 6) GAM 7) Autocorrelation (serial/spatial) 8) GLMM/GAMM 9) Association measures 10) Ordination – Gradient methods 11) Cluster Analysis 12) Classification				
Course types and forms of instruction:	• L Advanced Statistics for Biologists • E Advanced Statistics for Biologists - Exercise				2 SEM./HRS 3 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L Advanced Statistics for Biologists		28	56	20
	• E Advanced Statistics for Biologists - Exercise		42	124	-
	Total Workload	9	70	180	20
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the exercise, presentation (pass/fail) *examinations:* Written examination (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Quinn, Gerry P., and Michael J. Keough. Experimental design and data analysis for biologists. Cambridge University Press, 2002. [1,2,3,4] Gotelli, N. G., and A. M. Ellison. A Primer of ecological statistics (2004). "Sinauer Associates." [1,2,3,4] Zuur, A. F., Ieno, E. N., Walker, N., Saveliev, A. A., & Smith, G. M. (2009). Mixed effects models and extensions in ecology with R. Springer. [7,8]				

	Bolker, B. M. (2011). Ecological models and data in R. Princeton University Press. [1,3,4] ! Free Download of older version at : http://www.math.mcmaster.ca/~bolker/emdbook/book.pdf Fahrmeir, L., Kneib, T., & Lang, S. (2006). Regression: Modelle, Methoden und Anwendungen. Springer DE. [3,4,5,6,7,8] - McCune, B., Grace, J. B., & Urban, D. L. (2002). Analysis of ecological communities (Vol. 28). Gleneden Beach, Oregon: MjM Software Design. [9,10,11,12] - Zuur, A. F., Ieno, E. N., & Smith, G. M. (2007). Analysing ecological data (Vol. 680). New York: Springer. [3,4,5,6,7,9,10,11] - Izenman, A. J. (2008). Modern multivariate statistical techniques: regression, classification, and manifold learning. Springer. [10,11,12] - Leyer, I., & Wesche, K. (2008). Multivariate Statistik in der Ökologie: Eine Einführung. Springer. - CRAN: 2013 - An Introdruction to R: Free Download at : http://cran.r-project.org/doc/manuals/R-intro.pdf - Scientific articles related to the specific topics will be distributed during the course

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(dot)de				
Instructors:	PD Dr. Dörthe Müller-Navarra				
Language	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, 50%) and presentation (graded, 50%)				
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:	Summer				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	Comprehensive knowledge in genetics is required				
Module coordinator:	Prof. Dr. Mathilde Cordellier, Phone 42838 3933, mathilde.cordellier (at) uni-hamburg (dot) de				
Instructors:	Prof. Dr. Mathilde Cordellier Suda Ravindran				
Language	German and English				
Intended learning objectives:	Students will gain an overview of the data gained through the latest sequencing methods and the new opportunities that this data opens up for biological research. They have in-depth knowledge and practical skills (analysis of NGS data, transcriptome assembly, gene expression analysis, new population genetic analysis, first introduction to scripting languages).				
Contents	Sequencing method, quality control, manipulation of next gene data, de novo assembly of genes and transcripts, overview of methods of comparison of genes and transcripts, RNA seq: gene expression analysis, intra- and inter-population variation of the gene sequence				
Course types and forms of instruction:	• L: Introduction to the NGS World • E: Hands-on Training in NGS Data Analysis • P: Case Study				1 SEM./HRS 5 SEM./HRS 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
	• P: 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, 60%), presentation (graded, 20%) and oral examination (graded 20%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced				

Title:	**Evolution and Systematics of Terrestrial Arthropods**				
Module number:	MBIO-W-29				
Semester:	Winter				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	Biological experience in the field, basic knowledge of molecular genetics and morphology in theory and practice. Interest in zoological classification, phylogenetics, biogeography and comparative morphology, basic knowledge in the field of determination of invertebrates, interest in biological collections				
Module coordinator:	Dr. Danilo Harms, Phone 42838 5983, danilo.harms (at) uni-hamburg (dot) de				
Instructors:	Prof. Dr. Matthias Glaubrecht Dr. Danilo Harms Dr. Martin Husemann				
Language	German / English				
Intended learning objectives:	The students gain an overview of the diversity, ecological importance and evolution of terrestrial arthropods and in-depth knowledge of the systematics of insects, millipedes and arachnids. They develop practical skills in collection, preparation, collection-related, molecular and morphological methods in the field of phylogenetics, population genetics and systematics. The independent planning and implementation of methodologically diverse research projects and the drafting of scientific publications are acquired as core competencies.				
Contents					
Course types and forms of instruction:	• L: Introduction to Modern Phylogenetic, Molecular Genetic and Morphological Methods • S: Evolution and Systematics of Terrestrial Arthropods • P: Phylogenetic and Population Genetic Studies on Terrestrial Arthropods				2 SEM./HRS 2 SEM./HRS 4 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: Introduction to Modern Phylogenetic, Molecular Genetic and Morphological methods		28		
	• S: Evolution and Systematics of Terrestrial Arthropods		28	35	27
	• P: Phylogenetic and Population Genetic Studies on Terrestrial Arthropods		56	96	-
	Total Workload	9	112	131	27
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, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**Geographical Information Systems in Ecology**				
Module number:	MBIO-SP-3				
Semester:	Winter				
Applicability, type of module, and curricular area	Elective module M.Sc. Biology				
Prerequisites for participation:	The module "Introduction Geographic Information Systems" or equivalent modules are required				
Module coordinator:	Dr. Veit Hennig, Phone 42838 4235, Veit.Hennig(at)uni-hamburg(dot)de				
Instructors:	Dr. Veit Hennig Dr. Jens Oldeland				
Language	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	42	20
	• E: Geographical Information Systems in Ecology		56	96	28
	Total Workload	9	84	138	48
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the exercise *examinations:* Oral examination (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:	**Infection and Peroxisome Biology of Plants**				
Module number:	MBIO-W-43				
Semester:	Summer				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	Basic knowledge in biochemistry, molecular biology and cell biology in theory and practice.				
Module coordinator:	Prof. Dr. Sigrun Reumann, Phone 42816 743, sigrun.reumann (at) uni-hamburg (dot) de				
Instructors:	Dr. Christian Falter Thu Nguyen Saugat Pokhrel Prof. Dr. Sigrun Reumann PD Dr. Dirk Warnecke				
Language	German and English				
Intended learning objectives:	Students possess knowledge of molecular biology and cell biology of plants, with particular emphasis on plant-pathogen interactions of bacterial pathogens. They have advanced methodological knowledge of infection and peroxisome biology, biochemistry, molecular biology and applied bioinformatics. They have in-depth basic knowledge and practical skills (analysis of pathogen-resistant and susceptibale Arabidopsis plants, organelle isolation, proteome analysis by 2D gel electrophoresis, etc.).				
Contents					
Course types and forms of instruction:	• L: Introduction to Infection and Peroxisome Biology of Plants • P: Infection and Peroxisome Biology of Plants				2 SEM./HRS 6 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Introduction to Infection and Peroxisome Biology of Plants		*28*	*35*	*27*
	• P: Infection and Peroxisome Biology of Plants		*84*	*96*	-
	Total Workload	9	112	131	27
Coursework and examinations:	*Formal requirements for examinations:* Active participation in the practical course and seminar; protocol (pass/fail) *examinations:* Presentation (graded, 50%) and oral examination (graded, 50%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced				

Title:	**Fundamentals in Cell Biology and Biochemistry**				
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 42838 240, gilberger(at) bni-hamburg (dot) 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:					

Title:	**Concepts, Methods, and Techniques of Systematics**				
Module number:	MBIO-W-39				
Semester:	Winter				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	Basic knowledge of the morphology of plants				
Module coordinator:	Prof. Dr. Jens G. Rohwer, Phone 42816 397, jens.rohwer (at) uni-hamburg (dot) de				
Instructors:	Prof. Dr. Jens G. Rohwer Dr. Barbara Rudolph				
Language	German				
Intended learning objectives:	The students have knowledge of dealing with collections of the herbarium, taxonomic monographs as well as the relevant reference works, databases and other Internet resources. You can apply this knowledge, apply it to similar situations and evaluate the information found. They know scanning electron microscopic and molecular systematic techniques; They can perform phylogenetic and population genetic analyzes, combining their individual results, interpret and critically evaluate.				
Contents	Herbarization, handling and use of herbarium material; species concepts; Rules for describing and naming taxa; typing; Online resources for taxonomic work; Possible applications of the scanning electron microscope incl. Preparation; molecular systematic and population genetic work in the laboratory and on the computer.				
Course types and forms of instruction:	• L: History of Systematics • L: Concepts and Methods of Systematics • P: Methods of Preparation and Molecular Systematics • E: Phylogenetic and Population Biological Analyses				1 SEM./HRS 1 SEM./HRS 4 SEM./HRS 2 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: History of Systematics		14	14	10
	• L: Concepts and Methods of Systematics		14	28	10
	• P: Methods of Preparation and Molecular Systematics		56	112	
	• E: Phylogenetic and Population Biological Analyses		28	56	18
	Total Workload	12	112	210	38
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and exercise *examinations:* Completion of the practical course (graded, 50%) and presentation (graded, 50%)				
Duration	one semester				
Module frequency:	annual				
Literature:					

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:	none				
Module coordinator:	Prof. Dr. Esther Schnettler, Phone 42818 840, schnettler(at)bnitm(dot)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, defense 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*	*32*	*30*
	• P: Molecular Entomology and arbovirology		*42*	*20*	*28*
	Total Workload	*6*	*70*	*52*	*58*
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar *examinations:* Protocol (graded, 34%), presentation (graded, 33%), presentation (graded, 33%)				
Duration	one semester				
Module frequency:	annual				
Literature:					

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:	Prof. Dr. Matthias Kneussel, Phone 7410 56275, matthias.kneussel@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:	irregular				
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:	**Multivariate Data Analysis in R**				
Module number:	MBIO-W-19				
Semester:	Winter				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	Mandatory: In-depth knowledge in applied mathematics and biostatistics, basic knowledge of R				
Module coordinator:	Dr. Karina Montero, karina.montero(at)uni-hamburg.de				
Instructors:	Dr. Karina Montero				
Language	German				
Intended learning objectives:	Students will be familiar with multivariate datasets and multivariate analysis methods in the R programming language. They will be familiar with explorative analysis, multivariate techniques, interpretation of results, and data visualization. The students have the knowledge of design and technical aspects of poster production.				
Contents	Basics of matrix algebra, association indices, clusters and ordination analyses. Plotting techniques. Data analysis and presentation exercises based on selected sample data from ecological studies.				
Course types and forms of instruction:	• L: Introduction to Statistical Programming Language • E: Exercises in R				1 SEM./HRS 3 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: Introduction to Statistical Programming Language		14	24	
	• E: Exercises in R		42	84	12
	Total Workload	6	56	112	12
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the exercise *examinations:* Completion of the exercise (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**Motor Proteins**				
Module number:	MBIO-W-28				
Semester:	Winter				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Wim Walter, Phone 42816 323, wim.walter (at) uni-hamburg (dot) de				
Instructors:	Isabel Machens Prof. Dr. Wim Walter				
Language	German				
Intended learning objectives:	The students have an overview of the structure and function of the plant cytoskeleton and its associated motor proteins. They master microscopic methods for the analysis of motor protein functions at the multi- and single-molecule level.				
Contents	Microtubules and kinesins, microtubule-associated proteins, actin filaments and myosins, microtubulidynamics, cell division, mechanochemical cycle of motor proteins, epifluorescence and TIRF microscopy, basics of recombinant gene expression in E. coli, protein isolation by IMAC				
Course types and forms of instruction:	• S: Molecular Principles of Intracellular Movement • P: Analysis of Motor Proteins				2 SEM./HRS 6 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• S: Molecular Principles of Intracellular Movement		28	58	20
	• P: Analysis of Motor Proteins		84	60	20
	Total Workload	9	112	118	40
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the practical course and seminar, engineering journal *examinations:* Written examination (graded, 70%) and presentation (graded, 30%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced				

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. Clemens Wülfing
Language	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 and Biodiversity of Africa**				
Module number:	MBIO-SP-5				
Semester:	Winter				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Norbert Jürgens, Phone 42816 260, norbert.juergens(at)uni-hamburg(dot)de				
Instructors:	Prof. Dr. Norbert Jürgens Dr. Jens Oldeland				
Language	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 • S: Ecology and Biodiversity of Africa • P: Ecology and Biodiversity of Africa				1 SEM./HRS 1 SEM./HRS 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:	Richter, M. (2001): Vegetationszonen der Erde. – 448 S., Klett-Perthes, Gotha [u. a.]. 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.				

Title:	**Redox Signaling and Antioxidants**				
Module number:	MAMB-04f				
Semester:	Summer				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	Basic knowledge of biochemistry / molecular biology in theory and practice is desirable.				
Module coordinator:	PD Dr Sabine Lüthje, Phone 42816-340, sabine.luethje(at)uni-hamburg(dot)de				
Instructors:	PD Dr Sabine Lüthje				
Language	German and English				
Intended learning objectives:	Students have knowledge of plant molecular biology and biochemistry, with particular emphasis on electron transport processes (redox systems) and antioxidant systems, as well as their role in the oxidative stress organism, including functional characterization of the genes and proteins involved. They have extended methodological knowledge of systems biology. Students can transfer the learned knowledge to other systems and are able to develop an experimental strategy to investigate a problem.				
Contents	Theoretical basics of redox processes and their significance for animal and plant life. Knowledge of the most important protein families with relevance to oxidative stress. Application of systems biology and biochemical methods to the structure and function of electron transport processes.				
Course types and forms of instruction:	• S: Redox Systems and Antioxidants • P: Redox Systems and Antioxidants				1 SEM./HRS 4,5 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• S: Redox Systems and Antioxidants		12	30	20
	• P: Redox Systems and Antioxidants		68	50	
	Total Workload	6	80	80	20
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the course *examinations:* Protocol (pass/fail) and oral examination (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced				

Title:	**Scientific Dispute**				
Module number:	MBIO-W-35				
Semester:	Summer				
Applicability, type of module, and curricular area	• Elective module M.Sc. Biology				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Axel Temming, Phone 42828-6617, atemming (at) uni-hamburg (dot) de				
Instructors:	Prof. Dr. Axel Temming				
Language	German				
Intended learning objectives:	Students have learned that science is developing through controversy.				
Contents	The much quoted "consensus" of science (for example in the climate discussion) should be critically questioned. Using concrete examples, it should be shown that controversial discussion of alternative theories is indispensable for scientific progress. In addition, concrete case studies are to be conducted on the extent to which social influences promote or suppress controversy and which role the scientists themselves play in this process. Possible topics include the scientific assessment of climate change, the assessment of global overfishing, or the role of genetic research in agriculture				
Course types and forms of instruction:	• L: Scientific Controversies • S: Seminar				1 SEM./HRS 3 SEM./HRS
Workload (module components and total):		credits	P (hrs)	S(hrs)	EP (hrs)
	• L: Scientific Controversies • S: Seminar		14 42	10 84	10 10
	Total Workload	6	56	94	30
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the seminar *examinations:* Presentation (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:					

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				
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 • S: Cytology		*28* *28*	*42* *42*	 *40*
	Total Workload	6	56	84	40
Coursework and examinations:	*Formal requirements for examinations:* Active participation at the seminar *examinations:* Presentation (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**Introduction to Lichenology**				
Module number:	BBIO-WPW-21				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module B.Sc. Biology • Elective module M.Sc. Biology				
Prerequisites for participation:	none				
Module coordinator:	Dr. Matthias Schultz, Phone 42816 694, matthias.schultz (at) uni-hamburg.de				
Instructors:	Dr. Matthias Schultz				
Language	German				
Intended learning objectives:	The students have acquired basic and in-depth knowledge in anatomy and morphology, biology as well as systematics, phylogeny and classification of lichens (Lichenes) [lecture]. They learn to recognize and determine frequent lichens in Hamburg, Germany and Central Europe. [practical course] Applied aspects such as standardized methods of lichen mapping, bioindication, nature and species protection are dealt with in practical field exercises				
Contents	Morphology, biology, systematics and phylogeny of lichen-forming Ascomyceten (lichens, lichens)				
Course types and forms of instruction:	• L: Introduction to Lichenology • P: Identification of Lichens • E: Introduction to Lichen Mapping				1 SEM./HRS 1 SEM./HRS 0,5 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Introduction to Lichenology		*14*	*14*	
	• P: Identification of Lichens		*14*	*14*	
	• E: Introduction to Lichen Mapping		*7*	*7*	*20*
	Total Workload	*3*	*35*	*35*	*20*
Coursework and examinations:	*Formal requirements for examinations:* Active participation. *examinations:* Written examination (100%).				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				